Digitalization and Flexibility for Organizational Management and Transformation

Proceedings of the Eighteenth Global Conference of

The Global Institute of Flexible Systems Management, GLOGIFT 18 (December 18-20, 2018)

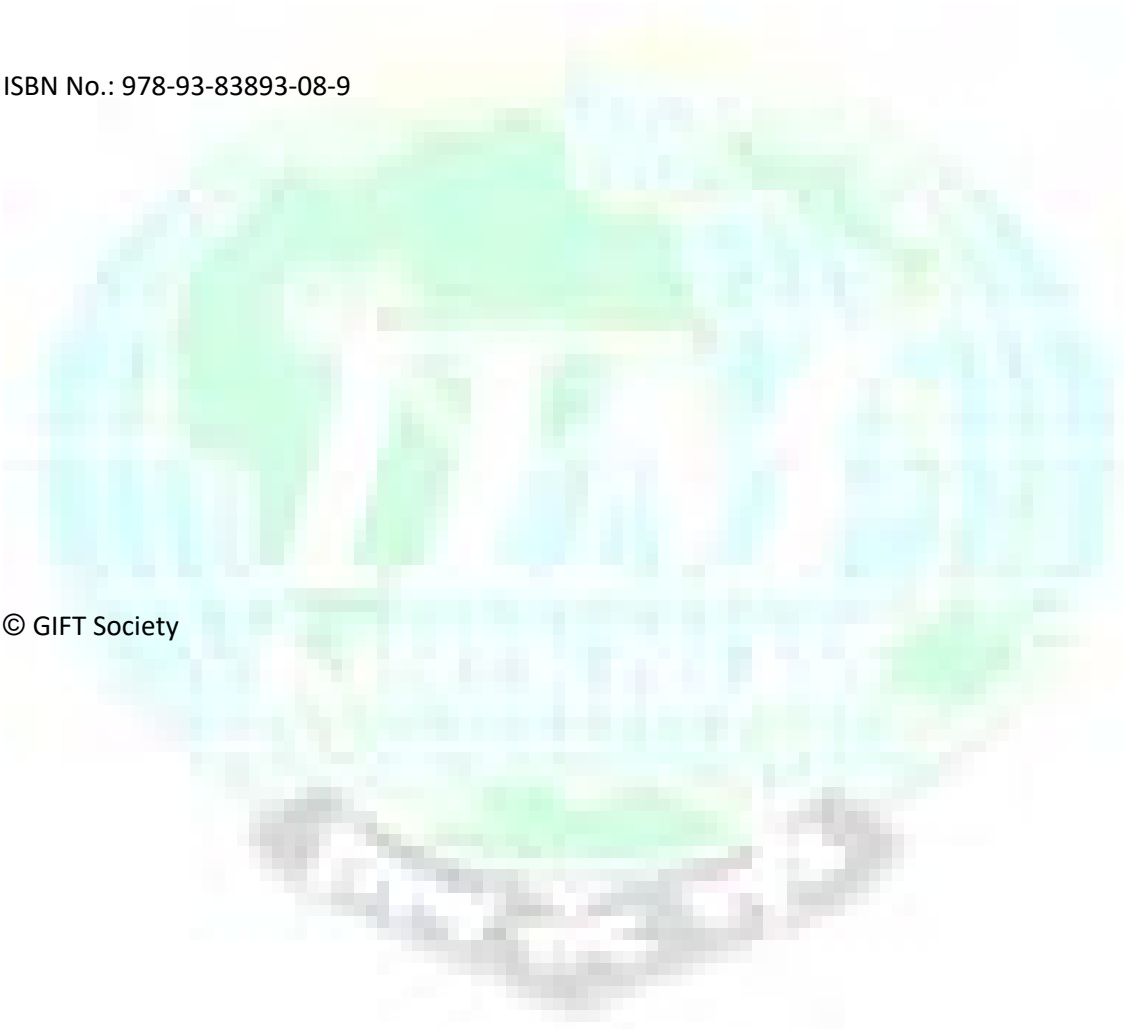
Editors:

Vivek Gupta, Pradeep Kumar

Omkarprasad S Vaidya, Sushil Kumar

Indian Institute of Management Lucknow

ISBN No.: 978-93-83893-08-9



GLOGIFT 18

Digitalization and Flexibility for Organizational Management and Transformation

Eighteenth Global Conference on
Flexible Systems Management

Venue

Indian Institute of Management Lucknow, India

Annual Conference of
Global Institute of
Flexible Systems Management

Organized by
Indian Institute of Management Lucknow, India

Knowledge Partner

Springer

Sponsor

MIDHANI

Conference Chairs:

Dr Sushil Kumar
Professor, IIM Lucknow

Dr Dinesh K Likhi
CMD, Mishra Dhatu nigam Ltd, Hyderabad

Organizing Committee Members:

Prof Omkarprasad S Vaidya, IIM Lucknow

Prof Pradeep Kumar, IIM Lucknow

Prof Vivek Gupta, IIM Lucknow

Prof Seshadev Sahoo, IIM Lucknow

Prof Prem Prakash Dewani, IIM Lucknow

Prof Vikas Srivastava, IIM Lucknow

Preface

Flexibility has been one of the most important dimensions in today's astoundingly fast paced business world. A rigid organization cannot sustain the pulls and pushes of the ever-changing dynamic market. Business Gurus and experts support the positive outlook that flexibility brings on the table in current times of uncertainty and vulnerability.

Developments in the field of Information Technology have opened up immense possibilities. It enables the organizations to examine the traditional ways of handling the things and opening up a totally new perspective enhancing organizational flexibility. That would surely help responding to the chaotic challenges which are increasingly being faced.

Appreciating need of the hour, the 18th Global Conference of the Global Institute of Flexible Systems Management was organized at the Indian Institute of Management Lucknow, India, from 18th to 20th of December 2018. Theme of the conference was "Digitalization and Flexibility for organizational Management and transformation."

Over 100 National and International delegates both from the academia and industry shared their experiences, observations, and research during the conference. Experts from variety of fields related to management presented their research work and shared experiences during the conference in various sessions. Only those papers were presented during the conference which were found to have been relevant and fitting the standards set by the organizing committee through a proper process of evaluation by the referees.

A 'Book of Abstracts' was published that contains the abstracts of all papers presented during the conference; and the same was distributed to the delegates. The present e-proceedings is a compilation of a selected full papers presented by the authors at the conference. After due process of additional editorial review, the papers have been classified into seven broad areas: Manufacturing Management, Supply Chain management, Digital Transformation, Human Resource and Knowledge Management, Setup and Strategy, Marketing Management, and Financial Management.

Each of these broad areas consists of papers representing a collection of views from different authors in that area. It is hoped that this e-proceedings will help sharing the knowledge created during the conference, not only among the delegates that participated in the conference, but also amongst different individuals from academia and industry who may be interested in this emerging area of digitalization and flexibility.

Acknowledgements

A conference of this repute evidently is possible only with the enthusiastic support from a vast number of people. First of all, the organizing team is grateful to all the authors of various papers for having contributed to the conference proceedings. We particularly appreciate their time and effort in editing their manuscript to conform to a common prescribed format for the proceedings. We also record our thanks to all the conference delegates, for an overwhelming response, in attending and presenting their work during the conference.

The organizing team expresses deep gratitude to Prof Sushil, IIT Delhi who motivated and facilitated us to host the conference in IIM Lucknow. Thanks to Prof. Kiran Momaya, IIT Bombay for being there as the president GLOGIFT, and guiding the organizers throughout the course of the conference. Special thanks to the management team at GIFT society for letting us host this prestigious conference in IIM Lucknow.

IIM Lucknow faculty members deserve a special word of appreciation for all their help and support for the conference. IIM Lucknow staff members from all sections contributed to the best of their abilities to the success of the conference. A big thank you to each one of them.

Our heartfelt gratitude and thanks go to Prof. Ajit Prasad, Patron of this conference and the then Director of IIM Lucknow, whose vision and encouragement ensured the overwhelming success of this effort at IIM Lucknow. This conference would not have been possible without his active interests in the initial phase of the conference work.

We were the most unfortunate to have missed his physical presence during the conference due to his untimely sad demise. But he was there in our collective memory during the entire period of the conference. He would have been very happy and proud of what the team has achieved in terms of organizing efforts. We will miss you Sir, always!

Thanks are due to Prof. Rajiv K. Srivastava, acting Director IIM Lucknow during the conference, for sparing his valuable time for the conference inauguration. His words of wisdom benefited the participants.

Our big thanks and a huge appreciation to Dr. Dinesh K. Likhi, CMD of Mishra Dhatu Nigam Limited (MIDHANI), Hyderabad, for motivating us to organize the conference and generously proving sponsorship to the main event.

The organizing team wishes to express deep appreciation and heartfelt thanks to Prof. Shailendra Singh, Director IIM Ranchi for his keynote speech that was appreciated much by the audience. Thanks are due to Mr. Varun Vidyarthi, Founder Manavodaya Lucknow for delivering his keynote speech.

Our special thanks to the colleagues from IIM Lucknow and other institutions who reviewed the papers thoroughly that resulted in high quality presentations and papers in the proceedings.

And finally to the organizing team…Good Show!

CONTRIBUTORS

Abhishek Srivastava
Indian Institute of Management,
Kozhikode, Kerala, India

Akshay Vyavahare
Indian Institute of Management Indore
Indore, India

Anab Kidwai
Indian Institute of Management, Lucknow, India
& Symbiosis International University, Pune, India

Anupam Saraph
Symbiosis Institute of Computer Studies
and Research (SICSR), Pune, India

Ashok K Pundir
Professor
National Institute of Industrial Engineering,
Vihar Lake, Mumbai, India

Dhanshyam Mahavadi
Research Scholar
Indian Institute of Management
Lucknow, India

Dimple Bhandari
Research Scholar
Delhi Technogical University,
Delhi, India

Farah Hashim
Research Scholar
Department of Business Administration
Frank & Debbi Islam Management Complex
Aligarh Muslim University, Aligarh, UP, India

Harpreet Singh
Department of Mechanical Engineering
I.K. Gujral Punjab Technical University
Jalandhar, Punjab, India

Jaspreet Singh Oberoi
Department of Mechanical Engineering
I.K. Gujral Punjab Technical University
Jalandhar, Punjab, India

Kamala Kannan Dinesh
Department of Management Studies
Indian Institute of Technology Delhi
New Delhi, India

Ahmad Faraz Khan
Assistant Professor
Department of Business Administration
Frank & Debbi Islam Management Complex
Aligarh Muslim University, Aligarh, UP, India

Anurag Saxena
School of Management Studies, IGNOU
New Delhi, India

Anamika Chawhan
SJM School of Management
Indian Institute of Technology Bombay
Powai, Mumbai, India

Bhargav Deori
Research Scholar
Department of Business Administration
Gauhati University, Guwahati, Assam, India

Doordarshi Singh
Department of Mechanical Engineering
I.K. Gujral Punjab Technical University
Jalandhar, Punjab, India

Feza T Azmi
Associate Professor
Department of Business Administration
Frank & Debbi Islam Management Complex
Aligarh Muslim University, Aligarh, UP, India

Gunjan Sharma
GLA University
17km Stone, NH-2, Mathura-Delhi Road
P.O. Chaumuhan, Mathura, UP, India

Hinadi Akbar
Research Scholar
Department of Business Administration
Frank & Debbi Islam Management Complex
Aligarh Muslim University, Aligarh, UP, India

István Fekete PhD
ICG Integrated Consulting Group
Kft. Senior Consultant, Sas Utca
10-12, 1051 Budapest, Hungary

Kalyani Sahoo
Indian Institute of Management Indore
Indore, India

TABLE OF CONTENTS

Manufacturing Management

Supply Chain Management

Digital Transformation

Human Resource and Knowledge Management

Startups and Strategy

Marketing Management

Financial Management

Addressing carbon regulation variants in manufacturing network

Shraddha Mishra[1], Surya Prakash Singh[1]

[1]Department of Management Studies, Indian Institute of Technology Delhi, India

shradhamishra625@gmail.com , surya.singh@gmail.com

Abstract. Growing environmental problems and unchecked emission of greenhouse gasses has influenced the climatic conditions adversely, causing an unnatural weather change. This has raised the consciousness of the government to take prudent steps for the low carbon development of the economy in future. In fact, consumers also prefer eco-accommodating products and are attracted towards the organizations that are socially and environmentally responsible. Thus, there is a need to regulate the ongoing carbon emissions and businesses are confronting a cutting edge competition to adopt green technologies and processes to survive in the eco-conscious economy. In perspective of this, the paper provides a mixed integer mathematical programming formulation to design an international facility distribution network. The model considers carbon emissions due to production, storage, and transportation activities and the objective is to optimize the overall cost and carbon emissions. Further, the model is illustrated using carbon cap, cap and trade, and carbon tax regulations.

Keywords. Sustainability, carbon emissions, facility network, mixed integer linear program (MILP)

1 Introduction

With the advancement in technologies and emergence of artificial intelligence and robotics, humans have transformed the world to the next level of virtual reality. Nevertheless, this technological shift has made the life comfortable; it has effected the environment drastically. The tremendous surge in the level of atmospheric CO_2 has raised the average temperature of the earth causing global warming. It is believed that the major cause of this imbalance is the industrial revolution, which began in the second half of the 18th century and is continued till date around the globe. A report says that after the industrial revolution, humans have emitted 1540 billion tonnes of CO2 [12]. The temperature of the Earth is rising at an alarming rate and according to a NASA report, 2016 was the warmest year in last 136 years [21]. Although, countries have taken various initiatives in this direction to mitigate the catastrophic effects of climate change, one such is the Paris Agreement [30], where the signatories pledged not to exceed the temperature above the 2^o celsius of the pre-industrialization level and set the target as 1.5^o celsius. However, an editorial published that most of the signatories gave indication that they might not fulfill the targets [25].

China, US and India are the major contributors of the CO_2 with 28.21%, 15.99%, 6.24% share respectively, where global manufacturing sector itself accounts for 20% share [29]. Thus, there is a need to regulate ongoing carbon emission especially in the manufacturing sector. Production and logistic activities of the supply chain have a major contribution in the carbon emission. Transportation activities alone have 14% contribution in the total carbon emission [7].Therefore, it is required to recalibrate the manufacturing process by making operational adjustments to minimize the carbon emission. The most common carbon regulating policies are carbon cap, carbon tax and carbon offset through cap and trade. Due to difference in their mechanism, they incur different form of carbon emission cost and have different managerial implications. Their comparison may help to guide the government or policy makers to determine the carbon cap (under cap and trade) and tax level.

The paper explores the above mentioned carbon regulating policies in the context of international manufacturing network. A facility allocation network has been designed considering international trade issues such as import/export costs, government subsidies such as loans and grants with low interest rates. A mixed integer linear programming model is developed for optimal facility locations in different countries to optimize the overall cost in conjunction with carbon emission cost. The paper addresses the carbon emission due to production, storage and transportation under three scenario carbon cap, cap and trade and carbon tax. The remainder of the paper is organized as follows. Section 2 provides the extant literature review which is discussed under two subsections Section 2.1 addresses the literature related to sustainable supply chains for green production. Section 2.2 provides the literature review for international manufacturing network and global supply chains. Section 3 provides the mathematical modeling framework which is illustrated using a randomly generated case of reasonable size in Section 4. Results and discussions are provided in Section 5. Future scope and concluding remarks are provided in Section 6.

2 Literature Review

The detailed literature review is provided in the following subsections. Section 2.1 provides the literature related to the carbon regulating policies for sustainable supply chains. Section 2.2 provides the literature review on international manufacturing network for global supply chains.

2.1 Review on carbon regulating policies in sustainable supply chains

The growing environmental problems and the continuous rise in the level of greenhouse gasses has raised the average temperature of the earth 2^0 Celsius above the pre-industrialization level. It is assumed that manufacturing sector is heavily adding to the existing level of CO_2. Thus, carbon regulating policies such as inflexible carbon cap, cap and trade and carbon tax have received a lot of attention in theoretical as well as empirical researches. In view of this, [10] provided a detailed literature survey on the carbon tax and trading permits and their procedures. They concluded that these carbon regulating policies are efficient in achieving emission reduction targets at lower cost. [32] suggested that carbon tax is better to combat global warming as compare to carbon cap. They asserted that carbon cap and trade is more complicated to implement as it firstly requires to set a baseline for carbon cap, then, decisions pertaining to the creations of allowances and their distributions also need to be monitored to avoid duplicity in trading. Further, if carbon is traded with other countries, it requires to coordinate with the cap and trade policies of the other countries whereas revenue generated from carbon tax can be straightaway invested in carbon sequestration and similar carbon offset projects. In contrast to this, [13] suggested that cap and trade regulation is more suitable for business and job creation. Gradually, researchers started incorporating these theories empirically and discussions followed on how these carbon footprints can be quantified in supply chains[28]. [22] suggested that both carbon cap and trade and carbon tax can be used simultaneously for superior outcomes rather than adopting either carbon tax or cap and trade. [4] calculated carbon emission in transportation and warehousing activities of a supply chain. [8] provided a mixed integer programming formulation for green supply chain considering strict carbon cap and observed that decrease in carbon emission allowances results in higher cost. [2] studied how to evaluate carbon emission in operational decisions. They concluded that strategic adjustments in operational decisions can reduce the carbon emission at lower the cost. [14] determined the production lot size under carbon cap and trade and carbon tax using economic order quantity model. The have considered that the buying and selling price of the permits are different for a firm. Further, they compared the carbon emitted under these two regulations and found that under cap and trade, that optimal emission decision depends upon these differentiated trading prices and if per unit of carbon emitted, setup and holding costs are same then, both carbon cap and trade and carbon tax yield the same results. [31] focused on emission reduction in a closed loop supply chain using game theory. [18] provided a mixed integer non-linear model for supplier selection in big data environment under different carbon emission regulations. They noticed that altering the carbon cap in cap and trade has no impact on total carbon emission whereas carbon price impacts the carbon emission up to a certain extent but not always. They further asserted that carbon emission can be successfully monitored under strict cap by a little increase in the total cost and under carbon tax, emission gets stable after a certain tax level. For more details on carbon emission refer [15], [17], and **[1]**.

2.2 Review on international manufacturing network for global supply chains

From the past few decades, manufacturing industries around the globe have evolved dramatically. Decisions pertaining to facility allocation, operational decisions, logistics management, performance improvement, collaboration and networking have gained considerable attention of the researchers. Manufacturing firms have extended their boundaries by shifting their focus from supplying products to manufacturing of products in international markets [11]; [23]. In view of the above, [5] addressed international issues in quantitative modeling. They provided an integer linear programming formulation to maximize the overall profit of the firm after deducting all operating expenses. Further, they extended their model to address the problem for multi-periods. [16] provided a mixed integer linear program to address the optimal facility location problem in the context of global supply chains simultaneously considering international parameters such as import/export, government subsidies in the form of loans, grants and taxes. [9] proposed a framework for global facility network under the competitive environment. In addition the above, various researchers emphasized the significance of networking and collaboration among the supply chain partners, one such work is by [3], they highlighted the strengths and the trade-offs of such collaborations. [6] studied various types of logistics networks in the context of global sourcing and evaluated their overall cost and effectiveness through simulation. [20] identified the driving factors for designing an international manufacturing

network. They classified the factors according to their domain into political, economic, social, technological, legal and environmental. Apart from these literatures, various attempts have been made to address environmental sustainability in the context of global supply chains. [27] proposed a mixed integer linear programming model for facility location under uncertain environment in the context of manufacturing and remanufacturing network. For more details on international manufacturing refer [26], [19], [24].

This paper is an attempt to integrate the useful insights drawn from the literature to address the persisting environmental problems in the context of international manufacturing network. In view of this, the paper provides a comprehensive mathematical model to design an international facility network of plants and warehouses along with monitoring total carbon emission at each stage of the supply chain. The proposed model is computationally tested under carbon cap, cap and trade and carbon tax scenarios using randomly generated data instance of a reasonable size.

3 Proposed Mathematical Model

3.1 Problem statement

The paper proposes a mathematical formulation to design an international facility network to meet the demand arising from markets located in different countries of the world. The proposed model addresses multi-product, multi-plants, multi-warehouses and multi-period problem. The proposed model is tested under various carbon regulating policies such as carbon cap, carbon cap and trade and carbon tax. Under carbon cap policy, a mandatory cap is put on the overall carbon emitted in production, storage and transportation. Under cap and trade regulation, an inflexible cap is exercised over the total carbon emission like carbon cap. However, the carbon emission saved over and above the carbon cap can be traded within the country or outside. The model addresses carbon emission due to various supply chain activities such as production, holding and transportation. The carbon emissions from the logistics is defines as a function of total distance travelled by the carrier (d_j), trips required by the carrier (η_j), mileage (mil_j) and the fuel type of the carrier (emission factor e_j). The objective is to provide the optimal facility locations by minimizing the overall cost for the low carbon economy.

3.2 Model Assumptions

The proposed mathematical model is a network of plants and warehouses where each plant can ship the product to the other plants, warehouses or directly to the market. The warehouse can either directly satisfy the demand of the market or it can ship to other warehouses to satisfy the demand. All the shipments are allowed within the same country as well to the other country. Throughout the paper plants and warehouses are interchangeably referred as facilities. The model is governed by the following set of assumptions:

- Facilities are selected from the pre-defined set of candidate locations.
- The production cost and market demand are dynamic but known for each product in each period with certainty.
- The capacities of Plants and warehouses are known
- Import/Export costs and depreciation expenses are calculated per unit of production.
- Carbon emission is calculated for production, storage and transportation.
- Only one type of carrier is considered with known volumetric capacity.

3.3 Mathematical formulation

3.3.1 List of indices:

b, c=countries, *b* is the country of shipment and c is the country of operation *b*, $c \in C$.
i= plant, *j*= warehouse, *k*=market, *p*= product, *t*= 1, 2…, T time period

3.3.2 List of parameters:

$F1_{ict}$ = Setup cost of i^{th} plant in c^{th} country for t^{th} period

$F2_{jct}$ = Setup cost of j^{th} warehouse in c^{th} country for t^{th} period

CP_{pic} = Production cost of p^{th} product in i^{th} plant in c^{th} country for t^{th} period

Qp_{pict}^{max} =Maximum production capacity of i^{th} plant at c^{th} country for p^{th} product in t^{th} period

QW_{pjct}^{max} =Maximum storage capacity of j^{th} warehouse located in c^{th} country to store p^{th} product in t^{th} period

$T1_{pici'bt}$= Transportation cost for shipping a unit of p^{th} product from i^{th} plant located in c^{th} country to i'^{th} plant located in b^{th} country for t^{th} period

$T2_{picjbt}$= Transportation cost for shipping a unit of p^{th} product from ith plant located in c^{th} country to j^{th} warehouse located in b^{th} country for t^{th} period

$T3_{pickbt}$= Transportation cost for shipping a unit of p^{th} product from ith plant located in c^{th} country to k^{th} market located in b^{th} country for t^{th} period

$T4_{pjcj'bt}$= Transportation cost for shipping a unit of p^{th} product from j^{th} warehouse located in c^{th} country to j'^{th} warehouse located in b^{th} country for t^{th} period

$T5_{pjckbt}$= Transportation cost for shipping a unit of p^{th} product from j^{th} warehouse in c^{th} country to k^{th} market located in b^{th} country for t^{th} period

QS_{pkct}= Demand for pth product at market k in c^{th} for t^{th} period

SP_{pct} = Selling price of pth product in c^{th} country for t^{th} period

H_{pjct} = Holding cost per unit of pth product in c^{th} country for t^{th} period

$T6_{pcbt}$= Import/Export cost per unit of pth product transported from c^{th} country to b^{th} country for t^{th} period

DP_{pict} = Depreciation expense per unit of pth product in i'^{th} plant located in c^{th} country for t^{th} period

LA_{ct} = Loan granted to the firm to setup facilities in c^{th} country in t^{th} time period

LI_{ct} = Interest rate calculation factor for loan granted to c^{th} country with interest to be repaid in time T

Ω = max load capacity of carrier in volume

V_p =packaged volume of product p

α_{ct} = Carbon emission quota in country c for t^{th} period

C_c = Carbon price in country c

$E1_{pt}$ = Amount of carbon emission caused when p^{th} product is manufactured in t^{th} period

$E2_{pt}$ = Amount of carbon emission caused in holding a unit of p^{th} product in warehouse for t^{th} period

3.3.3 List of Variables:

$$X_{ict} = \begin{cases} 1 \text{ if plant i is to be established in country c for period t} \\ 0 \text{ otherwise} \end{cases}$$

$$Y_{jct} = \begin{cases} 1 \text{ if warehouse j is to be established in country c for period t} \\ 0 \text{ otherwise} \end{cases}$$

Q_{pict} = Units of product p produced at i'^{th} plant in c^{th} country for t^{th} period

$Q2_{picjbt}$= unit of p^{th} product shipped from i'^{th} plant in c^{th} country to j^{th} warehouse in b^{th} country for t^{th} period

$Q5_{pjckbt}$= unit of p^{th} product shipped from j^{th} warehouse in c^{th} country to market k in b^{th} country for t^{th} period

$Q3_{pickbt}$= unit of p^{th} product shipped from i'^{th} plant in c^{th} country to market k in b^{th} country for t^{th} period

$Q1_{pici'bt}$= unit of p^{th} product shipped from i'^{th} plant located in c^{th} country to plant i' located in b^{th} country for t^{th} period

$Q4_{pjcj'bt}$= unit of p^{th} product shipped from j^{th} warehouse located in c^{th} country to j'^{th} warehouse located in b^{th} country for t^{th} period

$\eta 1_{ici'bt}$ =number of carriers required by i^{th} plant in c^{th} country to ship to i'^{th} plant in b^{th} country in t^{th} period

$\eta 2_{icjbt}$= number of carriers required by i^{th} plant in c^{th} country to ship to j^{th} warehouse in b^{th} country in t^{th} period

$\eta 3_{ickbt}$ = number of carriers required by i^{th} plant in c^{th} country to ship to k^{th} market in b^{th} country in t^{th} period

$\eta 4_{jcj'bt}$ = number of carriers required by j^{th} warehouse in c^{th} country to ship to j'^{th} warehouse in b^{th} country in t^{th} period

$\eta 5_{ijkbt}$ = number of carriers required by j^{th} warehouse in c^{th} country to ship to k^{th} market in b^{th} country in t^{th} period

IN_{pjct} =Balance inventory of p^{th} product at j^{th} warehouse located in c^{th} country for t^{th} period

Y_{ct} = Carbon bought/purchased in country c for t^{th} period

3.3.4 Model Formulation under cap and trade:

Objective function

a) Fixed cost

$$FC_{ct} = \sum_i F1_{ict} X_{ict} + \sum_j F2_{jct} Y_{jct} \qquad \forall c, t \tag{1}$$

b) Production cost

$$PC_{ct} = \sum_p \sum_i QP_{pict} CP_{pict} \qquad \forall c, t \tag{2}$$

c) Inventory carrying cost

$$IH_{ct} = \sum_p \sum_j H_{pjct} IN_{pjct} \quad \forall c, t \tag{3}$$

d) Transportation cost

$$TC_{ct} = \sum_p \sum_i \sum_{i'} \sum_b T1_{pici'bt} Q1_{pici'bt} + \sum_p \sum_i \sum_j \sum_b T2_{picjbt} Q2_{picjbt} + \sum_p \sum_i \sum_k \sum_b T3_{pickbt} Q3_{pickbt} \sum_p \sum_j \sum_{j'} \sum_b T4_{pjcj'bt} Q4_{pjcj'bt} + \sum_p \sum_j \sum_k \sum_b T5_{pjckbt} Q5_{pjckbt} \quad \forall c, t \tag{4}$$

e) Import/Export duties

$$IE_{ct} = \sum_p \sum_i \sum_{i'} \sum_b T6_{pcbt} Q1_{pici'bt} + \sum_p \sum_i \sum_j \sum_b T6_{pcbt} Q2_{picjbt} + \sum_p \sum_i \sum_k \sum_b T6_{pcbt} Q3_{pickbt} \sum_p \sum_j \sum_{j'} \sum_b T6_{pcbt} Q4_{pjcj'bt} + \sum_p \sum_j \sum_k \sum_b T6_{pcbt} Q5_{pjckbt} \quad \forall c, t \tag{5}$$

f) Depreciation expense

$$DE_{ct} = \sum_p \sum_i DP_{pict} QP_{pict} \qquad \forall c, t \tag{6}$$

g) Interest payments on loan

$LN_{ct}=LI_{ct}LA_{ct} \quad \forall c,t$ (7)

h) Carbon emission cost

$Z_{ct} = C_c * Y_{ct} \quad \forall c,t$ (8)

TOTAL COST (OC_{ct}) $=FC_{ct}+PC_{ct}+IH_{ct}+TC_{ct}+IE_{ct}+DE_{ct}+LN_{ct}+Z_{ct} \quad \forall c,t$ (9)

Min z$=\sum_{c=1}^{C}\sum_{t=1}^{T}(OC_{ct})$ (10)

Set of constraints

Capacity constraint

$$QP_{pict}+\sum_{i\prime\neq i}\sum_{b=c}^{b} Q1_{pici\prime bt}+\sum_{i\prime}\sum_{b\neq c}^{b} Q1_{pici\prime bt}\leq QP_{pict}^{max}X_{ict} \quad \forall\ p,i,c,t \quad (11)$$

$$\sum_i\sum_b Q2_{pibjct}+\sum_{j\prime\neq j}\sum_{b=c}^{b} Q4_{pj\prime bjct}+\sum_{j\prime\neq j}\sum_{b=c}^{b} Q4_{pj\prime bjct}\leq QW_{pjct}^{max}Y_{jct} \quad \forall p,j,c,t \quad (12)$$

Continuity constraint

$$QS_{pkct}=\sum_i\sum_b Q3_{pibkct}+\sum_j\sum_b Q5_{pjbkct} \quad \forall c,t,k,p \quad (13)$$

$$QP_{pict}+\sum_{i\prime\neq i}\sum_{b=c}^{b} Q1_{pi\prime bict}+\sum_{i\prime}\sum_{b\neq c}^{b} Q1_{pi\prime bict}=\sum_{i\prime\prime\neq i}\sum_{b=c}^{b} Q1_{pici\prime\prime bt}+$$
$$\sum_{i\prime\prime}\sum_{b\neq c}^{b} Q1_{pici\prime\prime bt}+\sum_j\sum_b Q2_{picjbt}+\sum_k\sum_b Q3_{pickbt} \quad \forall c,t,i,p \quad (14)$$

Inventory Balance

$$\sum_i\sum_b Q2_{pibjct}+\sum_{j\prime\neq j}\sum_{b=c}^{b} Q4_{pj\prime bjct}+\sum_{j\prime}\sum_{b\neq c}^{b} Q4_{pj\prime bjct}+IN_{pjc(t-1)}=\sum_k\sum_b Q5_{pjckbt}+$$
$$\sum_{j\prime\neq j}\sum_{b=c}^{b} Q4_{pjcj\prime bt}+\sum_{j\prime}\sum_{b\neq c}^{b} Q4_{pjcj\prime bt}+IN_{pjct} \quad \forall j,c,t,p \quad (15)$$

Carbon emission

$$\eta 1_{ici'bt}=\frac{\sum_p(Q1_{pici\prime bt}V_p)}{\Omega} \quad \forall i,c,i',b,t \quad (16)$$

$$\eta 2_{icjbt}=\frac{\sum_p(Q2_{picjbt}V_p)}{\Omega} \quad \forall i,c,j,b,t \quad (17)$$

$$\eta 3_{ickbt}=\frac{\sum_p(Q3_{pibkct}V_p)}{\Omega} \quad \forall i,c,k,b,t \quad (18)$$

$$\eta 4_{jcj'bt}=\frac{\sum_p(Q4_{pibj\prime ct}V_p)}{\Omega} \quad \forall j,c,j',b,t \quad (19)$$

$$\eta 5_{ijkbt}=\frac{\sum_p(Q5_{pibkct}V_p)}{\Omega} \quad \forall j,c,k,b,t \quad (20)$$

$CE1_{ct} + CE2_{ct} + CE3_{ct} = \alpha_{ct} + G_{ct}$ (For Carbon Cap and Trade) (21)

Where

$CE1_{ct}$=$Ef\frac{1}{Mil}(\sum_i\sum_{i'}\sum_b \eta 1_{ici'bt} d1_{ici'bt} + \sum_i\sum_j\sum_b \eta 2_{icjbt} d2_{icjbt} + \sum_i\sum_k\sum_b \eta 3_{ickbt} d3_{ickbt}$
$+\sum_j\sum_{j'}\sum_b \eta 4_{jcj'bt} d4_{jcj'bt} + \sum_i\sum_j\sum_b \eta 5_{jckbt} d5_{jckbt}$) (22)

$CE2_{ct}$=$\sum_p\sum_i E1_{pt} * QP_{pict}$ $\forall\, c,t$ (23)

$CE3_{ct} = \sum_p\sum_j E2_{pt} * IN_{pjct}$ $\forall\, c,t$ (24)

$X_{ict}, Y_{jct},$ = 0, 1 $\forall i,j,c,t$ (25)

$Q1_{picjbt}, Q2_{pjckbt}, Q3_{pickbt}$, $Q4_{pici'bt}$, *and* $Q5_{pjcj'bt}, IN_{pjct}$ *are integers* (26)

$G_{ct} = unrestricted$ (27)

3.3.5 Model Formulation under strict carbon cap:

TOTAL COST (OC_{ct}) =FC_{ct}+PC_{ct}+IH_{ct}+TC_{ct}+IE_{ct}+DE_{ct} + LN_{ct} $\forall c,t$ (28)

Min z=$\sum_{c=1}^{C}\sum_{t=1}^{T}(OC_{ct})$ (29)

Subject to the constraint (11) to (27) where (21) is to be replaced with (30)

$CE1_{ct} + CE2_{ct} + CE3_{ct} \leq CAP_{ct}$ (30)

3.3.6 Model Formulation under carbon tax:

TOTAL COST (OC_{ct}) =FC_{ct}+PC_{ct}+IH_{ct}+TC_{ct}+IE_{ct}+DE_{ct} + LN_{ct} + $TAX(TE_{ct})$ $\forall c,t$ (31)

Min z=$\sum_{c=1}^{C}\sum_{t=1}^{T}(OC_{ct})$ (32)

Subject to the constraint (11) to (27) where (21) is to be replaced with (33)

$TE_{ct} = CE1_{ct} + CE2_{ct} + CE3_{ct}$ (33)

Equation (1), (2), (3) and (4) represent the fixed cost, production cost, inventory holding cost and transportation cost respectively. Equation (5) corresponds to the import/export cost incurred when a product is shipped from one country to another country. Equation (6) represents calculation for the expense incurred on depreciation of plant's assets per unit of production. Equation (7) represents the interest payments towards the loan sanctioned for country *c* in period *t*. Equation (8) corresponds to the carbon emission cost where the carbon price is considered same for both buying and selling of the carbon credits. Equation (9) provides the total cost for all countries and for all time periods. The objective function is represented by equation (10) which minimizes the total cost calculated in equation (9) for all the countries over the entire planning horizon. The capacity constraints corresponding to plants and warehouses are represented by (11) and (12). Constraint (13), (14) ensure the continuous flow of the product. Inventory balance equation for each product in each warehouse for each time period is represented by (15). Equation (16) to (20) corresponds to the number of carriers required by each facility in each time period. $\eta 1_{ici'bt}$ represents the number of carriers required to ship the product from plants to plants either in same country or different country in each time period. Similarly, $\eta 2_{icjbt}$, $\eta 3_{ickbt}$, $\eta 4_{jcj'bt}$, *and* $\eta 5_{ijkbt}$ represents the carriers required for shipping product from plant to warehouse, plant to market, warehouse to warehouse, and warehouse to market

respectively. The total carbon emission due to production, handling and transportation is balanced in equation (21) against the total permissible carbon quota and the extra carbon that has been traded in country *c* in period *t*. Equation (22) to (24) corresponds to carbon emission due to transportation, production and handling the product in each country for each time period. (25), (26) and (27) impose the binary, integer and unrestricted restrictions onto the decision variables.

Equations (28) to (30) represent the mathematical model under strict carbon cap. Equation (28) represents the total cost under carbon cap regulation. Objective function is represented by equation (29) which is to minimize the total cost evaluated in (28). Equation (30) ensures that the total carbon emission should remain within the limit of prescribed carbon cap. Equations (31) to (33) represent the mathematical model under carbon taxation. Equation (31) represents the total cost under carbon tax regulation. Objective function is represented by equation (32) which is to minimize the total cost evaluated in (31). Equation (33) evaluates the total carbon emission through transportation, production and storage. The model is illustrated using a randomly generated case in the next section.

4. Numerical Illustration

The proposed mathematical model is computationally tested using a case instance of two countries (2C). The firm wants to setup its production-distribution network in these two countries to manufacture five different products (5P). For this, the firm has shortlisted suitable locations in each country. A maximum of three plants (3I) and five warehouses (5J) can operate in each country in each time period to serve the demand originating from seven known market locations (7K). The facilities can full fill the demand of the home country as well as the other country. The firm is operating in a low carbon economy, therefore, carbon emissions need to be tracked at each stage of the supply chain. The model is solved on Lingo 17 software on operating system Windows 7 (i7 processor). The results under different carbon regulations are demonstrated and analyzed in the next section.

5. Results and Discussion

In the cap and trade scenario, a carbon quota is assigned to each firm and the carbon emission less than or more than this predefined carbon cap can be traded. This trading can take place within the same country or with the outside country. In the considered problem (2C-5P-3I-5J-7K), carbon cap has been varied from 30000 to 100000 with step size 5000. Three carbon prices 1000, 1500, and 2000 have been considered. The inventory holding cost is taken 0.2 for all the products in all the time periods. The carbon emission is considered due to production, storage and transportation. The carbon emission due to production of each unit for all five products (5P) in all time periods is 60, 55, 70, 65, and 50 respectively. The carbon emission due to transportation is evaluated as fixed and variable emission. In the fixed emission, a standard carbon emission is associated with the carrier which is taken as 200 in this case. The variable emission is a function of distance travelled by the carrier, type of fuel used by the carrier, capacity of carrier utilized and the mileage given by the carrier per liters of fuel used. The emission factor for variable emission is taken as 2.39. The volumetric capacity of the carrier is considered as 12000000 and the packaged volume of the products are 3000, 5000, 10000, 20000, and 40000.

5.1 Analysis under carbon cap and trade

The experimental results for carbon cap and trade regulation with varied carbon cap and carbon price is provided in Table 1. It is to be noted that the total cost increases with increase in carbon price irrespective of the carbon cap value. However, the total carbon emission decreases. Upon increasing the carbon cap when carbon price is 1000/ton, the total carbon emission shows random nature whereas the total cost decreases considerably. The minimum emission occurs when carbon cap is set 35000 with total carbon emission 6957.50. The total cost at this point is 4.4758×10^8. In contrast to

this, the minimum cost 4.4719 x10^8 occurs at the maximum carbon cap value 100000 with total emission 6971.36. When the carbon price is 1500/ton, increase in carbon cap results in lower total cost however, the total carbon emission shows discrete nature. The emission increases suddenly when the carbon cap is changed from 30000 to 35000, then it starts decreasing till carbon cap value 55000, after that it shows random pattern. For this case, the minimum carbon emission 6941.17 occurs at 30000 carbon cap value with total cost 4.5100x10^8. The minimum cost 4.5037x10^8 occurs when carbon cap is set 100000 with total emission 6941.33. Further increasing the carbon price to 2000/ton, it is noticed that the carbon emission is almost stable; it jumps for carbon cap value 70000 but then decreases again. The total cost is also stable in this case and starts decreasing when carbon cap is increased from 60000 and then gets stable again. The minimum carbon emission corresponds to carbon cap value 75000 with total emission 6921.06 and total cost corresponding to this value is 4.5383x10^8. The cost is minimized at the maximum carbon cap with total cost 4.5353 x10^8 and total emission 6922.01. This can be clearly inferred from circles 4, 5, 6, 7, 8 and 9 of Figure 1.

Table 1. Cap and Trade scenario for different carbon price.

Carbon cap	CC=1500/ton		CC=1000/ton		CC=2000/ton	
	emision(tons)	cost(10^8)	emission(tons)	cost(10^8)	emission(tons)	cost(10^8)
30000	6941.17289	4.5100	6972.64276	4.4761	6921.39866	4.5437
35000	6942.88564	4.5095	6957.50383	4.4758	6921.98205	4.5431
40000	6942.53100	4.5091	6975.20846	4.4755	6921.50206	4.5425
45000	6942.48555	4.5086	6974.52936	4.4752	6921.79559	4.5419
50000	6942.29906	4.5082	6977.77024	4.4749	6921.64836	4.5413
55000	6941.57953	4.5077	6978.33732	4.4746	6921.19992	4.5407
60000	6942.70283	4.5073	6976.10324	4.4743	6921.18297	4.5401
65000	6942.15400	4.5068	6973.39429	4.4740	6921.81243	4.5395
70000	6941.70652	4.5064	6972.90712	4.4737	6924.58998	4.5389
75000	6941.77019	4.5059	6978.49550	4.4734	6921.06682	4.5383
80000	6941.23967	4.5055	6972.80623	4.4731	6922.06972	4.5377
85000	6942.20232	4.5050	6973.06354	4.4728	6922.06972	4.5371
90000	6942.34606	4.5046	6973.09724	4.4725	6921.61998	4.5365
95000	6941.83291	4.5041	6976.97363	4.4722	6921.45710	4.5359
100000	6941.33757	4.5037	6971.36228	4.4719	6922.01128	4.5353

From, table 1, it is clearly evident that total cost is linear and decreases with increase in carbon cap value. However, varying the carbon cap does not have a significant influence on the total carbon emission. It depends on the objective of the firm whether it wishes to minimize the cost or minimize the emission. The firm can opt for an optimal trade off by reducing carbon emission through a little bit increase the total cost.

5.2 Analysis under carbon cap

Under strict carbon cap regulation, an inflexible carbon emission limit is set and the firm has to operate keeping the total emission within the prescribed limit. For this purpose, the model is computationally tested on different carbon caps varying from 6917000 to 7000000. This carbon cap range has been obtained in accordance with the total carbon emission range in the cap and trade scenario. From the table 1, it is clear that the total carbon emission value ranges from 6921 to 6978. Therefore, in order to check whether the further reduction in total carbon emission is possible or not, carbon cap has been varied beyond this range. Table 2 shows the experimental results of the model. The model does not provide the solution for carbon cap value less than 6917000. Hence, for the given set of data, total carbon emission cannot be reduced beyond 6917 tons through operational adjustments.

Table 2. Total cost and Carbon emission under strict carbon cap.

Carbon		carbon emission (tons)			
cap(kg)	Cost(10^8)	production	storage	transportation	emision
6917000	4.4094	6818.7	16.7	81.6	6917.0
6918000	4.4097	6818.7	17.2	82.1	6918.0
6919000	4.4092	6818.7	15.5	84.8	6919.0
6920000	4.4092	6818.7	18.1	83.2	6920.0
6930000	4.4093	6818.7	29.9	81.4	6930.0
6940000	4.4093	6818.8	35.8	85.3	6940.0
6950000	4.4089	6818.7	45.9	85.4	6950.0
6960000	4.4097	6818.8	58.4	82.9	6960.0
6970000	4.4082	6818.7	58.4	92.9	6970.0
6980000	4.4088	6818.7	76.6	84.7	6980.0
6990000	4.4085	6818.7	84.6	86.7	6990.0
7000000	4.4080	6818.8	87.5	93.7	7000.0

If the firm wishes to reduce the carbon emission further, up gradation of technologies will be required especially the plant machinery as it is clearly evident that the majority of carbon emission is due to production. The carbon emission increases in same proportion with increase in carbon cap Also, it is interesting to note that the total cost corresponding to all the value of carbon caps is less than the minimum cost under cap and trade scenario. Production cost has no impact on change in carbon cap while storage cost increases from 16.7 to 87.5. The minimum carbon emission corresponds to carbon cap value 6917000 and the total cost in this case is 4.4094×10^8. The minimum cost occurs at carbon cap 7000000. From the figure 1, it can be clearly visualized that the production cost is constant whereas the transportation cost increases on increasing the carbon cap, contributing the increase in total carbon emission.

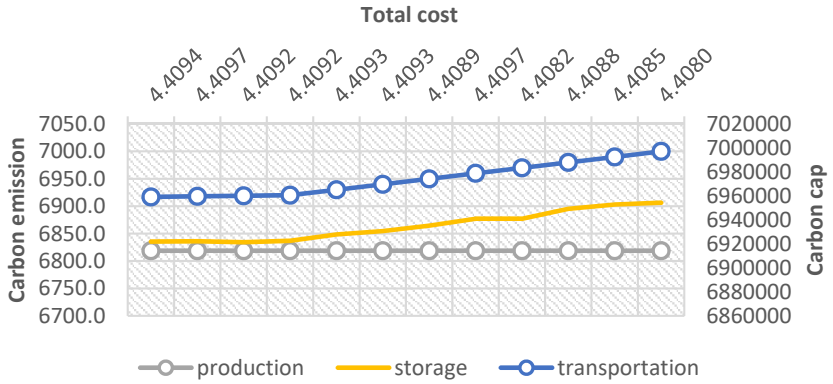


Fig1. Carbon cap regulation

5.3 Analysis under carbon tax

Unlike carbon cap and carbon cap and trade, there is no carbon cap under carbon taxation. However, the firm has to pay a standard tax per ton of carbon emission. In this regard, the experiment is computed by varying carbon tax from 100 to 1000 with the step size of 50.

Table 3. The experimental results under carbon tax regulation.

tax		carbon emission(tons)			emission
	Cost(10^8)	production	storage	transportation	
100	4.414	6818.700	258.880	101.127	7178.707
150	4.418	6818.700	232.570	101.293	7152.563
200	4.421	6818.700	224.410	100.207	7143.317
250	4.425	6818.700	219.130	101.041	7138.871
300	4.428	6818.700	60.580	98.619	6977.899
350	4.432	6818.700	68.986	97.917	6985.603
400	4.436	6818.700	77.046	98.919	6994.665
450	4.439	6818.700	78.250	99.584	6996.534
500	4.443	6818.700	93.290	98.034	7010.024
550	4.446	6818.700	118.490	98.595	7035.785
600	4.450	6818.700	137.130	101.641	7057.471
650	4.453	6818.700	144.810	99.390	7062.900
700	4.457	6818.700	155.290	98.429	7072.419
750	4.460	6818.700	175.130	101.017	7094.847
800	4.464	6818.700	185.050	100.974	7104.724

850	4.467	6818.700	202.490	100.876	7122.066
900	4.471	6818.700	202.490	100.478	7121.668
950	4.474	6818.700	208.730	100.857	7128.287
1000	4.478	6818.700	208.730	100.666	7128.096

From the above table, it can be clearly seen that on increasing the carbon tax, the total cost increases linearly. Further, the carbon emission due to production is same, however, the carbon emission due to storage and transportation shows a sharp decrease when the tax is increased from 250 to 300. The carbon emission value remains relatively low till carbon tax value 500, although it increases slowly. Once the carbon tax is increased from 500 to 500, the emission due to storage sharply increases and it increases even on further increase in the tax value. Thus the optimal trade off can be obtained at carbon tax 300 with total emission 6977.89 and total cost $4.428x10^8$.

The overall result under carbon cap, cap and trade and carbon tax is represented in Figure2. The total carbon emission, total cost corresponding to carbon cap or tax is provided against each case represented by the circle labeled 1 to 11. It is clearly evident from figure 2 that minimum carbon emission occurs under strict carbon cap policy. Also, the minimum total cost is obtained under the same category. For the considered problem (2C-5P-3I-5J-7K), strict carbon cap regulation provides the best results. Carbon emission can be reduced considerably by raising the cost from $4.4080x10^8$ to $4.4093x10^8$

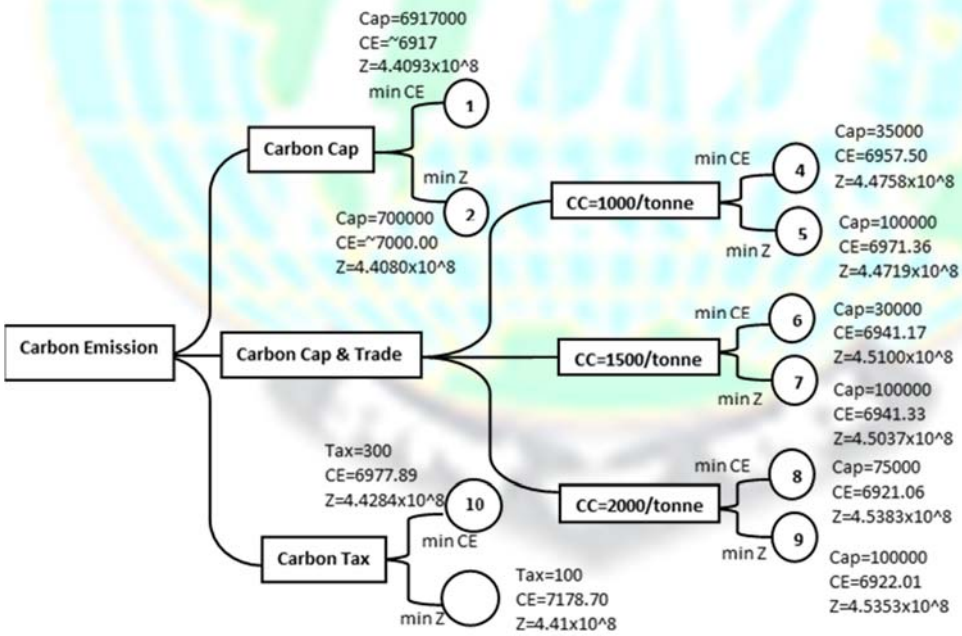


Fig2. Result for minimum carbon emission or minimum total cost.

6. Conclusion and future scope

The paper explores the impact of carbon regulating policies on reduction in the overall carbon emission of the firm. For this purpose, a mixed integer formulation is proposed to address the facility location decisions under low carbon economy. The paper incorporates international trade issues under three carbon regulating policies viz. carbon cap, carbon cap and trade, and carbon tax. The model is

computationally tested through a randomly generated case and a comparative analysis of results is provided under three type of carbon regulations. Under carbon cap and trade regulation, it is noticed that changing the carbon cap does not have any significant impact on the carbon emission. However, as the carbon price increases, carbon emission reduces considerably. Under strict carbon cap regulation, it is noticed that carbon emission is significantly smaller as compared to cap and trade and carbon tax regulation. The carbon emission can further be reduced by a little increase in the total cost. Under carbon tax regulation, it is observed that total cost increases linearly with increase in carbon tax. However, the carbon emission remains stable up to a certain value of carbon tax after that carbon emission reduces sharply and becomes stable again. On further increasing the carbon tax, carbon emission starts increasing and the minimum carbon emission is obtained when the carbon tax value is 300/ton. The paper provides useful insights to the management of the organization to adopt the apt carbon regulating policy according to its business compatibility to promote eco-friendly growth of the economy. Subsequent research can be done in future to incorporate stochastic demand and uncertainties in exchange rate.

Acknowledgements

The authors would like to thank the Department of Science and Technology, Ministry of Science and Technology, New Delhi, India for funding this research.

References

1. **Arampantzi**, C. and Minis, I., 2017.A new model for designing sustainable supply chain networks and its application to a global manufacturer. *Journal of Cleaner Production*, *156*, pp. 276-292.
2. Benjaafar, S., Li, Y. and Daskin, M., 2013. Carbon footprint and the management of supply chains: Insights from simple models. *IEEE transactions on automation science and engineering*, *10*(1), pp.99-116.
3. Bhatnagar, R. and Viswanathan, S., 2000. Re-engineering global supply chains: alliances between manufacturing firms and global logistics services providers. *International Journal of Physical Distribution & Logistics Management*, *30*(1), pp.13-34.
4. Cholette, S. and Venkat, K., 2009. The energy and carbon intensity of wine distribution: A study of logistical options for delivering wine to consumers. *Journal of Cleaner Production*, *17*(16), pp.1401-1413.
5. Cohen, M.A. and Lee, H.L., 1988. Strategic analysis of integrated production-distribution systems: Models and methods. *Operations research*, *36*(2), pp.216-228.
6. Creazza, A., Dallari, F. and Melacini, M., 2010. Evaluating logistics network configurations for a global supply chain. *Supply Chain Management: An International Journal*, *15*(2), pp.154-164
7. Dekker, R., Bloemhof, J. and Mallidis, I., 2012. Operations Research for green logistics–An overview of aspects, issues, contributions and challenges. *European Journal of Operational Research*, *219*(3), pp.671-679.
8. Abdallah, T., Diabat, A. and Simchi-Levi, D., 2010. A carbon sensitive supply chain network problem with green procurement. *Institute of Electrical and* ***Electronics*** *Engineers. DOI:* http://hdl.handle.net/1721.1/66601
9. Dong, L., Kouvelis, P. and Su, P., 2013. Global facility network design in the presence of competition. *European Journal of Operational Research*, *228*(2), pp.437-446.
10. Elkins, P. and Baker, T., 2001. Carbon Taxes and Carbon Emission Trading. *Journal of Economic Surveys*. https://doi.org/10.1111/1467-6419.00142. Pp 325-376. Vol 15. Issue 3.
11. Ferdows, K., 1989. Mapping International Manufacturing Networks in Managing International Manufacturing, Edited by Kasra Ferdows.
12. Hansen, J., Sato, M., Kharecha, P., von Schuckmann, K., Beerling, D. J., Cao, J., Marcott, S., Masson-Delmotte, V., Prather, M. J., Rohling, E. J., Shakun, J., Smith, P., Lacis, A., Russell, G., and Ruedy, R. 2017: Young people's burden: requirement of negative CO2 emissions, Earth Syst. Dynam., 8, 577-616, https://doi.org/10.5194/esd-8-577-2017.
13. Harrison, T. and Smith, G., 2009. *Cap and Trade versus a Carbon Tax*. Working paper, Citizens Action Coalition of Indiana, Indianapolis, IN 46204.
14. He, P., Zhang, W., Xu, X. and Bian, Y., 2015. Production lot-sizing and carbon emissions under cap-and-trade and carbon tax regulations. *Journal of Cleaner Production*, 103, pp.241-248.
15. Kaur, H. and Singh, S.P., 2017. Heuristic modeling for sustainable procurement and logistics in a supply chain using big data. *Computers & Operations Research*.
16. Kouvelis, P., Rosenblatt, M.J. and Munson, C.L., 2004. A mathematical programming model for global plant location problems: Analysis and insights. *IIE transactions*, *36*(2), pp.127-144.
17. Lamba, K. and Singh, S.P., 2018. Dynamic supplier selection and lot-sizing problem considering carbon emissions in a big data environment. *Technological Forecasting and Social Change*.

18. Lamba, K., Singh, S.P. and Mishra, N., 2018. Integrated decisions for supplier selection and lot-sizing considering different carbon emission regulations in Big Data environment. *Computers & Industrial Engineering. DOI:* https://doi.org/10.1016/j.cie.2018.04.028
19. Meijboom, B. and Voordijk, H., 2003. International operations and location decisions: a firm level approach. *Tijdschrift voor economische en sociale geografie*, *94*(4), pp.463-476.
20. Mishra, S., Singh, S.P., Johansen, J., Cheng, Y. and Farooq, S., 2018. Evaluating indicators for international manufacturing network under circular economy. *Management Decision. DOI:* https://doi.org/10.1108/MD-05-2018-0565
21. NOAA-NASA Annual Global Analysis (2016). A NASA report: 2016 was third successive record warm year. https://www.giss.nasa.gov/research/news/20170118/NOAA-NASA_Global_Analysis-2016-FINAL.pdf
22. Mandell, S., 2008. Optimal mix of emissions taxes and cap-and-trade. *Journal of environmental economics and management*, 56(2), pp.131-140.
23. Rudberg, M. and Olhager, J., 2003. Manufacturing networks and supply chains: an operations strategy perspective. *Omega*, *31*(1), pp.29-39.
24. Schmenner, R.W., 1979. Look beyond the obvious in plant location. *Harvard Business Review*, 126–132.
25. Schwanberg, V. D., 2018. Can the Paris Agreement save us from a climate catastrophe? *THE LANCET Planetary Health*. DOI: 10.1016/S2542-5196(18)30056-1.Vol 2. Issue 4. PE 140
26. Shi, Y. and Gregory, M., 1998. International manufacturing networks—to develop global competitive capabilities. *Journal of operations management*, *16*(2-3), pp.195-214.
27. Srinivasan, S. and Khan, S.H., 2018. Multi-stage manufacturing/re-manufacturing facility location and allocation model under uncertain demand and return. *The International Journal of Advanced Manufacturing Technology*, *94*(5-8), pp.2847-2860.
28. Sundarakani, B., De Souza, R., Goh, M., Shun, C., 2008. Measuring carbon footprints across the supply chain. In: Proceedings of the 13th International Symposium on Logistics, July 2008, Bangkok, Thailand, pp. 555–562
29. The Emission Gap Report (2017).A UN environment synthesis report. https://wedocs.unep.org/bitstream/handle/20.500.11822/22070/EGR_2017.pdf. Accessed date: 6June 2018.
30. The Paris Agreement (2015). https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement . Accessed date: 10 June 2018
31. Xu, L. and Wang, C., 2017. Sustainable manufacturing in a closed-loop supply chain considering emission reduction and remanufacturing. *Resources, Conservation and Recycling*.
32. Yonah, R.S. and Uhlmann, D.M., 2009. Combating global climate change: Why a carbon tax is a better response to global warming than cap and trade. *Stan. Envtl. LJ*, 28, p.3.

Application of Multi-Objective Flow Shop Scheduling for Indian Manufacturing Industry

Harpreet Singh*[1], Jaspreet Singh Oberoi[1] and Doordarshi Singh[1]
[1]Department of Mechanical Engineering, I.K. Gujral Punjab Technical University, Jalandhar, Punjab (India)
*Corresponding author: harpreet.mech9@gmail.com

Abstract. It is increasing the advancements of MFSP in respect to demand in industries for single and multi-objective flow shop scheduling. As per literature survey, many research gaps have been found out in regard to theories, concepts, and practical implications for multi-objective heuristics algorithms for parameters such as tardiness, lateness, cycle time, process time, and process inputs. In this context, the present article explains the comprehensive review of both former and current state-of-art approaches on MFSP. It is also introducing the broad concept and critical analysis of MFSP. Secondly, the exhaustive investigations of research articles and publications have been presented in present work. The respective research current trends and challenges are addressed and it is contributing towards the significant interest of researchers.

Keywords: Flow shop scheduling, Multi-objective optimization algorithms, Heuristics algorithms, Production scheduling

1 Introduction to Scheduling

In the real time scenario, there exist many situations in manufacturing system like due date changes, unexpected job release, machine breakdowns and greater processing times, than estimated and expected. The cost of production aggregates to high proportion of any firm's expenditure, hence every firm tries to get a proper design of

shop and scheduling of jobs on various machines to optimize the task times for long-term and short-term goals. Scheduling, hence, is a non-ignorable aspect of every manufacturing system. Scheduling is the allocation of limited resources (man and machinery), by organizing, controlling and optimizing various set of activities in a manufacturing process in a specific amount of time. Simply, it authenticates the production facility when to make, on which equipment and with which staff. Johnson (1954) studied two and three stage production system with included set-up times. Li and Willis (1992) mentioned two aspects, forward scheduling, in which activities are

to be planned from the date they become available to determine the due date, and backward scheduling, in which activities are planned for later as possible, to meet the due date. Singh and Mahapatra (2012) and Huang et al. (2014) specified the various criterions as minimizing the make-span, lateness, machine idle cost, inventory cost and tardiness. The objective is to increase the production efficiency, optimization of resources, minimizing production cost and increase in competitive strength. Rossi (2016) defined it as a set of n jobs (different or same) processed on m set of machines to minimize the given criterion. Scheduling is an effective method to plan the sequence of tasks and is applicable to service industry, project control, electronic industry, computer science, food processing industry, chemical, textile and so on.

1.1 General Terms Describing a Job in a Scheduling Problem

The following terms describe jobs in single machine scheduling problem.

(i) Processing time: It is the time required to process job j. It includes both, the act processing time and set-up time.

(ii) Ready time: It is the difference between the arrival time of the job and the time at which, the processing of job starts.

(iii) Due date: It is the time at which the processing of the job j is to be completed.

(iv) Completion Time: It is the time at which the job j is actually completed in a sequence.

(v) Flow time: It is the amount of time that job j spends in a system. It is difference between completion and ready time.

(vi) Lateness: It is the amount of time by which completion time of job j differs from its due date. It can be positive or negative. Positive lateness implies completion of job after its due date, and is a measure of poor service, while negative lateness is measure of better service.

(vii) Tardiness: it is the lateness of job „j", if it fails to meet its due date, else it will be zero. The maximum of zero and difference of completion and due date is tardiness.

1.2 Assumptions in Scheduling

The following conditions prescribe the scheduling process:

1. A set of „n" independent jobs, each with single operation is available for processing at time zero.
2. Set-up time of each of the jobs is independent of its position in the sequence of jobs. Therefore, the set-up tie of each job can be included in its processing time.
3. Job descriptors are to know in advance.
4. One machine is continuously available and is never kept idle when work waiting.
5. Each job is processed until its completion without any pre-emption.

1.3 Classification of Scheduling

Scheduling is allocating the resources from the initial to the final times, for the various tasks associated with different jobs, to optimize some performance measures. Figure 1 depicts classification of scheduling problem.

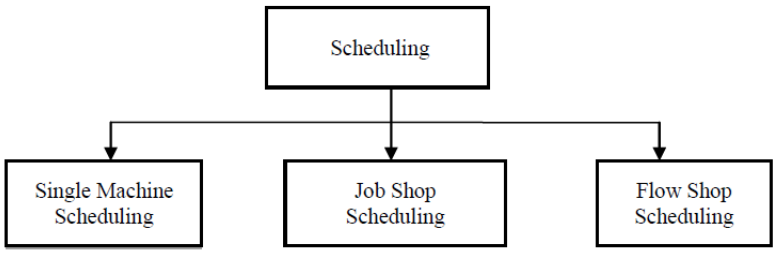


Figure 1: Depiction of Classification Scheduling Problem

2 RESEARCH MODELS

Azzi et al. (2012) presented a heuristic procedure to solve hybrid flow shop scheduling problem in a flexible multistage batch production system with an aim to minimize make-span. The other aim was to increase production capacity utilization (affected due to decrease in marketing time and increased number of models) by using a batch splitting or aggregation strategy and introduced workload leveling function (which determines the cost by reducing the make-span by rearranging the machines or by splitting into batches) as each stage comprises of certain number of machines. This condition is acceptable when benefits considered be function of setting up new machines and reducing process

time and when same job is required at the different stages of production batches, set-up times be reduced. The system includes two or more production stages and a job processed on one, none or every machine groped in the batches with buffers of work in progress among different stages.

When compared with short processing time method, reduced make-span by 65 % and increased capacity to 60%. The proposed heuristic has a potential to reduce make-span with inter-operational buffer limits in multi-stage multi-product batch production system with first-in-first-out flow.

$$\text{Liv}(m_1, m_2, \dots, m_h, m_z, j_z) = \text{PT } m_z - \text{PT } m_1 - \text{TS}(j_z)\, H + 1 \quad (1)$$

$$\text{PT } (m_{inew}) = \text{PT}(m_i) + \text{TS}(j_z) - \text{Liv}(m_i, m_j j_z) \quad (2)$$

$$\text{PT}(m_z)_{new} = \text{PT } m_z - \text{Liv } m_i, m_z, j_z \,.\, H \quad (3)$$

$$\text{PT } m_z - \text{PT } m_1 > \quad (4)$$

Javandi et al. (2012) proposed a mathematical model and immune algorithm for hybrid flow shop scheduling problem with sequence dependent set-up times, time lags and possibility of jobs to skip stage, with an aim to minimize make-span in solving small size problems in a reasonable computational time. The algorithm uses mutation to search near optimal solution and redeploys the best solution in the subsequent population, thus striking out the solution with better convergence. Immune algorithm outperformed the presented mathematical model in producing optimal solutions in less computational time. The proposed algorithm was coded in MATLAB 7.5 and solved in LINGO 8.0 0in Pentium IV 2-GHz processor with 1GB RAM.

Singh and Mahapatra (2012) presented Particle Swarm Optimization (PSO) algorithm to solve flexible flow-shop scheduling problem, which combines both flow shop and parallel machines in order to minimize the make-span so that multiprocessor system be executed with minimum length. The algorithm uses mutation operator to avoid premature convergence and trapping of solution in the local minima. Chaotic numbers generated with help of logistic mapping to converge the solution rapidly towards near-optimal solution, thus reducing the computational time. When compared, the average percentage deviation in PSO was 2.961 to that of 3.559 in genetic algorithm (GA), hence making PSO to be more effective in producing quality solutions in less computational time and with less parameters. The algorithm was structured in C++ on Pentium 4 3GHz processor with 1 GB RAM.

Elyasi and Salmasi (2013) proposed a dynamic method for flow-shop scheduling problem with an aim to reduce number of tardy jobs constrained by stochastic due dates and included processing times. The due dates followed normal distribution with pre-known mean and variance. The proposed method decomposes m-machine flow shop problem into sub-problems of m-stochastic single machine scheduling, each of which regarded as individual mathematical problem. The presented method when compared to shortest processing time (SPT) proved 23.9% better on scheduling average industry-size problem and observed that more the environment is dynamic better were the results produced. The computational time of both the compared methods was same. This method has a potential to solve large size problems with random processing times or weighted jobs. C# language was used to code the algorithm along with LINGO 11.0 to solve the individual problems on 2 GHz Intel core processor with 3GB RAM.

Khorasanian and Moslehi (2017) presented variable neighborhood search algorithm (VNS) for two-machine flow shop scheduling problems with an aim to minimize the make-span and constrained by blocking. Two characteristics, multi-task flexibility to process the operations of at least one other machine a preemption, to allow the solution space to grow in order to find efficient solutions, were added. As schedules were infinite in number, a dominant schedule was defined for each sequence. A variant of VNS called dynamic VNS (DVNS) presented produces high quality solutions for large sized instances and two mathematical models formulated for small sized instances. VNS algorithm

was coded in C# and GAMS 24.4.6/CPLEX solved the mathematical models using Intel core 3.06 GHz processor with 4GB RAM.

3 PROBLEM FORMULATION OF PROCESS FLOW- PISTON MACHINERY SHOP

In a piston manufacturing industry, there are two products are being manufactured they are ring carrier pistons and 4-strokes bi-wheeler piston rings are manufactured and the process is done in a flow shop manner. Therefore, the flow patterns of both the products are described and depicted below:

3.1 Stroke Bi-Wheeler Pistons Flow Process

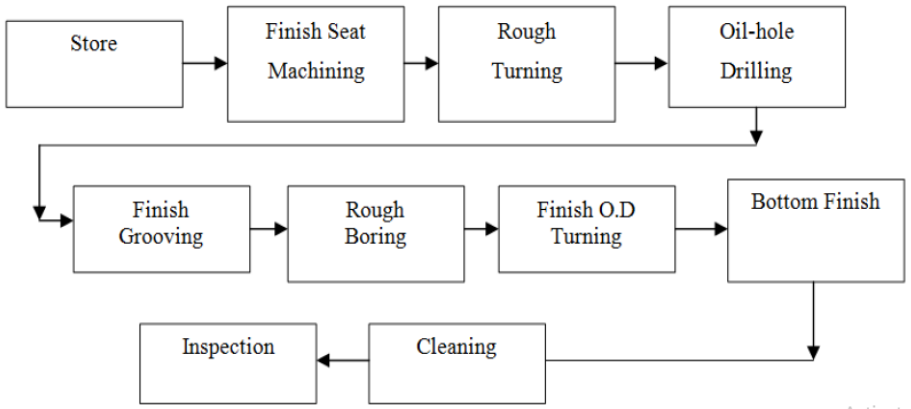


Figure 2: 4-Stroke Bi-wheeler Pistons Flow Process for a Piston Manufacturing Industry

Business plan of a piston manufacturing industry is the important factors that are described on the occurrence of data. They are listed below:

Business plan target for the month	=	45,155
Production target for the month	=	49,671
Actual production till date	=	22,760
Asking rate of start of month	=	1910 nos. /days
Asking rate for remaining WD‟s	=	1416 nos. /days

3.2 Prepare Database Sheet

Preparation of the database sheet is most necessary step of this research approach. Here we prepare a sheet according to our need i.e., data needed for initializing the work is collected in these sheets. These sheets may consist of the information like:

(a) Cycle time

(b) Processing time

(c) Due date

(d) Number of workers

(e) Work in process

(f) Task Time

3.3 Fitness Function

Fitness function is gained from the target operation and applied in sequence ingenetic operations. Several genetic operators demand that there should be the fitness function is nonnegative, even though several operators may not have these necessities. For the minimization of these problems, the fitness operation is a similar maximization problem is chosen so that the optimal point retains unaltered. The fitness function is frequently used as

$$F(x) = 1/ (1+f(x) \quad (5)$$

The function of genetic algorithms starts with the population of stochastic strings indicating design or else decision variables. Thence after, individual string is calculated to identify the fitness value.

4. IMPLEMENTATION OF HEURISTICS ALGORITHM FOR FLOW SHOP SCHEDULING PROBLEM

Using heuristics algorithm for the achievement of attaining the optimal solutions in orders that to minimize the make-span of each and every machine and identify the best fitness function and prioritize accordingly. Fitness function is gained from the target operation and applied in sequence in genetic operations. Several genetic operators demand that there should be the fitness function is nonnegative, even though several operators may not have these necessities.

4.1 Heuristics

Heuristics refers to as an approach to problem solving, or discovery that employs a practical method not guaranteed to be optimal, but sufficient to obtain results. Polya (1945) gave some heuristics like working backward if unable to find a result, considering an example for an abstract problem, or picturing a problem rather than mathematically or theoretically focusing on it.

The majorly implemented heuristics algorithms are as follows:

i. Sequence Dependent Setup Times (SDST)
ii. Backlogging in scheduling
iii. Biogeography Based Optimization (BBO)
iv. Teacher Learning Based Optimization (TLBO)
v. Immune Algorithm
vi. Differential Evolution
vii. Tabu Search
viii. Particle Swarm Optimization
ix. Ant Colony Optimization
x. Branch and Bound Method
xi. Simulated Annealing
xii. Genetic Algorithms

Table 1: Summary of Applications in MFSP Field

Problem	Algorithm	Reference
$Fm\|\|C_{max}, F$	B&B	Ignall and Schrage (1965)
$F3\|\|C_{max}, F$	B&B	Lomnicki (1965)
$Fm\|nwt\|C_{max}, D$	HDTPL	Shao et al. (2016)
$Fm\|prmu\|C_{max}$	NS-SGDE	Shao and Pi (2016)
$Fm\|no\text{-}wait\|C_{max}$	DWWO	Zhao et al. (2018)

5. CONCLUSIONS AND FUTURE DIRECTIONS

In this paper, it is provided a comprehensive review of most famous approaches to solve MFSP with insights of research of their operations. The study of MFSP has attracted a great many researchers to develop effective and efficient approaches. The categorical based literature review in the form of groups and analysis of combinatorial optimization approaches are introduced. The review depicts that some interesting research progress has already been conducted in this area, but more needs to be done. In this paper, some important directions are proposed for further research: (1) Identification of uncertain indicators for dynamic MFSP. (2) Computation modeling performance to MFSP scheduling problems and (3) Design of constraints for MFSP scheduling problems.

References

Elyasi, A., Salmasi, N.: Stochastic Flow-Shop Scheduling with Minimizing The Expected Number of Tardy Jobs. International Journal of Advanced Manufacturing Technology. 66 (2013) 337– 346.

2. Ignall, E., Schrage, L.: Application of the Branch and Bound Technique to Some Flow-Shop Scheduling Problems. Operations Research. 13, 3 (1965) 400-412.

3. Johnson, S. M.: Optimal Two and Three Stage Production Schedules with Setup Times Included. Naval Research Logistics. 1, 1 (1954) 61–68.

4. Khorasanian, D., Moslehi, G.*: Two-Machine Flow Shop Scheduling Problem with Blocking, Multi-Task Flexibility of the First Machine, and Preemption*. Computers and Operation Research. 79 (2017) 94-108.

5. Kim, Y., Lim, H., Park, M.: Search Heuristics for a Flow-shop Scheduling Problem in a Printed Circuit Board Assembly Process. European Journal of Operational Research. 91, 1 (1996) 124-143.

6. Kirlik, G., Oguz, C.: A Variable Neighborhood Search For Minimizing Total Weighted Tardiness With Sequence Dependent Setup Times on A Single Machine. Computers & Operations Research. 39, 7 (2017) 1506-1520.

7. Lomnicki, Z. A.: A Branch-And-Bound Algorithm for the Exact Solution of the Three-Machine Scheduling Problem. Operations Research. 16, 1 (1965) 89-100.

8. Pessoa, L.S., Andrade, C.E.: Heuristics for A Flowshop Scheduling Problem with Stepwise Job Objective Function. European Journal of Operational Research. 266, 3 (2018) 950-962.

9. Polya: Flow Shop Scheduling with Lot Streaming. Operations Research Letters. 8, 6 (1945) 297-303.

10. Shao, W., Pi, D.: A Self-Guided Differential Evolution with Neighborhood Search for Permutation Flow Shop Scheduling. Expert Systems with Applications. 51 (2016) 161-176.

11. Shao, W., Pi, D., Shao, Z.: A Hybrid Discrete Optimization Algorithm Based on Teaching–Probabilistic Learning Mechanism for No-Wait Flow Shop Scheduling. Knowledge-Based Systems. 107 (2016) 219-234.

12. Singh, M. R., Mahapatra, S. S.: A Swarm Optimization Approach for Flexible Flow Shop Scheduling with Multiprocessor Tasks. International journal of Advances Manufacturing and Technology. 62 (2012) 267–277.

13. Zhao, F., Liu, H., Zhang, Y., Ma, W., Zhang, C.: A Discrete Water Wave Optimization Algorithm for No-Wait Flow Shop Scheduling Problems. Expert Systems with Applications. 91 (2018) 347-363.

Industry 4.0 based technologies for Manufacturing sector: Opportunities and Challenges

Dimple Bhandari[1], Prof. Rajesh Kumar Singh[2], Prof. S.K. Garg[1]

[1]Research Scholar, Delhi Technical University, India
[2]Management Development Institute, Gurugram

Abstract. The objective of this paper is to analyse challenges for manufacturing organizations in Industry 4.0 environment. Industry 4.0 initiatives can affect business model via converting the way the products are described, made and dispatched. Industry 4.0 is comparatively novel to developing nations like India. It requires a clear definition for better understanding and practices in business. Industry 4.0 initiatives can guide industries to absorb environmental protection and control initiatives as well as process safety measures in manufacturing industries. However, acceptance of Industry 4.0 inventiveness is not so easy due to presence of various challenges. The present study has noticed majorly eight key challenges to Industry 4.0 technologies implementation in manufacturing sector on basis of literature review. These challenges are Need for Enhanced Skills, High Implementation Cost, Lack of knowledge management systems, Lack of Standards and Reference Architecture, Security and Privacy Issues, Regulatory Compliance issues, Lack of Internet coverage and IT facilities, Legal and Contractual Uncertainty.

Keywords: Industry 4.0 challenges, opportunities, manufacturing sector, IOTs, Digitisation

1 Introduction

The outgrowth of technological vary has emerged in the contingency of a basal change from the information processing system integration manufacturing (CIM, ERP) to the consideration of "Industry 4.0". The next business whirl supported on the Internet of stuff and advance technologies is not a continuity of present bend in automation. It emerges from the modifications of the stoicism of construction systems momentous for the production or benefit [1]. Expanding consideration is actually being satisfied to the associations of integrating Internet of Things and Services (IoTS) technologies into industrial value formulization. This new paradigm of digital and affiliated manufacturing is referred to as “Industry 4.0” or “Industrial Internet of Things” (IIoT) and is converting well established factories into intelligent and self driven production units. Connected with this flexibility, Industry 4.0 reduces contemporary challenges, like enhancing worldwide competition, volatile markets and demands and supplies, required customization, also well as decreasing innovation and life cycles of various products. Industry 4.0 serves as a profitable and targeted manner to deal with these defiance necessities [3]. Industry 4.0 has seen the robot’s practical abreast factory workers, and sovereign vehicles reinstate work line contribute. Sensor meshwork and communications technologies have been used to torch designers with pottery workers, with poignant bicycle and software communicating independently through the tarnish, and facilities associated in actual age to suppliers and customers [4]. The aim of Industry 4.0 is to create a flexible model of production of personalized and digital products and services, with real-time communications between people, products and devices during the production process.

2 Literature Review

The best encouraging and successful sectors to focus ahead the manufacturing industry, is rapid enhancing in India [5]. According to Report (2018), the manufacturing industry provides 15–16% to national GDP and engage around 12 percent of the existing population. By the year 2022, it is created 100 million new jobs that is more or less 25% of gross domestic product (GDP) in Indian manufacturing sector. The advancing of the manufacturing ecosystem in India is bearing a definite outlook to this sector is started initiative by the government of India named as "Make in India". The manufacturing sector in India has endorsed an increase in the gross value added (GVA) at a CAGR of 4.34 % of the financial year 2012 and 2018 according to the reports advertised by the government of India. The smart city and digital India are moderately taken place through projects in some way the arrangement of the internet of things and industry 4.0 are to be carried out [6]. Improved cost, flexibility, quality, productivity and employee achievement are assumed to offer by the new technologies. However, the level of implementation of these technologies and their suitability across industries in India is distinctive. The specific agenda on the application of Industry 4.0 are picked up by the requirement of the manufacturing organization. A powerful case for the Government, industry associations, and other policymakers for advancing offered by industry 4.0. Job formation along with increased productivity and competitiveness are powerful important drivers of Indian manufacturing promoting the goals set up by "Make in India" initiative [7]. Chua and Srivastava postulates sunrise sector in India are aviation, railways, automobiles & automobile components, electronics, pharmaceuticals, and textiles. These industries promising to provide $80-100 billion to India's GDP every year till 2025 and industry 4.0 is adopted by this sector instantly. The Indian manufacturing into digital decade are advanced by the commitment of industry 4.0 as per report received by business world. Hence it is mandatory to construct an ecosystem that is powerful on infrastructure, skill development and policy. The appearance of Indian industry is focussed the potential by industry 4.0. However, there are many benefits, industry 4.0 promises, there is still an air of uncertainty in acceptance of industry 4.0. Hence for advantage the industry practitioners and to overwhelmed barriers to identify the challenges for hold good of industry 4.0 acceptance [8]. Identification of important barriers for adopting of industry 4.0 in Indian manufacturing sector are analysed in this paper. This paper also advise how the industry practitioners and policy makers must take steps in overwhelming these barriers to successful acceptance of Industry 4.0.

In November 2011, the German government brought a concept of the Industry 4.0 in a article through advertisements as a high tech approach for 2020.Industry 4.0, the fourth stage of industrialization was nomenclature after mechanisation and electrification. "Industry 4.0". In April 2013, the term "Industry 4.0" came into again at an industrial fair in Hannover Germany, and speedily rose as the German national strategy. In recent years, "Industry 4.0" has been broadly discussed, and has become a hit spot for best global industries and the information industry. Industry 4.0 will be a advanced industrial revolution, which will have a great impact on international industry [9]. "With Industry 4.0 in full swing, it's up to technology holders to help manufacturing companies overwhelm the challenges it carries and grasp the opportunities". A current report from Future Market Insights concluded smart factories will make US$215 billion by 2025. That's up from $ 51.9bn in 2014. According to General Electric, the intelligent factory concept could be worth $10–15 trillion to global GDP over the next 20 years.

Having the first three industrial transformations, it is observed and generated by human perfunctory, electrical and tip technology, which were converse at incremental productiveness advance. As yet there are four industry transformations are carried out which are as mentioned below:

Business transformation increased effectiveness through the acceptance of hydropower, better manner of steam power and production of machine tools; the second industrial transformation carry electricity and mass product (assemblage lines); the third business transformations additional speeded up automation worn electronics and information technology, and now in present era business transformation is arising which is led by CPS technology to favour the real mankind with the information century for coming industrial development. Figure 1 [10] guide the four stages of the industrial revolution.

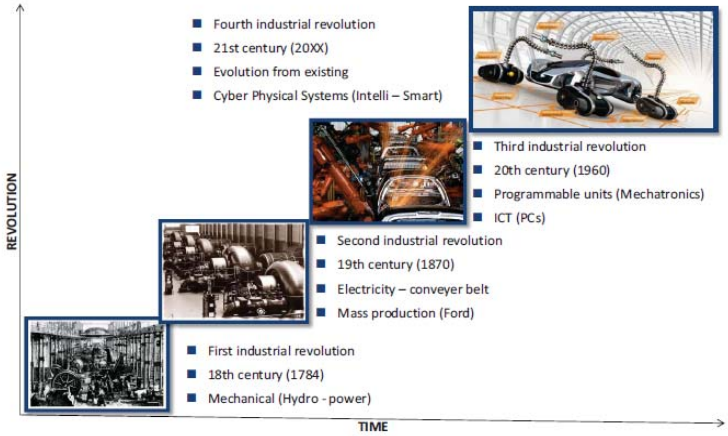


Fig. 1. Four stages of Industry Revolutions

Industry 4.0 emerged relatively newly in New Zealand, and small to medium range enterprises (SMEs) have some censure for fit this industrial transformation [11]. Despite their fine size, SMEs constitute up more than 97% of businesses in New Zealand and go 28% to the national GDP. However, failure of enough experience and scarcity of available assets attributes to the challenges for New Zealand SMEs towards implementation of Industry 4.0.

3 Key Technologies for Industry 4.0

The Industry 4.0 evolves many technologies along with variety context like automation, networking, digital manufacturing and translating complete processes of various interconnected system with the integration of various intricate and flexible systems. Industry 4.0 holds the key in evaluating real time results and data that will lead to industry into new level of achievements.

To understand industry 4.0, the following five terms to be understand well, as they contribute next industrial revolutions.
1) Cyber physical production systems
2) Mobile internet and Internet of things
3) Smart factory
4) Cloud computing technologies
5) Big Data and Advanced analysis techniques
The benefit resulting industry 4.0 application are: computing and control of communications, manage real time management of intelligent production, automated manufacturing process and information systems. Though industry 4.0 is not simple to understand as it evolves many interdisciplinary technologies used in different context. Thus IoT, IoS, professional analytical method, cyber physical production system, big data, smart factory, cloud computing and various advance analysis techniques are key technologies of industry 4.0.

A. Cyber physical production system

It is an integration of computations networking, network monitoring, control of physical processes and feedbacks for business effective transformations. The physical systems like hydropower, machine tools and electricity basically are being embedded with computers and software in a loop of actions and machines to speeding up automation for global business transformations. An intelligent factory to be more smart to develop mass productions system allowing and accelerating production condition. Thus, CPS technology and software devices will be embedded with computers where there usage will not only computing, rather it will be a loop of actions, analysis, machine integration & its control allowing mass production conditions as shown in figure 2[12].

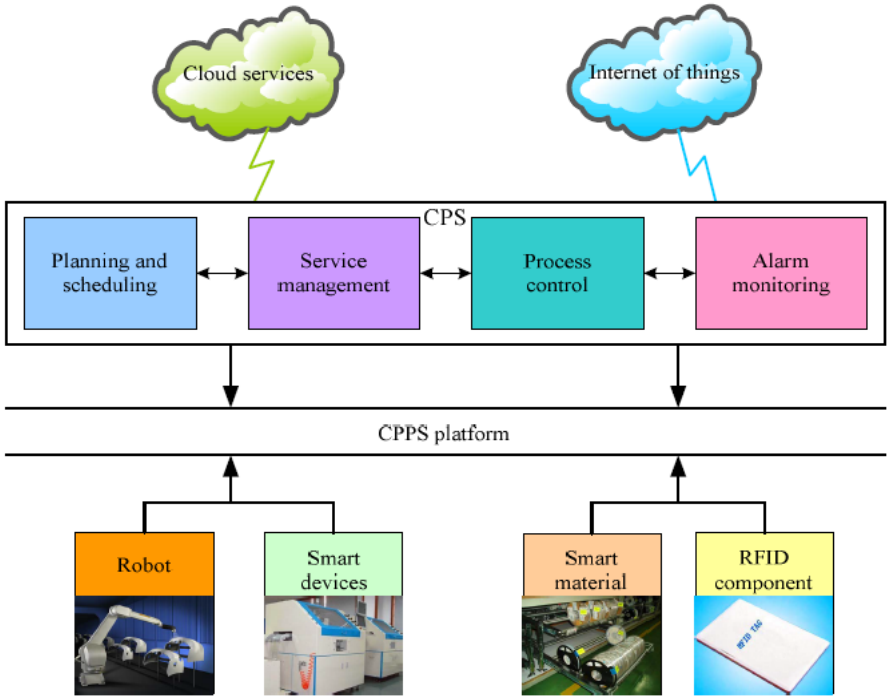


Fig. 2. CPPS Platform in Industry 4.0

B. Mobile Internet and Internet of Things Technologies

The internet of things is the connection of all devices to the internet with each other which become real world and are used for communications among people as well as among human and machines allowing intelligent manufacturing [4]. The industry 4.0 application will allow more use of communications, mobile internet and internet of things among human and machines which will take manufacturing to fourth generations having significant impact on people and industries.

C. Smart factory

The smart factory is the next generation, leap forward, fully connected and flexible distributed mass production systems by using constant stream of data for requisite industrial demands with integration of web technology. A true smart factory can integrate data from systems through physical, operational, maintenance, inventory tracking, digitalization and human assets integrations etc. To drive intelligent mass manufacturing network. This improve greater ability to predict and tackle changes to have less down tome leading to positioning business in competitive global market. The IoT, IoS, and CPS integration will be more friendly usage across the globe which will authorise a social integrated network [13].

D. Cloud Computing Technology

Cloud computing, a computing technology that can suggest low cost and high achievement began from a search engine platform. It is presently a significant platform to provide various Internet services viz. virtualization technology supports, cloud computing with flexible extensions resource sharing, dynamic allocation, and other characteristics. The cloud computing model enables services to the user along with software and hardware platforms with other IT infrastructure resources as recommended. The user simply employs resources depending on application needs based on required on-demand access.

E. Big Data and Advanced Analysis Techniques

It is the collection of data from conventional, digital microprocessors and various devices installed by amulgating developing technologies in manufacturing and services. But, todays challenge with modern industry is that, it's still in process of developing methods to interpret data. The evolution of industry 4.0 will change the scenario, to those organisations who will make better smarter decision to integrate and interpret data. The conventional traditional data base technologies have limitations and unexplained to manage wide range of structured data and unstructured data which may be production value chain, operational or external data.

4 Challenges for Industry 4.0

For research and application, industry 4.0 is a critical area as it offers value addition to the manufacturing outputs and systems by amalgamating budding technologies in manufacturing and services. Nevertheless, organizations still have a mountain to cross for the thriving and timely implementation of the digital concepts. The chief reasons for the reservations lie in the lofty investment levels and the indistinct cost benefits for the business 4.0 application areas. Further, the employees lack the adequate skills essential to cope up with the forthcoming automation and there is a need of transparency in the standards for the implementation of industry 4.0 which has created uncertainty in many organizations. This digital transformation will need to cross many hurdles prior to being successfully embraced truly by all organizations [14].

In present study, the challenges for Industry 4.0 are identified based on existing literature review and opinions of experts from academia and industry. Based on the literature review, eight challenges were identified. The review considered research articles on Industry 4.0 published in Web of Science, Scopus and Emerald Insights. Few industry reports, trade magazines and news articles were also referred for added information on Industry 4.0 and the barriers affecting its functioning. The list of challenges for Industry 4.0 with a brief description is presented in Table 1.

Table 1: Challenges for implementing Industry 4.0.

S.No	Challenges	Description	Source
1	High Implementation Cost	This associates to the cost that the industries have to be compelled to acquire for developing the Industry 4.0 infrastructure in their industries. Industry 4.0 is difficult to adopt in small and medium industries as there is an inadequacy of fund for appropriate technologies.	[4], [15], [16]
2.	Need for Enhanced Skills	With the execution of the Industry 4.0, the abilities and adequacy of the workforce can become the winning formula of an extremely inventive works. The companies should be focused on the development of qualified workforce by the Human Resources Management.	[17], [18]
3.	Lack of knowledge management systems	Knowledge management systems suggest to information technology systems that provision and retrieve knowledge, improve collaboration, locate knowledge sources, mine repositories for hidden knowledge, capture and use knowledge, and aggravate the knowledge management process. Knowledge management can benefit by impaste IoT and processing incoming big data possessed from IoT devices.	[19], [20], [21]
4	Lack of Standards and Reference Architecture	The Industry 4.0 structure specifically its pattern and choice for different uses have been an important contest as Industry 4.0 is a new conception. There are scarcity of criteria's and referral structures for example the construction of effective IoT structure throughout the modular production entangling items connectively, data services, appliances are identified as important hurdles flourishing IoT acceptance.	[22], [23], [24]
5.	Security and Privacy Issues	There is a comprehensive amount of information flow that appears on the Industry 4.0 platform posing cybersecurity threatening and data privacy issues. Virtual performance on servers or platforms compel employees to be aware of cyber assurance. An accurate	[25], [26], [27]

		outlook of the CPS is cybersecurity. CPS is more passionate to cyber-assail with the recent advancements in IT.	
6.	Regulatory Compliance issues	Regulatory compliance relates to the objective that industries ask for to attain in their efforts to assure that they are attentive of and take needful steps to suits appropriate laws, policies, and rules. Organizations have to be compelled to have stricter rules in for IT security, operating with the machine, or operating hours	[28][29]
7.	Lack of Internet coverage and IT facilities	Refers to the failure of IT infrastructure that is direct to uphold the Industry 4.0 implementation. Internet of things plays a vital role in Industry 4.0 framework. Lack solutions for effective intelligence and signal coverage may action as a significant siege for various products/services. Signal attenuation appears due to low remarkable coverage in certain manufacturing condition	[30], [31]
8	Legal and Contractual Uncertainty	Digitalization set a censure for the justice as the competition gets fierce. Laws concerning data security, liability for artificial intelligence, standardization must be estimate while unfold a digital strategy. Without a legal individuality, the virtual organization does not legally be and so cannot be identified as a legally free being. Every virtual organization that uses ICT necessarily to insure that by move data online they do so in confident manner, and they do not trespass retreat regulations or that the contracts include are prevalent and enforceable.	[32], [33]

5 Future Scenario for Industry 4.0

As mentioned in previous section, manufacturing industry has to cope with various challenges. Regardless of those challenges, we present some of the upcoming scenarios from industry 4.0 perspectives, as follows:-

5.1 Real-time Data Access to/from Shop Floor Level

Real-time data access in a production is very important whether it is linked to processes, products, or machines functioning in the factory. Traditionally, real time information access for processes was not accessible at shop floor level. In case of change in processes or actions, workers or machines have to wait until instructions are manually transferred or data is loaded in the production system. Future factories require a close integration between ERP and shop-floor and real time access of data at production level for real time execution and vice versa. Data collected from machines and in business processes, data is filtered, analysed, and then delivered in required format to provide insights which in return will help to give better process control, optimize and diminish overhead costs.

5.2 Predictive Maintenance

The industry practice scheduled maintenance on daily, weekly, monthly and quarterly basis in reference to days as well as operating hours or after number of product to be produced. The predictive maintenance strategies are also planned in view of number of or products processed, operating hours and time period established with the history of system/ machine /processed data collected. This plays very crucial role for safeguarding of machine and desired output. A model to be developed to forecast to obtain zero risk and thereby zero part per million failures. [34][35].

6. Conclusion

Industry 4.0 and smart manufacturing have started demonstrating their significance in manufacturing industry. In our paper, we provide an iterative approach for industry 4.0. In our study, we examine what are the current challenges. We also discuss the new scenarios which are possible in manufacturing industry to gain the profit from industry 4.0. Although, we listed only current challenges but in future these new scenarios may also pose some challenges. In future, we want to explain our approach in detail and to develop an industry 4.0 project prototype (proof of concept) to demonstrate the utility of our approach. The present study identifies eight barriers for Industry 4.0 adoption. However, few barriers may not have been listed which may have a significant impact in adopting Industry 4.0 in different countries context. Future studies may be done in different countries to explore the existence of a variety of barriers and assess the inter-relationships between them.

References

1. Mrugalska, B., Wyrwicka, M.K.: Towards lean production in industry 4.0. Procedia Engineering, Vol. 182 (2017) 466-473.
2. Arnold, C., Kiel, D.,Voigt, K.I.: How the Industrial Internet of Things Changes Business Models in Different Manufacturing Industries. International Journal of Innovation Management (2016).
3. Kiel, D., Müller, J., Arnold, C., Voigt, K.I.: Sustainable Industrial Value Creation: Benefits and Challenges of Industry 4.0. International Journal of Innovation Management, Vol. 21(2017).
4. Zhou, K., Zhou, T.L.L.: Industry 4.0: Towards Future Industrial Opportunities and Challenges.12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD) (2015).
5. Mehta, Y., Rajan, J.: Manufacturing sectors in India: outlook and challenges. Proc. Eng. Vol. 174 (2017) 90–104.
6. Abhishek, R.: Towards Smart Manufacturing- Industry 4.0 and India. http://www.makeinindia.com/article/-/v/towards-smart-manufacturing-industry-4-0-and-india (2017).
7. Chua, J., Srivastava, R.: Industry 4.0 can Transform Indian Manufacturing. https:// economictimes.indiatimes.com/news/company/corporate-trends/et-gbs-2018industry-4-0-can-transform-indianmanufacturing/articleshow/62893842.cms (2018).
8. Koch, V., Kuge, S., Geissbauer, R., Schrauf, S.: Industry 4.0: Opportunities and Challenges of the Industrial Internet. http://www.strategyand.pwc.com/reports/ industry-4-0 (2018).
9. Schmidt, R., Möhring, M., Härting, R.C., Reichstein, C., Neumaier, P., Jozinović, P.: Industry 4.0-potentials for creating smart products: empirical research results. International Conference on Business Information Systems, Springer, Cham (2015) 16–27.
10. MacDougall, W.: Industries 4.0 smart manufacturing for the future. Germany Trade and Invest (2014).
11. Small Business Sector Report.: Ministry of Business, Innovation and Employment (MBIE), New Zealand (2016).
12. Strang, D., Anderl, R.: Assembly Process driven Component Data Model in Cyber-Physical Production Systems. Proceedings of the World Congress on Engineering and Computer Science, Vol. 2 (2014).
13. Kagermann, H., Helbig, J., Hellinger, A., Wahlster, W.: Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0: Securing the Future of German Manufacturing Industry. Final Report of the Industrie 4.0 Working Group. Forschungs union, (2013).
14. Mueller, Chen, X.L., Riedel, R.: Challenges and requirements for the application of industry 4.0: a special insight with the usage of cyber-physical system. China Journal of Mechanical Engineering, Vol.3, No.5 (2017) 1050–1057
15. Kamigaki, T.: Object Oriented RFID with IoT: a design concept of information systems in manufacturing. Electronics, Vol. 6, No.1, (2017) 14.
16. Spath, D., Gerlach, S., Hämmerle, M., Krause,T., Schlund, S.: Production Work of the Future–Industry 4.0. United Organisation (IAO), (2013) 451–456.
17. Gehrke, L., Kühn, A.T., Rule, D., Moore, P., Bellmann, C., Siemes, S., Dawood, S., Lakshmi, J., Kulik and Standley, M.: A Discussion of Qualifications and Skills in the Factory of the Future: A German and American Perspective. VDI The Association of German Engineers, Düsseldorf, Germany, (2015) 15.
18. Peter, J. Ryan. and Richard, B.: Research challenges for the internet of things: what role can OR play"? Systems, Vol. 5, No.1 (2017) 17–24.
19. Lorna, U., He, W.: How the internet of things can help knowledge management: a case study from the automotive domain. Journal of Knowledge Management, Vol.21, No.1 (2017) 57–70.
20. Davies, A., Fidler, D., Gorbis, M.: Future Work Skills 2020. Available at Institute for the Future for University of Phoenix Research Institute (2011) 540.
21. Rymaszewska, A., Helo, P., Gunasekaran, A.: IoT powered servitization of manufacturing–an exploratory case study. International Journal of production Economy, Vol. 192 (2017) 92–105.
22. Mueller, E., Chen, X.L., Riedel, R.: Challenges and requirements for the application of industry 4.0: a special insight with the usage of cyber-physical system. China Journal of Mechanical Engineering, Vol. 30, No.5 (2017) 1050–1057.
23. Geisberger, E., Broy, M.: AgendaCPS: Integrierte Forschungsagenda Cyber Physical Systems, Springer-Verlag. Gilchrist, Alasdair. Industry 4.0: the industrial internet of things", A press, Vol.1 (2016).

24. Haddud, A., DeSouza,A., Khare, A., Lee, H.: Examining potential benefits and challenges associated with the internet of things integration in supply chains. Journal of Manufacturing Technology Management, Vol. 28, No.8 (2017) 1055–1085.
25. Hecklau, F., Galeitzke,M., Flachs, S., Kohl, H.: Holistic approach for human resource management in industry 4.0. Proc. CIRP, Vol. 54, (2016) 1–6.
26. Yu, Z., Ouyang, J., Li, S., Peng, X.: Formal modelling and control of cyber-physical manufacturing systems. Advance Mechanical Engineering, Vol. 9, No. 10 (2017).
27. Babiceanu, R.F., Seker, R.: Big data and virtualization for manufacturing cyber physical systems: a survey of the current status and future outlook, Computational Industries, Vol. 81, (2016) 128–137.
28. Lin, T.C.: Compliance, technology, and modern finance. Brook. Journal of Corporate Financial and Commercial Law, Vol.11 (2016).
29. Störmer, E., Patscha, C., Prendergast, J., Daheim, C., Rhisiart, M., Glover, P., Beck.: The Future of Work: Jobs and Skills in 2030 (2014)
30. Yan, J., Xin, S., Liu, Q., Xu, W., Yang, L., Fan, L.: Intelligent supply chain integration and management based on cloud of things. International Journal of Distributed Sensor Network, Vol.10, No.3 (2014).
31. Yan, Z., Zhang, P., Vasilakos, A.V.: A survey on trust management for internet of things. Journal of Network Computer Application, Vol.42, (2014)120–134.
32. Christians, A., Liepin, M. (2017), "The consequences of digitalization for German civil law from the national legislator's point of view", Intellectual Property Journal, Vol. 9, No.3, pp.331–339
33. Shelbourn, M., Hassan, T., Carter, C.: Legal and contractual framework for the VO, Virtual Organizations. Springer, Boston, MA, (2005) 167–176.
34. Lee, J., Bagheri, B., Kao, H.-A.: A cyberphysical systems architecture for industry 4.0-based manufacturing systems. Manufacturing Letters, Vol.3, (2015) 18 – 23.
35. Wang,T., Yu, J., Siegel, D., Lee, J.: A similarity based prognostics approach for remaining useful life estimation of engineered systems. In Prognostics and Health Management (2008) 1 -6.

Which Sector is More Prone to Bullwhip Effect?: An Indian Sectoral Study

Sachin Gupta[1], Anurag Saxena[2]

[1] Vivekananda Institute of Professional studies, New Delhi, India
[2] School of Management studies, IGNOU, New Delhi, India
orsachin@gmail.com, anurags@ignou.ac.in

Abstract. The amplification of demand as one moves up in supply chain is considered as Bullwhip effect. Bullwhip effect creates disturbance in operations and supply chain management (OSCM). Overproduction or underproduction, unmanaged demand, short of cash-in-hand to carry out operations, excessive inventory carrying cost, decrease in service level and profit are the implications of bullwhip effect which results in disturbance of the entire supply chain. Bullwhip effect is experienced among all types of products, all types of sectors and all types of supply chain in varying quantum. The present study computes the bullwhip effect among 10 different Indian sectors from past 12-year data. The study analyzes the various changes that occur within these sectors in terms of bullwhip effect and seeks the improvement in the bullwhip effect from first half to second half of data within that sector. Results show that the improvement in bullwhip is not significant. Surprisingly in many sectors, the correlation of bullwhip from first half to second half is negative in nature.

Keywords: Bullwhip effect, Bullwhip ratio, Indian Sector analysis, Supply Chain Management

1 Introduction

Implementation of supply chain management over a past three decades became essential for the growth and sustainability of an organization. Globalization, change in consumer preference, shorter life cycle of product, cut throat competition, etc. compel the organizations to streamline their production, operations and logistics management. Supply chain management comprises of many aspects like production, operations, logistics, inventory, finance, marketing and information management. Christopher (1994) [7] defines supply chain management in terms of upstream and downstream linkage- when the flow of product and ownership is from supplier to customer such a direction is termed as downstream whereas when the flow of information and money is from customer to supplier such a direction is considered as upstream. As demand moves upstream in supply chain it amplifies and this is considered as bullwhip effect. The disruption at one end in supply chain causes poor performance and supply chain does not remain effective [22]. Retailers order more to wholesalers than their actual experienced demand and wholesalers order more to manufacturer than their combined retailers demand. This amplification is highest at supplier level as more material is supplied than actually required.

Many studies felt presence of bullwhip effect and provide various remedial measures to deal with the same. Information sharing across supply chain, reduced number of echelon in supply chain, less lead time, better pricing and promotion strategies, operational efficiency and better forecasting are few remedial measures to mitigate bullwhip effect. Variability among demand and supply is causing the bullwhip effect. Due to inherent dynamic nature of supply chain it is very difficult to match demand and supply. In a study on Intel it has been found that the both match only few minutes in 10 years [18]. Forrester (1958)[8] and Sterman (1989)[21] studied bullwhip effect using simulations. Forester (1958) states that the variance in the demand of manufacturer is far greater than the variance of what actually consumers consume whereas Sterman (1989)[21] uses the famous beer distribution game to show the increase in variability as one move up in supply chain. Lee et al. (1997)[16] reported four main reasons of bullwhip effect viz. rationing and shortage, price fluctuation, forecasting and order

batching. Study by Lee et al. (1997)[16] was based on structure of supply chain whereas previous studies were based on irrational behavior of decision makers. Later the reasons of bullwhip effect increased from four to many. Safety stock, advertisement effect, lead time, information delay, machine breakdown at factory, capacity level planning, number of echelon are the few reasons among many identified by the researchers.

Many of the reasons to counter bullwhip effect have been identified and large numbers of solutions are given to mitigate this problem. Forecasting methods to accurately estimate the future demand, use of information technology to collect point of sales information, eliminate number of echelon in supply chain, applying techniques like JIT to deal with inventory, Management information system, reducing lead time and well managed logistics are widely suggested and implemented by researchers over past two decades to mitigate bullwhip effect. Plethora of research is available on bullwhip effect. Research database like Science Direct, Emerald and Proquest shows hundreds of studies about bullwhip effect, its mitigation and implementation of mitigation methods in the industry. Since it is not a new concept any more companies are implementing strategies to deal with bullwhip effect. Present study seeks to study the change in bullwhip effect over a period of time in Indian industries.

The present research has the following objectives: First objective is to measure the bullwhip effect occurring in Indian sectors. Second objective is to see what changes in bullwhip effect are having over a period of last decade for these sectors.

The rest of the study is organized as follows: Section 2 deals with the related literature review of the study. Section 3 gives the data and research methodology. Section 4 deals with analysis and results and Section 5 gives conclusion and future scope.

2 Literature Review

The dynamics of supply chain moves around the suppliers, manufacturer and customers in a big way, though there are few uncertainties on part of wholesalers and retailers. Manufacturer's uncertainties may be due to quality checks, shortages, machine breakdown, unavailability of raw material, etc. whereas that on customer end are change in taste and preference, change in technology etc. Due to presence of these uncertainties they tend to place such an order to subsequent partner so that shortages will not take place and that results in bullwhip effect. Bullwhip effect is not only a concern for operations and supply chain managers but is also studied by economist like Blanchard (1983)[1] who studied the empirical data of the automobile industry. He finds that inventory movement plays a crucial role in bullwhip effect; the study concludes that the variance in production is greater than the variance in sales after the seasonal variations are adjusted. Kahn (1987)[13] found that to avoid stock out situations companies maintain high inventory hence the variance of inventory is more than that of sales.

Caplin(1985) [3]studied the (S,s) inventory model and found that this policy add variability to the demand hence the variance of order exceeds the variance of sales. Chen et al., (2000)[5] quantifies the bullwhip effect on ratio of variability of quantity ordered to the variability of quantity demanded. The study by Cachon et al., (2007) [2]also quantifies the bullwhip effect on basis of variability of production to the variability of sales.

Past studies show that bullwhip effect is experienced in many sectors. Studies on Procter and Gamble in FMCG industry, HP in IT industry, Eli Lilly in pharmaceuticals, IBM and Motorola in electronics are benchmark case studies of bullwhip effect. Study of Bullwhip effect on Automobile sector can also be cited in many recent studies. Seles et al., (2016)[20] studied Brazil automobile sector and showed an existence of green bullwhip effect. Chiang et al., (2016)[6] recently studied US automobile industry and concluded that order upto policy always results in bullwhip effect and better forecasting may decrease the same. Greek retail industry experienced the bullwhip effect (Kelepouris et al.,

2008)[15] and effect increases due to increase in lead time. Hamister & Suresh (2008) explored retail sector for bullwhip effect on basis of pricing strategy. Chang et al., (2007)[4] studied retail industry and point of sale information and augmented collaborative forecasting is suggested to deal with bullwhip effect. Telecom sector [17] also experienced bullwhip effect. Most of the above mentioned studies use the bullwhip ratio to calculate bullwhip effect. Isaksson & Seifert (2016)[12] measure bullwhip effect using bullwhip ratio in US industries like FMCG, mining, etc. Hull (2005)[11] carried out case study on oil sector and stated that implementation of strong administration can avoid reverse bullwhip effect in oil sector. Kaipia et al. (2006)[14] explored electronic industry of Europe and found that bullwhip effect can be countered if nervousness in supply chain is managed.

None of the above studies explored bullwhip effect in Indian Context. Ravichandran (2006)[19] studied bullwhip effect in Indian scenario on the basis of two case studies. In present study coefficient of variation is computed for the production as well as sales and coefficient of variation is used to compute the ratio that quantifies the bullwhip effect at manufacturer end. Such ratios are used in many studies to quantify the bullwhip effect. Fransoo and Wouters (2000)[9] who studied bullwhip effect in food industry computed bullwhip ratio at product, outlet and echelon level in a supply chain.

At manufacturer end, if the coefficient of variance of production is more than that of coefficient of variance of sales then it is considered as presence of bullwhip effect otherwise not [5]. The ratio is computed of both the quantities to signify that if ratio is greater than one then this implies presence of bullwhip effect otherwise not, i.e. bullwhip will be present if,

$$\text{coefficient of variance of production} > \text{coefficient of variance of sales}$$

or,

$$\frac{\text{coefficient of variance of production}}{\text{coefficient of variance of sale}} > 1$$

3 Data and Research Methodology

Bombay Stock Exchange (BSE) sectoral indices represent and reflect the performance and behavior of that particular sector. It is a representative of the performance of companies that represent the movement in that specific sector selected on various factors like market capitalization, trading frequency, etc. These sectors are independent in nature hence it has been decided to study various sectors present in Indian Economy.

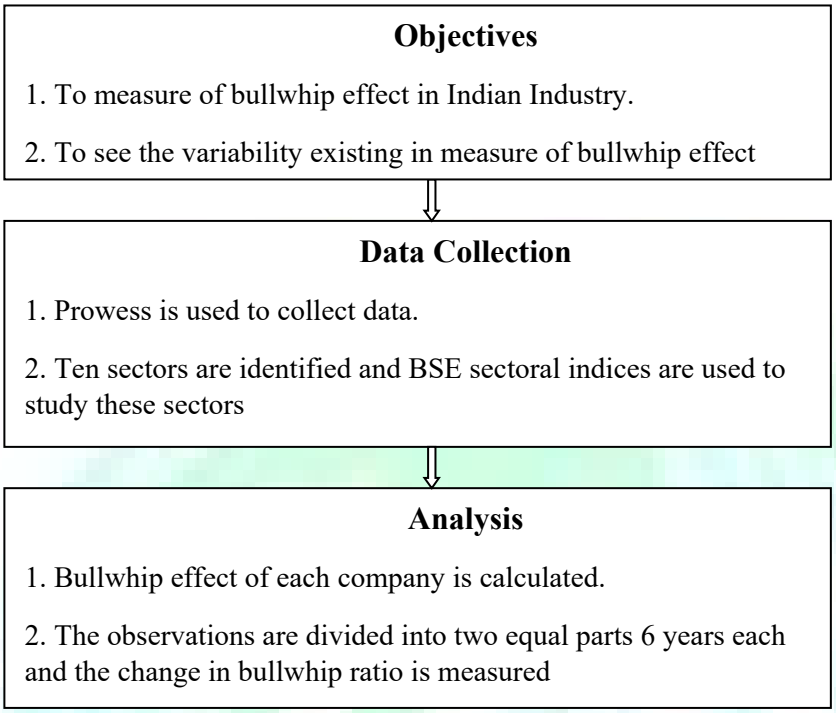
The leading 10 sectors of the Indian economy are studied in the present study. These are the sectors that represents 80% of the total market capitalization. Since these sectors play a vital role in Indian economy and hence chosen by interest to see the performance of these sectors. BSE sectoral indices are used to study as the companies present in these sectors represent the performance of sector. The sectors considered in present study are Automobile, Consumer Durable, Energy, FMCG, IT, Oil and Gas, Power, Real, Telecom and Utility sectors. Table 1 shows the number of companies belonging to 10 different sectors. BSE sectoral listed companies are selected from these sectors. From the selected companies last 12-year data is taken (from 2006 to 2017) using Prowess® Database. The variables chosen to compute the bullwhip ratio are cost of goods sold and cost of production. The cost of production denotes the manufacturing cost during that accounting period whereas cost of goods sold is the cost related to production of goods that are sold during that year.

Table 1: Sector and number of companies taken in present study.

Name of Sector	Automobile	Consumer Durable	Energy	FMCG	IT	Oil and Gas	Power	Real	Telecom	Utility
Number of Companies	13	10	26	77	57	10	19	10	16	32

The analysis on basis of bullwhip ratio is carried out in next section. Figure 1 shows the detailed research methodology to achieve the objectives.

Fig. 1: Steps in Research methodology.



4 Analysis and Results

The analysis part is broadly divided into three parts as shown in figure 1.

4.1 Bullwhip ratio

Bullwhip effect is computed for each sector. Bullwhip ratio is used as tool to compute the bullwhip effect on basis of past 12 year data. The ratio of coefficient of variation of production to that of sales is used to compute bullwhip ratio. Every sector shows the sign of bullwhip effect. Table 2 shows the percentages of companies experiencing or not experiencing the bullwhip effect.

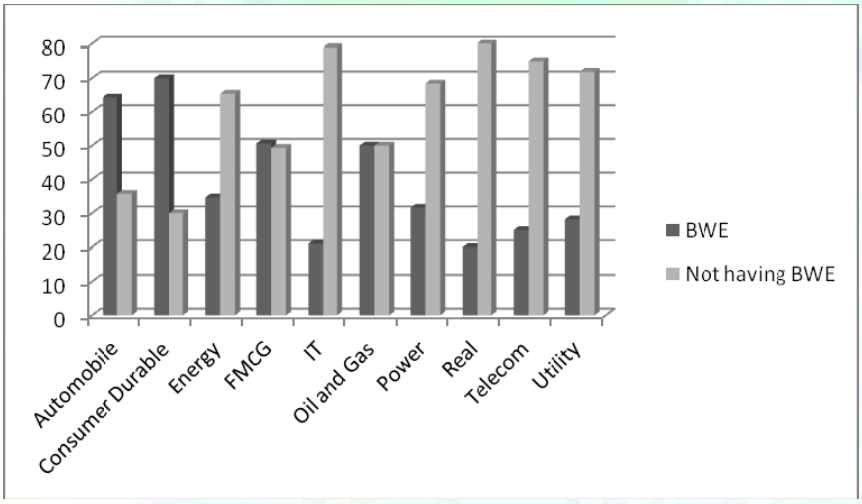
Table 2: Percentage of Companies showing bullwhip effect in different sectors

	Percentage of companies	
Name of Sector	BWE	Not having BWE
Automobile	64.29	35.71
Consumer Durable	70	30
Energy	34.62	65.38
FMCG	50.64	49.36
IT	21	79
Oil and Gas	50	50

Power	31.58	68.42
Real	20	80
Telecom	25	75
Utility	28.12	71.88

In automobile, consumer durable, FMCG sectors the number of companies having bullwhip effect is more than those who do not possess the same. IT sector is broadly divided into two categories hardware manufacturers (17 companies) and software service providers (40 companies). Hardware manufacturers have been experiencing bullwhip effect. Telecom, Real and Utility sectors are having least bullwhip effect whereas in oil and gas sector 50% companies are experiencing bullwhip effect. The pictorial representation of the bullwhip effect computed in different sector is shown in figure 2.

Fig 2: The comparison of percentage of companies showing bullwhip effect against not showing bullwhip effect in different sectors



4.2 Change in bullwhip effect

To see the change in bullwhip effect over a period of time, the data of each sector is divided into two halves and bullwhip ratio is computed for each halves for each company. In spite of so much research being done in past two decade on bullwhip effect and presence of a fierce competitive environment where every company want to optimize their operations, the bullwhip effect has been found to increase if comparison is done form first half to second half of the time series data. This shows there is still scope left to deal with bullwhip effect effectively even in today's dynamic scenario. In automobile sector nine companies shows increase in bullwhip effect where as four shows decrease in bullwhip effect. In consumer durable sector seven companies increase in bullwhip effect and only two show decrease in bullwhip effect. Energy sector is showing decrease in bullwhip effect. In Energy sector 16 companies were able to decrease the bullwhip ratio and in comparison only five depicted increase in the same. FMCG sector showed very fluctuating results, 39 companies showed increases in the bullwhip ratio whereas 38 companies recorded decrease in the bullwhip ratio. IT sector consists of majority of solution based companies is one of the most stabilized sector. Oil and gas sector also registered decrease in its bullwhip ratio but Power sector presented the reverse trend. The results of increase, decrease and no change of all sectors are given in table 3.

Table 3: Number of companies in different sectors that has increase, decrease and no change in bullwhip effect.

	Number of Companies		
Sectors	Increase in BWE	Decrease in BWE	No change in BWE
Automobile	9	4	0
Consumer Durable	7	2	1
Energy	5	16	5
FMCG	39	38	0
IT	12	17	28
Oil and Gas	2	7	1
Power	10	6	3
Real	3	6	1
Telecom	4	5	7
Utility	8	12	12

4.3 t- test and correlation analysis

The average bullwhip ratio of each sector is computed for both the halves. To see whether the change is significant or not in bullwhip ratio, t- test is computed and correlation is also computed to see the direction corresponding to each sector. The results are shown is table 4.

Table 4: Table showing t- test to analyze the difference in bullwhip effect when data is categorize into two halves.

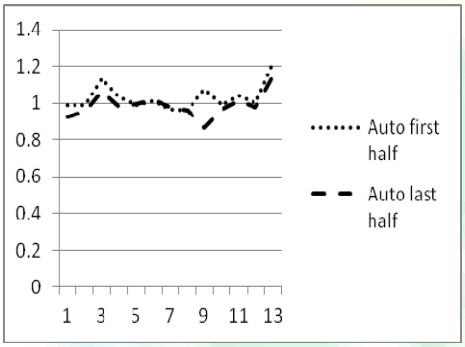
	Automobile		Consumer Durable		Energy		FMCG		IT		Oil & Gas		Power		Real		Telecom		Utility	
	f6	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*	*f6*	*l6*
Mean	1.032	0.9	1.32	1.178	1.02	0.96	1.03	1.08	1.02	1.03	1.143	0.86	0.969	1.12	1	1	1.147	1.02	1.06	1.01
Var	0.005	0.005	0.4	0.72	0.03	0.04	0.05	0.16	0.04	0.23	0.114	0.016	0.014	0.33	0.0003	5.00E-06	0.255	0.01	0.055	0.13
Obs	13	13	10	10	26	26	77	77	57	57	10	10	19	19	10	10	16	16	32	32
d.f.	12		9		25		76		56		9		18		9		15		31	
t Stat	2.67		0.375		1.02		-0.79		-0.131		2.032		-1.32		0.33		1.24		0.68	
t-Critical two-tail	2.178		2.262		2.05		1.99		2.003		2.26		2.1		2.262		2.13		2.03	
H0	Rejected		Accepted		Accepted		Accepted		Accepted		Accepted		Accepted		Accepted		Accepted		Accepted	
Pearson Corr	0.679		-0.296		-0.352		-0.104		-0.204		-0.723		0.631		-0.05		0.958		0.125	
Sig. at 5% level	significant		Not significant		Not significant		Not significant		Not significant		significant		Significant		Not significant		significant		Not significant	

F6: first six years, L6: last six years, Var: Variance, Obs: number of observations, d.f.: Degree of Freedom, Corr: correlation, Sig.: Significance for correlation coefficient

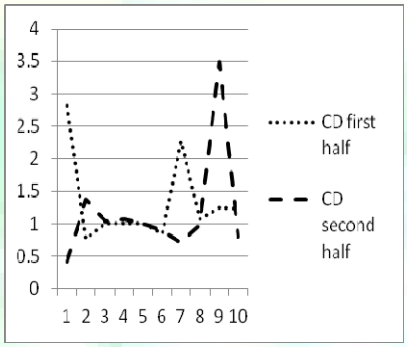
The null hypotheses for the t- test is set as, there is not a significant difference exist between the average values of two halves of bullwhip ratio. For automobile sector the average value of last 6 years is significantly different from first 6 years and H0 is not accepted and termed as rejected in this case. In other sectors, the average ratio of the bullwhip has not change significantly.

The correlation between the four sectors has been positive out of which three sectors Automobile, Telecom and Power, it is significant, where as in Utility, correlation is not significant. All other sectors are having negative correlation out of which Oil and Gas is significant.

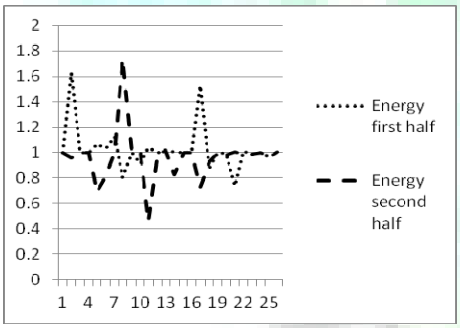
Fig 3. Correlation graph of bullwhip ratio when divided into two halves of different sectors



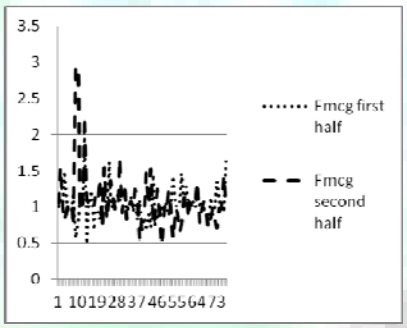
(a) Automobile Sector



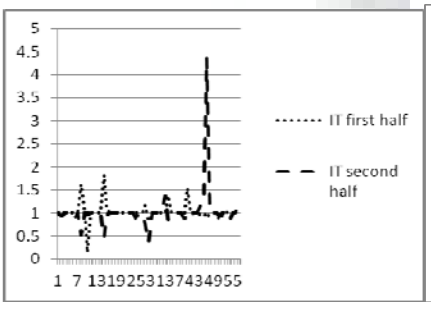
(b) Consumer Durable Sector



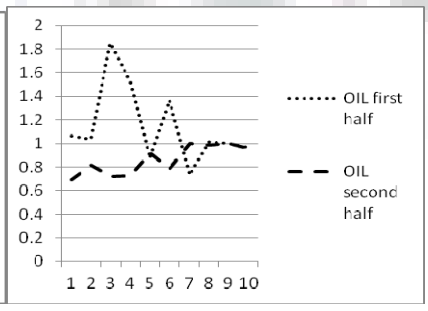
(c) Energy Sector



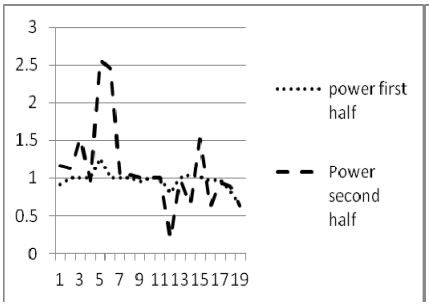
(d) FMCG Sector

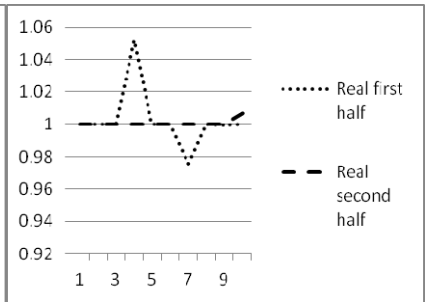


(e) IT Sector

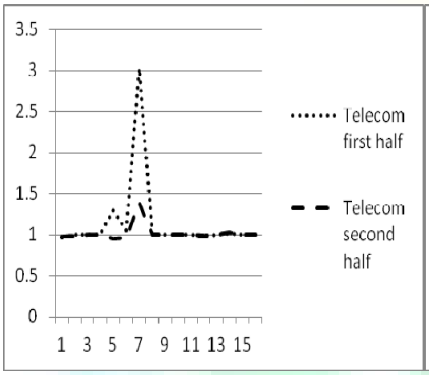


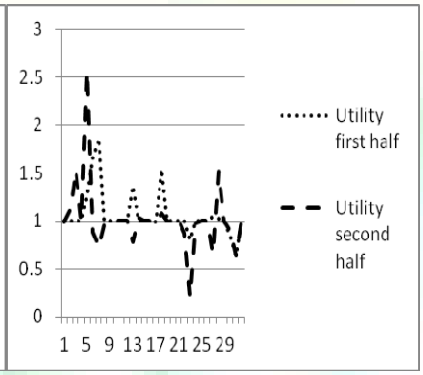
(f) Oil and Gas Sector





(g) Power Sector (h) Real Sector





(i) Telecom Sector (j) Utility Sector

5. Conclusion and Future Scope

Amplification of demand causing inefficiency in supply chain, hence mitigation of bullwhip effect is required for effective implementation of supply chain. This study is unique in the aspect that it is the first in Indian sectoral context considering 10 sectors at a time. These 10 sectors combine to represent the 80% of the remaining market capitalization keeping finance sector apart (which is representing 31% of market). BSE sectoral indices have been taken under study to see the performance of sectors in terms of bullwhip effect. Bullwhip ratio is computed to measure the bullwhip effect at manufacturer end and it has been found that all sectors possess bullwhip effect. Out of 10 selected sectors Automobile, Consumer Durable and FMCG sector is having high percentage of companies possessing bullwhip effect where as IT sector and Real sector is least affected. The change in bullwhip effect over a period of time has also been studied by dividing the series into two halves. The change in bullwhip ratio is found to be significant in automobile sector. The correlation is also found to be significant in 4 sectors, automobile, power and telecom is showing the positive correlation whereas Oil and gas sector is showing the negative correlation when the time series is divided into two halves. The average bullwhip ratio has not changed much but the study of correlation direction is surely a future scope of research.

References

1. Blanchard, O. J. (1983). The Production and Inventory Behavior of the American Automobile Industry. *Journal of Political Economy, 91*(31), 365-400.

2. Cachon, G. P., Randall, T., & Schmidt, G. M. (2007). In Search of the Bullwhip Effect. *Manufacturing and service operations management, 9*, 457-479.

3. Caplin, A.S. (1985), "The Variability of Aggregate Demand with (S, s) InventoryPolicies", *Econometrica,* Vol.53 No.6, pp. 1395-1409.

4. Chang, T.-H., Fu, H.-P., Lee, W.-I., Lin, Y., & Hsueh, H.-C. (2007). A study of an augmented CPFR model for the 3C retail industry. *Supply Chain Management: An International Journal, 12*, 200-209.

5. Chen, F., Drezner, Z., Ryan, J. K., & Simchi-Levi, D. (2000). Quantifying the Bullwhip Effect in a Simple Supply Chain: The Impact of Forecasting, Lead Times, and Information. *Management Science, 46*(3), 436-443.

6. Chiang, C.-Y., Lin, W. T., & Nallan, S. C. (2016). An empirically-simulated investigation of the impact of demand forecasting on the bullwhip effect : Evidence from U.S. autoindustry. *Int. J.Production Economics, 177*, 53-65.

7. Christopher, M. (1994). *Logistics and Supply Chain Management.* London, UK: Pitman Publishing.

8. Forrester, J. W. (1961). Industrial dynamics - a major breakthrough for decision makers. *Harv. Business Review, 4*, 37-66.

9. Fransoo, J. C., & Wouters, M. J. (2000). Measuring the bullwhip effect in supply chain. *Supply Chain Management: An International Journal, 5*(2), 78-89.

10. Hamister, J. W., & Suresh, N. C. (2008). The impact of pricing policy on sales variability in a supermarket retail context. *Int. J. Production Economics, 111*, 441-455.

11. Hull, B. (2005). The role of elasticity in supply chain performance. *Int. J. Production Economics, 98*, 301-314.

12. Isaksson, O. H., & Seifert, R. W. (2016). Quantifying the bullwhip effect using two-echelon data: Across-industryempirical investigation. *Int. J. Production Economics, 171*, 311-320.

13. Kahn, J. A. (1987). Inventories and volatility of Production. *The American Economic Review, 77*(4), 667-679.

14. Kaipia, R., Korhonen, H., & Hartiala, H. (2006). Planning nervousness in a demand supply network: an empirical study. *The International Journal of Logistics Management, 17*, 95-113.

15. Kelepouris, T., Miliotis, P., & Pramatari, k. (2008). The impact of replenishment parameters and information sharing on the bullwhip effect: A computational study. *Computers & Operations Research, 35*, 3657-3670.

16. Lee, H. L., Padmanabhan, V., & Whang, S. (1997). Information Distortion in a Supply Chain: The Bullwhip Effect. *Management Science, 43*(4), 546-558.

17. Mahmoudi, J., & Lamothe, J. (2006). Risk analysis for corperation policies benefits in reducing the bullwhip effect. *IFAC.*

18. Oliver, J., & Houlihan, J. B. (1986). Logistics Management- the Present and the Future. *Proceeding BPICS Conference*, (pp. 91-99).

19. Ravichandran, N. (2006). Managing Bullwhip Effect: Two Case Studies. *Indian Institute of Management, Ahmedabad, W.P. No 2006-08-01*, 1-20.

20. Seles, B. M., Jabbour, A. B., Jabbour, C. J., & Dangelico, R. M. (2016). The green bullwhip effect,the diffusion of green supply chain practices,and institutional pressures : Evidence from the automotive sector. *Int. J. Production Economics 182(2016) 342–355, 182*, 342-355.

21. Sterman, J. (1989). Modeling managerial behavior: Misperceptions of feedback in a dynamic decision making. *Management Science, 35*, 321-339.

22. Towill, D. R., Naim, M. M., & Winker, J. (1992). Industrial Dynamics Simulation Models in the Design of Supply Chains. *International Journal of Physical Distribution and Logistics Management, 22*(5), 3-13.

Application of Value Stream Mapping Tool: A Case Study of Indian Apparel Manufacturing Firm

Rohit Gupta[1], Abhishek Srivastava[2], Sushil Kumar[3]

[1]Operations Management Area, Institute of Management Technology Ghaziabad

[2]Indian Institute of Management, Kozhikode, India

[3]Operations Management Area, Indian Institute of Management Lucknow

rohit.gupta@imt.edu; abhisheks10fpm@iimk.ac.in; sk@iiml.ac.in

Abstract: The study comprises quantitative and empirical observations of an Indian apparel manufacturing organization with the primary objective to reduce waste and lead time of shirt manufacturing by using lean manufacturing tools and techniques. It is very difficult to identify the best performing lean tool or technique for reduction of non-value added processes in apparel production. Initially, we shortlist all the relevant lean techniques by going through extensive literature review and weights for all techniques are calculated using Analytical Hierarchy Process technique by the questionnaire responses of fifteen managers of different apparel production houses. On the basis of calculated weights, we found that Value Stream Mapping gets the highest weight among the other lean techniques. So, we select Value Stream Mapping technique for our analysis of apparel production process. We perform detailed analysis of shirt manufacturing processes. We study process flow of material in each section of shirt manufacturing division and wastes are identified in each section. These wastes include overproduction, waiting time, unnecessary transport, incorrect processing, excess inventory, unnecessary movement and defects. The main parameters of study are operational time, transportation necessity, inspection and process line delay due to previous process. After monitoring the processes on a shift basis, we design the current state of Value Stream Mapping. Further, we recommend the future state of value stream mapping after performing cause and effect analysis to reduce non-value added processes. The future state map shows the reduction of lead time by 10 percent.

Keywords: Lean manufacturing; Apparel industry; Value stream mapping; Lead time; AHP

1. Motivation and Introduction

In today's competitive era, various manufacturing organizations are finding the new ways for their survival, and it is done by reducing cost and improving the performance. The apparel industry is also one of the competing manufacturing industry. According to India Brand Equity Foundation (IBEF), readymade garments is the largest contributor to total textile and apparel exports from India.[1] The Textile and Apparel Industry is one of the most important industries for the Indian economy. Indian textile and apparel industry accounts for about 14 percent of India's industrial production and around 4.78 percent share in the country's total export in 2013-14 which shows a great potential but low performance (Kar, M., 2015). After the removal of textile quotas on 1 January 2005, an intense restructuring of the existing pattern of sourcing, production and supply is creating anxiety among apparel producers for their positioning in global competition. In 2013-14 India's apparel export was US $14.93 billion which is expected to reach US $82 billion by 2021, which is showing huge prospects for further growth in this sector (Kar, M., 2015). Indian

[1] http://www.ibef.org/industry/indian-textiles-and-apparel-industry-analysis-presentation

garment manufacturing Industries are suffering from many problems related to below capacity production, delay in delivery and large lead time due to inefficient production and poor production management system (Kar, M., 2015). By considering all aforementioned facts, our study provides a forward direction as well as solutions for Indian apparel industries to improve their efficiency by eliminating non-value adding activities and reduction of lead time.

A lean production is a multi-dimensional approach that includes a wide-ranging variety of management practices, comprising just-in-time, quality systems, cellular manufacturing, supplier management, etc. in an integrated system (Shah, 2003, Hodge, 2011). Lean Manufacturing, also known as the Toyota Production System (TPS), is a systematic approach to identifying value-adding (VA) and non-value-adding (NVA) process steps and eliminating wastes through continuous improvement in the process (Wilson, 2009). Value Stream Mapping (VSM), a lean tool, is a collection of all value added as well as non-value-added processes or activities, required to bring a product or group of product that uses the similar resources from raw material to the delivery to end customer by recognizing production system with lean manufacturing vision. VSM approach helps to visualize and record cycle times, changeover times, resource utilization, inventory management, modes of transportation and workforce deployment and provides benefits by identifying the different types of waste generated and their sources and redesign the process to reduce waste by preparing a future state of value mapping. VSM is particularly useful for industries lacking of robust material requirements planning, production scheduling, or production distribution systems. One of the examples of such industry is Indian apparel manufacturing industries (Yang, 2013). Silva et al. (2012) referred that implementation of VSM tool in apparel industry resulted in reduced waste in inventory and minimization of defects in the production process.

2. Objective of the Study

Our study focuses on quantitative and empirical observations of an apparel manufacturing processes of an Indian firm with a primary objective to reduce lead time of shirt manufacturing using VSM tool. After extensive literature survey, we shortlist the relevant lean techniques and weights for all techniques are calculated using Analytical Hierarchy Process (AHP) technique by the questionnaire responses of fifteen managers of apparel production houses. On the basis of calculated weights by AHP technique, VSM tool gets the highest weight, so it is the most suitable lean technique for reduction of non-value added processes for apparel manufacturing. After adoption of VSM as a lean tool, characterization of various stages in garment production process (fig.1) is performed and wastes are identified in each stage of the processes. Then possible improvements are identified through analyzing the current state of VSM. After implementing improvements, future state of VSM is proposed which shows the significant reduction of lead time in shirt manufacturing.

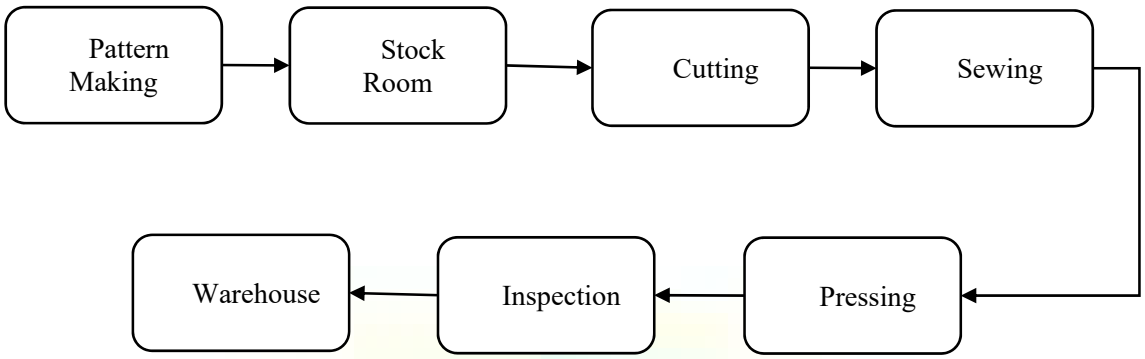


Fig.1. Different stages in apparel production process

3. Apparel Production Process

Diagrammatic representation of apparel production process is shown in fig.1. The production process starts with the pattern making. It includes the development, grading and lay planning of the pattern which is set according to the required design of the garment. The pattern of the different parts of the garment is made before the main production of fabric is started. Purchased fabric is stored in the stock room according to design and quality of fabric. In the cutting process, first layering of fabric is done on the cutting table. Number of Layers of fabric depends upon the type of order and fabric quality. The pattern which is generated using CAD machine is spread on the layers of fabric. Main cutting is done with the help of cutting machines which are already located on the table. In sewing process, different parts are stitched according to the design of the garment. It is done on an assembly line where different types of machines are arranged in sequence. The end product of this assembly line is the fully stitched garment. In pressing process, ironing is done on the garment to remove wrinkles. In the inspection process, the garment is inspected two times to avoid any defects and quality issues. Inspected garments are packaged according to the requirement of the buyers and shipped or stored in the warehouse.

4. Analysis of Current State Map

By analyzing current state map, we find out following critical wastes or non-value added processes. First, there are no separate space allocated for tape and other tools in cutting table which increases the unnecessary movements of workers in cutting section. Second, by drawing process activity bar chart, we find out that delay in subsequent processes in shirt manufacturing has a major proportion in total production time. Third, we find a large quantity of buffer stock in start of all the major processes which also blocks the easy movement of workers. Fourth, by performing pareto analysis of production processes timings of apparel manufacturing processes, it reveals that sewing process consumes major portion of shirt manufacturing production time. So we focus on sewing operation and cycle time study of sewing process is performed. Finally, we find out that in some processes, Kanban cards are missing.

5. Proposed State Map

Current state map provides evidences for improvement in different processes. In future state map, we recommend the following major suggestions. First, we recommend a separate space for tape and other tool in cutting section to avoid unnecessary movement of workers. Second, we recommend Kanban cards in between the fabric store to cutting sections which reduces the excess inventory in cutting section and will ease the movement of workers. Third, to ensure smoother movement of workers and accessories in the production section, very high storage of buffer stock is minimized in the beginning of processes and layout for worker movement is restructured by providing proper path for transportation. Fourth, we recommend to change of some damaged patterns in cutting section. Damaged patterns adversely affect the efficiency of workers. Finally, in sewing department, some processes, such as collar making and pressing are combined which reduces the cycle time and overall lead time.

6. Conclusion

Our study, first, identifies the most relevant tool i.e. VSM, for reduction of non-value added processes for shirt manufacturing by using AHP, a multi-criteria decisions making technique. Second, it provides a case study of the improvement of a shirt manufacturing process by eliminating the non-value added activities by VSM tool. Lead time reduction by 10 percent is clearly visible from future state map.

References

Dal Forno, A. J., Pereira, F. A., Forcellini, F. A., & Kipper, L. M. (2014). Value Stream Mapping: a study about the problems and challenges found in the literature from the past 15 years about application of Lean tools. *The International Journal of Advanced Manufacturing Technology*, 72(5-8), 779-790.

Hodge, G. L., Goforth Ross, K., Joines, J. A., & Thoney, K. (2011). Adapting lean manufacturing principles to the textile industry. Production Planning & Control, 22(3), 237-247.

Kar, M. (2015). *The Indian Textile and Clothing Industry: An Economic Analysis*. Springer

Shah, R., & Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of operations management*, 21(2), 129-149.

Silva, S. K. P. N. (2012). Applicability of value stream mapping (VSM) in the apparel industry in Sri Lanka. *International journal of lean thinking*, 3(1), 36-41.

Wilson, L. (2009). How to implement lean manufacturing. *McGraw Hill Professional*.

Yang, M. G. M., Hong, P., & Modi, S. B. (2011). Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. *International Journal of Production Economics*, 129(2), 251-261.

Formulation of risk breakdown structure for green supply chain using interpretive structural modelling

Vijaya Dixit[1], Priyanka Verma[1]
[a] Indian Institute of Management Ranchi, Jharkhand, 834008
vijaya.dixit@iimranchi.ac.in
[b] National Institute of Industrial Engineering, Vihar Lake, Powai, Mumbai, 400087
priyankaverma.nitie@gmail.com , priyankaverma@nitie.ac.in

Abstract. Sustainability is one of the key drivers of business in today's world because of the growing concern of the climatic changes that are occurring at such a fast rate. A sustainable business is gaining attention due to the environmental requirement. Conserving nature and for the long term benefit to society, demand for green products has increased. This drives businesses to focus on their operations and supply chain design which is catering to the green needs. While making such changes in the supply chain, several risks will emerge and make the system susceptible to collapse. A deeper understanding of these risks across several functions of the supply chain will help the managers to manage these risks. Strategies can be planned for focusing on critical risks and managing the remaining for ensuring a sustainable business. The main purpose of this paper is to understand the risks of green supply chain and its several functions. Interpretative structural modeling is used to understand the hierarchical relationships among these risks. Further developed information can be used by managers to achieve environmental & economic benefits.

Keywords: Sustainability, Green Supply Chain, Risks, Interpretive Structural Modelling, Hierarchy

1. Introduction

Sustainability is one of the key drivers of environmentally conscious business organizations in today's world with the growing concern for climatic changes that are occurring at such a massive rate. [6] emphasized the importance of environmental management as a competitive advantage. The concern for getting green is mainly because of the rising emission and climatic changes, rapidly depleting natural resources and an increase in waste and pollution.

Environmental dimensions of operations and production should be viewed as a stimulus for innovation and more efficient allocation of business resources, not just as a requirement for regulatory compliance. Green supply chain management (GSM) has emerged as an important organizational philosophy to reduce environmental risks. It is evolving into an important approach for organizations in emerging economies to manage their environmental responsibility ([1], [2]). GSM involves the integration of green dimension to supply chain management with the perspective of the environment in each stage starting from green sourcing (GS), green production (GPR), green packaging (GP), green logistics (GL), green marketing (GM) and green recycling (GR).

The key drivers of supply chain play an important role in making a supply chain green. [5] explored the factors namely organizational factors, regulation, customers, suppliers, competitors and society that drive or hinder organizations to implement GSM initiatives. [1] identified following key drivers affecting the implementation of green supply chain (GSC): environmental collaboration with suppliers, collaboration between product designers and suppliers to reduce and eliminate product environmental impacts, government regulation and legislation, green design, integrating quality environmental management into planning and operation process, reducing energy consumption, reusing and recycling materials and packaging, environmental collaboration with customers and reverse logistics. [2] identified crucial drivers of green supply chain adoption that collectively affect a firm's green purchasing, design-for-environment and reverse logistics initiatives.

However, while making supply chain green, different production and business activities in green supply chain induce several different types of risks ([3] and [4]). While some risks are reduced others are increased. These risks are interrelated as they simultaneously impact one or more drivers of the supply chain, these have been identified based on literature and expert opinion and is shown in Figure 1.

Extant literature on green supply chain had identified risks and studied the interrelationship between the drivers of GSM. However, a study that studies the interrelationship between the risks because of their simultaneous impact on multiple drivers of different stages of the green supply chain is missing. The present study overcomes this research gap. It analyses 32 risks affecting five drivers namely sourcing, transportation, facilities, information, pricing of six stages Green sourcing, Green production, Green packaging, Green Logistics, Green marketing, and green recycling, as shown in figure 1.

The interrelationships between these 32 risks are analyzed using interpretive structural modelling (ISM) approach. The steps of ISM yield a hierarchical risk break down structure (RBS) as shown in Figure 2. Such an intra-related RBS will identify the root causes of risks corresponding to each driver of each stage and facilitate cost-effective risk response actions. This will provide insights to the practicing managers about the potential watchpoints that need to be addressed to successfully convert their supply chain into a green supply chain.

2. Exploring risks across different stages

There are five drivers namely sourcing, transportation, facilities, information, pricing across six stages Green sourcing, Green production, Green packaging, Green Logistics, Green marketing, and Green recycling. Different risks are explored around these stages based on drivers of supply chain interacting at that stage. The same is shown below in figure 1 and is discussed in detail in subsections.

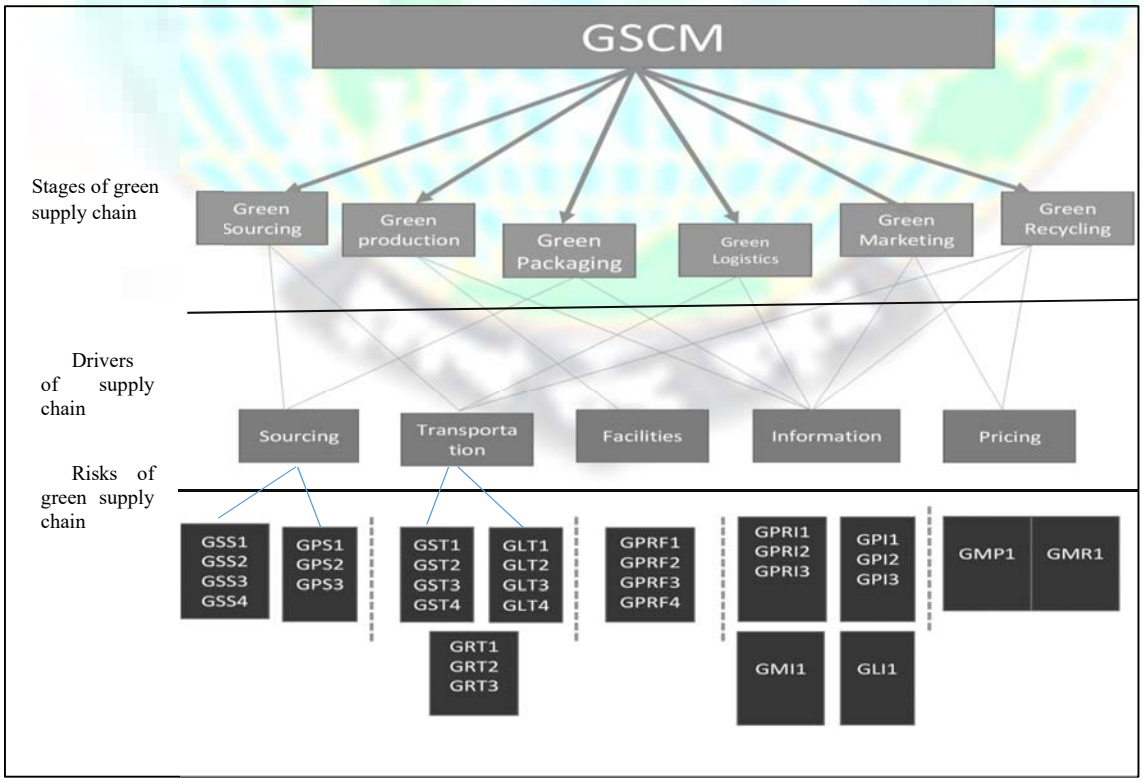


Figure 1: Green supply chain stages, drivers and risks

2.1 Green Sourcing Risks

- *Outsourcing Sourcing Risk (GSS1)* - Making the outsourcing green will decrease the outsourcing risk.
- *Sourcing Environmental Risk (GSS2)* - Green sourcing will reduce environmental damage.
- *Sourcing Cost risk (GSS3)* - Short term increase in cost because of the high setup cost but in long term sourcing cost will decrease.
- *Sourcing Quality Risk (GSS4)* - Improvement in the quality of the supplied product with green and sustainable production reduces the quality risk.
- *Agility Risk (GST1)* - With an increase in green transportation practices and running vehicles at optimum speed, the agility risk increases.
- *Customer Sentiment risk (GST2)* - Using green transportation will have a positive impact on the customer's mind and thus reduces the sentiment risk.
- *Transportation Environmental risk (GST3)* - Reducing the carbon emission and efficiently using the fuel will reduce the environmental risk in the form of air pollution.
- *Transportation Cost Risk (GST4)* - Due to green practices the company will incur an extra cost which will be transferred to the customers and hence increase in the transportation cost risk.

2.2 Green Production Risks

- *Facility Environmental Risk (GPRF1)* - Using eco-friendly production method will reduce the environmental risk.
- *Regulatory Risk (GPRF2)* – When production becomes green, regulatory compliance cannot be ignored.
- *Competitive Risk (GPRF3)* - The competitors will be far behind in terms of green products and following green practices during production can capture more market share reducing the competitive risk
- *Production Quality Risk (GPRF4)* - By making products green it increases the quality of the product as well reduces the unhealthy effects of it reducing the quality risk of the products.
- *Production Environmental Risk (GPRI1)* - Use of IT and sensors to control the wastage will reduce the environmental risk and make the production sustainable
- *Forecasting Risk (GPRI2)* - As product stabilizes in the market, the forecasting error reduces and thus the risk of over production or under production decreases.
- *Human Error (GPRI3)* - Better monitoring and less human inference in the automated system will reduce the risk of human errors and results in less wastage.

2.3 Green Packaging Risks

- *Packaging Sourcing Outsourcing risk (GPS1)* – Raw material for green packaging can be difficult to procure thus increases the outsourcing risk
- *Packaging Sourcing Environmental Risk (GPS2)* - using the recycled paper or reusing the products will reduce the carbon footprints reducing the environmental impact.
- *Packaging Sourcing Quality Risk (GPS3)* - Packaging material from recycled paper or material may be fragile and low strength increasing the packaging quality risk.

- *Packaging Information Cost risk (GPI1)* - with the use of IT in packaging we can reduce the amount of material used and thus reduces the cost of material to the cost of transportation.
- *Packaging Information Environmental Risk (GPI3)* - IT reduces the environmental risk where the product packaging design will *be* appropriate using the least material and decreasing the carbon footprint.

2.4 Green Logistics Risks

- *Logistics Transportation Agility Risk (GLT1)* - Due to a reduction in speed to keep the fuel economy the delivery time will increase and the agility risk will reduce.
- *Logistics Transportation Customer Satisfaction (GLT2)* - There can be an increase in the risk of customer satisfaction as time may *increase*.
- *Logistics Transportation Environmental Risk (GLT3)* - Since the optimized routes are taken, low emission cars are used and less fuel wastage is done the carbon footprint is also reduced and hence the environmental risk is reduced.
- *Logistics Transportation Pricing Risk (GLT4)* - In the short run, the price risk may increase because of the additional cost of servicing while route optimization can reduce it in the long term.
- *Logistics Information Environmental Risk (GLI1)* – Better information sharing will give improved route planning thus reducing the *vehicle* movements and affecting the environment positively.

2.5 Green Marketing Risks

- *Marketing Social and cultural* grievances *(GMP)* - by using green marketing, use of green products makes people attached to the brand and thus reducing the social risk.
- *Marketing Communication Risk (GMI)* - Using green marketing the message delivered to the consumers and non-consumers will be strong and will reach a number of people because of public acceptance and their association with it.

2.6 Green Recycling Risks

- *Recycling Transportation Agility Risk (GRT1)* - Delivery time will increase, and the agility risk will reduce in recycling.
- *Recycling Transportation Customer* Satisfaction *(GRT2)* - Increase in the risk of customer satisfaction as the time may increase in recycling.
- *Recycling Social and cultural* grievances *(GRP)* - by reusing the products company will position as an eco-friendly one which in *turn* will increase the market share and help in brand strengthening.
- *Recycling Environmental Risk (GRI2)* - using proper technology can help in reducing the wastage, recycling toxic chemicals and reusing the packaging and other material will reduce the carbon emission and decreases the environmental risk

3. ISM Methodology

The interrelationships between these 32 risks are analyzed using Interpretive Structural Modeling (ISM). ISM is an interactive learning process which develops the contextual relationship among the items defining problem. Any complex problem defined by these items can be understood well with their relationship through ISM. The direct and indirect relationships between these items can be used to develop a systematic model and useful insights can be later developed. The output can be shown graphically as well as in words thus making interpretation of the same model,

simple and interesting for managers in practice. In this work, ISM is adapted suitably from Ravi and Shankar (2005) and applied to the identified above 32 risks. The results obtained are discussed in detail in the next section.

4. Analysis - Risk Breakdown Structure

Different risks across different levels are shown in figure 2.

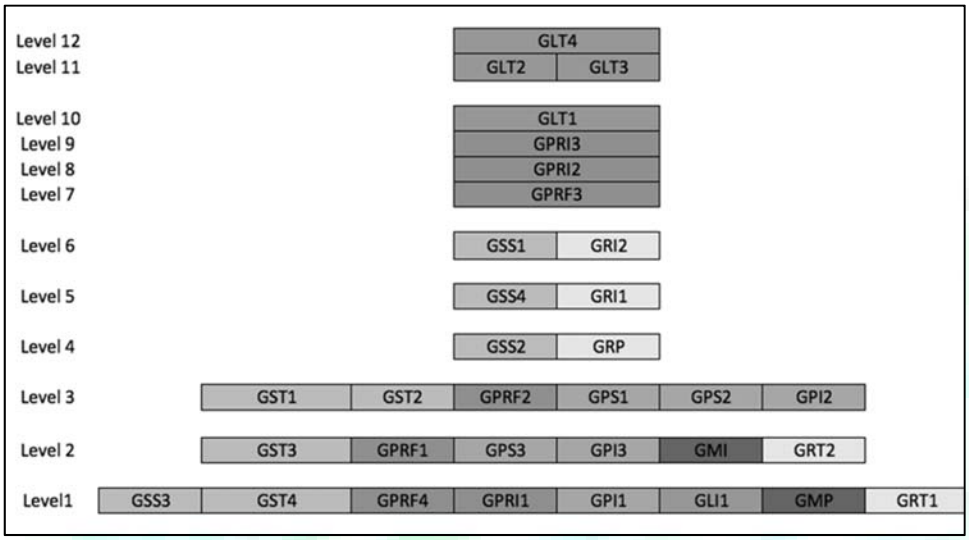


Figure 2. Risk break down structure of the green supply chain

In level 1 it can be seen from ISM output that mostly cost and environmental risks across different stages are prominent. Sourcing, information and transportation drivers are majorly impacted by these risks. Information, facility, and transportation in level 2 are impacted by related environmental risks, sourcing is impacted by the quality risk where as Information and Transportation drivers are impacted by the customer care and communication risk. In level 3, Green Packaging is the major risk at this level, Sourcing is impacted by the related environmental risk, information by the human error risk, transportation by the related agility and customer sentiments risk while production facility driver is impacted by the regulatory risk. In level 4, Sourcing is impacted by the related environmental risk and production by the Social and cultural grievances risks. Green sourcing and Green recycling are the components of value chain at this level. In level 5, Sourcing is impacted by the sourcing quality risk and Information by the brand communication risk. In level 6, Information driver is impacted by the environmental risk related to green Recycling, Sourcing driver is impacted by the Outsourcing risk related to green sourcing. In level 7, 8, 9 - Competitive risk impacts facility driver for green production, Forecasting risk and human error impact Information driver for green production. In level 10 and 11 - Green logistics is the most impacted stage, Agility, customer care, and Environmental risks impact transportation driver. In Level 12 - Cost risk is the most significant risk which is being controlled by all other risks and if we can manage those risks then the cost can be reduced in case of transportation for making green transportation. This risk is at the top and is not affecting any other risk but is affected by all other risks.

5. Conclusion

Sourcing, transportations, facility, information, production are the drivers which are the most exposed drivers to risks. Out of the eight bottom most risks, 3 are driven by information stating technology. Information driver will play an important role in making a supply chain green. New and advanced technology can help reduce the risk and make supply chain greener. Quality, environmental and cost risk at different stages will have long-lasting impact on the supply chain operations and impact in multiple ways. However, utmost care needs to be taken from the consumer side on cost and quality side when making a supply chain green. Quality may increase by making the supply chain green at the facility while production will become critical because of the more sustainable approach. Green marketing will support the sustainable supply chain and reduce the risk of Social and cultural grievances. While the agility risk is main and this will increase the time to reach the customers which can impact the service level, but at the same time, we will have other risks reduced. It's a trade-off between agility, quality, environment, cost, and branding.

References

1. Diabat, A., & Govindan, K. (2011). An analysis of the drivers affecting the implementation of green supply chain management. *Resources, Conservation and Recycling*, *55*(6), 659-667
2. Hsu, C. C., Choon Tan, K., Hanim Mohamad Zailani, S., & Jayaraman, V. (2013). Supply chain drivers that foster the development of green initiatives in an emerging economy. *International Journal of Operations & Production Management*, *33*(6), 656-688.
3. Mangla, S. K., Kumar, P., & Barua, M. K. (2015 a). Prioritizing the responses to manage risks in green supply chain: An Indian plastic manufacturer perspective. *Sustainable Production and Consumption*, *1*, 67-86.
4. Mangla, S. K., Kumar, P., & Barua, M. K. (2015 b). Risk analysis in green supply chain using fuzzy AHP approach: A case study. *Resources, Conservation and Recycling*, *104*, 375-390.
5. Walker, H., Di Sisto, L., & McBain, D. (2008). Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors. *Journal of purchasing and supply management*, *14*(1), 69-85.
6. Zhu, Q., & Sarkis, J. (2006). An inter-sectoral comparison of green supply chain management in China: drivers and practices. *Journal of cleaner production*, *14*(5), 472-486.

Integrating supply chain Resilience and Flexibility for supply chain risk Mitigation: A modeling approach

[a] Kushwaha, S. J. and [b] Singh K. N.

[a] Operations Management at Indian Institute of Management, Lucknow, 226013, India

[b] Operations Management at Indian Institute of Management, Ranchi, 834008, India

Abstract. In today's highly globalized and interdependent world, the success of the firm depends on how well it is connected with its partners. It is experienced that even the planned and organized companies are being caught by the events that are beyond their control or which are the results of plans and designs not working as expected. To understand and manage these type of uncertainty it is vital to have an end-to-end view of supply chain. The firms have to plan their strategy in a way in which they can overcome the supply chain risks and fulfill the customers demand. To mitigate the supply chain risk, in the present study we intend to improve the supply chain resilience by strategically incorporating supply chain flexibility. The objective is to maximize resilience and at the same time as flexible system tends to increase cost, we have minimized cost in our objective function making the problem as a multi objective decision making problem. The problem under consideration is a three stage supply chain consisting of multiple suppliers, multiple plants, multiple distribution centres and multiple retailers. The paper proposes a hybrid Genetic and Particle swarm optimization algorithm to solve the considered problem. Also, we have developed a Novel SCM software tool in JAVA J2EE platform, which involves implementation of effective supply chain strategies. The software is capable to capture the real time input data and algorithm output can be studied in an excel sheet form. The benefits of this software is that simulation runs can be performed and different 'what-if' scenarios can be studied by SC managers in the case of dynamic change in demand or disruption occurrence to quickly estimate the recovery policies and impacts on operational and financial performance.

Keywords: Supply chain management, Supply chain risk management, Multi-objective optimization, Non-linear programming

1. Introduction

On March 17, 2000, a small fire hit a microchip plant at Albuquerque, New Mexico owned by Royal Philips Electronics, the Dutch company. The smoke and water contaminated millions of chips, almost the entire stock in the plant and chip production was stopped. This plant supplied chips to the giant cell phone manufacturers namely Ericsson LM and Nokia Corporation. These firms completely relied on these chips to produce their cell phones and 40% of the plant production were shipped to these two firms. This information quickly spread within the Nokia's supply chain team and they reacted to the situation by reserving capacity in other Philip plants and every other supplier worldwide to procure the chips. They also re-engineered some of their phones to procure chips from other Japanese and American suppliers. On the other hand, Ericson waited for the fire damage to recover and plant production to start again and by the time they realized their mistake it was too late to react. Ericson few years back had simplified its supply chain by procuring components from a single supplier and had to face the consequence of having no other source of supply. This disruption led the company to lose a huge share of the market, mainly to Nokia, such that in 2001 Ericsson announced its retreat from the phone handset market (Sheffi, 2007). With the globalization of the supply chains (SCs), they have become more vulnerable to disruptive events. Another example, on March 11, 2011 an earthquake struck coast of Japan posing a great threat to business and operations causing 80% of Japanese automotive plants production suspension. Nissan, Honda and Toyota were impacted by the disaster and Nissan suffered a damage to 6 production facilities

and about 50 of its suppliers were impaired. Nevertheless, the company had owners to manage risks and was able to withstand the shocks and was remarkably better than its competitors. During the next six months after disaster, Nissan's production in Japan decreased by only 3.8% whereas the industry production decreased by 24.8%. More interestingly, Nissan could benefit from this incident and increased the production by the end of 2011 by 9.3% while the industry-wide production indicated a decrease of 9.3% ([47]). Supply chain risk, disruptions and uncertainties effect the supply chain performances and real-time decisions. If these problems persist in a supply chain network, then there would be huge losses in sales, market share and impact on customer service level [26]. Thus, there is a need to build resilient supply chain system to address to supply chain network problems when it is subject to unforeseen disruptions or demand. [2] suggest that recovery policies are the most important drivers to build a resilient supply chain. The recovery option comprises of capacity expansion, buffer inventory and contingency plans or backup strategies, that is, backup suppliers, plants, distribution centers and alternate transportation channels ([12]; [60]). The action to these plans must happen quickly to ensure supply chain operations and business continuity and avoid long-term impact. Companies need a tool to analyze and implement such plans and policies, also, to understand the next best available option to address the occurred disruptions and respond quickly to the market situation. One of the objective of this research is to find best possible solution to the supply chain network which has undergone certain disruptive activity. Therefore, optimization is one of the emphasis of this research. An optimized supply chain is not necessarily a resilient one. Modeling technology and tools can be used to identify supply chain risk and develop mitigation strategies through simulations and scenario development.

Optimization is a mathematical method used to determine the optimal solution for a problem with limited resources and constraints. In this paper, a multi-echelon supply chain is considered consisting of multiple suppliers, multiple plants, multiple distribution centers and multiple retailers for multiple raw material and multiple products through alternate logistic options. The problem has two conflicting objectives to optimize. The first objective is to maximize supply chain resilience which includes inherent and adaptive resilience. The second objective is to minimize the total supply chain cost which includes the fixed cost of running suppliers, manufacturing plants, distribution centers and retailers, the processing cost of raw material and products, transportation cost of raw materials shipped from suppliers to plants, the transportation cost of shipping products from plants to distribution centers and from distribution centers to retailers, and holding cost of products at distribution centers. The problem is formulated into a bi-objective mixed integer non-linear programming model. Methodologies *Particle swarm optimization and Genetic algorithm* are employed to solve the considered problem using the J2EE platform. This paper includes analytical review of theoretical base of multi-objective supply chain optimization approaches and focuses on further understanding and utilization of it to solve the developed model. The academic contribution of this paper is the in-depth model development, solution procedure and scenario analysis using supplier and plant flexibilities, logistics flexibilities and changes in demand of products to take care of the disruptions occurring at any stage of the supply chain.

Section 2 presents the literature review in the area of supply chain resilience and supply chain flexibility. Section 3 deals entirely with optimization; it discusses the various mathematical optimization techniques and their application to supply chain management. Section 4 is where the actual design process takes place, where the final model bi-objective model is formulated with constraints, elaborated and discussed with a solution approach. Section 5 discusses experimental analyses based on a case study; it also includes insights for practitioners under different scenarios. Finally, section 6 concludes the research possible improvements regarding the feasibility are located.

1.1 Problem context

In the past few years, there has been lot of focus on developing an efficient, effective, robust integrated supply chain and logistics network, giving competitive advantage for companies to help them cope with increasing operational and environmental uncertainties. The presence of these uncertainties have affected the real time decision making which proposes to make the system flexible. Although the available literature on flexibility is quite rich and vast, there exist a few limitations as well the current literature has mainly focused on manufacturing flexibility and not on the entire supply chain flexibility. Most of the authors ([49]; [29]; [6]) have considered manufacturing firms as a single entity and not considered the partners attached to the firm thus ignoring the supply chain partners linked to the firm. With the increase in the awareness towards supply chain management concepts, business entities have been realizing that the business competition is no longer between two business firms but the real competition is between the two entire supply channels linked to both the firms ([15]; [42] and [41]). The most important point of supply chain management is that the entire system is considered to be a single entity. The overall performance of the supply chain depends on each active member in the system. In supply chain system as the products or services subsequently move from one channel partner to another, firms have recognized that to respond to the end customer demand, all the channel partners must be flexible. Thus, the requirement of understanding supply chain flexibility arose. The various reasons to understand the supply chain flexibility is explained as follows; firstly, the paradigm shift of mass production to mass customization has made customers play a key role during product manufacturing. Firms start the product development taking into consideration the customer requirements for the product. This kind of requirement can be accomplished either by hiring new plants or developing new products as per the requirements in a way that would not affect the performance of the supply chain much in terms of cost, time and effort. This would also bring the fact that partners supplying the inbound material should be able to provide the demanded inbound material. Secondly, the demand is not deterministic, it is completely uncertain. In order to quickly cater to the changing demand in all parts of the world and avoid the uncertainty, the firms need to have responsive supply chain and the ability to increase or decrease the production output with minimal penalty to supply chain performance. Thus, [16] in her study clearly stated that inclusion of effective flexibility measures resolves most of the Supply Chain uncertainty issues. Thirdly, there is uncertainty in the environmental conditions which means a disruption could be caused at any facility or path due to fire, breakdown, earthquake, traffic on the path, etc. So it is important to build resilient supply chain to overcome the consequences of disruptions. Despite its importance, till date there is limited literature addressing supply chain flexibility and resilient supply chain. There exists, however, literature on the definition, concept building and empirical studies in the area of supply chain flexibility and supply chain resilience. Overall, there is dearth of knowledge in modeling the supply chain flexibility and resilience and still there is a gap between the practical need and research results. Besides, very limited research has focused on supply chain with multiple stages and multiple objectives. In this study, we proposed to build a multi-objective problem to minimize cost and maximize resilience and subject to supply chain flexibility constraints. This research is based on mathematical modeling to describe the mentioned uncertainties and risk in supply chain network.

2. Literature Review

Supply chain risk management is the most relevant stream of literature to this study. This study mainly deals to address and manage the different sources of uncertainty occurring in the supply chain network. These uncertainties impact the operational-level decisions throughout the network. These

uncertainties can either be in the form of disruptions or change in customer demand. There are several risk mitigation strategies explored in literature to reduce the impact of disruptions on the network. [54] suggest that flexibility in supply chain network helps to mitigate risks and leads to a better performance. These mitigation strategies are implemented either at a strategic or at an operational level. The most common strategy applied in practice and reviewed in literature is to have alternate option such that if there occurs any disruption in an existing facility, then back-up facilities can be activated in the system or if there occurs a disruption in the transportation route, then an alternate route should be considered, to maintain the operations of the supply chain network ([8]; [13]). Another strategy, is to avail an extra reserved capacity incase disruption occurs or there is an increase in demand ([8]; [9]). Moreover, at the operational level, other strategy is to keep safety stock at different stages of supply chain network. Further, in the below part of this section, literature related to supply chain resilience and flexibility is presented.

Supply chain management deals with number of activities that involve movement and storage of raw material and products from point of origin to point of consumption. In majority of organizations, supply chain has been considered as one of the most important coordinated set of activities. The supply chain problem that we have chosen for our research is a practical problem and not very trivial. There has been a growing interest in supply chain risk management which has drawn great attention of a number of researchers to propose advanced models and develop efficient methods on the integration of each process as a network design problem. To understand the motivation of making a resilient supply chain, it is important to understand the different supply chain practices which are highlighted below. In the following sub-sections we first give a brief overview of the concept and advantages of supply chain resilience along with the strategy to achieve it. The section following it, highlights existing research work done, research gaps and the motivation behind using the flexibility measures and strategies to enable resilient supply chain involving supplier flexibility, internal manufacturing flexibility and logistic flexibility.

2.1 Supply Chain Resilience

Supply chain resiliency focuses on designing your business and supply chain to quickly bounce back from disruptions. The goal is to improve your ability to recover from a disruption by identifying areas of potential risk, designing the supply chain to mitigate these risks, and maintaining living models of contingency plans for potential disruptive events. Resilience is all about how you maintain a self-organized capacity or ability of a system. How much can u change before losing your identity is what resilience will answer. Supply chain resilience concepts have been discussed by many researchers such as [10] conceptualized resilient supply chain and [34] addressed an analytical methodological framework for the optimal design of resilient supply chain. In literature, measurement of supply chain resilience doesn't exist widely, but there are some studies which report its quantification. To quantify the resilience of network edges and nodes [46] presented the concept of 'Structure based Resilience Metrics', to analyze logistic network resilience. [58] used the resilience evaluation approach and in Intermodal Freight Transport [7] quantified resilience. By modifying and using these existing studies, our research formulates a model to maximize supply chain resilience. The formulation addresses the ability of the network to absorb the disruption with its internal operational capability and also with the capability of recovery activities that may be implemented in the aftermath of a disaster. [58] have given the formula for evaluating resilience in case of multiple resources which depends on the source reliability, the path reliability between the sources and the quantity of demand, supply or link capacity. It is noticed that multiple and redundant reliable supplies bring higher resilience to a demand node. [45] classified this type of resilience as inherent resilience and defined it as the ability in normal conditions to reallocate resources

in response to market signals. The author also suggested second type of resilience called adaptive resilience which is defined as the ability in crisis situations due to ingenuity or extra effort. [7] quantified this type of resilience as the ability to satisfy the proportion of demand in case of occurrence of a disruptive event. In both of these works it is seen that authors have considered one tier system but our network is a complex three tier system. We have adapted the given formulae to build our supply chain network. [40] in their paper argued that resilience is more than just recovery and in its definition there is an implicit notion of level of flexibility and also, summarized that important aspects of resilience include adaptability, flexibility, maintenance and recovery. Flexibility has been a research topic since decades and researchers have discussed it in economic and organizational perspectives. These days the trend is to analyze the firm's flexibility along with its attached partner's flexibility and thus our work focuses on supply chain flexibility and supply chain resilience.

2.2 Supply chain flexibility

The concept of supply chain flexibility is stated as flexibility dimensions required by all the supply chain participants to successfully meet volatile customer demands [19]. The definition and review presented by authors [51] have empirically argued that in future supply chain should be designed from a network prospective, in which supply chain should be treated as a single entity and this would explore complete understanding of the effects of flexibility across whole supply chain. They suggested that supply chain flexibility encapsulates components of flexibility that are inherent to the firm level called intra-firm level flexibility and those which are external to the firm called inter-firm level flexibility. The detailed review discusses the different studies done in the area of supply chain flexibility related to building concept models of supply chain flexibility ([19]; [36] and [32] supply chain flexibility empirical analysis ([52]; [61]; Sanchez and Perez, 2005; and [53]), measuring of supply chain flexibility ([5]; [23] and [41]) and considering supply chain flexibility in the design and simulation model ([4]; [57]; [3] and [50]). After 2006, some authors worked on the flexibility modeling based papers that are similar to our approach. Like [33] discussed about the outsourcing and vertical integration concept, [1] suggested creating long-term capacity pools, [48] discussed extra capacity/extra inventory related approaches and [16] integrated capacity, product mix, distribution and input supply flexibility in mixed integer supply chain planning model to mitigate supply and demand uncertainty and improve market responsiveness. The idea of our proposed work is in line with the existing work of creating network partners for extra capacity where demand dictates. This study proposes a supply chain flexibility model that takes care of most of the relevant issues related to supply and demand variation and disruption. The model considers supplier flexibility, plant and product flexibility which come under the concept of internal manufacturing flexibility and logistic flexibility thus catering to upstream, internal and downstream flexibility. This would help the managers to plan their strategic process and create the flexibility that will allow them to face the evolving market [16] paper is a seminal paper of our problem but there are few limitations existing in the model, which are further explained. Firstly, the author has formulated the capacity flexibility by adding a new or extra capacity depending on the anticipated increase in demand for a product which is computed considering mean demand and estimated percentage increase in demand for that product. This modeled capacity flexibility did not address demand decrease cases. To eliminate this limitation, we modeled plant flexibility to cater to increase and decrease in demand of a particular product. The plant can be added to or removed from the supply chain system depending on the demand. Secondly, in the product mix flexibility formulation the total number of product types in an organization's product portfolio is compared with the minimum base level of that product types. They have divided the products into two ranges – fast moving product range and extended product range. To satisfy the targeted

customer demand an organization selects the product types from appropriate ranges, to make sure that the right product mix in their portfolio. Our formulation captures this, since the plants produce multiple products and thus demand of any new product can be either satisfied with existing plant which produces products that are similar to new demanded product or add new plant which can produce the demanded product. Thirdly, the supplier flexibility was formulated by creating two pools of suppliers, one pool of high quality supplier which was the existing supplier pool and the other pool for affiliated supplier which was the extended supplier pool. When the high quality suppliers failed to accommodate the entire supply input requirements, only the quantity of increase in demand or product mix change for the input supply is fulfilled by the affiliated suppliers by adding the entire extended pool. Our formulation is different than this model, as it doesn't consider adding the entire pool of affiliated suppliers, instead adds a relevant supplier one at a time in the system when the demand cannot be met by the existing system. [19] and [51] in their literature review have clearly said that there is a need for development of more sophisticated models and need to explore the relationship between supply chain design and flexibility across larger network. We have tried to solve a complex problem considering the risk of entire supply chain network. Thus, our proposed model enhances the supply chain flexibility literature and is useful to mitigate supply chain risk. To cater to the constantly changing customer demand all the partners attached in the supply chain network needs to be flexible. The concept of supply chain flexibility is a multi-dimensional concept including the supplier flexibility, manufacturing flexibility and logistic flexibility [53]. In this sub-section, the existing literature of these concepts are explained.

Supplier flexibility

Supplier flexibility is considered as an important tool to respond to environmental uncertainties. [36] defined supplier flexibility as the availability of qualified materials and services and the ability to reconfigure the supply chain, altering the supply of product in response to unanticipated demand. [19] defined supply flexibility as "the ability to alter the supply of inbound material in line with the customer demand". It facilitates a faster response when there is uncertainty; therefore, it has a positive impact on supply chain flexibility. Flexible suppliers are capable of supplying/processing other jobs in addition to the one for which they are the original supplier. In a cluster of flexible suppliers, it is expected that flexibility of suppliers be utilized more expressively through better control of the supply chain. As mentioned earlier [16] formulated supplier flexibility in a way such that the pool of affiliated suppliers is added to the system to fulfill the increased in supply order which could not be accommodated by the pool of high quality suppliers. The supplier flexibility formulated in our study also strategically mitigates the supply side risk, but is different than the above mentioned ones. The constraints consider the ability to ramp up or down size the production, the ability to add or remove a supplier and the ability to change the portfolio of the inbound material supplied by suppliers. The supplier is added or deleted one at a time and not together as a pool when the quantity or product mix change demanded cannot be met by the existing supplier system. Thus we can see that supplier flexibility is extensively studied empirically and there is need to model the supplier flexibility to bridge the gap.

Manufacturing flexibility

The term flexibility was first used for manufacturing firms, to describe the manufacturing ability to cope with the unexpected environmental variations ([49]; [24]). [37] defined flexibility as the ability of a production system to maintain its performance against the variation caused by the environment. [11] defined manufacturing flexibility as the ability of the plant to respond to market variations.

Manufacturing strategy treats manufacturing flexibility as one of its important attribute/entity and helps the manufacturing firms to remain unaffected by environmental uncertainty. There exists vast empirical research that addresses to manufacturing flexibility; [62] conducted a survey using postal questionnaire and suggested that mix flexibility and volume flexibility have positive influence on customer satisfaction. [39] defined flexibility as the ability of the manufacturing system to cope and adjust to the changes made in respect to products, processes, loads and machine breakdown. [27] presented that volume flexibility has positive impact on firm performance. [21] is regarded as a seminal work on product flexibility and they have optimized the capacity level(s) of one flexible resource that can manufacture all n products and n dedicated resources producing n products. The investment done in flexible system is based on the cost differential between the flexible and dedicated technologies as well as demand uncertainty and demand correlation. There are few mathematical model formulated in this area. [18] and [30] defined manufacturing flexibility as the ability to provide products with a wide range of features and volumes according to customer specifications. In literature, there exist many dimensions of manufacturing flexibility. As we are modeling supply chain flexibility we need not go into the intricacy of each dimension and consider the dimensions which are important and suitable to our study. Our model is different than the existing model in terms we have considered only two types of manufacturing flexibility which mainly is important in terms of supply chain flexibility. Considering all the parts of manufacturing flexibility will make the model very cumbersome to understand and solve. So we limit ourselves to plant and product flexibility. It is seen that volume flexibility, has also been handled in the model as a resource can temporarily alter its capacity to meet the demand and incase the capacity can't be increased then plant flexibility helps to cater the demand.

1) Plant flexibility: At the strategic level during the planning phase, the supply chain managers have a provision to acquire or rent new plant in addition to using the existing capacity to offset the anticipated increase in demand. The idea of renting or acquiring a plant can be done for a shorter period or longer period of time depending on the demand increase history. Our model adds or removes plants to cater to the changing demand.

2) Product flexibility, whereby a resource can produce multiple products, has been widely studied in the literature, including in [21]; [28]; [56]; [31]; [22] and [55]. There is a very slight difference between Product flexibility and mix flexibility. Our study's interest lies in the fact that manufacturing plant are capable to accept the orders of new products called the extended product which are similar to the existing products produced in the plants. It clearly suggests that product portfolio can be changed from the existing one to a new portfolio in which some products are added or removed. Our model addresses this fact.

Logistics flexibility

Logistic flexibility or Distribution flexibility is defined as firm's ability to control the movement and storage of products or items under constantly changing marketplace conditions ([19]; [53]). [38] clearly mentions in his study that there exist very few studies relevant to logistics flexibility or transportation flexibility or distribution flexibility and thus there is a need for studies that consider this flexibility. [17] highlight the need to consider distribution to have greater competitive advantage for the business. Most often it is seen that firms take precautionary measures and proper security against equipment failure, terrorist attack, fire attacks, earthquakes, etc. but it is beyond the firms control to prevent the delivery routes from any disruption or traffic congestion, closure of national borders due to sanctions, terrorist attacks, wars or strikes at port, breakdown in transportation due to extreme weather conditions, [59].

Thus, logistic flexibility proves to be important aspect to make the supply chain system resilient. Logistic flexibility consists of many components but our model focus only on Link, Mode and Node flexibility [38]. Link flexibility caters to establishing new paths between the nodes or resources [20]. Mode flexibility is defined as the ability to provide different modes of transport but in our model by giving different modes we can consider different vehicle types also which depends on the quantity to be shipped. Node flexibility reflects the fact to add any node which implies to add a resource in the system [20]. [63] studied the impact of network disruption on human behavior and described the various options opted by the travelers immediately after the network is disrupted. Travelers may change their normal route because of traffic congestion or road and ramp closure, adjust travel time to avoid congestion or switch to alternative travel modes. The main purpose of having logistics flexibility firstly, is that if a path/route is disrupted or damaged then an alternative path/route can be used to deliver the items between the sources. Secondly, depending on the quantity to be shipped the relevant mode and vehicle type will be selected. Thirdly, when there is some disruption or demand change then the ability to connect the new resources or facilities in the system.

3. Mathematical model formulation

The aim of this article is to determine a supply chain network configuration recommended after the occurrence of disruptions or to fulfill the demand. The problem considered in this paper consist of multiple suppliers (s) supplying multiple raw material (), multiple plants (p) producing multiple products, multiple distribution centres (d) storing multiple products and multiple retailers (r) having all products to sell to the customers.

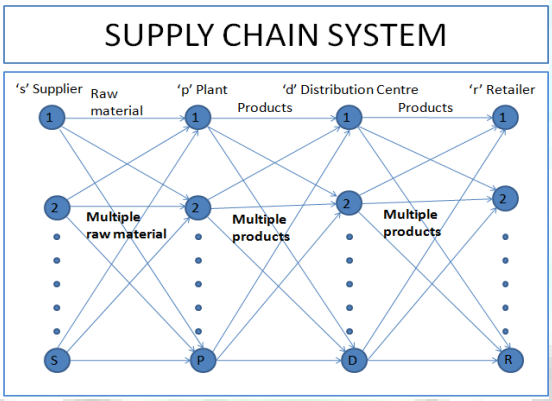


Figure 3.1: Supply chain system for the considered problem

In the model there are two objective functions to be simultaneously optimized. One objective is to maximize supply chain resilience which includes inherent and adaptive resilience. The second objective is to minimize the total supply chain cost which includes the fixed cost of running suppliers, manufacturing plants, distribution centers and retailers, the processing cost of raw material and products, transportation cost of raw materials shipped from suppliers to plants, the transportation cost of shipping products from plants to distribution centers and from distribution centers to retailers, and holding cost of products at distribution centers. The problem is formulated into a bi-objective mixed integer non-linear programming model. Further, we have considered a single period SCND problem. This particular formulated problem can be used for products that are stable in market and do not undergo much demand fluctuations such as products with seasonal demand. The products of considered case study, follow a stable demand pattern, so

a single period demand is considered to represent the whole planning period. Let us understand the functionality of this network model. Incase there is any kind of disruption or a breakdown in a facility/facilities or the delivery path/paths of the existing system or there is an increase in demand of existing product or demand for a new product, then there needs to be alternative option generated to make the product available to the required stage and complete the supply chain operations/process. Thus, this paper addresses this issue and tries to build a resilient supply chain. Further, we need to understand that it is very unlike that this type of disruption will lasts more than a single period. So we have tried to model a single time period model and reduced the complexity of the model too. Also, this model is flexible to handle a demand of new product or increase and decrease in demand of existing products.

Mixed-integer programming (MIP) has been extensively applied to SCD beginning with the seminal study by [14]. The model aims at finding optimal SCD with assignments of customers to locations with the objective to minimize total SC costs. [35] developed a MIP model to incorporate reliable back-up supplier which can be used if an existing supplier is destroyed. The related recovery costs are modeled into the objective function. [44] modeled a comprehensive problem statement with multiple time periods and multiple products with considerations of available warehouse space at each destination, available machine capacity, resource levels at each source, transportation capacity at each node, back ordering and inventory. The authors analyzed the settings with a backup trans-shipment node and backup supplier with reserved capacity that satisfied demands at higher prices without disruption facility. The solution to the model is based on a priority-based genetic algorithm. [25] used an MIP model to investigate resilience in light of correlated disruptions. Solution is implemented as a Taguchi-based memetic algorithm that incorporates a customized hybrid parallel adaptive large neighborhood search. The model is solved for a real-life case of a global medical device manufacturer. [43] developed a resilient topology of an SC that is able to recover from and react quickly to disruptions. Three policies are analysed in regard to keeping emergency stock at the retailers, reserving back-up capacity at the suppliers, and multiple-sourcing. The authors apply non-linear MIP model to find the most profitable network and mitigation policies. Major results of this study suggest that risk mitigation policies not only improve the SC control by sustaining and improving its market share but also benefit customers by stabilizing retail prices in the market. Further, the analysis reveals that downstream “emergency stock” is the most preferable risk mitigation strategy if suppliers are unreliable. The mathematical formulation constructed for the considered problem is given below:

***Indices*:**

s →supplier

p →plant

d →distribution centre

r →retailer

i →product

w →inbound material

l →link

m →mode

g’ → index for the existing supplier which supply inbound material in the normal condition

g'' → index for the extended supplier which supply inbound material only when the existing suppliers cannot accommodate the supply order

q' → index for the existing plants which produce products in the normal condition

q'' → index for the extended plants which produce products only when the existing plants cannot accommodate the production

Parameters:

Parameters related to cost:

CS_w^{sp} → Per unit processing cost of wth inbound material supplied from sth Supplier to pth Plant

CP_i^{pd} → Per unit processing cost of ith product sent from pth Plant to dth Distribution centre

CD_i^{dr} → Per unit processing cost of ith product distributed from dth Distribution centre to rth Retailer

C→ Total processing cost of material

Parameters related to cost:

$mt\cos t_m$ → Per unit transportation cost defined for mth mode

mfc_m → Fixed cost for mth mode

$mkm\cos t_m$ → Per unit transportation cost for mth mode

km_{wl}^{sp} →Distance in km for wth product shipped from sth supplier to pth Plant, through lth link

km_{il}^{pd} →Distance in km for ith product shipped from pth Plant to dth Distribution centre, through lth link

km_{il}^{dr} →Distance in km for ith product shipped from dth Distribution centre to Retailer rth through lth link

TC→ Total Transportation cost of the system

Parameters related to fixed cost:

CS^s → Fixed cost for the sth Supplier

CP^p → Fixed cost for the pth Plant

CD^d →Fixed cost for the dth Distribution centre

FC→ Total fixed cost of the system

ΔC →Fixed cost of reserving the facilities

ϕs_l^{sp} →Fixed cost of lth link for inbound material shipped from sth Supplier to pth Plant

ϕp_l^{pd} →Fixed cost of lth link for products shipped from pth Plant to dth Distribution centre

ϕd_l^{dr} →Fixed cost of lth link for products shipped from dth Distribution centre to rth Retailer

Parameters related to Capacity of the facility:

$\hat{S}_w^s$ → Capacity of sth Supplier to supply wth inbound materials

$\hat{P}_i^p$ → Capacity of pth Plant to produce ith products

$\hat{D}_i^d$ →Capacity of d[th] Distribution centre to store i[th] products

Parameters related to Link capacity:

$L\hat{S}_{lm}^{sp}$ → Capacity of link from s[th] Supplier to p[th] Plant through l[th] link and m[th] mode

$L\hat{P}_{lm}^{pd}$ → Capacity of link from p[th] Plant to d[th] Distribution centre through l[th] link and m[th] mode

$L\hat{D}_{lm}^{dr}$ → Capacity of link from d[th] Distribution centre to r[th] Retailer through l[th] link and m[th] mode

Parameters related to Demand:

DP_w^p → Demand of w[th] inbound material at the p[th] Plant

DD_i^d → Demand of i[th] product at the d[th] Distribution centre

DR_i^r → Demand of i[th] product at the r[th] Retailer

Parameters related to Reliability and Resilience:

Δp_w^p → Excess of w[th] inbound material supply available at p[th] Plant

Δd_i^d → Excess of i[th] product supply available at d[th] Distribution centre

Δr_i^r →Excess of i[th] product supply available at r[th] Retailer

ρs_w^s → Reliability of the s[th] Supplier for w[th] inbound material

ρp_i^p → Reliability of the p[th] Plant for i[th] product

ρd_i^d → Reliability of the d[th] Distribution centre for i[th] product

$pathp^{sp}$ →Reliability of the path between the s[th] Supplier to p[th] Plant

$pathp^{pd}$ →Reliability of the link between the p[th] Plant to d[th] Distribution centre

$pathd^{dr}$ →Reliability of the link between the d[th] Distribution centre to r[th] Retailer

rp_w^p →Resilience at the p[th] Plant for w[th] inbound material

rd_i^d →Resilience at the d[th] Distribution Centre for i[th] product

rr_i^r →Resilience at the r[th] Retailer for i[th] product

$Weight_w^p$ → Proportion of demand of the w[th] inbound material at the p[th] Plant

$Weight_i^d$ → Proportion of demand of the i[th] product at the d[th] Distribution centre

$Weight_i^r$ → Proportion of demand of the i[th] product at the r[th] Retailer

V_w^p →Redundant coefficient for w[th] inbound material at the p[th] Plant

V_i^d →Redundant coefficient for i[th] product at the d[th] Distribution centre

V_i^r →Redundant coefficient for i[th] product at the r[th] Retailer

$\rho\ell^{sp}$ →Reliability of the link between the s[th] Supplier to p[th] Plant

$\rho\ell^{pd}$ →Reliability of the link between the p[th] Plant to d[th] Distribution centre

$\rho\ell^{dr}$ →Reliability of the link between the d[th] Distribution centre to r[th] Retailer

Parameters related to the Suppliers present in the system:

S1→ First pool of suppliers named as "Existing suppliers" that exist and supplies the inbound material in the normal conditions

S → total number of suppliers of the existing pool

$s'_{g'}$ → Elements of set S1

S1 = {1, 2, . . . , S} and $s'_{g'} \in S1$

S2→ Second pool of suppliers named as "Extended suppliers" supplies inbound material to the Plants only when the first pool of suppliers cannot accommodate the supply order

n1 → Number of suppliers in the extended pool of suppliers

$s'_{g''}$ → Elements of set S2

S2 = {1, 2, . . . , n1}and $s''_{g'} \in S2$

SP→ Total pool of Suppliers

$SP = S1 \cup S2$

IS → Intermediate set of suppliers selected from the extended pool that can accommodate the change in supply order

Parameters related to the Plants present in the system:

P1→ First pool of Plants named as "Existing plants" that produces the products in the normal conditions

P → total number of plants in the existing pool

$p'_{q'}$ → Elements of set P1

P1 = {1, 2, . . . , P}and $p'_{q'} \in P1$

P2→ Second pool of Plants named as "Extended plants" that produces the products only when the first pool of Plants cannot accommodate the production order

n2 → Number of plants in the extended pool of plants

$p'_{q''}$ → Elements of set P2

P2 = {1, 2, . . . , n2}and $p'_{q''} \in P2$

PP→ Total pool of Plants

$PP = P1 \cup P2$

IP → Intermediate set of plants selected from the extended pool that can accommodate the change in production

Parameters related to quantity of material shipped from one facility to another for mode selection:

$\underline{q}_m^{sp}$ →The minimum amount (lower limit) of the quantity to be shipped from s^{th} supplier to p^{th} plant through m^{th} mode

$\overline{q}_m^{sp}$ →The maximum amount (upper limit) of the quantity to be shipped from s^{th} supplier to p^{th} plant through m^{th} mode

$\underline{q}_m^{pd}$ →The minimum amount (lower limit) of the quantity to be shipped from p^{th} plant to d^{th} Distribution centre through m^{th} mode

$\overline{q}_m^{pd}$ → The maximum amount (upper limit) of the quantity to be shipped from p^{th} plant to d^{th} Distribution centre through m^{th} mode

$\underline{q}_m^{dr}$ → The minimum amount (lower limit) of the quantity to be shipped from d^{th} Distribution centre to r^{th} Retailer through m^{th} mode

$\overline{q}_m^{dr}$ →The maximum amount (upper limit) of the quantity to be shipped from d^{th} Distribution centre to r^{th} Retailer through m^{th} mode

Decision Variables:

x_{wlm}^{sp} → Quantity of w^{th} inbound material supplied from s^{th} Supplier to p^{th} Plant through l^{th} link and m^{th} mode

y_{ilm}^{pd} → Quantity of i^{th} product sent from p^{th} Plant to d^{th} Distribution centre through l^{th} link and m^{th} mode

z_{ilm}^{dr} →Quantity of i^{th} product distributed from d^{th} Distribution centre to r^{th} Retailer through l^{th} link and m^{th} mode

Binary variables:

α_{wlm}^{sp} = 1 if w^{th} inbound material is supplied from s^{th} Supplier to p^{th} Plant through l^{th} link and m^{th} mode else = 0

β_{ilm}^{pd} = 1 if i^{th} product is sent from p^{th} Plant to d^{th} Distribution centre through l^{th} link and m^{th} mode else = 0

θ_{ilm}^{dr} = 1 if i^{th} product is distributed from d^{th} Distribution centre to r^{th} Retailer through l^{th} link and m^{th} mode, else = 0

A^s = 1 if s^{th} Supplier is active in the supply chain system, else = 0

A^p = 1 if p^{th} Plant is active in the supply chain system, else = 0

A^d = 1 if d^{th} Distribution centre is active in the supply chain system, else = 0

$e'_{g'}$=1 if the quantity of w^{th} inbound material shipped from the s^{th} Supplier to p^{th} Plant through l^{th} link and m^{th} mode is less than the demand of the w^{th} Inbound material at p^{th} plant when g'^{th} supplier in the approved supplier pool can supply the w^{th} required Inbound material, else = 0

f'= 1 if any inbound material shipped from the Supplier to Plant is less than the demand at the Plant, else = 0

$v'_{g'}$=1 if the demand of w^{th} inbound material shipped from the s^{th} Supplier to p^{th} Plant through l^{th} link and m^{th} mode is met even after removing the g' supplier, else = 0

u'= 1 if any supplier can be removed from existing supplier and still the demand of the plant can be satisfied, else = 0

$e''_{q''}$= 1 if the quantity of i^{th} product shipped from the p^{th} Plant to d^{th} Distribution centre through is less than the demand of the i^{th} product at the d^{th} Distribution centre when g''th Plant in the approved Plant can produce the i^{th} required product, else = 0

f '' = 1 if any product shipped from the Plant to Distribution centre is less than the demand at the Distribution centre, else = 0

$v''_{q'}$=1 if the quantity of i^{th} product shipped from the p^{th} Plant to d^{th} Distribution centre through is met even after removing the g'' plant, else = 0

u''= 1 if any supplier can be removed from existing supplier and still the demand of the plant can be satisfied, else = 0

Formulae:

$$C = \sum_{s=1}^{S}\sum_{p=1}^{P}\sum_{w=1}^{W}\sum_{l=1}^{L}\sum_{m=1}^{M} CS_w^{sp} * x_{wlm}^{sp}$$
$$+\sum_{p=1}^{P}\sum_{d=1}^{D}\sum_{i=1}^{I}\sum_{l=1}^{L}\sum_{m=1}^{M} CP_i^{pd} * y_{ilm}^{pd}$$
$$+\sum_{d=1}^{D}\sum_{r=1}^{R}\sum_{i=1}^{I}\sum_{l=1}^{L}\sum_{m=1}^{M} CD_i^{dr} * z_{ilm}^{dr}$$

$$TC = \sum_{s=1}^{S}\sum_{p=1}^{P}\sum_{w=1}^{W}\sum_{l=1}^{L}\sum_{m=1}^{M} (mfc_m + mt\cos t_m * x_{wlm}^{sp} + mkm\cos t_m * km_{wl}^{sp})$$
$$+\sum_{p=1}^{P}\sum_{d=1}^{D}\sum_{i=1}^{I}\sum_{l=1}^{L}\sum_{m=1}^{M} (mfc_m + mt\cos t_m * y_{ilm}^{pd} + mkm\cos t_m * km_{il}^{pd})$$
$$+\sum_{d=1}^{D}\sum_{r=1}^{R}\sum_{i=1}^{I}\sum_{l=1}^{L}\sum_{m=1}^{M} (mfc_m + mt\cos t_m * z_{ilm}^{dr} + mkm\cos t_m * km_{il}^{dr})$$

$$FC = \sum_{s=1}^{S} FS^s * \lambda^s + \sum_{p=1}^{P} FP^p * \lambda^p + \sum_{d=1}^{D} FD^d * \lambda^d$$

$$\text{Resilience} = R = \sum_{p=1}^{P} R_p + \sum_{d=1}^{D} R_d + \sum_{r=1}^{R} R_r$$

$$R_p = 1 - \prod_{w=1}^{W}[1 - V_w^p * Weight_w^p * r_w^p]$$

$$\begin{pmatrix} r_w^p = 1 - \prod_{s=1}^{S}[1 - \rho_w^s(path^{sp}).(\frac{\min(DP_w^p, \hat{C}_w^s)}{DP_w^p}) * \sum_{l=1}^{L}\alpha_{wl}^{sp}] \\ V_w^p = \min\{\frac{\Delta_w^p}{DP_w^p}, 1\} \\ \Delta_w^p = [\sum_{s=1}^{S}\hat{C}_w^s * \sum_{l=1}^{L}\alpha_{wl}^{sp}] - DP_w^p \\ Weight_w^p = DP_w^p / \sum_{w=1}^{W}\sum_{p=1}^{P} DP_w^p \end{pmatrix} \quad \forall p, \forall w$$

$$R_d = 1 - \prod_{i=1}^{I}[1 - V_i^d * Weight_i^d * r_i^d]$$

$$\begin{pmatrix} r_i^d = 1 - \prod_{p=1}^{P}[1 - \rho_i^p(path^{pd}).(\frac{\min(DD_i^d, \hat{C}_i^p)}{DD_i^d}) * \sum_{l=1}^{L}\mu d_{il}^{pd}] \\ V_i^d = \min\{\frac{\Delta_i^d}{DD_i^d}, 1\} \\ \Delta_i^d = [\sum_{p=1}^{P}\hat{C}_i^p * \sum_{l=1}^{L}\mu p_{il}^{pd}] - DD_i^d \\ Weight_i^d = DD_i^d / \sum_{i=1}^{I}\sum_{d=1}^{D} DP_i^d \end{pmatrix} \quad \forall d, \forall i$$

$$R_r = 1 - \prod_{i=1}^{I}[1 - V_i^r * Weight_i^r * r_i^r]$$

$$\left(\begin{array}{l} r_i^r = 1 - \prod_{d=1}^{D}[1 - \rho_i^d(path^{dr}).(\frac{\min(DR_i^d, \hat{C}_i^p)}{DR_i^d}) * \sum_{l=1}^{L} \mu d_{il}^{dr}] \\ V_i^d = \min\{\frac{\Delta_i^d}{DR_i^d}, 1\} \\ \Delta_i^r = [\sum_{d=1}^{D} \hat{C}_i^d * \sum_{l=1}^{L} \mu d_{il}^{dr}] - DR_i^d \\ Weight_i^r = DR_i^r / \sum_{i=1}^{I}\sum_{r=1}^{R} DR_i^r \end{array} \right) \quad \forall r, \forall i$$

$$\begin{aligned} AdtRs = & \sum_{s=1}^{S}\sum_{p=1}^{P}\sum_{w=1}^{W}\sum_{l=1}^{L}\sum_{m=1}^{M}(x_{wlm}^{sp} * \alpha_{wlm}^{sp}) / \sum_{p=1}^{P}\sum_{w=1}^{W} DP_w^p \\ & + \sum_{p=1}^{P}\sum_{d=1}^{D}\sum_{i=1}^{I}\sum_{l=1}^{L}\sum_{m=1}^{M}(y_{ilm}^{pd} * \beta_{ilm}^{pd}) / \sum_{d=1}^{D}\sum_{i=1}^{I} DD_i^d \\ & + \sum_{d=1}^{D}\sum_{r=1}^{R}\sum_{l=1}^{I}\sum_{l=1}^{L}\sum_{m=1}^{M}(z_{ilm}^{dr} * \theta_{ilm}^{dr}) / \sum_{r=1}^{R}\sum_{i=1}^{I} DR_i^r \end{aligned}$$

OBJECTIVE FUNCTION:

Maximize Resilience and Minimize Cost

$$Max[InhRs + AdtRs]$$
$$Min[C + TC + FC + \Delta C]$$

CONSTRAINTS:

The quantity shipped from one facility (eg one supplier) to other facilities (eg many plants) should be within the capacity limit of that facility (one supplier)

$$\sum_{p=1}^{P}\sum_{m=1}^{M}\sum_{l=1}^{L} x_{wlm}^{sp} \leq \hat{} \; {}_w^s \qquad \forall w, \forall s$$

$$\sum_{d=1}^{D}\sum_{m=1}^{M}\sum_{l=1}^{L} y_{ilm}^{pd} \leq \hat{} \; {}_i^p \qquad \forall i, \forall p$$

$$\sum_{r=1}^{R}\sum_{m=1}^{M}\sum_{l=1}^{L} z_{ilm}^{dr} \leq \hat{} \; {}_i^d \qquad \forall i, \forall d$$

The quantity that is shipped from one facility (eg one supplier) to other facilities (eg many plant) should fulfill the demand facilities:

$$D_w^p \leq \sum_{s=1}^{S}\sum_{m=1}^{M}\sum_{l=1}^{L} x_{wlm}^{sp} \qquad \forall w, \forall p$$

$$D_i^d \leq \sum_{p=1}^{P}\sum_{m=1}^{M}\sum_{l=1}^{L} y_{ilm}^{pd} \qquad \forall i, \forall d$$

$$D_i^r \leq \sum_{d=1}^{D}\sum_{m=1}^{M}\sum_{l=1}^{L} z_{ilm}^{dr} \qquad \forall i, \forall r$$

Supplier flexibility

There are two pools of suppliers and the total number of suppliers is denoted by SP. The first pool consists of suppliers denoted by S1 and named as “existing suppliers” always supplies the inbound material in the system. The suppliers in the second pool denoted by S2 and named as “extended suppliers”, supplies inbound material to the Plants only when the first pool of suppliers cannot accommodate the supply order.

S1 = {1, 2, . . . , S}

S2 = {1, 2, . . . , n1}and $s''_{g'} \in S2$

$$SP = S1 \cup S2$$

The approved suppliers need to be transformed into existing supplier pool so as to fulfill the required demand, are temporary assigned in the set IS which are then moved to the set S1 which comprises of the partner suppliers.

$$IS = \{\}$$
$$IS = f' \times [IS \cup (e'_{g''} \times \{s'_{g''}\})] \quad \forall g''$$
$$S1 = S1 \cup IS$$
$$S = S + card(IS)$$

If the demand falls, then some of the existing suppliers should be removed.

$$S1 = u' \times [S1 - (v'_{g'} \times \{s'_{g'}\})] \; \forall g'$$
$$S = card(S1)$$

Plant flexibility

There are two pools of plants and the total number of plants is denoted by PP. The first pool consists of plants denoted by P1 and named as “Existing plants” that always produce the products in the system. The plants in the second pool denoted by P2 and named as “Extended plants”, produce products only when the first pool of plants cannot accommodate the order production.

P1 = {1, 2, . . . , P}

P2 = {1, 2, . . . , n2}and $p''_{g''} \in P2$

$$PP = P1 \cup P2$$

The extended plants need to be transformed into existing plants so as to produce products to fulfill the required demand, are temporary assigned in the set $PS_{g''}$ which are then moved to the set P1 which comprises of the existing plants.

$$IP = \{\}$$
$$IP = f'' \times [IP \cup (e''_{q''} \times \{p'_{q''}\})] \quad \forall q''$$
$$P1 = P1 \cup IP$$
$$P = P + card(IP)$$

$$P1 = u'' \times [P1 - (v''_{q'} \times \{p'_{q'}\})] \; \forall q'$$
$$P = card(P1)$$

The items shipped through a link should be within the capacity of that link.

$$\sum_{m=1}^{M}\sum_{w=1}^{W} x_{wlm}^{sp} \le \sum_{m=1}^{M} L\hat{\square}_{lm}^{sp} \quad \forall s, \forall p, \forall l$$

$$\sum_{m=1}^{M}\sum_{i=1}^{I} y_{ilm}^{pd} \le \sum_{m=1}^{M} L\hat{\square}_{lm}^{pd} \quad \forall p, \forall d, \forall l$$

$$\sum_{m=1}^{M}\sum_{i=1}^{I} z_{ilm}^{dr} \le \sum_{m=1}^{M} L\hat{\square}_{lm}^{dr} \quad \forall d, \forall r, \forall l$$

To constraint on number of activated links at a time

$$\sum_{l=1}^{L}\prod_{w=1}^{W}\sum_{m=1}^{M} \alpha_{wlm}^{sp} = 1 \quad \forall s, \forall p$$

$$\sum_{l=1}^{L}\prod_{i=1}^{I}\sum_{m=1}^{M} \beta_{ilm}^{pd} = 1 \quad \forall p, \forall d$$

$$\sum_{l=1}^{L}\prod_{i=1}^{I}\sum_{m=1}^{M} \theta_{ilm}^{dr} = 1 \quad \forall d, \forall r$$

To decide the modes depending upon the quantity

$$\begin{bmatrix} |\sum_{w=1}^{W} x_{wlm}^{sp} - \underline{q}_m^{sp}| + |\bar{q}_m^{sp} - \sum_{w=1}^{W} x_{wlm}^{sp}| + \\ |\sum_{w=1}^{W} \alpha_{wlm}^{sp} - 1| \end{bmatrix} = \begin{bmatrix} (\sum_{w=1}^{W} x_{wlm}^{sp} - \underline{q}_m^{sp}) + (\bar{q}_m^{sp} - \sum_{w=1}^{W} x_{wlm}^{sp}) + \\ (\sum_{w=1}^{W} \alpha_{wlm}^{sp} - 1) \end{bmatrix}$$

$$for \forall s, \forall p, \forall l, \forall m$$

$$\begin{bmatrix} |\sum_{i=1}^{I} y_{ilm}^{pd} - \underline{q}_m^{pd}| + |\bar{q}_m^{pd} - \sum_{i=1}^{I} y_{pdilm}| + \\ |\sum_{i=1}^{I} \beta_{ilm}^{pd} - 1| \end{bmatrix} = \begin{bmatrix} (\sum_{i=1}^{I} y_{ilm}^{pd} - \underline{q}_m^{pd}) + (\bar{q}_m^{pd} - \sum_{i=1}^{I} y_{pdilm}) + \\ (\sum_{i=1}^{I} \beta_{ilm}^{pd} - 1) \end{bmatrix}$$

$$for \forall p, \forall d, \forall l, \forall m$$

$$\begin{bmatrix} |\sum_{i=1}^{I} z_{ilm}^{dr} - \underline{q}_m^{dr}| + |\bar{q}_m^{dr} - \sum_{i=1}^{I} z_{ilm}^{dr}| + \\ |\sum_{i=1}^{I} \theta_{ilm}^{dr} - 1| \end{bmatrix} = \begin{bmatrix} (\sum_{i=1}^{I} z_{ilm}^{dr} - \underline{q}_m^{dr}) + (\bar{q}_m^{dr} - \sum_{i=1}^{I} z_{ilm}^{dr}) + \\ (\sum_{i=1}^{I} \theta_{ilm}^{dr} - 1) \end{bmatrix}$$

$$for \forall d, \forall r, \forall l, \forall m$$

4. Solution Procedure

The considered problem is a multi-objective non-linear problem, wherein no optimal solution is defined clearly, rather there exists a set of optimums. The solution of this multi-objective problem generate set of non-dominated points which form the front. These problems are very large and have complex search space due to which they can't have an exact solution but can be solved to get a near to optimal solution by applying certain heuristic algorithms and find proximity to global optimal solution. There are many mathematical programming methods and algorithms existing in literature used to solve the complex supply chain network design problem. This study proposes a solution algorithm to solve the above multi objective problem. The solution involves Stochastic Optimization Technique called Particle Swarm Optimization (PSO) and Genetic Algorithm (GA) which are naturally evolutionary process.

4.1 Particle Swarm Optimization (PSO)

Inspired by the flocking and schooling patterns of birds and fish, PSO was invented by Russell Eberhart and James Kennedy in 1995. Originally, these two started out developing computer software simulations of birds flocking around food sources, and then later realized how well their algorithms worked on optimization problems. PSO learned from the scenario and used it to solve the optimization problems.

Flow Chart:

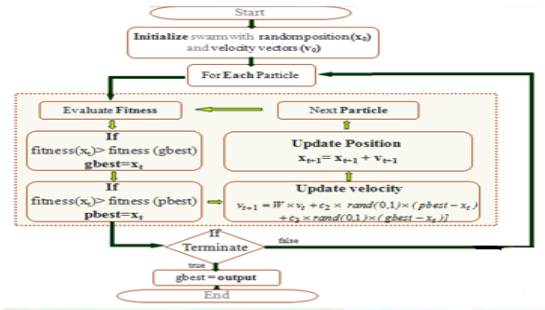


Figure 4.1: Flowchart presenting PSO algorithm

Pseudocode:

For each particle
  Initialize particle
END
Do
  For each particle
    Calculate fitness value
    If the fitness value is better than the best fitness value (pBest) in history
      set current value as the new pBest
  End
Choose the particle with the best fitness value of all the particles as the gBest
  For each particle
    Calculate particle velocity according equation (a)
    Update particle position according equation (b)
  End
While maximum iterations or minimum error criteria is not attained

4.2 Genetic Algorithm

Genetic algorithms (also known as evolutionary algorithms) developed by John Holland, and his students and colleagues at the University of Michigan. It uses evolutionary principles to design systems that perform specific functions. Among other areas, computer programming with genetic algorithms is used to create programs and data structures that are continually redefined and refined to accomplish a particular state or purpose.

Flowchart:

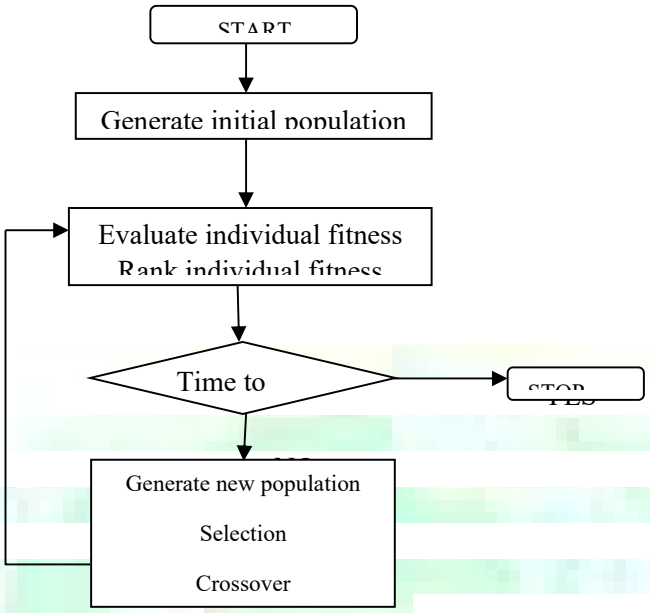


Figure 4.2: Flowchart presenting GA algorithm

Pseudocode

START

Generate the initial population

Compute fitness

REPEAT

Selection

Crossover

Mutation

Compute fitness

UNTIL population has converged

STOP

Disadvantage of PSO over GA_PSO

PSO and GA both are good, it's depend on problem(objective). PSO is easy to implement compared to GA. GA is having problem of less exploitation in work space but in PSO can exploit more than GA. GA solves binary variable and converts it into number, which can skip the optimal point for handling the problem, require big dimension of binary bit and that will take more time in conversion than PSO. GA-PSO can find fit solutions which are good according to the defined heuristic in a very less time. The random mutation guarantees to some extent that we see a wide range of solutions. Coding them is really easy compared to other algorithms which does the same job.

4.3 GAPSO

We propose a hybrid Genetic and Particle swarm optimization algorithm to solve the considered problem. The algorithm steps are defined below:

Step 1. Determine the number of chromosomes, generation, and mutation rate and crossover rate value

Step 2. Generate chromosome-chromosome number of the population, and the initialization value of the genes chromosome-chromosome with a random value

Step 3. Process steps 4-7 until the number of generations is met

Step 4. Evaluation of fitness value of chromosomes by calculating objective function

Step 5. Chromosomes selection

Step 6. Crossover

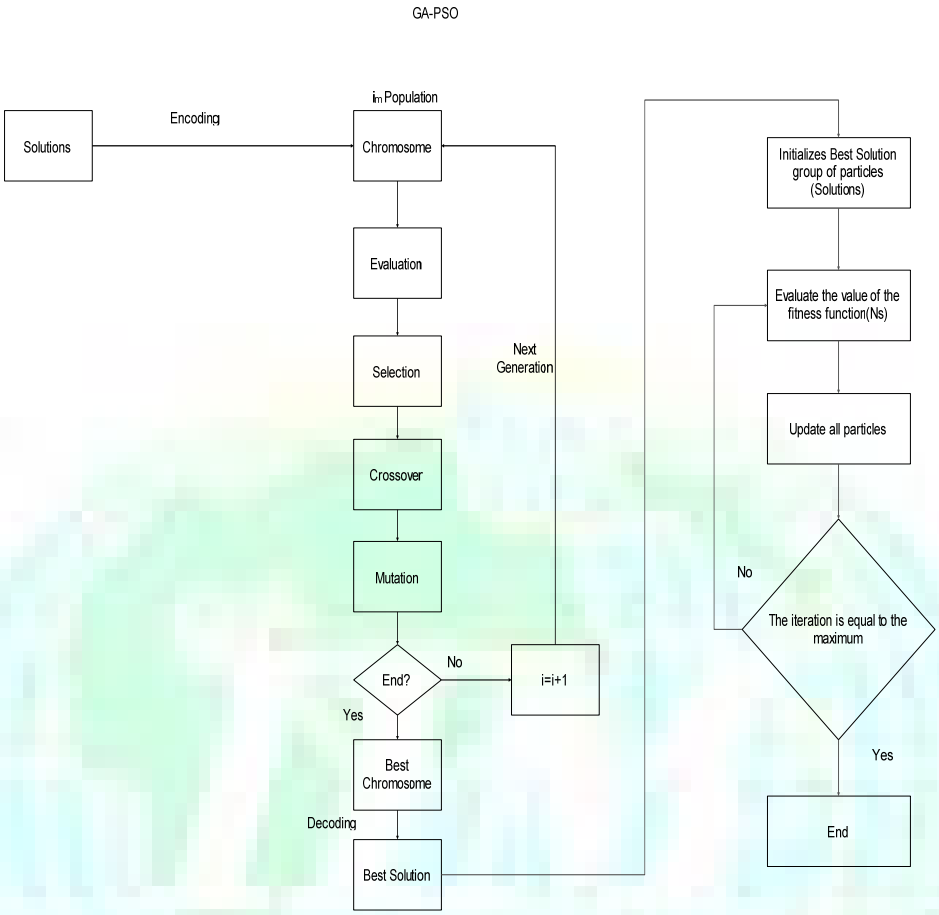
Step 7. Mutation

Step 8. Solution (Best Chromosomes)

Step 9. For each particle (Solution (Best Chromosomes))
  Initialize particle
END

Do
  For each particle
    Calculate fitness value
    If the fitness value is better than the best fitness value (pBest) in history
      set current value as the new pBest
  End

  Choose the particle with the best fitness value of all the particles as the gBest
  For each particle
    Calculate particle velocity according equation (a)
    Update particle position according equation (b)
  End
While maximum iterations or minimum error criteria is not attained



Flow chart

Figure 4.3: Flowchart presenting GA-PSO algorithm

5. Software/Programming language:

C is a structured & Procedure oriented programming language. It was developed by Dennis Ritche in 1972. This Programming Structure Strategies comes under one part of Unix Programming. The drawbacks of this language are large complexity of program cannot able to manage easily. It does not have concept of OOPs and there is no runtime checking. There is no strict type checking. For example, we can pass an integer value for the floating data type. It doesn't have the concept of namespace or the concept of constructor or destructor. For these reasons C++ is developed. C++ is an object orient programming language. C++ = C Basic Features + Simula 67. C++ can able to handle large complexity of program using oops structure. C++ used reusability of code and inheritance, polymorphasm. But again C++ is not purely Object Oriented. Without Class Structure we can able to execute the program. It is not secure because it has a pointer, friend function, and global variable and has a bootable. It is complex in a very large high-level program. Commonly, used for platform specific application. When C++ used for web applications complex and difficult to debug. So we plan to use Java, which is a programming language and a platform. A Platform is any hardware or software environment in which a program runs, is

known as a platform. Java is a high level, robust, secured and object-oriented programming language. Since Java has its own runtime environment (JRE) and API, it is called platform.

In our proposed research methodology, we have developed a Novel Resilience supply chain software, where in real time data can be input and output is completely based on the processing time the Particle Swarm Optimization (PSO) and Genetic Algorithm (GA) heuristic algorithms. Therefore, to produce efficient results, we have implemented the research work in Java with following software specifications.

5.1 Software Specifications

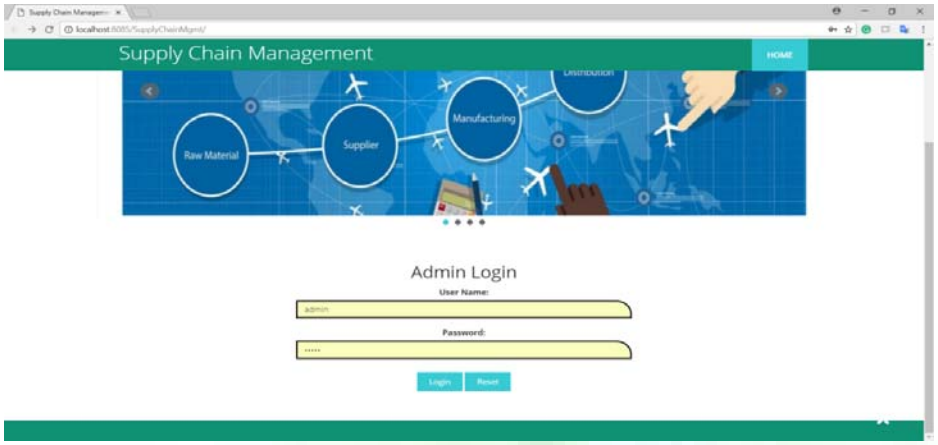
The software used to implement this proposed research work is specified below:

Language	Java
Database	MYSQL
J2EE Technologies	JDBC, Servlets, JSP
Web Technologies	HTML, CSS, JavaScript
IDE	Eclipse 3.8 (Juno)
Operating System	Windows 10

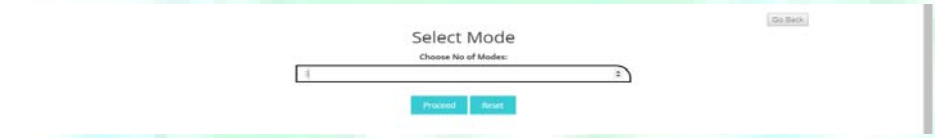
In our research work, we have developed a Novel SCM software tool which involves implementation of effective supply chain strategies. This software system drives the undertakings in an efficient and economical manner to create competitive advantage. The software is capable to capture the real time input data and algorithm output can be studied in an excel sheet form. The benefits of this software is that simulation runs can be performed and different 'what-if' scenarios can be studied by SC managers in the case of disruption occurrence to quickly estimate the recovery policies and impacts on operational and financial performance. Further sensitivity analysis can be performed by changing key parameters of the problem, such as variation in disruption, variation in uncertain demand and changes in probability. Sensitivity study part shows how changing these parameters can affect the network configuration and also, verifies robustness and correctness of the proposed model.

5.2 Scenario built up, Data structure, Results

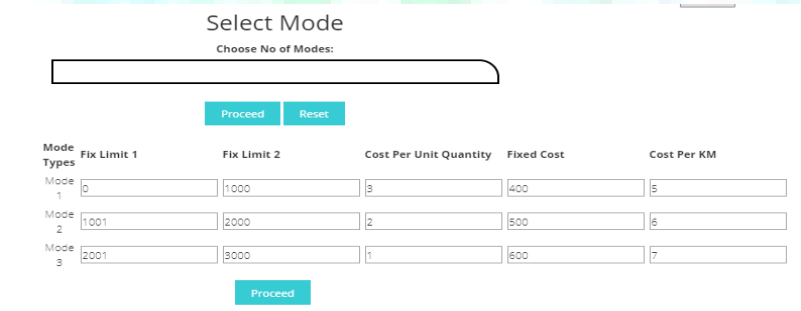
Login Page -> Enter Username: admin and Password: admin. Submit Form->Redirects to AdminLogin.java -> Checks Both the values are valid from database. If valid rsupledirects to Modetype.jsp else index.jsp with an error message



Modes: Enter Number of Modes Required then submit form->Redirects to ModeT1.jsp to generate dynamic fields

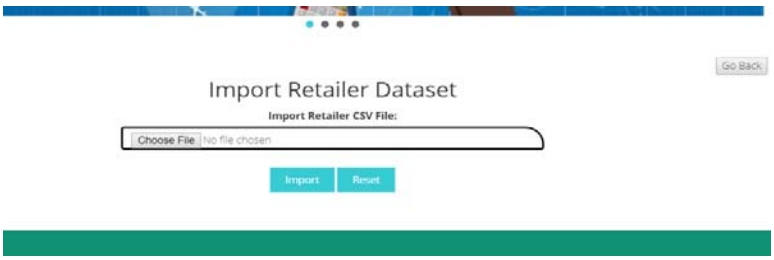


Mode Limits: Enter Mode Limits, Cost per Unit, Fixed Cost, and Cost Per KM then submit form ->Redirects to ExpertLearner.jsp to choose the scenario.

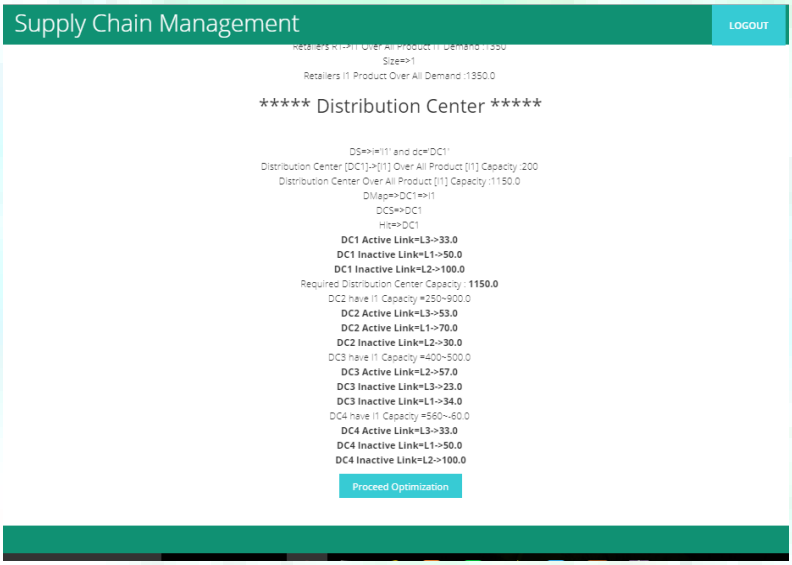


Expert Learner Scenario: Either Proceed with database scenario or proceed with CSV-> submit then redirects to NewModel.jsp to Check the Distribution Centre Capacity Availability

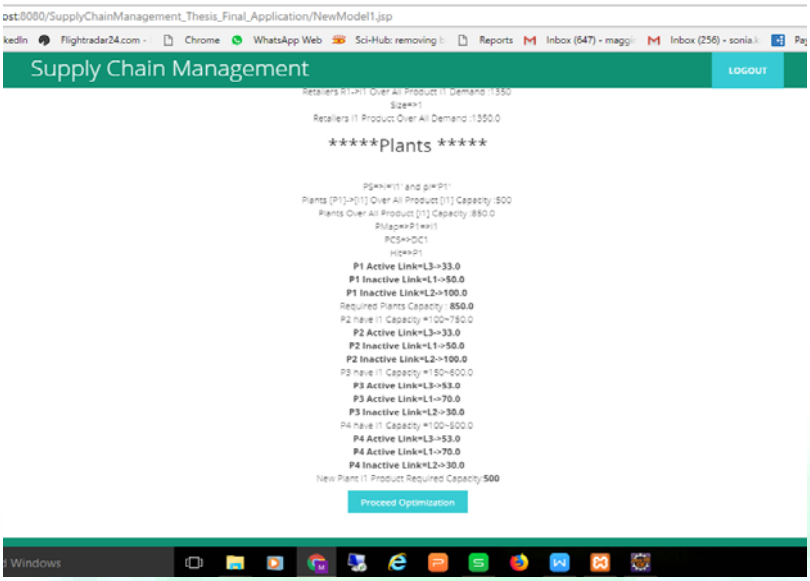
Upload CSV Files: Upload CSV Dataset for Retailer, Distribution Centre, Plants, and Supplier to proceed the models.



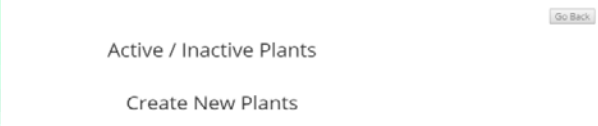
NewModel.jsp: It will checks the retailer based distribution centre available capacity then submit form -> Redirects to Learner.java. if ndc>0 -> Redirects DDCT.jsp. In this page either choose Active/Inactive DC or Create New DC to Proceed further. If Choose Create New DC -> Redirects to DCT.jsp to enter number of DC Required then submit->Redirects to DCT1.jsp to create a dynamic fields -> enter all respective values -> submit -> Redirects to DCT2.jsp to store all the values into database ->redirects to NewModel.jsp -> Proceed Optimization -> redirects -> Learner.java -> if ndc!>0 redirects to NewModel1.jsp to proceed Plants Capacity



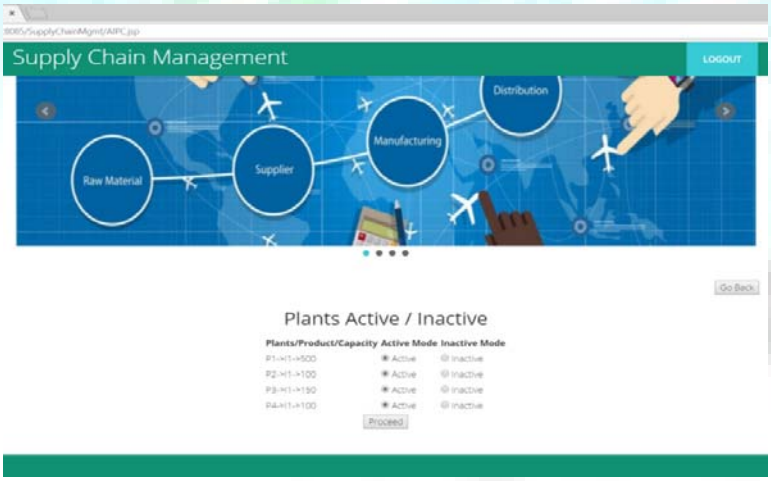
New Model1.jsp: Plants required new 500 capacity->submit->Redirects->Learner1.java->Check if npc>0->Redirects->PPCT.jsp->Either Choose Active / Inactive Plants or Create New Plants.



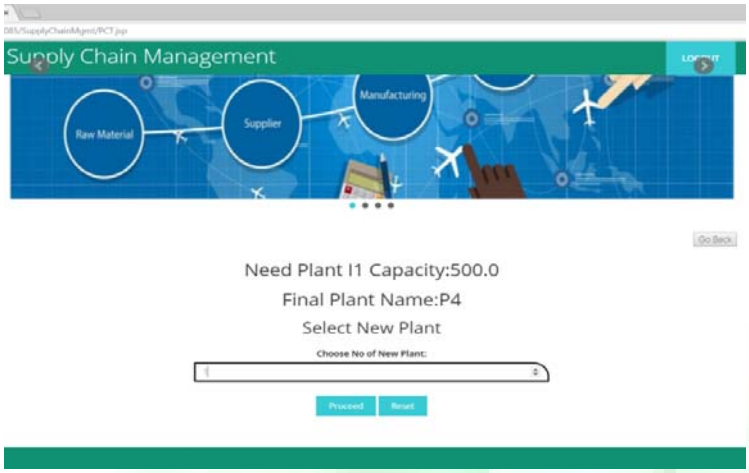
PPCT.jsp: Either choose Active / Inactive Plants or Create New Plants.



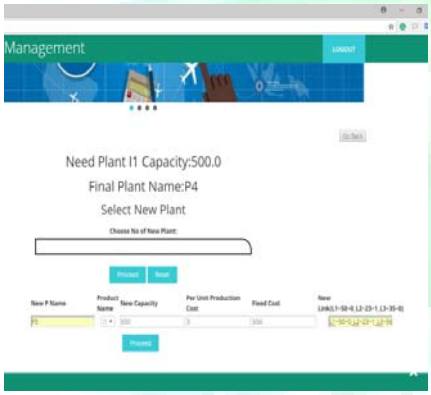
AIPC.jsp: Here we can activate or inactive any plants depending on the real time information

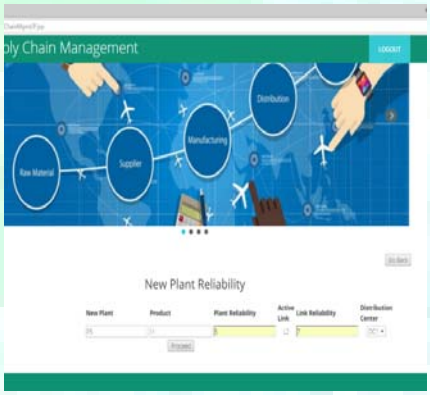


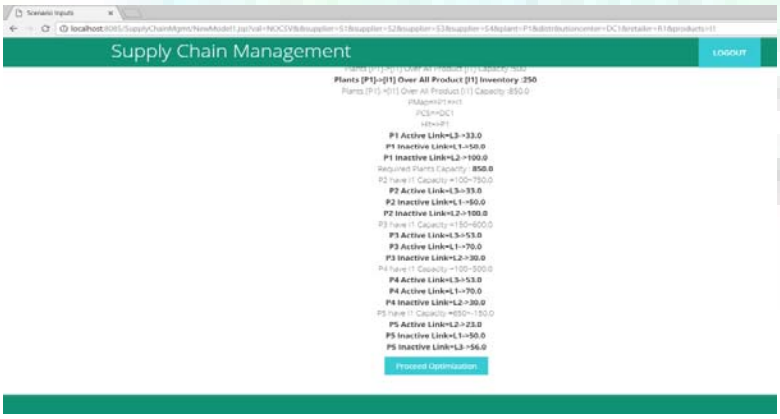
PCT.jsp: Enter the number of new plants required-> submit -> redirects to PCT1.jsp.



PCT1.jsp: Enter All the respective values then submit->Redirects to PCT2.jsp to store all values then redirects to P.jsp to get the reliability values and then finally to NewModel1.jsp for optimization







Similarly, the supplier screens are developed.

Note: Same as Distribution centre & Plants Proceeding the Supplier Capacity Scenario->Proceed Optimization->Redirects to ExpertInput.jsp to Rank the Distribution Centre, Plants, and Supplier based on Transportation Cost & per Unit Cost.

Cost Calculation:

Capacity = 400 // This Capacity Plotted in Mode 1, Active Link with its KM: L2-> 57,

Fixed Cost = 55 and Transportation Cost = (tcost*capacity) + (kmcost*km) = (5*400) + (57*7)

Over All Cost 1 = (Mode Fixed Cost + Transportation Cost) = (55 + 2000 + 399) = 2454

Over All Cost 2 = (DC Fixed Cost + (per unit Cost * capacity)) = (400000 + (10*400)) = 404000

Per Unit Cost = (Over All Cost 1+ Over All Cost 2)/Capacity = (2454 + 404000)/400 = 1016.135

Similarly for Capacity = 200 the per unit cost is 1016.43

Similarly for Capacity = 560 the per unit cost is 1016.5107

Similarly for Capacity = 250 the per unit cost is 1021.704

Over All Retailer Demand fulfilled By Distribution Centre: 1350

(DC3 (400) + DC1 (200) + DC4 (560) + DC2 (190)) =1350

DC3 = 400 * 1016.135 = 406454

DC1 = 200 * 1021.704 = 203286

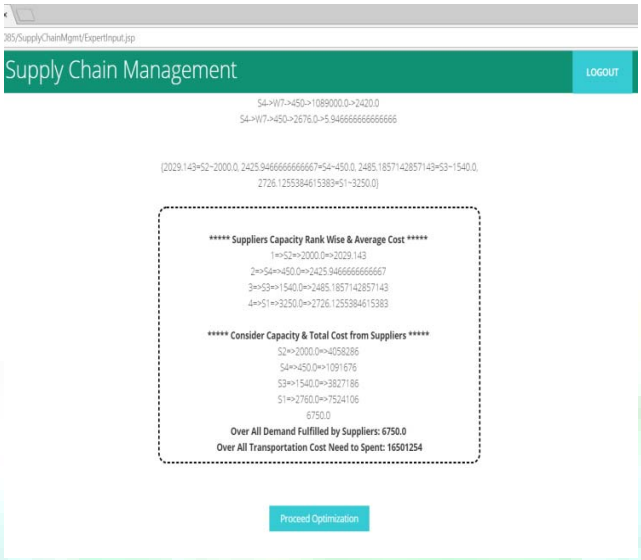
DC4 = 560 * 1016.5107 = 569246

DC2 = 190 * 1021.704 = 194123

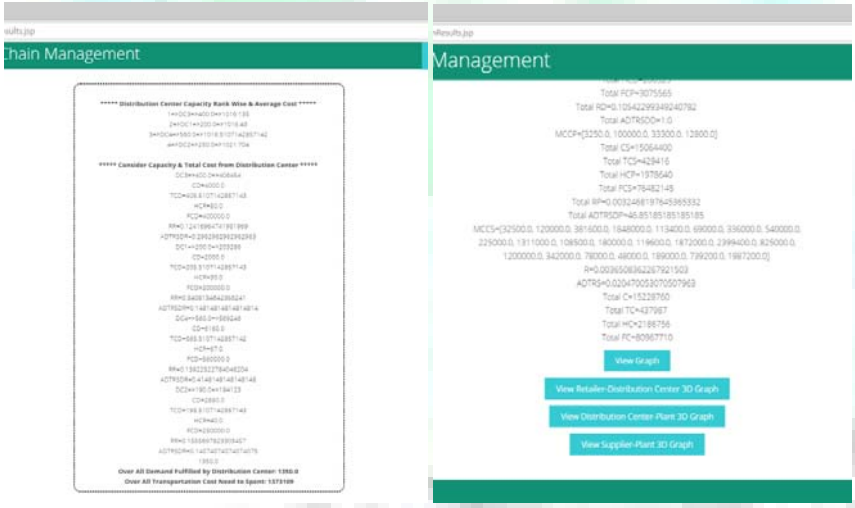
Over All Cost Need to Spent: (DC1+DC2+DC3+DC4)

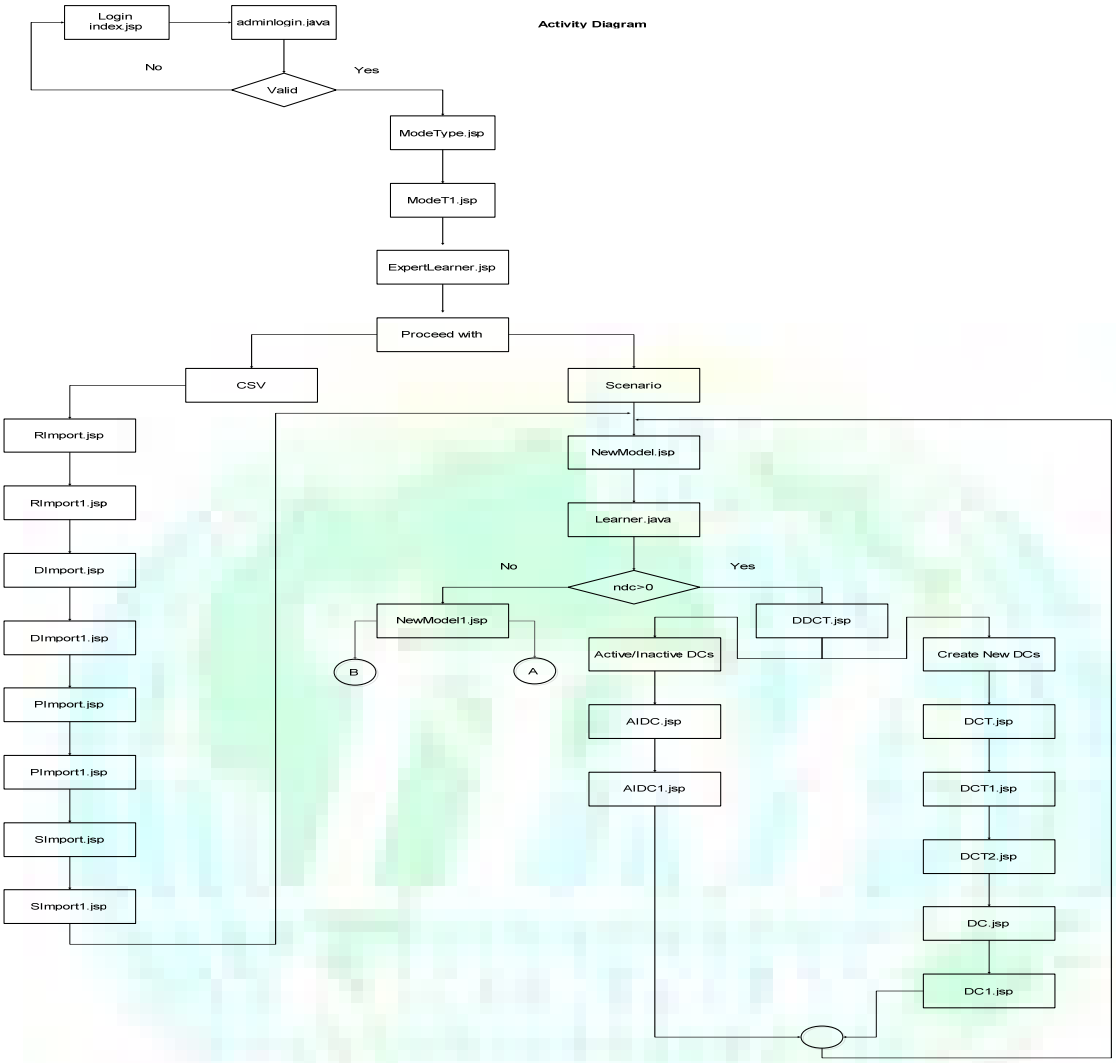
= (406454+203286+569246+194123) = 1373109

Note: Same calculation is done to obtain the rank for Plants & Suppliers



Optimization Results:




Activity Diagram
Login
index.jsp
adminlogin.java
No
Valid
Yes
ModeType.jsp
ModeT1.jsp
ExpertLearner.jsp
Proceed with
CSV
Scenario
RImport.jsp
RImport1.jsp
DImport.jsp
DImport1.jsp
PImport.jsp
PImport1.jsp
SImport.jsp
SImport1.jsp
NewModel.jsp
Learner.jsp
No
Yes
ndc>0
NewModel1.jsp
DDCT.jsp
B
A
Active/Inactive DCs
Create New DCs
AIDC.jsp
AIDC1.jsp
DCT.jsp
DCT1.jsp
DCT2.jsp
DC.jsp
DC1.jsp

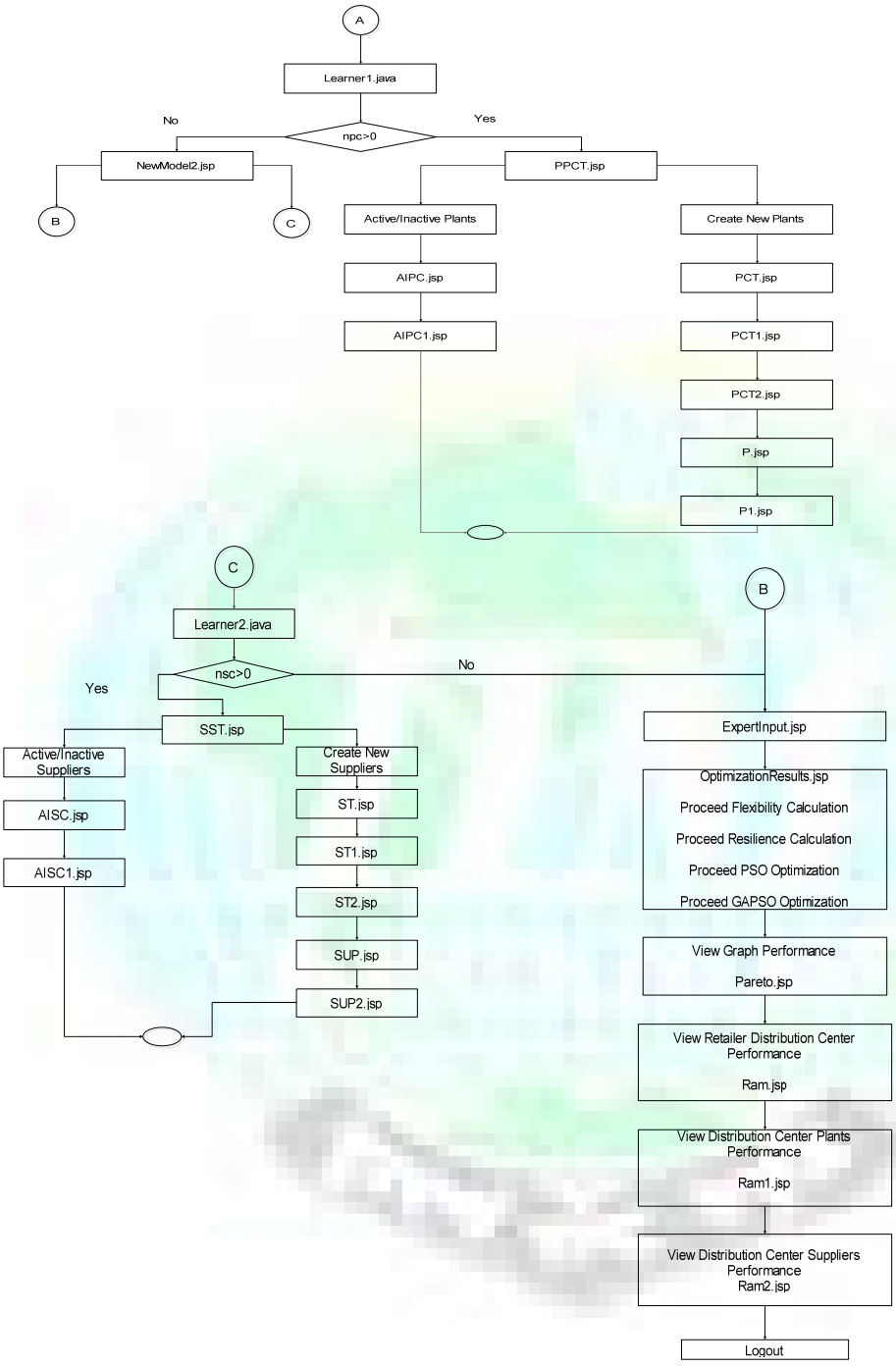
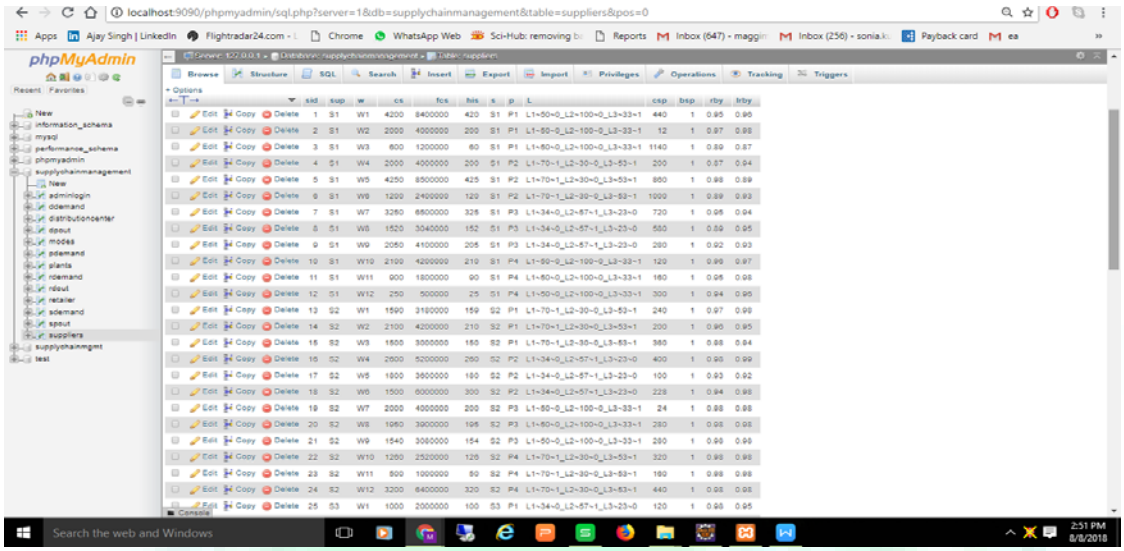
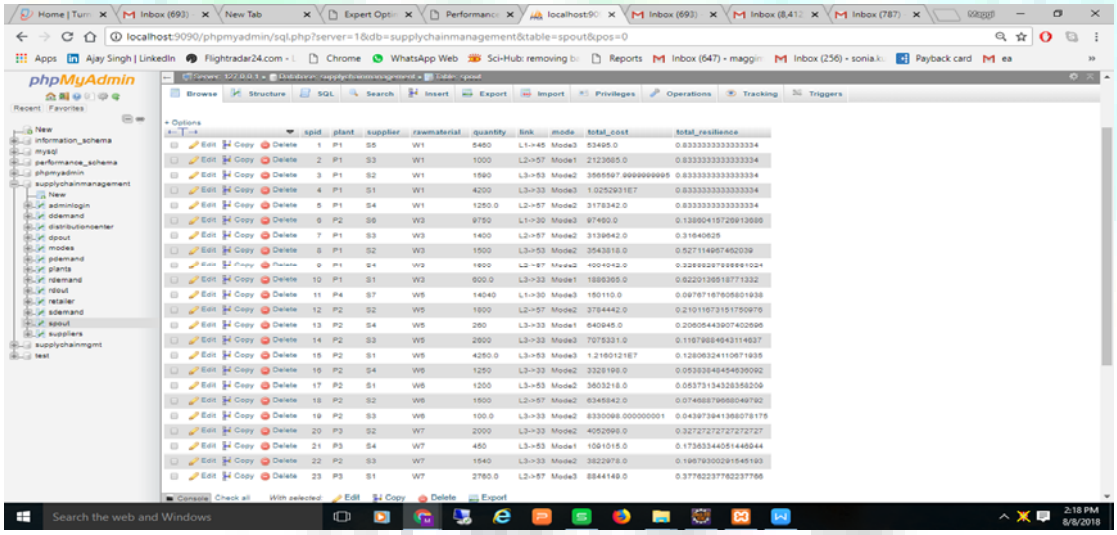


Figure 3.7: Activity diagram for the developed screens

5.4 Input data structure:



5.5 Output data structure:



6 Conclusion

The strongest motivation behind this work is to create an efficient and resilient supply chain network model coping to unforeseen disruptions and tough competition. With globalization, supply chain network has drawn lot of attention in industry as well as in academics. Over the past decades, in literature there are many practical cases reported that suggest any failure to satisfy the customer demand causes loss of customer which results in loss of market share. Therefore, companies need to plan in advance and develop the risk mitigation strategies that can be activated if SCN experiences disruptions. In this work RSCN is built on the idea of reliability and flexibility which comes into play when disruption occurs at either stages of supply chain nodes or during transportation or there is a change in demand. Most of the previous studies in literature are either a single stage or single echelon system with usually single objective and single type of flexibility is considered. Hence, there has been an increasing

attention on the multi-stage supply chain network with multiple objective and integration of all the supply chain flexibility parameters.

This article explains the mathematical formulation of the supply chain network. It consists of multi-raw material, multi-product, multi-stage with supplier, manufacturing and logistic flexibility to satisfy uncertain disruptions and demand. The proposed multi-objective mixed integer non-linear model aims to assist operations management to take strategic and tactical decisions under supply chain disruptions. We were successfully able to build the supply chain resilience and flexibility model to mitigate the supply chain risks. This model re configures itself to satisfy the changing demand and also avoids the supply chain failure against disruptions from either supply side or internal manufacturing or from the logistics perspective. In the model, there are two objective functions optimized simultaneously. A Novel Supply chain software is developed to enhance the solution to the above mentioned problem, which proves to be beneficial to perform simulation runs, sensitivity analysis and different 'what-if' scenarios can be studied by SC managers in the case of disruption occurrence to quickly estimate the recovery policies and impacts on operational and financial performance. A cost comparison of Non-resilient system and resilient system can be performed using this supply chain software. A numerical example has been used to illustrate the applicability of the developed model. PSO and hybrid GA-PSO algorithms are adopted to compare the computational performance because there exists trade-off between the objectives. The computational cost related to model, shown as CPU running time, has been found to be relatively low in case of GA-PSO algorithm, thus making the model favorable in solving large-scale problems.

7 References

[1] Ahlert, K.-H., Corsten, H. and Gossinger, R. (2009). Capacity management in order-driven production networks–A flexibility-oriented approach to determine the size of a network capacity pool International Journal of Production Economics, 118, pp. 430–441

[2] Ambulkar, S., Blackhurst, J., and Grawe, S. (2015). Firm's resilience to supply chain disruptions: Scale development and empirical examination. *Journal of operations management*, 33, 111-122

[3] Aprile, D., Garavelli, A.C., Giannoccaro, I. (2005), "Operations planning and flexibility in a supply chain", Production Planning & Control, Vol. 16 No.1, pp.21-31.

[4] Barad, M., Sapir, D.E. (2003), "Flexibility in logistic systems – modelling and performance evaluation", International Journal of Production Economics, Vol. 85 pp.155-70

[5] Beamon, B.M. (1998), "Supply chain design and analysis: models and methods", International Journal of Production Economics, Vol. 55 No.3, pp.281-94.

[6] Chen, I.J., Calantone, R.J., Chung, C.H., 1992. The marketing manufacturing interface and manufacturing flexibility. Omega 20 (4), 431–443

[7] Chen, L., & Miller-Hooks, E. (2012). Resilience: an indicator of recovery capability in intermodal freight transport. Transportation Science, 46(1), 109-123.

[8] Chopra S., Reinhardt G., Mohan U. (2007) The importance of decoupling recurrent and disruption risks in a supply chain. *Naval Research Logistics*, 54(5); 544–555

[9] Chopra S., Sodhi MS. (2004) Managing risk to avoid supply chain breakdown, *MIT Sloan Management Review* 46(1); 53–62

[10] Christopher, M., & Peck, H. (2004). Building the resilient supply chain.International Journal of Logistics Management, The, 15(2), 1-14.

[11] Cox, J.T. (1989). Towards the measurement of manufacturing flexibility, Production and Inventory Management Journal (First Quarter) (1989) 68–72.

[12] Cui, T., Ouyang, Y., Shen, Z.-J.M., 2010. Reliable facility location design under the risk of disruptions. *Operations Research,* 58 (4-Part-1), 998–1011

[13] Dada, M., N.C. Petruzzi, and L.B. Schwarz. 2007. A newsvendor's procurement problem when suppliers are unreliable. *Manufacturing and Service Operations Management,* 9 (1), 9–32

[14] Daskin, M. S., Snyder, L. V., and Berger, R. T. (2005). Facility location in supply chain design. In *Logistics systems: Design and optimization* (pp. 39-65). Springer, Boston, MA

[15] D.M. Lambert, M.C. Cooper, J.D. Pagh, Supply chain management: Implementation issues and research opportunities, The International Journal of Logistics Management 9 (2) (1998) 1–19.

[16] Das, K. (2011). Integrating effective flexibility measures into a strategic supply chain planning model. European Journal of Operational Research, 211(1), 170-183.

[17] De Toni, A., & Tonchia, S. (1998). Manufacturing flexibility: a literature review. International journal of production research, 36(6), 1587-1617.

[18] D'Souza, D. E., and Williams, F. P. (2000). Toward a taxonomy of manufacturing flexibility dimensions. *Journal of Operations Management*, 18(5), 577-593

[19] Duclos L.K., Vokurka R.J. and Lummus R.R. (2003). A Conceptual Model of Supply Chain Flexibility. Industrial Management and Data Systems, 103 (6), 446-456.

[20] Feitelson, E., & Salomon, I. (2000). The implications of differential network flexibility for spatial structures. Transportation Research Part A: Policy and Practice, 34(6), 459-479.

[21] Fine, C. H., & Freund, R. M. (1990). Optimal investment in product-flexible manufacturing capacity. Management Science, 36(4), 449-466.

[22] Graves, S. C., & Tomlin, B. T. (2003). Process flexibility in supply chains. Management Science, 49(7), 907-919.

[23] Gupta, M.P., Nehra, G. (2002), "Analysis of flexibility and supply chain management in select Indian industries", Global Journal of Flexible Systems Management, Vol. 3 No.2/3, pp.31-44.

[24] Gupta, Y. P., & Goyal, S. (1989). Flexibility of manufacturing systems: concepts and measurements. European journal of operational research, 43(2), 119-135.

[25] Hasani, A., A. Khosrojerdi (2016). Robust global supply chain network design under disruption and uncertainty considering resilience strategies: A parallel memetic algorithm for a real-life case study. *Transportation Research Part E: Logistics and Transportation Review,* 87, 20-52

[26] Hendricks, K. B., and Singhal, V. R. (2003). The effect of supply chain glitches on shareholder wealth. *Journal of operations Management*, *21*(5), 501-522

[27] Jack, E. P., & Raturi, A. (2002). Sources of volume flexibility and their impact on performance. Journal of operations management, 20(5), 519-548.

[28] Jordan, W. C., & Graves, S. C. (1995). Principles on the benefits of manufacturing process flexibility. Management Science, 41(4), 577-594.

[29] Kathuria, R., Partovi, F.Y., 1999. Work force management practices for manufacturing flexibility. Journal of Operations Management 18 (1), 21–39

[30] Koste, L.L., Malhotra, M.K., Sharma, S., 2004. Measuring dimensions of manufacturing flexibility. Journal of Operations Management 22 (2), 171–196.

[31] Kouvelis, P., and Vairaktarakis, G. (1998). Flowshops with processing flexibility across production stages. *IIE transactions*, *30*(8), 735-746

[32] Kumar, V., Fantazy, K. A., Kumar, U., & Boyle, T. A. (2006). Implementation and management framework for supply chain flexibility. Journal of Enterprise Information Management, 19(3), 303-319.

[33] L.M. Wang, L.W. Liu, Y.J. Wang, Capacity problem and supply price games under flexibility of backward integration International Journal of Production Economics, 110 (2007), pp. 85–96

[34] Lakovou, E., Vlachos, D., & Xanthopoulos, A. (2007). An analytical methodological framework for the optimal design of resilient supply chains.International Journal of Logistics Economics and Globalisation, 1(1), 1-20.

[35] Lim, M., Daskin, M.S., Bassamboo, A., and Chopra, S. (2010). A facility reliability problem: formulation, properties and algorithm. *Naval Research Logistics*, 57, 58–70

[36] Lummus, R.R., Duclos, L. K. and Vokurka, R. J. (2003). Supply Chain Flexibility: Building a New Model. Global Journal of Flexible Systems Management, 4(4), 1-13.

[37] Mascarenhas, B., Planning for flexibility, Long Range Planning 14 (5) (1981) 78–82.

[38] Mohamed M. N., Andrew T. P., Robert J. M., and Bateman, N. (2006) "The role of transport flexibility in logistics provision", International Journal of Logistics Management, The, Vol. 17 Iss: 3, pp.297 - 311

[39] Nagarur, N. (1992). Some performance measures of flexible manufacturing systems, International Journal of Production Research 30 (4), 799–809.

[40] Ponomarov, S.Y. and Holcomb, M.C., 2009. Understanding the concept of supply chain resilience. International Journal of Logistics Management, 20 (1), 124–143.

[41] Pujawan, I.N. (2004), "Assessing supply chain flexibility: a conceptual framework and case study", International Journal of Integrated Supply Management, Vol. 1 No.1, pp.79-97.

[42] R.R. Lummus, R.J. Vokurka, Defining supply chain management: A historial perspective and practical guidelines, Industrial Management & Data Systems 99 (1) (1999) 11–17.

[43] Rezapour S., Farahani, R. Z. and Pourakbar, M. (2016). Resilient Supply Chain Network Design under Competition: A Case Study *European Journal of Operational Research* (2016)

[44] Rafiei, M., Mohammadi, M., and Torabi, S. (2013). Reliable multi period multi product supply chain design with facility disruption. *Decision Science Letters*, *2*(2), 81-94

[45] Rose, A. (2004). Defining and measuring economic resilience to disasters.Disaster Prevention and Management, 13(4), 307-314.

[46] Rosenkrantz, D. J., Goel, S., Ravi, S. S., & Gangolly, J. (2005). Structure-based resilience metrics for service-oriented networks. In Dependable Computing-EDCC 5 (pp. 345-362). Springer Berlin Heidelberg.

[47] Schmidt, W., Simchi- Levi, D. (2013) Nissan Motor Company Ltd: Building operational resiliency, *MIT Sloan Management*, Case Number 13–150

[48] Schutz, P., Tomasgard, A. 2010. The impact of flexibility on operational supply chain planning, International Journal of Production Economics, in press.

[49] Sethi, A. K., & Sethi, S. P. (1990). Flexibility in manufacturing: a survey.International journal of flexible manufacturing systems, 2(4), 289-328.

[50] Shen, Z-J.M. (2006), "A profit-maximizing supply chain network design model with demand choice flexibility", Operations Research Letters, Vol. 34 pp.673-82.

[51] Stevenson, M. and Spring, M., 2007. Flexibility from a supply chain perspective: definition and review. *International Journal of Operations and Productions Management,* 27 (7), 685–713

[52] Suarez, F.F., Cusumano, M.A., Fine, C.H. (1995), "An empirical study of flexibility in manufacturing", Sloan Management Review, Vol. 37 No.1, pp.25-32.

[53] Swafford, P.M., Ghosh, S., Murthy, N. (2006), "The antecedents of supply chain agility of a firm: scale development and model testing", Journal of Operations Management, Vol. 24 pp.170-88

[54] Tang, C., and Tomlin, B. (2008). The power of flexibility for mitigating supply chain risks. *International journal of production economics*, *116*(1), 12-27

[55] Tomlin, B., & Wang, Y. (2005). On the value of mix flexibility and dual sourcing in unreliable newsvendor networks. Manufacturing & Service Operations Management, 7(1), 37-57.

[56] Van Mieghem, J. A. (1998). Investment strategies for flexible resources. Management Science, 44(8), 1071-1078.

[57] Wadhwa, S., Rao, K.S. (2003), "Enterprise modelling of supply chains involving multiple entity flows: role of flexibility in enhancing lead time performance", Studies in Informatics and Control, Vol. 12 No.1, pp.1-16.

[58] Wang, Q., & Ip, W. H. (2009). Evaluation and analysis of logistic network resilience with application to aircraft servicing. Systems Journal, IEEE, 3(2), 166-173.

[59] Wilson, M. C. (2007). The impact of transportation disruptions on supply chain performance. *Transportation Research Part E: Logistics and Transportation Review*, *43*(4), 295-320

[60] Yang, Z., Aydin, G., Babich, V., and Beil, D. R. (2012). Using a dual-sourcing option in the presence of asymmetric information about supplier reliability: Competition vs. diversification. *Manufacturing and Service Operations Management*, *14*(2), 202-217

[61] Young, G., Sapienza, H., Baumer, D. (2003), "The influence of flexibility in buyer-seller relationships on the productivity of knowledge", Journal of Business Research, Vol. 56 pp.443-51.

[62] Zhang, Q., Vonderembse, M. A., & Lim, J. S. (2003). Manufacturing flexibility: defining and analyzing relationships among competence, capability, and customer satisfaction. Journal of Operations Management, 21(2), 173-191.

[63] Zhu, S., & Levinson, D. M. (2012). Disruptions to transportation networks: a review. In Network Reliability in Practice (pp. 5-20). Springer New York.

Supply Chain Flexibility: Introduction, Classification and its Measures

Ramesh Kumar[1], Ravindra Gokhale[2], L. Ganapathy[1]

[1] Industrial Engineering & Manufacturing System, National Institute of Industrial Engineering (NITIE), Mumbai, 400087, India.
[2] Operations & Supply Chain Management, National Institute of Industrial Engineering (NITIE), Mumbai, 400087, India.
ramesh.kumar.2017@nitie.ac.in, rgokhale@nitie.ac.in, lganapathy@nitie.ac.in

Abstract. This paper presents the introduction, definition and classification of Supply Chain Flexibility (SCF). SCF is an essential operations strategy for organisations to meet the dynamic demand of customer and maintain the uncertainty of today's business environment. The increasing global market network, competitive pressure, and customer expectations have forced to adopt flexible supply chain in the organisation. The primary function of supply chain flexibility is to respond the system to change with little penalty in time, cost, performance and effort. In manufacturing, flexibility is defined as the ability of a manufacturing system to react by shifting between various states of the system with little penalty in time, cost and performance [8]

Keywords: We would like to encourage you to list your keywords in this section.

The literature review of classification and its measures are based on the strategy suggested by Esmaeilikia et al. (2016). Vickery et al. (1999) categorised five supply chain flexibilities based on previous operations literature namely: product flexibility, volume flexibility, new product flexibility, distribution flexibility and responsiveness flexibility. Esmaeilikia et al. (2016) classified the three dimensions of supply chain flexibility namely: supply flexibility, manufacturing flexibility and distribution/logistics flexibility. Supply flexibility concerns with flexibility in procurement and sourcing processes, manufacturing flexibility concerns with flexibility in the manufacturing process and assembly operations, and distribution/logistics flexibility concerns with flexibility in warehousing processes and transportation. These three dimensions of Supply chain flexibility are further classified, which shown in Table 1.

Supply chain flexibility is categorizations by several authors (Vickery et al.,1999; Sabri and Beamon, 2000; Garavelli, 2003; Sanchez and Perez, 2005; Swafford et al., 2006; Gosling et al., 2010; Schutz and Tomasgard, 2011) in various form, some of which are listed in Table 2.

Table 1. Three dimensions of Supply chain flexibility

Supply Flexibility	• Make-and /or- buy decisions • Sourcing Decision
Manufacturing Flexibility	• Manufacturing multiple product types at each plant • Tactical production capacity expansions • Backlogging
Distribution/Logistics Flexibility	• Multi-model transport • Multi-carrier transport • Multi-rout transport • Tactical storage capacity expansions

[source: Esmaeilikia et al.,2016]

Table 2. Classification of supply chain flexibility and its measures

Authors	Flexibility	Definition of Measures
Sabri and Beamon (2000)	Volume flexibility	The ability to change the aggregate production capacity in response to customer demand
Vickery et al. (1999)	Product flexibility	The ability to control or to adjust the nonuniform or sudden orders, to meet customer specifications, and to produce products categorised by numerous features.
Sabri and Beamon (2000)	Delivery flexibility	The ability to changes in delivered amount lead-time and delivery date.
Sanchez and Perez (2005)	Operational decision flexibility	The ability to respond to fluctuations in operational decisions such as changes in the assignment of jobs to machines and bill of material.
Schutz and Tomasgard (2011)	Storage flexibility	The ability to control sudden changes in inventory, supply, demand and production,
Garavelli (2003) Sanchez and Perez (2005)	Process flexibility	The facility to produce a range of product types at each production plant
Garavelli (2003) Sanchez and Perez (2005)	Logistics flexibility	The ability to accept different logistics strategies to deliver the finished goods to customers.
Swafford et al. (2006) Gosling et al. (2010)	Vendor flexibility	The ability to accept different vendors that support production, distribution and transportation.
Gosling et al. (2010)	Sourcing flexibility	The ability to redesign a supply chain network through the different choice of vendors selection.

[Adapted from Esmaeilikia et al., 2016]

This paper presents a small review of introduction, classification and its measures in supply chain flexibility. This study also incorporates the multiple flexibility measurements across supply chain network design and define each of them as an ability, response and control in the supply chain. Supply chain flexibility is a significant and growing area of research as evidenced by increasing complexity in the organisation, global competition, uncertain and customisation demand.

References:

1. Esmaeilikia, M., Fahimnia, B., Sarkis, J., Govindan, K., Kumar, A., & Mo, J. Tactical supply chain planning models with inherent flexibility: definition and review. Annals of Operations Research, 244 (2016) 407-427.
2. Garavelli, A. C. Flexibility configurations for the supply chain management. International Journal of Production Economics, 85 (2003) 141-153.
3. Gosling, J., Purvis, L., & Naim, M. M. Supply chain flexibility as a determinant of supplier selection. International Journal of Production Economics, 128 (2010) 11-21.
4. Martínez Sánchez, A., & Pérez Pérez, M. Supply chain flexibility and firm performance: a conceptual model and empirical study in the automotive industry. International Journal of Operations & Production Management, 25 (2005) 681-700.
5. Sabri, E. H., & Beamon, B. M. A multi-objective approach to simultaneous strategic and operational planning in supply chain design. Omega, 28 (2000) 581-598.
6. Schütz, P., & Tomasgard, A. The impact of flexibility on operational supply chain planning. International Journal of Production Economics, 134 (2011) 300-311.
7. Swafford, P. M., Ghosh, S., & Murthy, N. The antecedents of supply chain agility of a firm: scale development and model testing. Journal of Operations Management, 24 (2006) 170-188.
8. Vickery, S. N., Calantone, R., & Dröge, C. Supply chain flexibility: an empirical study. Journal of Supply Chain Management, 35 (1999) 16-24.

Closed loop supply chain under flexible product return policy: A literature review

Priya Ambilkar[1], Ashok K. Pundir[2] and L. Ganapathy[2]

[1] Research Scholar, National Institute of Industrial Engineering (*NITIE*), Mumbai, India
[2] Professors, National Institute of Industrial Engineering (*NITIE*), Mumbai, India

Abstract

Rapid developments in e-commerce related technologies have enabled and motivated several manufacturers to offer online distribution channels as a replacement or complement to their existing physical retail channels (Tsay & Agrawal, 2004). However, the template of e-commerce platforms has obligated additional customer service requirements on the seller. One such feature is providing the product return policy as an option to online buyers since they have no access to the physical product before making a purchase decision. Handling such flexible options on product returns imposes an additional burden on the supply chain management of the manufacturer. In the classical closed loop supply chains, the manufacturer can decide which components of the product can be taken back for recycling or reuse, and accordingly provide collection centers and handling facilities. However, these are not readily suited for customer returns from e-commerce channel that are flexible in terms of both the quantity as well as timing. The reasons for returns are also unknown and beyond the control of the manufacturer. This paper looks at some of the available literature and findings in this new area.

Keywords: reverse logistics, reverse supply chain, closed loop supply chain, online returns, ecommerce product returns

Introduction

Innovation for improved lifestyle is constantly happening by putting together multiple business processes using available technologies. Developments in online distribution channels has encouraged many manufacturers to adopt this option instead of or in addition to their existing retail channels. In order to attract more customers and to stay competitive, many manufacturers offer a return policy in their online distribution channel. The return policy has also made many manufacturers more interactive with customers. This, in turn, helps to understand specific customer needs and to deliver products that will meet the individual requirements (Liu, Choi, Yuen, & Ng, 2012; Mukhopadhyay & Setoputro, 2005). The academia has so far discussed issues related to closed-loop supply chains (CLSC) where the manufacturer provides the customer with options for return and recycling of used products. Addressing online returns poses additional challenges in redesigning the supply chain channel structure.

Closed Loop Supply Chain

A supply chain, in its classical form (forward supply chain), is a system of suppliers, manufacturers, transporters, warehouses, retailers, and customers themselves involve in moving the combination of processes to fulfill customers' requests (Chopra and Meindl, 2010). According to Daniel, Guide, Wassenhove, & Van, 2009, the new and business-perspective type definition of CLSC is, "the design, control, and operation of a system to maximize the value creation over entire

life cycle of the product with dynamic recovery of value from different types and volumes of returns over time." The main twofold duties of a closed-loop supply chain are: first, it is responsible for value-added processes to cover customers' demands (as before) and second, it tries to collect the EOL products (called return products) from customers, appropriated processes are then performed product either be repaired, resold, disassembled, remanufactured, reused, recycled, and disposing of them in an environmentally sensitive manner (Ruchi et al. 2011, Govindan, Soleimani, & Kannan, 2015; Wang, Soleimani, Kannan, & Xu, 2016).

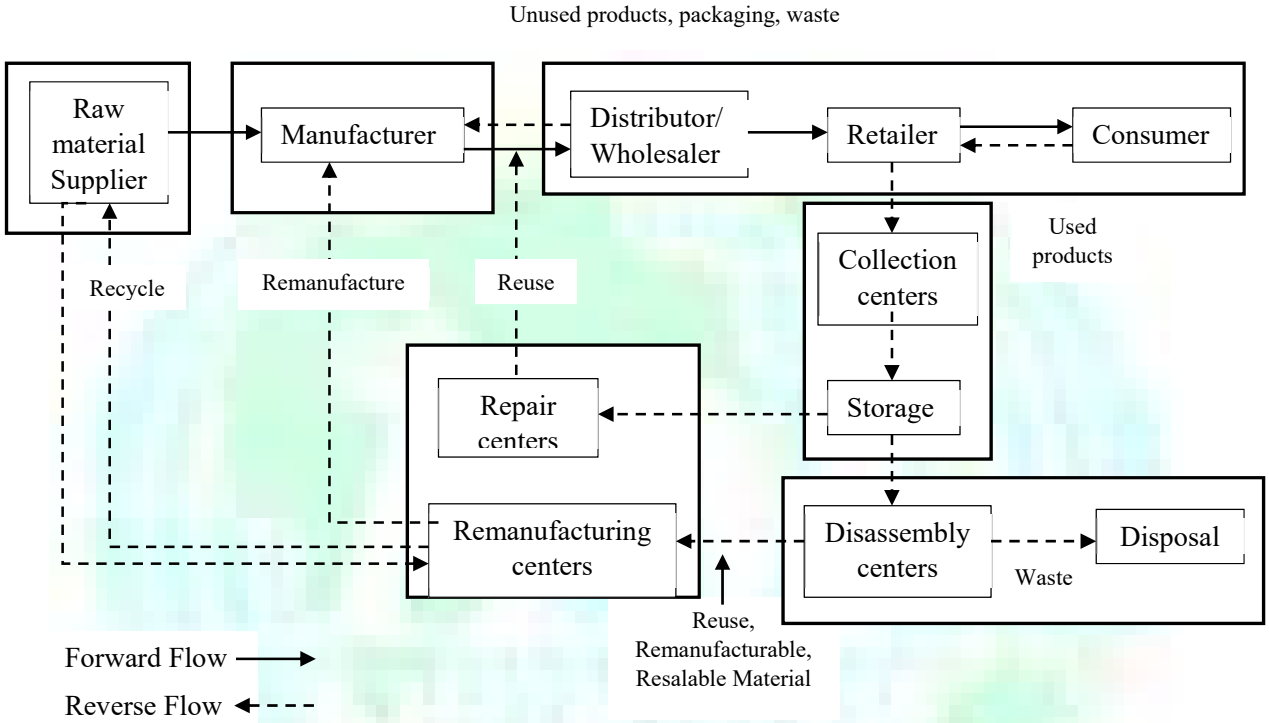


Fig. 1. Network of closed loop supply chain (Adapted from Kadambala et.al, 2017)

Reverse Logistics

The accepted concept of RL has been revised and clarified over the years (De Brito and Dekker 2003). According to the American Reverse Logistics Executive Council, reverse logistics is defined as "The Reverse logistics is process of planning, designing, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, packaging and finished goods and related information from, a manufacturing, distribution or use for the purpose of recapturing value or else properly disposing the goods (Rogers and Tibben-Lembke, 1998, Rubio, Chamorro, and Miranda 2008, Ruchi et al. 2012, Shahu R. et al. 2012, Lal, Ganapathy, & Sambandam, 2010).

This paper studies production, refurbishing, collection, and waste disposal processes of a supply chain system. The customers can return the purchased item by opting for return policy and get a refund. Selling strategies under two cases, that is, a single channel (traditional physical retail channel) and a dual channel (combination of retail channel and an online channel) are discussed.

Literature Review

Many research papers discuss the forward movement (the materials transformation from the suppliers to the end consumer): (Guide, Harrison, and Van Wassenhove 2003; Giri, Chakraborty, and Maiti 2017; Heydari, Govindan, and Jafari 2017). In comparison, the reverse logistics field has got lesser attention (Anzi et al., 2007). Sustainable initiatives have resulted in higher concern toward the environment by accounting for End-of-Life (EOL) of products (Ruchi et al. 2013, Govindan and Soleimani 2017; Pauliuk et al. 2017). Businesses are also looking at supply chains in a broader way by considering the Reverse Logistics (RL) of products instead of purely focusing on the forward flow of Supply Chains, (Batarfi, Jaber, and Aljazzar 2017; Diabat et al., 2013). The evolution of the supply chains to an integrated approach considering both forward and reverse supply chains simultaneously results in closed-loop supply chain (CLSC).
Many of the researchers formulated network designs in reverse logistics for product recovery (reuse, remanufacturing, recycling, and repair) by using mixed integer programming. Table 1 presents a summary of some of the literature sources for reverse logistics network design along with the proposed models.

Table 1: Literature review on reverse logistics network

Sr. No.	Authors	Model
1	Chen and Su (2010)	fuzzy goal programming
2	Dehghanian and Mansour (2009)	mathematical programming model
3	Das and Chowdhury (2012)	Mixed integer programming (MIP)
4	Du and Evans (2006)	optimization model
5	Mingyong and Erbao (2010)	Mixed integer programming
6	Ghezavati et al. (2009)	Nonlinear integer programming model
7	Kannan et al. (2009)	Mixed integer linear programs (MILP-model)
8	Kannan et al. (2010)	Mixed-integer programming model
9	Ko and Evans (2007)	Mixed integer nonlinear programming model
10	Lee et al. (2009)	Mixed-integer programming model
11	Lee and Dong (2009)	Mixed Integer Programming (MIP)
12	Lieckens and Vandaele (2007)	Mixed integer nonlinear program (MINLP-model)
13	Min et al. (2006a)	Mixed integer nonlinear programming
14	Min et al. (2006b)	Mixed-integer programming model
15	Pishvaee et al. (2011)	Deterministic mixed-integer linear programming model
16	Qin and Ji (2010)	Simulation and genetic algorithm
17	Yongsheng and Shouyang (2008)	Mixed integer formulation

The purpose of study is to examine relevant papers for searching and classifying the body of literature for discovering the impact of product return on the closed loop supply chain. We used a systematic review and bibliometric analysis to search and classify the body of the literature. A systematic literature review which analyze the literature in structured way (Abedinnia et al. 2017; Fahimnia, Sarkis, and Davarzani 2015) and bibliometric analysis used to present the literature results in an objective, transparent, and reproducible way (Hochrein and Glock 2012).

Research Methodology

Product Return" and "Closed-Loop Supply Chain" are used as two important domains for the study. The literature search methodology was adopted from Mayring, 2010, includes four steps: material collection, descriptive (bibliometric) analysis, content analysis and material evaluation. The literature search strategy was adopted from previous studies (For example, Ruchi et al. 2014, kazemi, 2018,). Prior to evaluating the publications, the quantitative analysis on the body of literature in CLSC, RL and Product Return is presented. In the preliminary exploratory search phase multiple journal database are used like Web of Science, Science Direct, ProQuest, J-Gate, EBSCO, Google Scholar databases were designated and explored for identifying the germane statistical data for bibliometric analysis.

Bibliometric Analysis

The bibliometric study and scientometrics research is done for quantitatively analyze a research field to gain insights, how a discipline has developed over time period (Sushil 1994, Apriliyanti and Alon 2017; Broadus 1987; Merigó and Yang 2017; Zupic 2013; Zupic and Čater 2015). The study follows the structure of many bibliometric studies for bibliometric analysis, conducted on diverse topics (see, for instance, Akhavan et al. 2016; Charvet, Cooper, and Gardner 2008; Laengle et al. 2017a; Merigó et al. 2017; Podsakoff et al. 2008). Fig. 2 illustrates the distribution of publication per year across the period of study.

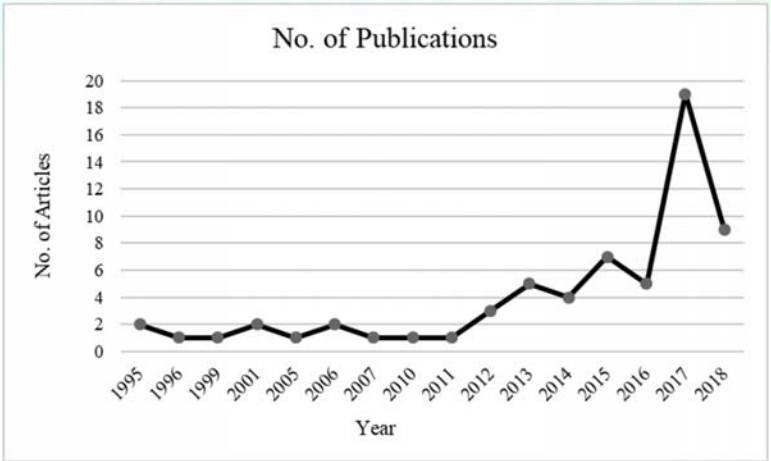


Fig.2. Year wise publication on product return

As can be seen from the fig.-, Product Return plays an insignificant role in terms of numbers of academic publication before 2012. While the field remains small before 2015 with fewer than year wise 5 publications, 2017 is earmarked as the year in which substantial scholarship emerged. In

addition, around 80% of the papers have been published in last three years, which confirms that the domain has gained more popularity for researchers recently. The statistics indicate that a total of 40 journals have contributed to the publication of papers in this field, among which approximately 48% of the papers have been published by the first 20 journals. Table 2 ranks the 20 primary journals in which the publications of the field appeared. As is clear from Table-, International Journal of Production Economics (IJPE), JCP and EJOR are the most contributory journals of product return studies. In order to analyse the contribution of authors to the field, the data is extracted from Scopus based on the frequency of the appearance of author's name. Table 2 further analyses the field based on the influence of authors. As the Table reveals, K. Govindan, J. Chen, Yj, Li., Mr. Shaharudin Kc. Tan and S. Zailani reside at the top of the list of the main contributors to the field.

Table 2: Select journals and authors on product return based on the search results.

No.	Journal	Result	Author (s)	Result
1	International Journal of Production Economics	8	Govindan, K.	6
2	European Journal of Operational Research	7	Chen, J.	3
3	Journal of Cleaner Production	5	Li, Yj.	3
4	Journal of Retailing and Consumer Services	3	Shaharudin, Mr.	3
5	Electronic Commerce Research and Applications	2	Dehghanian	3
6	Electronic Markets	2	Zailani, S.	3
7	International Journal of Physical Distribution & Logistics Management	2	Chen, J.	2
8	Journal of Business Research	2	Chen X.	2
9	Journal of Manufacturing Systems	2	Min	2
10	Journal of Operations Management	2	Du	2
11	Journal of Retailing	2	Das K.	1
12	Marketing Letters	2	Ko.	1
13	Resources Conservation and Recycling	2	Lieckens	1
14	Annals of Operations Research	1	Battini, D.	1
15	Computers & Industrial Engineering	1	Pishvaee	1
16	Information Systems Research	1	Abedinnia	1
17	International Journal of Advanced Manufacturing Technology	1	Lee A.	1
18	International Journal of Applied Mathematics and Computer Science	1	Lal P.	1
19	International Journal of Management Reviews	1	Mingyong	1
20	International Journal of Retail & Distribution Management	1	Yongsheng	1

In this part, the evolution of the RL&CLSCM in IJPR was assessed with respect to geographical hotspots and affiliations of the authors. For this purpose, the country/territory part of the search result, as well as the affiliation of the authors, was extracted from Scopus and summarized in Table 3. In terms of the contribution of countries, authors from the United States, China and India display the highest number of contributions to the journal. If we assign the countries to their corresponding continent, from North America two countries (US and Canada), from Asia five countries (China, India, Turkey, Hong Kong and Iran), and from Europe three countries (UK, Germany and Netherlands) contributed articles in the journal.

Content Analysis

The content analysis is used to explore the advancement of the studies of the selected sample papers. Content analysis is one of the necessary steps to recognize diverse topics that are covered by different databases. The content analysis enlightens for the areas that require further scholarship. Content analysis is a methodology which allows assessing a high volume of qualitative data in research to analyzes structured, systematic and reliable approach (haggarty, 2009). The categorization of the papers into a set of groups were adopted from inductive and deductive approaches, the approach helps in reflecting the important characteristics of the studies and their contributions towards research.

The analyses of various aspects of reviewed papers and tries to seek out appropriate and acceptable categorization of all papers are categorized in Table 1. Two criteria are implemented during categorization:

1. Each category ought to contain a large class of papers, which implies that the category a minimum of ought to cover and contain 50 percent of all papers.
2. The category ought to be capable of being subcategorize into sufficient subcategories. For instance, in surveys, all the papers covered, and their contribution is enlisted.

The further classifications of Table 1 and 2 falls in following categories:

1) A paper constructed based on survey or review study or could handle different types of quantitative/qualitative analyses.

(2) A paper regard any form of uncertainty for parameters (stochastic, fuzzy, interval, and scenario approaches), or simply embody deterministic assumptions.

(3) The modeling made conceptually or mathematically. There are also different solution methodologies like analytical, exact, approximation, heuristic approach, meta-heuristic approach, and other approaches.

(4) A paper constructed on a case study, it experiments with a case study in the numerical analyses, or it regard no real case throughout the study.

This finding is new and exceptionally significant for the organization under examination and additionally different associations thinking about the ongoing authoritative changes in regard to returns approaches.

Conclusion

The previously unexplored area studied in this paper, namely the moderating effects of different returns policies. Retailers regularly utilize lenient return policies perhaps because of the characteristic conviction that mercy expands item buy more than item returns regardless of the high handling expenses and low rescue esteems related with returns. Be that as it may, past research

investigating the impact of lenient return policies on buy and resulting returns is uncertain. Its findings add new learning to the current assemblage of literature and provide support for prior findings in both empirical and theoretical research. The study examines that, a plethora of research articles especially in the last few years are available in literature focusing on different aspects of product return a comprehensive analysis can provide new opportunities in this research area.

References

1. Abedinnia, H., Glock, C. H., Grosse, E. H., & Schneider, M. (2017). Machine scheduling problems in production: A tertiary study. *Computers & Industrial Engineering*, *111*, 403-416.
2. Akhavan, P., Ebrahim, N. A., Fetrati, M. A., & Pezeshkan, A. (2016). Major trends in knowledge management research: a bibliometric study. *Scientometrics*, *107*(3), 1249-1264.
3. Apriliyanti, I. D., & Alon, I. (2017). Bibliometric analysis of absorptive capacity. *International Business Review*, *26*(5), 896-907.
4. Al-Anzi, F. S., & Allahverdi, A. (2007). A self-adaptive differential evolution heuristic for two-stage assembly scheduling problem to minimize maximum lateness with setup times. *European Journal of Operational Research*, *182*(1), 80-94.
5. Batarfi, R., Jaber, M. Y., & Aljazzar, S. M. (2017). A profit maximization for a reverse logistics dual-channel supply chain with a return policy. *Computers & Industrial Engineering*, *106*, 58-82.
6. Broadus, R. (1987). Toward a definition of "bibliometrics". *Scientometrics*, *12*(5-6), 373-379.
7. Charvet, F. F., Cooper, M. C., & Gardner, J. T. (2008). The intellectual structure of supply chain management: A bibliometric approach. *Journal of business logistics*, *29*(1), 47-73.
8. Chopra, S., & Meindl, P. (2007). Supply chain management. Strategy, planning & operation. In *Das summa summarum des management* (pp. 265-275). Gabler.
9. Chen, K. H., & Su, C. T. (2010). Activity assigning of fourth party logistics by particle swarm optimization-based preemptive fuzzy integer goal programming. *Expert Systems with Applications*, *37*(5), 3630-3637.
10. Chen, J., & Bell, P. C. (2012). Implementing market segmentation using full-refund and no-refund customer returns policies in a dual-channel supply chain structure. *International Journal of Production Economics*, *136*(1), 56–66.
11. Chen, X., Zhang, H., Zhang, M., & Chen, J. (2017). Optimal decisions in a retailer Stackelberg supply chain. *International Journal of Production Economics*, *187*(March), 260–270.
12. Daniel, V., Guide, R., Wassenhove, & Van, L. N. (2009). OR FORUM — The Evolution of Closed-Loop Supply Chain The Evolution of Closed-Loop Supply Chain Research. *Operations Research Publication*, *57*(1), 10–18.
13. Das, K., & Chowdhury, A. H. (2012). Designing a reverse logistics network for optimal collection, recovery and quality-based product-mix planning. *International Journal of Production Economics*, *135*(1), 209-221.
14. Diabat, A., Kannan, D., Kaliyan, M., & Svetinovic, D. (2013). An optimization model for product returns using genetic algorithms and artificial immune system. *Resources, conservation and recycling*, *74*, 156-169.
15. De Brito, M. P., & Dekker, R. (2004). A framework for reverse logistics. In *Reverse logistics* (pp. 3-27). Springer, Berlin, Heidelberg.
16. F. Du, G.W. Evans(2008), A bi-objective reverse logistics network analysis for post-sale service, Computers & Operations Research, 35. 2617-2634
17. Fathi, M., Hasanzadeh, A., Raad, A., Dehghanian, F., & Mansour, S. (2009, December). Using compromised method in design of reverse logistics network with eco-efficiency consideration. In Industrial Engineering and Engineering Management, 2009. IEEM 2009. IEEE International Conference on (pp. 1454-1458). IEEE.
18. Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, *162*, 101-114.
19. Ghezavati, V. R., Jabal-Ameli, M. S., & Makui, A. (2009). A new heuristic method for distribution networks considering service level constraint and coverage radius. *Expert Systems with Applications*, *36*(3), 5620-5629.
20. Giri, B. C., Chakraborty, A., & Maiti, T. (2017). Pricing and return product collection decisions in a closed-loop supply chain with dual-channel in both forward and reverse logistics. *Journal of manufacturing systems*, *42*, 104-123.

21. Govindan, K., Kannan, D., & Noorul Haq, A. (2010). Analyzing supplier development criteria for an automobile industry. *Industrial Management & Data Systems*, *110*(1), 43-62.

22. Govindan, K., Soleimani, H., & Kannan, D. (2015). Reverse logistics and closed-loop supply chain : A comprehensive review to explore the future. *European Journal of Operational Research*, *240*(3), 603–626.

23. Guide, V. D. R., Harrison, T. P., & Van Wassenhove, L. N. (2003). The challenge of closed-loop supply chains. *Interfaces*, *33*(6), 3-6.

24. Heydari, J., Govindan, K., & Jafari, A. (2017). Reverse and closed loop supply chain coordination by considering government role. *Transportation Research Part D: Transport and Environment*, *52*, 379-398.

25. Hochrein, S., & Glock, C. H. (2012). Systematic literature reviews in purchasing and supply management research: a tertiary study. *International Journal of Integrated Supply Management*, *7*(4), 215-245.

26. Kadambala, D. K., Subramanian, N., Tiwari, M. K., Abdulrahman, M., & Liu, C. (2017). Closed loop supply chain networks : Designs for energy and time value ef fi ciency. *Int . J . Production Economics*, *183*, 382–393.

27. Kannan, G., Pokharel, S., & Kumar, P. S. (2009). A hybrid approach using ISM and fuzzy TOPSIS for the selection of reverse logistics provider. *Resources, conservation and recycling*, *54*(1), 28-36.

28. Ko, H. J., & Evans, G. W. (2007). A genetic algorithm-based heuristic for the dynamic integrated forward/reverse logistics network for 3PLs. *Computers & Operations Research*, *34*(2), 346-366.

29. Laengle, S., Merigó, J. M., Miranda, J., Słowiński, R., Bomze, I., Borgonovo, E., ... & Teunter, R. (2017). Forty years of the European Journal of Operational Research: A bibliometric overview. *European Journal of Operational Research*, *262*(3), 803-816.

30. Lal, P., Ganapathy, L., & Sambandam, N. (2010). Heuristic Methods for Capacitated Vehicle Routing Problem. *International Journal of Logistics and Transport*, *4*(1), 343–352.

31. Lee, A. H. (2009). A fuzzy supplier selection model with the consideration of benefits, opportunities, costs and risks. *Expert systems with applications*, *36*(2), 2879-2893.

32. Lee, D. H., & Dong, M. (2009). Dynamic network design for reverse logistics operations under uncertainty. *Transportation Research Part E: Logistics and Transportation Review*, *45*(1), 61-71.

33. Li, Y., Xu, L., & Li, D. (2013). Examining relationships between the return policy, product quality, and pricing strategy in online direct selling. *International Journal of Production Economics*, *144*(2), 451–460.

34. Lieckens, K., & Vandaele, N. (2007). Reverse logistics network design with stochastic lead times. *Computers & Operations Research*, *34*(2), 395-416.

35. Liu, Choi, Yuen, & Ng (2012). Optimal Pricing, Modularity, and Return Policy Under Mass Customization, *IEEE Transactions on Systems Man and Cybernetics - Part A Systems and Humans*, 42(3),604-614.

36. Mayring, P. (2010). Qualitative inhaltsanalyse. In *Handbuch qualitative Forschung in der Psychologie* (pp. 601-613). VS Verlag für Sozialwissenschaften.

37. Min, H., Ko, H. J., & Ko, C. S. (2006a). A genetic algorithm approach to developing the multi-echelon reverse logistics network for product returns. *Omega*, *34*(1), 56-69.

38. Merigó, J. M., & Yang, J. B. (2017). A bibliometric analysis of operations research and management science. *Omega*, *73*, 37-48.

39. Min, H., Ko, H. J., & Ko, C. S. (2006b). A genetic algorithm approach to developing the multi-echelon reverse logistics network for product returns. *Omega*, *34*(1), 81-94.

40. Mingyong, L., & Erbao, C. (2010). An improved differential evolution algorithm for vehicle routing problem with simultaneous pickups and deliveries and time windows. *Engineering Applications of Artificial Intelligence*, *23*(2), 188-195.

41. Mukhopadhyay, S. K., & Setoputro, R. (2005). Optimal return policy and modular design for build-to-order products. *Journal of Operations Management*, *23*(5), 496–506.

42. Pauliuk, S., Kondo, Y., Nakamura, S., & Nakajima, K. (2017). Regional distribution and losses of end-of-life steel throughout multiple product life cycles—insights from the global multiregional MaTrace model. *Resources, Conservation and Recycling*, *116*, 84-93.

43. Pishvaee, M. S., Rabbani, M., & Torabi, S. A. (2011). A robust optimization approach to closed-loop supply chain network design under uncertainty. *Applied Mathematical Modelling*, *35*(2), 637-649.

44. Podsakoff, P. M., MacKenzie, S. B., Podsakoff, N. P., & Bachrach, D. G. (2008). Scholarly influence in the field of management: A bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century. *Journal of Management*, *34*(4), 641-720.

45. Qin, Z., & Ji, X. (2010). Logistics network design for product recovery in fuzzy environment. *European Journal of Operational Research*, *202*(2), 479-490.

46. Rashmi Shahu, Pundir, A.K., Ganapathy, L. (2012). An Empirical Study on Flexibility: A Critical Success Factor of Construction Projects, Global Journal of Flexible Systems Management, 13(3), 123–128.

47. Rubio, S., Chamorro, A., & Miranda, F. J. (2008). Characteristics of the research on reverse logistics (1995–2005). *International journal of production research*, *46*(4), 1099-1120.

48. Ruchi, K., Pundir, A.K., Ganapathy, L. (2011). Aligning manufacturing flexibility with competitive strategy of the organization. *Paper presented in Eleventh Global Conference on Flexible System Management, organized at IIM Kozhikode*, Dec 9th -12th, 2011.

49. Ruchi,K., Pundir, A.K., Ganapathy, L. (2012). Manufacturing flexibility and firm performance: Literature review, *paper accepted for Twelfth global conference on flexible system management, Organized at University of Vienna*, Austria, July30-Aug1 2012.

50. Ruchi Mishra, Ashok Kumar Pundir, L. Ganapathy (2013). An Exploration of Firm Level Competitiveness through choices in manufacturing strategy: The Case of Indian Four-Wheeler Passenger Vehicle Companies, *EuroEconomica*, 32(2), 49-61.

51. Ruchi Mishra, Ashok Kumar Pundir, L. Ganapathy (2014). Manufacturing Flexibility Research: A Review of Literature and Agenda for Future Research, *Global Journal of Flexible Systems Management*, 15(2), 101-112.

52. Govindan, K., & Soleimani, H. (2017). A review of reverse logistics and closed-loop supply chains: a Journal of Cleaner Production focus. *Journal of Cleaner Production*, *142*, 371-384.

53. Shaharudin, M. R., Govindan, K., Zailani, S., & Tan, K. C. (2015). Managing product returns to achieve supply chain sustainability: an exploratory study and research propositions. *Journal of Cleaner Production*, *101*, 1–15.

54. Sushil (1994). Flexible systems methodology, *system practices*, 7(6), 633-652.

55. Tibben-Lembke, R. S., & Rogers, D. S. (1998). Going backwards: reverse logistics trends and practices. *Reverse Logistics Executive Council*.

56. Tsay, A.A. and Agrawal, N. (2004) Channel Conflict and Coordination in the E-Commerce Age. Production and Operations Management, 13, 93-110.

57. Wang, Z., Soleimani, H., Kannan, D., & Xu, L. (2016). Advanced cross-entropy in closed-loop supply chain planning. *Journal of Cleaner Production*, *135*, 201–213.

58. Yongsheng, Z., & Shouyang, W. (2008). Generic model of reverse logistics network design. *Journal of transportation systems engineering and information technology*, *8*(3), 71-78.

59. Zupic, I., & Cater, T. (2013). Bibliometric methods in management and organization: A review. In *Academy of Management Proceedings* (Vol. 2013, No. 1, p. 13426). Briarcliff Manor, NY 10510: Academy of Management.

60. Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429-472.

An Analysis of Factors Influencing Shopping Cart Abandonment and Its Impact on E- commerce Players in India

Rajeshwari Jain, Varimna Singh and Riddhi Dave

Som Lalit Institute of Business Management
St. Xavier Campus Corner, University Road
Navrangpura, Ahmedabad -380009

{rajeshwari_raj@rediffmail.com, varimna.s@gmail.com, drriddhidave@gmail.com}

Abstract: Most studies that have looked at shopping cart abandonment have looked at the problem from the aspect of either the website and its characteristics or as a function of the past experience with the portal, however only a few have looked at the cosumer behaviour as the main factor leading to cart abandonment. This research paper reveals various powerful reasons for consumers' to abort the process such as login issue or other technology glitches, convenient payment options, substandard product etc. In this research authors also analyze the impact of above mentioned factors influencing the cart abandonment on e-commerce players.

Key Words: E-commerce, online shopping, cart abandonmnet,

1 Introduction

The e-commerce has put the Indian Business Market in a new and very dynamic trajectory. It has transformed the way business is done in India. The ongoing internet revolution in the country has been at the back bone of rising e commerce market. Availability of wifi at very lower rates, Choice, convenience and discounted prices have accelerated growth of the e commerce market in India .Technology enabled innovations like digital payments, hyperlocal logistics, analytics driven customer engagement and digital advertisements are expected to fuel the growth of the sector further. The growth in e-commerce sector is expected to also boost up employment, increase revenues from export, increase tax collection by ex-chequers, and provide better products and services to customers in the long-term.

The very fast growing Indian e commerce industry is dominated by players like Amazon, Flipkart, Snapdeal, Paytm, MakeMyTrip, Big Basket, Groffers and fashion brands like Myntra, Jabong and Koovs. As per the analysis made by Indian Brand Equity Foundation, Indian e-commerce market propelled by rising smartphone penetration, the launch of 4G networks and increasing consumer ealth is expected to grow to US$ 200 billion by 2026 from US$ 38.5 billion in 2017. India's ecommerce industry's sales rose 40 per cent year-on-year toreach Rs 9,000 crore (US$ 1.5 billion) during the five-day sale period ending September 24, 2017, backed by huge deals and discounts offered by the major ecommerce companies.

Online retail sales in India are expected to grow by 31 per cent to touch US$ 32.70 billion, led by Flipkart, Amazon India and Paytm Mall. Apart from this Private Equity Investments in the segment are fuelling the growth in the market and innovative models are planned to be adopted by existing players for example E-commerce industry in India witnessed 21 private equity and venture capital deals worth US$ 2.1 billion in 2017 and six deals worth US$ 226 million in January-April 2018, Flipkart, after getting acquired by Walmart for US$ 16 billion, is expected to launch more offline retail stores in India to promote private labels in segments such as fashion and electronics. With the rising popularity of ecommerce the competition is intensifying among the key players and they are leaving no stone unturned to retain their own customers and woo competitors' customers. With the use of sophisticated algorithms and financial models they are coming up with better products, better quality and hefty discounts to lure buyers. The competition is intensifying and the companies are having an eagle's eye on what the customer is putting in the cart and what he is abandoning from the cart. It has been found that Cart abandonment and factors influencing the same are very interesting areas to explore as the same can make or break the fortune of the ecommerce players.

Types of Abandonment

Cart abandonment refers to a process where online shoppers leave a portal without completing the transaction

Booking abandonment

It refers to a situation within the travel industry, where a customer has begun to book a flight or a hotel but left without completing a purchase. Travel products like flights and holidays are often major purchases for shoppers, and many tend to spend time researching their options, finding the best deals and checking with other travellers. They may begin to book several times, often across different sites, before finally making a booking. The complexity of the process of booking is also one of the major reasons why people leave the site midway and prefer an agent to do it.

Form abandonment

It refers to a process where people abandon forms for quotes, subscriptions, and financial products, though of course any online purchase requires some level of form completion. Reasons understood for doing so are lengthy forms, too technical, poor form design, less motivation to complete and submit and finally too many personal questions asked. That's the reason why finance sites have higher abandonment rates than retail.

Browse abandonment

It refers to a situation where shoppers who browse a site, viewing category pages and products on site, but then leave the site abruptly. Even though these browsers may not go on to complete a purchase, they are expressing an interest in the products they viewed, and might be persuaded to return to checkout. latest technology in rural areas the use of the digital wallet payment system is expected to rise.

2 Literature Review

According to the Forrester Research (2005) it is found that 88% of online shoppers have abandoned their electronic cart in the past. Findings of the research also show that online shoppers abandon their carts approximately a quarter of the time. Specifically, Andersen Consulting and Forrester Research each show abandonment rates of 25%, and Jupiter Communications triangulates this finding by documenting a shopping cart abandonment rate of 27% (Tarasofsky 2008). While preparing to buy online, consumers encounter a range of prohibition which may encourage them to abort the process and abandon their cart. Traditionally, prohibitory situations to purchasing include: social influences, lack of availability, high price, financial status, and time pressure (Howard and Sheth 1969). A pre-requisite to online shopping cart use is consumer acceptance of electronic shopping. Beyond usability and ease of use (Ha and Stoel, 2009), consumer attitudes, perceived congruity of e- commerce websites (Wang et al., 2009), and website personality (Poddar et al., 2009) are important determinants of online shopping acceptance.

The current inquiry challenges the notion that virtual carts and the way consumers use them are analogous to using a in-store shopping basket. While such in-store baskets are utilitarian, virtual carts may have other, hedonic uses. (Monika Kukar-Kinney & Angeline G. Close, 2009).

According to research, the following reasons are citied where customers leave the portal without completing their shopping

- The checkout flow is too complex/difficult and involves too many steps
- The products are too expensive
- The shipping is too expensive
- The design looks shady – no trust
- Lack of payment options
- Technical bugs like a broken page link or long page-load time

3 Problem Statements

This research paper aims to find out the reasons for online cart abandonment. Customers abandoning their shopping cart before purchase completion are a huge source of frustration for retail outlets and marketers. In this research authors have proposed to accomplish the following objectives:

- To investigate the preference of application (apps) over websites or vice versa for online shopping.

- To investigate how the gender of an individual impacts the process of using virtual shopping cart and cart abandonment.
- To find out whether people who shop mainly during sale or discount time have more tendency to do cart abandonment.
- To find out the precise factors influencing cart abandonment
- To find out whether organic or specific visit impacts cart abandonment
- To find out the specific stages where cart abandonment happens in the entire buying process
- To find out methods of payments to avoid the process of cart abandonment.

4 Data Collection

Data collection was done by administering a questionnaire on respondents in the city ofAhmedabad, specifically on those who are accustomed to shopping via internet. The secondary data is collected from internet, books, magazines, journals and newspaper articles.

5 Sampling Design

Our Sample units were the respondents who frequented online shopping sites in the last one year. Sampling method is convenience sampling and sample size was 308. This study was conducted in Ahmedabad region.

6 Research Methodology

Through review of literature it was observed that factors like gender, age, educational qualification and occupation have a substantial influence on online shopping and cart abandonment. So for the demographic analysis of the data, the on-line shoppers surveyed were categorized on the basis of gender, age, educational qualification and occupation. 308 respondents were surveyed regarding their preference and patterns of online shopping and factors influencing cart abandonment while shopping online. Here below, the analysis of the same is presented.

7 Data Analysis

Out of 308 respondents surveyed, 62% happened to be male and 38% happened to be females. Majority of respondents happened to be in the age group of 31-35 years of age, followed by respondents in 36-40 years of age group. On categorizing the occupation of online shoppers surveyed it can be seen that 41% of the shoppers happened to be working in service industry. 27 % of respondents surveyed happened to be students. 21% of respondents happened to be business class people whereas an interesting 11% of respondents happened to be housewives. As far as education qualification is concerned 41 % of respondents surveyed happened to be post graduates, 27% of respondents surveyed happened to be pursuing post graduation, 11 % of respondents happened to be graduates whereas an interesting percentage of 21% respondents didn't want to reveal their educational qualifications. It was found that there is almost no difference in the preference of doing online shopping through application or website as 51% of respondents have preferred applications installed on their smart phones to do shopping whereas 49 % of respondents have preferred websites to do online shopping. From the responses generated, it was found that most of the respondents 19% happen to browse more during the onset of festivals. An equal number of respondents [18.8%] also happened to browse almost every day. It is closely followed by respondents who prefer to browse online shopping sites on a monthly interval. 14% of respondents cited that they browsed more during the sale offerings by the online sites. 12% of respondents cited that they browsed online shopping sites as and when required. Interesting, 19% of respondents cited that they browsed more during the weekends attributing to the fact that during weekends they had more spare time. **A multiple choice question was administered on the respondents to know the reasons attributed for shopping cart abandonment. The findings from the responses generated are:** 52% of the respondents do not trust the online shopping site's delivery/exchange/refund policy and almost the same percentage of respondents found it convenient to buy from a traditional retail store then to continue buying online on the site 46 % of the respondents couldn't find promotional code to be entered to avail additional discounts leading to online shopping card abandonment. 45% of the respondents were not convenient to create a new account as they didn't want to share any personal details and the same leading to cart abandonment. Around 49 %, 48 % and 40% of the respondents are found to abandon online shopping cart due to better discount available on other competitive sites Amazon, Snapdeal and E bay respectively. 51% of the respondents resorted to cart abandonment as they found that the information shared by the online shopping sites were incorrect and almost the same percentage of respondents abandoned the shopping cart as they believed that the online shopping sites didn't share the complete information or the information shared by the sites were misleading.

Face book login option is found to be important factor influencing on line shopping as around 52% of the respondents were found to abandoning shopping cart as they didn't have a facebook login option provided by the site/app. Technical issues like filling the same information twice over again or delay in proceeding further due to page refreshment are also found to be factors leading to cart abandonment as around 50% and 47% of the respondents were found to abandoning cart due to these two reasons respectively. Mode of payment was also found to be very significant factor while shopping online. 53% of the respondents abandoned the shopping cart as they didn't have digital payments applications like Paytm, Freecharge, oxiwallet installed in their devices for easy payment options. It is interesting to find that 49% of the respondents abandoned the shopping cart as the cash-on-delivery option was not preferred by them for uncited reasons and almost the same percentage of the respondents abandoned the shopping cart as they were not comfortable with the unique payment interface option. 42% of the respondents abandoned the shopping cart as they didn't want to share their debit and credit card and personal bank accounts details on the online shopping sites. To further analyze the data statistical tools like correlation and hypothesis testing have been done. The same is discussed here

Statistical Interpretations

Correlation between factors leading to shopping cart abandonment.

Correlation					
		Easily available at convenient stores	Not sure of the genuineness of products available online	No option of entering promotion code	Don't want to create new account
Easily available at convenient stores	Pearson Correlation	1	.597	-.825	-.774
	Sig. (2-tailed)		.000	.000	.000
	N	308	308	308	308
Not sure of the genuineness of products available online	Pearson Correlation	.597	1	-.773	-.812
	Sig. (2-tailed)	.000		.000	.000
	N	308	308	308	308
No option of entering promotion code	Pearson Correlation	-.825	-.773	1	.686
	Sig. (2-tailed)	.000	.000		.000
	N	308	308	308	308
Don't want to create new account	Pearson Correlation	-.774	-.812	.686	1
	Sig. (2-tailed)	.000	.000	.000	
	N	308	308	308	308

We can see from the above table that there is a strong correlation between the factors, easy availability of the same products at convenient stores and the respondents not sure of the genuineness of the products available online. From this, we can conclude that respondents like to check the products physically and then make a purchase decision.

8 Hypothesis testing

8.1 Hypothesis 1

H0: There is no significant association between the occupation of the respondents and they abandoning the cart as no facility to enter the available promotion code hence the reason to buy from a convenient physical store

H1: There is significant association between the occupation of the respondents and them abandoning the cart as no facility to enter the available promotion code hence the reason to buy from a convenient physical store

Cross tabulation					
Occupation			Non availability of promotion code		Total
			No	yes	
Student	Convenience physical store	no	6	34	40
		yes	41	3	44
	Total		47	37	84
housewives	Convenience physical store	no	1	18	19
		yes	13	1	14
	Total		14	19	33
Service	Convenience physical store	no	9	52	61
		yes	64	2	66
	Total		73	54	127
business	Convenience physical store	no	1	29	30
		yes	30	4	34
	Total		31	33	64
Total	Convenience physical store	no	17	133	150
		yes	148	10	158
	Total		165	143	308

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	49.394[a]	1	.001
Likelihood Ratio	55.938	1	.000
Linear-by-Linear Association	22.300	1	.000
N of Valid Cases	308		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 69.64			

8.1.1 Test Interpretation

We can see from Chi-square test results that there is an association (as the p-value of 0.001) is less than significance level of 0.05, we reject null hypothesis (Ho) and accept alternative hypothesis (H1) that there is considerable association between the occupation of the respondents and them abandoning the cart as no facility to enter the available promotion code hence the reason to buy from a convenient physical store

8.2 Hypothesis 2

H0: There is no significant association between respondents abandoning the shopping cart and the websites asking their personal questions

H1: There is significant association between respondents abandoning the shopping cart and the websites asking their personal questions

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	49.394[a]	1	.003
Likelihood Ratio	55.938	1	.000
Linear-by-Linear Association	22.300	1	.000
N of Valid Cases	308		
a. 3 cells (0.02%) have expected count less than 5. The minimum expected count is 71.4			

8.2.1 Test Interpretation

We can see from Chi-square test results that there is an association (as the p-value of 0.03) is less than significance level of 0.05, we reject null hypothesis (Ho) and accept alternative hypothesis (H1) that there is considerable association between respondents abandoning the shopping cart and the websites asking their personal questions

9 Conclusions and suggestions

From the observations and analysis made by the authors during the survey the following major conclusions can be made:

- Online shoppers abandoning their shopping cart is still a major hurdle in ecommerce business
- Ecommerce sites should run time-based offers, promoting urgency to attract shoppers and to convert them into a deal rather than leading to cart abandonment
- Certain strategies to be followed by e-commerce players should be on retargeting customers with simple steps leading to quick and easy checkouts
- Retargeting customers who have abandoned shopping cars can also be done by following ways:
    - Showing the similar products again on Facebook as suggested sites to visit
    - Emailing customers by telling them that the product is in high demand
    - Emailing customers by telling them that the product is going out of stock
    - Emailing customers by telling them that there is a discount available on the product
- They should maintain transparency in prices, as it's seen from the survey that users add a product to their cart just to know its final price. Users want to be aware of all the costs which might show up at the checkout page, such as the shipping cost and taxes before they finally decide to continue their buying process
- They should minimize too many form fields and papers work to avoid friction

- Personal information should be asked only if required otherwise should be restricted to barest minimum details
- Sites should provide the customers with Facebook login options or with any existing user account, so that they don't face the hassle to creating newer accounts every time
- Error messages sent and site loading time should be reduced as customer's exhibit less patience during waiting periods
- E-commerce shoppers should be allowed to modify and change orders by going back to the previous step unlike only leading to check-outs only
- Steps where filling the same information twice or more should be avoided
- It can be seen that shoppers abandoned a purchase at least once because of the bank rejecting the transactions, so the e-commerce sites should offer multiple payment options to users including digital wallets and cash on delivery service.
- Ecommerce sites should encourage users to write reviews for the products that they have bought, as it might help other buyers and can reduce the number of cart abandonment
- It should be the first search result on Google searches, so the firms should have proper SEO and SMO strategies
- The sites should provide trust signs like Norton, McAfee etc to convince shoppers and to reduce their cart abandonment
- Basically the sites should provide tempting bargains, so that the customer doesn't discard his shopping cart
- Express shopping options should be made easily available to reduce cart abandonment
- Long and confusing checkouts should be avoided

Bibliography:

A.G. Close, M. Kukar-Kinney Beyond buying: Motivations behind consumers' online shopping cart use/ Journal of Business Research 63 (2010) 986–992

Forrester Research. (2005). Rethinking the significance of cart abandonment. Carrie A. Johnson, Charles P. Wilson, Sean Meyer, (Ed)
Ha, S. & Stoel, L. (2009). Consumer E-Shopping Acceptance Antecedents in a Technology
Acceptance Model. Journal of Business Research, 62, 565-571

Howard, J. A., & Sheth, J. N. (1969). The theory of buyer behavior. New York: Wiley. Kukar-Kinney, M., & Close, A. G. (2010). The determinants of consumers' online shopping cart abandonment. Journal of the Academy of Marketing Science, 38(2), 240-250.

Poddar A, Donthu N, & Wei Y. (2009). Web site customer orientations, Web site quality, and purchase intentions: the role of web site personality. J Bus Res, 62(4), 441–50.

Tarasofsky, J. (2008). Online Reservations: Increasing Your Site's 'Look to Book' Ratio. Hotel Marketer. Retrieved from http://www.hotelexecutive.com (accessed October 30 2008)

Wang, K., Wang, E.T.G., & Fern, C. K. (2009) Influence of web advertising strategies, consumer goal-directedness, and consumer involvemnet on web advertising effectiveness. International journal of electronic commerce, 13 (4), 67-96.

E wallet system: Small merchant's perspective

Riddhi Dave, Varimna Singh and Rajeshwari Jain

Som Lalit Institute of Business Management
St. Xavier Campus Corner, University Road
Navrangpura, Ahmedabad -380009

{drriddhidave@gmail.com, varimna.s@gmail.com, rajeshwari_raj@rediffmail.com}

Abstract: India is marching rapidly toward digital payment system. Of the various digital payment systems available in India digital wallet system has turned out to be very popular due to its ease and convenience. This paper aims to find out the popularity of the digital wallet among small merchants and customers in Ahmedabad. The researchers in this paper are aiming to find out the factors which can make the system more user friendly by suggesting the strategies that can make the digital wallet system more robust.

Key Words: Digital payments, E wallet, cashless System, small traders

1 Introduction

The Indian economy has traditionally been dominated by cash. But factors like the increasing use of smart phones, favorable regulatory policies, relentless innovation, easy to use payment products, interoperable payment platforms and customer awareness have made payments industry in India change radically by driving the shift to digital payments. In this era of 'Digital Darwinism', India has displayed a significant growth in adoption of digital payments. The environment post demonetization has fuelled the growth of digital payment system in India and India is marching towards —"Faceless, Paperless, Cashless" payment system rapidly.

Online or mobile wallets, Debit/RuPay cards, Aadhar Enable Payment Systems (AEPS), Unstructured Supplementary Service Data based (USSD) Banking, UPI are the most widely used digital payment systems in India. Of these various prevalent modes of digital payments systems Online or mobile wallets also known as digital wallets has turned out to be very popular and convenient from the point of view of the traders as well as customers because of its simplicity and convenience. The popular digital wallets available in the digital market place in India are Mobikwik, Freecharge, Oxigen, Reliance Money, Paypal, Buddy, Lime, Payzapp, Pocket, Yes Pay, etc. The data from Reserve Bank of India shows the value of mobile wallet transactions standing at Rs 11,695 crore in April, 2018 and volumes for the same standing at 279.29 million for the same period. With the growing merchant community and urbanization and adoption of latest technology in rural areas the use of the digital wallet payment system is expected to rise.

This paper aims to find out the popularity of the digital wallet among small merchants and customers. The paper also strives to find out the challenges and inertia of the customers and the small traders toward using the same.

2 Literature Review

It has been more than a decade, usage of internet and mobile has increased tremendously. Dependability on internet, mobile phones and government's initiatives like Digital India has been spurring the growth exponentially for the use of digital payment method.

Tatjana Apanasevic (2014) discussed a case study of mobile payments applied in the Swedish retail industry. This research analyzed the factors that were characterized as hindrance or driving forces to adoption of e- Wallet. Some of the factors that author has identified are: adopter characteristics, social network and environmental influence etc. Many studies have identified various other factors as obstacles for the retailers perspective such as cost (Mallet and Tuunainen, 2005; Johnson, 2009; Frolick and Chen, 2004), firm size (Johnson, 2009), Uncertain Profitability /Return on Investment (Mallat and Tuunainen, 2005; Frolick and Chen, 2004), Complexity (for personnel) / IT sophistication (Mallat and Tuunainen, 2005; Chwelos et al., 2001), Learning time (Johnson, 2009), Resistance to organizational change (Johnson, 2010; Lapierre and Denier, 2005)

In a study Bamasak (2011) in Saudi Arabia mentioned that there is a bright future for m-payment. Security of mobile payment transactions and the unauthorized use of mobile phones to make a payment were found to be of great concerns or risk to the mobile phone users. Security and privacy were the major concerns for the consumers which affect the adoption of digital payment solutions (2003). Doan (2014) illustrated the adoption of mobile wallet among consumers in Finland as only at the beginning stages of the Innovation-Decision Process.

Singh Samsher and Rana Ravish (2017) in their study have made an attempt to understand customer perception regarding digital payment. They have found that demographic factor except education does not have much impact on the adoption of the digital payment and if a person has studied beyond matriculation and internet savvy, he or she will be inclined to use the digital payment mode. . The study further finds that the factors like gender age, profession and annual income do not have any significant impact on use of digital payment system.

3 Problem Statements

Through review of literature and data it is gathered that digital payment system is becoming very popular in India and of the various modes of digital payment e wallet has emerged to be very user friendly, economic and safe system and has it was thought to be a matter which should be researched further.

In this research authors have proposed to accomplish the following objectives:

- To understand the perspective of the small retailers as well as the consumers' about the e wallet system
- To know the motivation of consumer's towards the usage of application

4 Data Collection

Data collection was done by administering a questionnaire on respondents – small merchants in the city of Ahmedabad, Gujarat. The secondary data is collected from internet, books, magazines, journals and newspaper articles.

5 Sampling Design

Our Sample units were the small merchants who are accepting payment through e wallet mode. Sampling method is convenience sampling and sample size was 50. This study was conducted in Ahmedabad region and is based on the consumers of Ahmedabad.

6 Research Methodology

The category of merchants (shops) chosen for the survey happened to be of three types: **Convenience stores** like grocery stores, dairy booths etc, **Specialty** stores like stationery, pharmacy, apparel, shoe store etc, and **Service providers** like Salon, tailors, mechanics, small eateries, coaching centers etc. As they are the small Merchants whose role is inseparable in providing daily amenities and they have been chosen for the study.

Here below, the analysis of the data collected in this sphere is presented.

7 Data Analysis

Most of the shop keepers surveyed were male. Most of the respondents happened to be in the age group of 25 to 35 years of age. It was closely followed by respondents in the age group of 35 to 45 years of age. 12% of respondents happened to be in the age group of 45 to 55 years and around 4% happened to be above 55 years of age.

The category of shops chosen for the survey happened to be of three types: Convenience stores like grocery stores, dairy booths etc, Specialty stores like stationery, pharmacy, apparel, shoe store etc, and Service providers like Salon, tailors, mechanics, small eateries, coaching centers etc. The percentage of convenience stores happened to be 36 of the total number surveyed. Specialty stores happened to be 22 percentage and Service providers happened to be 42% of the total number of shops surveyed.

80% of the establishments happened to be fixed whereas 12% were temporary and 8% were moving type of establishments.

Percentage of people starting their own small firms with either graduation degree or high school degree was high around 42 and 36 percentages respectively. 12% of the establishment owners happened to be diploma holders whereas 10% of the establishment owners happened to have just cleared there elementary schooling

Maximum number of respondents around 44% happened to have a monthly income around twenty to forty thousand. Around 34% of respondents happened to have a monthly income around forty to seventy thousand. 12% of respondents happened to have a monthly income of ten to twenty thousand. 6% of respondents happened to have income less than ten thousand per month and the rest happened to earn around seventy thousand to one lakh per month.

All the respondents surveyed happened to own smart phones. On a multiple response question form, 50% of the shop owners happened to own computers in their establishments. 44.7% of the shop owners happened to own laptops. 34.2% of shop owners happened to own card swiping machines. 13.2% of owners cited to own Pos machines and 10.5% of shop owners happened to own tablets.

On a multiple response question form, even though cash was the most preferred mode of money transactions around 94%, 50% of the establishment owners did use e-wallets for monetary transactions. 46% of the owners used debit and credit card machines for the buyers' convenience and 36% of shop owners cited that they regularly used net banking.

Almost 82% of respondents mentioned that they used various e-wallet applications like Paytm, Mobikwick, Payzapp, Freecharge, Rupay etc

58.1% of establishment owners' preferred e-wallets for paying electricity bill, 55.8% of them did mobile recharge through e-wallet. 53.5% of them frequently booked tickets using e-wallet apps. E-wallet apps were also used by them to pay AMC and water bills.

47.7% of respondents cited that they preferred e-wallets at times whereas 13% of them mentioned that they preferred e-wallets always or whenever customer asked for electronic payment gateways and almost 40% of them said that they did not use e-wallet quite frequently but they did use.

Almost 69% of them said that they were satisfied to extremely satisfied with the services of e-wallets whereas 22.9% of them mentioned that they were happy with the services. Only 8.9% of them mentioned that they were slightly dissatisfied and where expecting more offers.

95.5% of establishment owners offered e-wallet services only when asked for by their customers whereas the rest offered e-wallet services on every transaction.

66% of establishment owners mentioned that the demonetization inclined them towards digital transactions. Almost 81% of the establishment owners cited that they are very compatible using e-wallet applications. More than 52.1% of establishment owners cited that they would definitely promote cashless transactions to the next level. 77.6% of establishment owners cited that that it wouldn't be difficult for people along their line of business to use digital mode of payment.

8 Hypothesis testing

8.1 Hypothesis 1

H0: There is no association between the age of establishment owners and them using e-wallets for payment mode

H1: There is strong association between the age of establishment owners and them using e-wallets for payment mode

Age * Do you use e wallet Cross tabulation				
		Do you use e-wallet		
		No	Yes	Total
age	25-35 years	3	22	25
	36-45 years	2	13	15
	46-55 years	1	4	5
	56 and above	3	1	4
Total		9	40	49

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.495[a]	3	.023
Likelihood Ratio	7.109	3	.069
Linear-by-Linear Association	5.840	1	.016
N of Valid Cases	49		
a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .73.			

8.1.1 Test Interpretation

We can see that the chi square calculated comes out to be less than Chi square tabulated [0.023< 0.05], which means, we reject the null hypothesis and accept the alternative hypothesis. It means that there is strong association between the age of establishment owners and them using e-wallets for payment mode. It is evident from the descriptive statistics that more from the younger age group prefer to use digital payments mode ass younger age group people accept and understand digital methods quickly.

8.2 Hypothesis 2

H0: There is no association between the educational qualifications of the establishment owners and them using e-wallets for payments

H1: There is strong association between the educational qualifications of the establishment owners and them using e-wallets for payments

qualification * Do you use e-wallet Cross tabulation				
		Do you use e-wallet		
		No	Yes	Total
qualification	10^{th} standard pass	4	1	5
	12^{th} Standard pass	2	16	18
	Diploma pass	2	18	20
	Graduate	1	5	6
Total		9	40	49

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.245[a]	3	.003
Likelihood Ratio	10.766	3	.013
Linear-by-Linear Association	4.709	1	.030
N of Valid Cases	49		
a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .92.			

8.2.1 Test Interpretation

We can see that the chi square calculated comes out to be less than Chi square tabulated [0.003< 0.05], which means, we reject the null hypothesis and accept the alternative hypothesis. It means that there is strong association between the educational qualifications of the establishment owners and them using e-wallets for payments. Even though education is not a priority for small establishment owners, still we can see a visible changing trend that as they get educated, the usage and acceptance towards digital mode of payments is on a rise.

8.3 Hypothesis 3

H0: There is no association between income earned by the small establishments and them using digital mode of payments

H1: There is strong association between income earned by the small establishments and them using digital mode of payments

Income * Do you use e-wallet Cross tabulation				
		Do you use e-wallet		
		No	Yes	Total
Monthly Income in Rupees	10,000 to 20,000	1	5	6
	21,000 to 40,000	5	17	22
	41,000 to 70,000	3	13	16
	70,000 to 1,00,000	0	2	2
	More than 1,00,000	0	3	3
Total		9	40	49

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.417[a]	4	.841
Likelihood Ratio	2.307	4	.680
Linear-by-Linear Association	.700	1	.403
N of Valid Cases	49		
a. 8 cells (80.0%) have expected count less than 5. The minimum expected count is .37.			

8.3.1Test Interpretation:

We can see that the chi square calculated comes out to be more than the tabulated value [0.841 > 0.05], which means, we reject the alternative hypothesis and accept the null hypothesis. It means that there is no association between income earned by the small establishments and them using digital mode of payments. It is evident from the above table that irrespective of how much the small establishments earn, nevertheless they willingly have embraced the digital mode of payments.

8.4 Hypothesis 4

H0: Digital mode of payments used by all categories of establishments is same
H1: Digital mode of payments used by all categories of establishments is different

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
Use of digital wallets	50	.9800	.14142	.00	1.00
Category of shops	50	2.20	.782	1	3

Ranks			
	Category of shops	N	Mean Rank
Use of digital wallets	Speciality Stores	11	23.73
	Convenience Stores	18	26.00
	Service Providers	21	26.00
	Total	50	

Test Statistics[a,b]	
	Use of digital wallets
Chi-Square	3.545
Df	2
Asymp. Sig.	.170
a. Kruskal Wallis Test	
b. Grouping Variable: Category of shop	

8.4.1 Interpretation

P value comes out to be 3.545, which is greater than 0.05. Therefore we accept the null hypothesis and conclude that digital mode of payments used by all categories of establishments is same. Which means, irrespective of whether the establishments are convenience stores, speciality stores or service providers, they all use digital mode of payments.

8.5 Hypothesis 5

H0: Preference of E-wallets over cash by all categories of establishments is same
H1: Preference of E-wallets over cash by all categories of establishments is different

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
Preference of digital wallets over cash	48	1.5000	.61885	1.00	3.00
Category of shops	50	2.20	.782	1	3

Ranks			
	Category of shops	N	Mean Rank
Preference of digital wallets over cash	Speciality Stores	11	23.14
	Convenience Stores	17	28.47
	Service Providers	20	21.88
	Total	48	

Test Statistics[a,b]	
	Preference of digital wallets over cash
Chi-Square	2.827
df	2
Asymp. Sig.	.243
a. Kruskal Wallis Test	
b. Grouping Variable: Category of shops	

8.5.1 Interpretation

P value comes out to be 2.827, which is greater than 0.05. Therefore we accept the null hypothesis and conclude that preference of digital wallets over cash by all categories of establishments is same.

8.6 Hypothesis 6

H0: Offering E-wallets services to their customers by all categories of establishments is same
H1: Offering E-wallets services to their customers by all categories of establishments is different

Test output

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
Category of shops	50	2.20	.782	1	3
How often do you prefer e-wallets	49	1.1633	.37344	1.00	2.00

Ranks			
	How often do you prefer e-wallets	N	Mean Rank
Category of shops	When Customer demands	41	24.84
	On every transaction	8	25.81
	Total	49	

Test Statistics[a,b]	
	Category of shops
Chi-Square	.035
Df	1
Asymp. Sig.	.851
a. Kruskal Wallis Test	
b. Grouping Variable: How often do you prefer e-wallets	

8.6.1 Interpretation

P value comes out to be 0.035, which is less than 0.05. Therefore we accept the alternative hypothesis and reject the bull hypothesis. Hence we can conclude that offering e-wallets services to their customers by all categories of establishments is different. In other words, the small establishment owners offer e-wallet services only when customers ask for e-wallet services

9 Conclusions and suggestions

It appears from the study that much has already been done on the issue of awareness on cashless economy and that a sizeable portion of the small establishments are already using the e-wallet facility for their day today transactions leading to use of less cash in the economy.

However it is observed from the data analysis that many of the small establishments are still reluctant in using e-wallet facility for their customers. They prefer to offer the e-wallet facility only when asked by the customers. It is also observed that there is no significant difference between the establishment type and the reason of their dissatisfaction towards the usage of e-wallet facilities. The observed reasons of their inertia are additional charges imposed by the e-wallet, not comfortable with technology due to security issues, frequent server problems and not educated about the technology usage etc.

It also appears that many people actually agree with the government on the usefulness of the cashless economy. Collectively people have voiced their opinion that cashless system will be helpful in the fight against corruption and money laundering. One most significant contribution of the cashless economy is that it is expected to reduce the risk associated with carrying cash. The most important issue of financial illiteracy should be addressed through financial literacy and creating awareness among the people. The government should conduct awareness camps for small establishment owners so that more retailers start using digital modes of payments.

Bibliography

1. Dorothy Sagayarani (2017): Digital Payments In India, IOSR Journal of Business and Management (IOSR-JBM), PP 28-33
2. Gupta Komal (2018): Mobile wallet transactions hit record Rs14,632 crore in June, shows RBI data, Live Mint, August 7,2018
3. Malviya Sagar and Maheshwari Richa (2016) Digital wallets and mobile wallets surge to their highest level, modern trade grows five-fold: Nielsen, Economic Times, Nov 24,2016
4. Report of the Working Group on Fin Tech and Digital Banking (2018): Report by the Reserve Bank of India, February 8, 2018
5. Salim Zoiab Shekh(2018): 4 reasons why UPI may overtake mobile wallets soon**,** Live Mint, May 22,2018
6. Singh Samsher and Rana Ravish (2017): Study of Consumer Perception of Digital Payment Mode, Journal of Internet Banking and Commerce, December 2017, vol. 22, no. 3

Policy formulation for Artificial Intelligence- Strategic Priorities for India

Dr. Manmohan Singh Rehsi

CEO, Thakral IT Services, Dubai, UAE,

msrehsi@gmail.com}

Abstract

The fourth industrial revolution is profoundly impacting the world economy and is disrupting almost every industry in an exponential manner. Artificial intelligence (AI) is at the forefront of this change and the technology promises India to be an economic leader in the world. In order to create a robust ecosystem for AI development and adoption, it is essential that a policy, legal and regulatory framework is put in place by the government. Niti Aayog, Government of India, has published a discussion paper on "National strategy for AI" and has branded this initiative as # *AI for all*, so that it can position India on the AI world map. In this paper, we attempt to put forward a 5-stage public policy framework and examine the national AI strategy of USA, China and draw lessons for India. AI effects the social, economic, cultural, political and technological aspects and the paper critically reviews the implications of AI policy on these aspects, in light of the recently published discussion paper on "National strategy for AI" for India. Finally, recommendations are made for policy framework and prioritization.

Keywords: AI, artificial intelligence, AI policy, agenda setting, India AI policy

1 Introduction

Artificial intelligence (AI) is a disrupting internet enabled technology that has a major effect on our everyday lives. AI traditionally refers to an artificial creation of human like intelligence that can learn, reason, plan, perceive or process natural language. AI has the potential to bring numerous socio-economic opportunities and also its accompanying challenges. It can play a major role in radically transforming the country's economic landscape by addressing issues like infrastructure, productivity, delivery of medical and other government services for the masses, bureaucracy, agriculture, education, entertainment, transportation, security & surveillance, military defence and practically all aspects of the economic value chain. Viewed in this context, for India, AI is a new engine for economic growth which requires a policy framework since it impacts the socio-economic fabric of the country. The policy framework needs to look at the development and deployment of this technology in a comprehensive manner both at the federal and regional level. The advent of Big Data and Internet of things (IoT) has created a perfect environment for new AI applications and services to grow. The fourth Industrial revolution which comprises of AI, quantum computing, virtual reality, Big data, IoT will create future proof smart factories and help optimize manufacturing processes. AI systems are capable of complex decision-making capabilities and sophistication.

India's diversity, unique social, cultural, political and lack of infrastructure, context has the potential to benefit from AI and at the same time these pose a rich set of challenging problems for AI [20]. With a large workforce [44], a fast-growing economy [28] and a vibrant, resilient democracy [34], India presents an opportunity for AI applications to have tremendous reach and scale. According to Srivastava [39], the rise in the number of AI applications is due to the increase in computational power and storage capacity of computers, cloud technology, deep neural networks, progress in machine learning, algorithms, IoT and high-speed communication networks.

The AI industry in India is currently estimated to be USD 180 Million in revenues and there are about 800 companies who are involved in AI in some form [15]. AI is expected to add USD 957 billion to the Indian economy by 2035. [2]

The emerging scale and challenges of AI makes it necessary for policy makers to understand the implications and devise suitable policy framework to enable leadership in this domain.

2 Objectives

The study has the following research objectives:

1. To understand the policy framework for AI in India based on the discussion paper released by National institute for transforming India (Niti Aayog) in June,2018 [32]
2. To do a comparative of the Indian policy with that of USA and China

USA has been chosen as the country for comparison of AI policies since it is the leading country in AI development in the developed world and China is the leader in Asia and is close behind USA.

3 Artificial Intelligence

3.1 What is Artificial Intelligence

The word Artificial Intelligence was first coined by John McCarthy in 1956. He chose the word AI to distinguish between "thinking machines", which was one of the tracks being followed in the Dartmouth conference [29]. AI is a multidisciplinary concept, and it is essential to understand the concept of "Intelligence". According to Legg & Hutter [23], intelligence is defined as being able to measure an agent's general ability to achieve goals in a wide range of environments. They devised a framework, as shown in Fig. 1, to explain the general nature of Intelligence

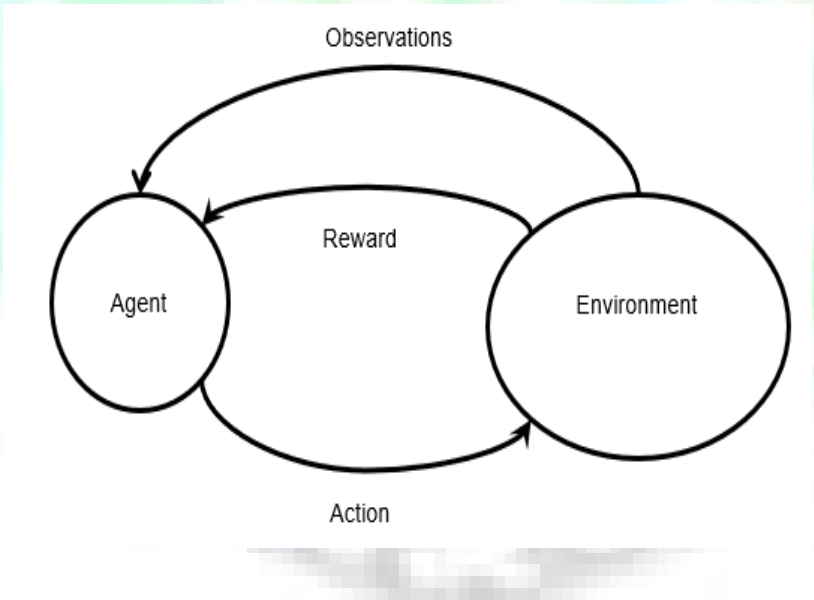


Fig. 1. General Framework for AI (Source: Legg & Hutter,2006)

The key concepts in this definition are that

1. Intelligence is a property of some entity or agent that interacts with some form of environment
2. Intelligence is generally indicative of an agent's ability to succeed (by a given set of criteria) at achieving a stated goal
3. There is an emphasis on learning, adaptation, and flexibility within a wide range of environments and scenarios

Since Intelligence is related to a context, it is generally difficult to have one single definition of AI, since it varies with the background and objectives.

According to Rusell and Norvig [36], AI is defined as “the designing and building of intelligent agents that receive percepts from the environment and take actions that affect that environment.” This definition by its nature unites many different splintered fields – speech recognition, machine vision, learning approaches, etc. – and filters them through a machine that is then able to achieve a given goal.

AI can be categorized in many ways and distinction is generally made between [32]

1. Weak AI vs. Strong AI: Weak AI describes "simulated" thinking. That is, a system which appears to behave intelligently, but doesn't have any kind of consciousness about what it's doing. For example, a chatbot might appear to hold a natural conversation, but it has no sense of who it is or why it's talking to you. Strong AI describes "actual" thinking. That is, behaving intelligently, thinking as human does, with a conscious, subjective mind. For example, when two humans converse, they most likely know exactly who they are, what they're doing, and why.

2. Narrow AI vs. General AI: Narrow AI describes an AI that is limited to a single task or a set number of tasks. For example, the capabilities of IBM's Deep Blue, the chess playing computer that beat world champion Gary Kasparov in 1997, were limited to playing chess. It wouldn't have been able to win a game of tic-tac-toe - or even know how to play. General AI describes an AI which can be used to complete a wide range of tasks in a wide range of environments. As such, it's much closer to human intelligence.

3. Superintelligence: The term "superintelligence" is often used to refer to general and strong AI at the point at which it surpasses human intelligence, if it ever does.

3.2 Why AI policy

Rapid fast paced developments in AI technology and its impact on socio-economic factors, necessitate that the government has a comprehensive vision and develop a framework so that the technology development and its applications can be channelized for the benefit of the country and society. AI policy is defined as public policies that maximize the benefits of AI, while minimizing its potential costs and risks. [11]

According to Brundage and Bryson [6], policy simply refers to a set of decisions that societies, through their governments, make about what they do and do not want to permit, and what they do or do not want to encourage. Policy should have good quality content, be consistent across different contexts, concise and comprehensive. [12]

AI policy can be categorized in three categories namely:

1. Direct AI Policy- directly concerned with orienting towards governing AI based technologies like self-driving cars
2. Indirect AI policy- indirectly affects AI based technology development and its diffusion like IP laws, legal policies
3. AI relevant Policy – matters that benefit policy makers such as education, urban planning, welfare policies

AI policy is needed to ensure development and adoption of AI technology, which is a game changer, so as to secure the benefits to society and economy and the effectiveness of the government programs.

Many countries in the world like USA, China, UK, Japan, Singapore, Germany, France, UAE and many others have released their national strategies for AI. India has also released a discussion paper on “National Strategy for Artificial Intelligence # AI for All”.

3.3 Framework for AI policy

For the purpose of this study, a five-stage policy framework proposed by Howlett and Ramesh [18], as shown in Fig. 2, has been used

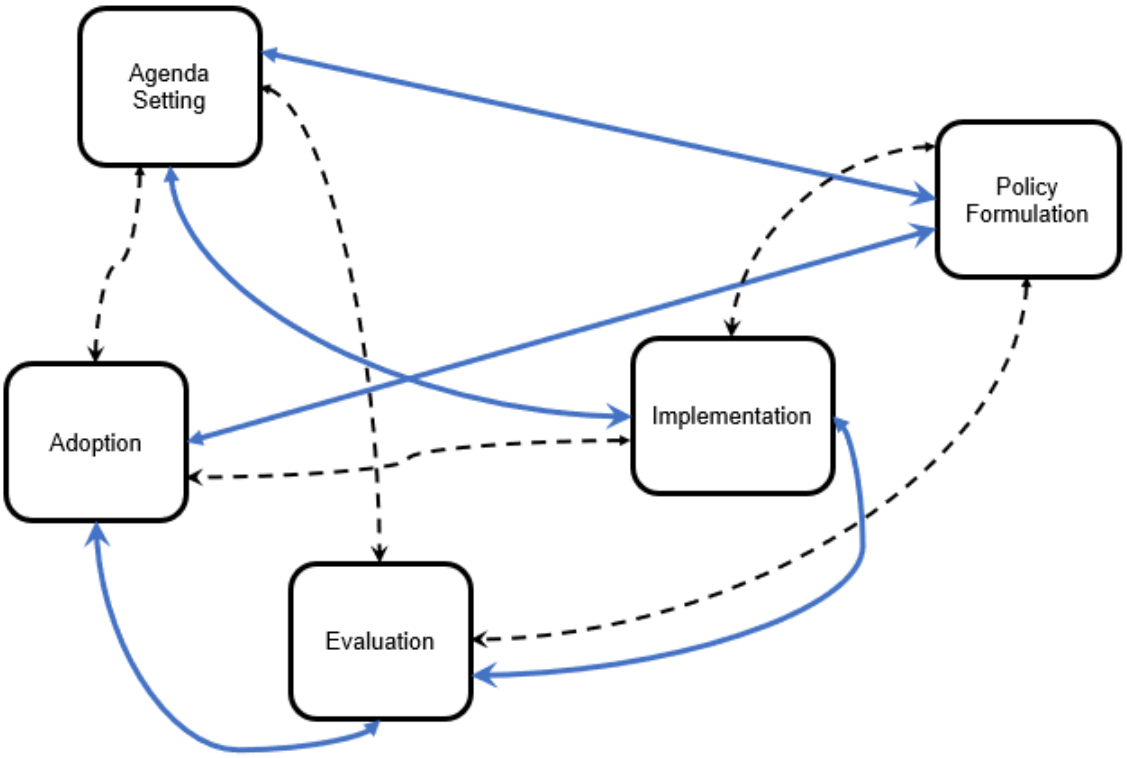


Fig. 2. Model for public policymaking (Source: Howlett & Ramesh, 2003)

The five stages are as under:

1. Agenda setting**:** Identifying a problem and bringing it to the attention of the policymakers.
2. Policy formulation: Considering available policy options and crafting solutions to identified problems.
3. Policy decision-making: Government choice of action or inaction on a policy item.
4. Policy implementation**:** Putting an adopted policy into practice.
5. Policy evaluation**:** Analyzing implemented policies to determine how well they are meeting objectives and sometimes followed by changes to improve the policy.

Agenda-setting is the first stage in a policy cycle and refers to the processes by which social conditions are recognized and have evolved into a "public problem" and have become the focus of debate in media and politics. [13]

Agenda setting is a critical stage in the policy cycle since its dynamics have a decisive impact on the whole policy process and the policies resulting from it. [24],[18]. Agenda-setting is a socially constructed process in which actors and institutions, influenced by their ideologies, play a fundamental role in determining the problems or issues requiring action on the part of the government. [18]

The next stage in policy cycle is policy formulation, which basically involves identifying and assessing, weighing pros ad cons of various solutions to policy problems, and deciding which options to accept or reject. [18]

The third stage is implementation, or the process of putting a public policy into effect. This is when a decision is carried out through the application of government directives and is confronted with reality. [27]

The fourth and fifth stages involves policy implementation and evaluation.

Based on the above model, the AI policy for India is today at the stage of agenda setting. Ideology plays an important part in agenda setting. The Indian ideology has been driven by the following three parameters. [32]

1. Opportunity: the economic impact of AI for India
2. AI for Greater Good: social development and inclusive growth
3. AI Garage for 40% of the world: solution provider of choice for the emerging and developing economies across the globe

The Chinese ideology for AI has been driven by the desire to transform China into a “nation of innovation” and create a world class AI industry. It wants to transform into a superpower in science and technology covering AI , Big data, intelligent manufacturing and robotics.

In China, the private sector has pioneered the AI revolution to date and has formed the initial impetus for the development of a national AI strategy. Major private sector technology companies like Baidu, Alibaba and Tencent (BAT) have been actively involved in advising the formulation of a national policy.

In USA, a bill named “Future of Artificial Intelligence Act 2017” [19] was introduced in the Congress to understand the usability and realistic evolution of AI. The main tenets of the bill are to ensure:

1. U.S. competitiveness, including the promotion of investment into the development of AI
2. The potential for using AI for rapid reskilling of workers, due to the possible effect of technological displacement
3. Education, including science, technology, engineering, and mathematics education to prepare workers as the needs of employers change
4. Open sharing of data and research on AI
5. International cooperation and competitiveness, including the competitive international landscape for AI-related industries.

As of date, US does not have a central AI policy, but most of the research in AI is led by private sector and the academic institutions.

4. Model for Agenda Setting for AI policy at a National level

Based on the available research literature and various reports on AI from China, US and India, the policy agenda setting framework is as shown in the Fig. 3.

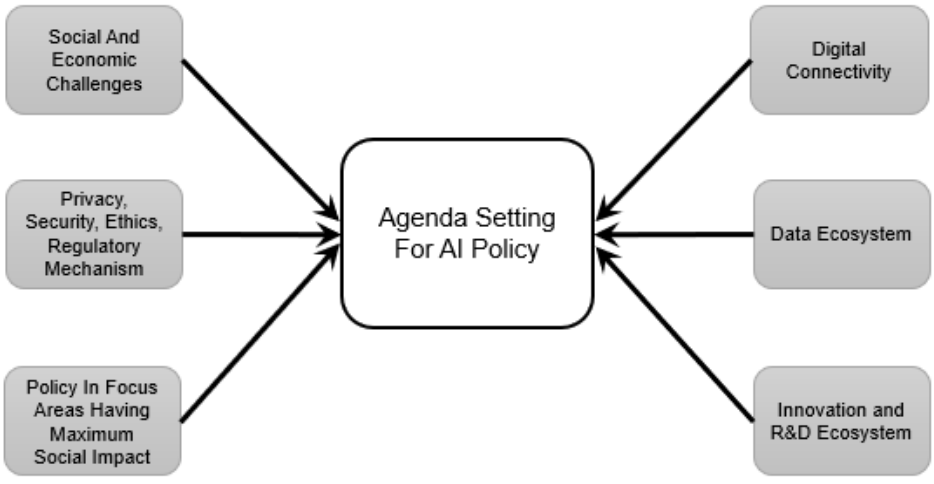


Fig. 3. Model for agenda setting for AI policy formulation

The various focus areas are detailed below:

4.1 Data Ecosystems

The amount of data being produced, exchanged and consumed has increased manifold over the Internet and Web. [26] The amount of data generated in the world has exploded as a result of the growth of smart phones and connected devices. Ninety percent of the data in the world today has been created in the last two years, and that growth rate continues to accelerate. [7]

A data ecosystem is a collection of infrastructure, analytics, and applications used to capture and analyze data. Data ecosystems are composed of complex networks of organizations and individuals that exchange and use data as a main resource and evolve over a period of time. [26], [3].

Data is an important requirement for AI to work effectively and hence it is necessary to have an integrated data policy. Open data and open standards are likely to be a great enabler for AI. [4] Data securitization, standardization and privatization are key challenges for policy makers, as datasets increase in size and quantity.[10]

In order to build a robust data ecosystem, the Indian government think tank recommends the creation of marketplace model focusing on data collection and aggregation, data annotation and deployable models for data sharing.[32]

In USA, government has expanded its flexible and open data initiatives, working with private sector to support data sharing in ways that protect privacy and supporting the development and deployment of new standards to improve data quality, thereby helping machine intelligence developers to develop new applications. It has a supportive regulatory regime for access and sharing data. [7]

China has weak data protection rules, and a weak regulatory environment and

limited considerations for ethical considerations in spite of the fact that China has the largest internet and smartphone penetration. Companies like BAT collect vast amounts of data through their proprietary platforms . [37]

China lags behind USA in creating data friendly ecosystem with unified standards and cross platform sharing. [5].Chinese cyber security law, which came into effect in June, 2017 limit cross border data flow and mandate data localization, could limit data flow to China impeding its AI development. [21]

In UK, the government has established a new Centre for Data Ethics and Innovation. It will identify the measures needed to strengthen and improve the way data and AI are used and regulated. It will also include articulating best practice and advising on how potential gaps in regulation are to be addressed.

The Centre will not, itself, regulate the use of data and AI - its role will be to help ensure that those who govern and regulate the use of data across sectors do so effectively. [9]

4.2. Innovation and R&D ecosystem

The term “innovation ecosystem” refers to the stakeholders and resources necessary to achieve ongoing innovation in a modern economy. According to the World Economic Forum Global Competitiveness Report 2015-2016, “The way economists and practitioners think about innovation has evolved considerably in the past decade and apart from generating new ideas, innovation is now seen as an “ecosystem” conducive to the generation of ideas and the “implementation” of these ideas in the form of new products, services, and processes in the marketplace.” [38]

National policies lay the foundation for Innovation and R&D dynamics in the country. Innovation ecosystem for AI requires a strong institutional framework, public private partnership, human talent and development of products which have maximum social impact.

AI research in India is still at the very initial stages and a focused approach is needed. India is not an innovation hub for cutting edge / fundamental research in AI. India’s R&D spending remains abysmal at less than 1% of GDP and has traditionally always bought its technology or licensed it from the developed world. It spent just 0.6% of GDP on

research and development in 2014-2015 while other BRICS countries—Brazil, Russia, China, and South Africa—spent a higher 1.24%, 1.19%, 2.05% and 0.73%, respectively. [41]

Niti Aayog [32] proposes formation of AI market place which will foster innovation and recommends setting up two main centers for promotion innovation and R&D for AI

1. Centre of Research Excellence (CORE) focused on developing better understanding of existing core research and pushing technology frontiers through creation of new knowledge;
2. International Centers of Transformational AI (ICTAI) with a mandate of developing and deploying application-based research. Private sector collaboration is envisioned to be a key aspect of ICTAIs.

Technology focused academic institutions and industry associations are also focusing on basic AI research and setting up center of excellence, which are aimed as labs to nurture innovation and foster a thriving AI ecosystem. It is essential to create an ecosystem of professionals, organizations, academic institutions and industry bodies for innovation and R&D to be relevant.

According to Moore [30] of Capgemini's digital transformation institute, India accounts for 25 percent of innovation centers in Asia and that 80 percent of new innovations are exploring artificial intelligence and big data analytics. Global capability centers of multinationals are doing research in AI and analytics.

As per Zinnov [46], a management consulting firm, India is today the top R&D outsourcing destination in the world, with 60% multinational companies establishing their Global in house centres (GIC) in India. GIC represents USD23.1 billion industry and are engaging with startups to strengthen the ecosystem.

USA is the main global country leading innovation and funding related to AI research [2]. In USA, the National Science and Technology Council (NSTC), which was formed in Nov,1993 is a cabinet-level council and is the principal means within the Executive Branch to coordinate science and technology policy across the diverse entities that make up the federal research and development enterprise.

The National Artificial Intelligence R&D Strategic plan 2016 [31] establishes a set of objectives for federally- funded AI research with a goal to produce new AI knowledge and technologies that provide a range of positive benefits to society, while minimizing the negative impacts. To achieve this goal, the AI R&D Strategic Plan identifies the following priorities for federally-funded AI research:

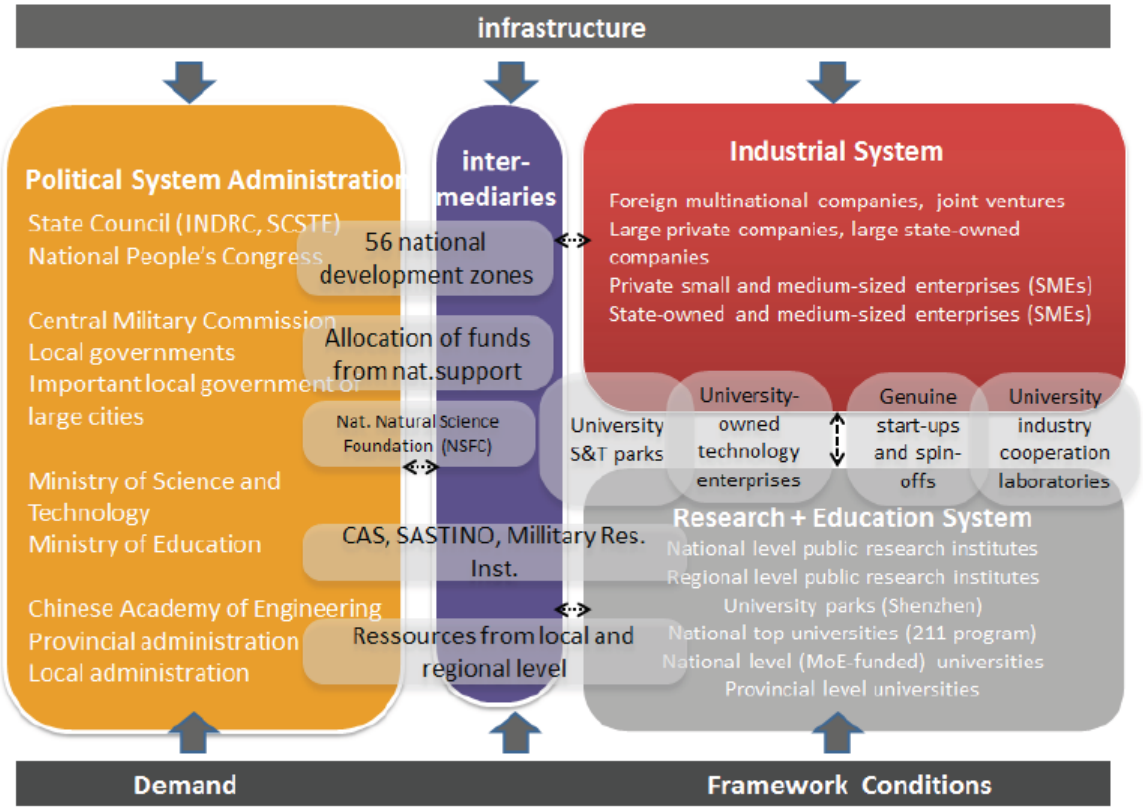
1. Strategy 1: Make long-term investments in AI research.
2. Strategy 2: Develop effective methods for human-AI collaboration.
3. Strategy 3: Understand and address the ethical, legal, and societal implications of AI.
4. Strategy 4: Ensure the safety and security of AI systems.
5. Strategy 5: Develop shared public datasets and environments for AI training and testing.
6. Strategy 6: Measure and evaluate AI technologies through standards and benchmarks.
7. Strategy 7: Better understand the national AI R&D workforce needs.

The AI R&D Strategic Plan closes with two recommendations:

1. Recommendation 1: Develop an AI R&D implementation framework to identify S&T opportunities and support effective coordination of AI R&D investments, consistent with Strategies 1-6 of this plan.
2. Recommendation 2: Study the national landscape for creating and sustaining a healthy AI R&D workforce, consistent with Strategy 7 of this plan.

In China, the Ministry of Science and Technology (MOST) is the primary agency responsible for directing science and technology development. According to a white paper on China's innovation system [42] the AI innovation ecosystem is developing in China as major technology hubs support AI researchers, entrepreneurs and investors.

China's innovation ecosystem is characterized by strong position of the local government and official research institutes. As shown in Fig 4. institutes are setting up technology enterprises in coordination with private sector enterprises. Technology parks and incubators connect entrepreneurs with local resources.



Acronym: CAS: Chinese academy of sciences; SASTINO: State administration of science, technology and industry for national defense

Fig. 4. China Innovation system (Source: World economic forum,2016)

Private sector enterprises are the main innovation driver. According to Credit Suisse [8] report, China R&D investment will surpass that of US by 2020 in purchase power parity basis and it is investing heavily in human capital. China is fast catching up with the United states in talent as well as in chip technology which is crucial for machine learning. [17] The main drivers for China's growth in AI are [35]

1. Abundant data
2. Hungry entrepreneurs empowered by new tools
3. Growing AI expertise
4. Mass government funding and support

4.3 Social and Economic Challenges

AI is a disruptive technology and it will have a profound impact on the social and economic progress of the country. The economic benefits of AI can only be realized if all the actors involved viz government policy makers, businesses, academics, industry bodies and all others associated with AI development work together in a focused manner.

AI is changing the business models across all industries, resulting in major disruptions to labor markets. New categories of jobs will emerge, partly or wholly displacing others. The skill sets required in both old and new occupations will change in most industries and transform how and where people work. It may also affect female and male workers differently and transform the dynamics of the industry gender gap. According to future of jobs report , 85% of jobs by 2030s do not exist today. [43]

AI could add USD 957 billion to Indian economy in 2035 by changing the nature of work to create better outcomes for the business and society. [25] Vibrant AI ecosystems are built on five pillars namely policy makers, universities, startups, businesses and multi stake holder partnerships. [1]

NITI Aayog [32] recognizes that with the advent of AI, the nature of jobs will change and that skilling and reskilling, and development of future workforce is an important part of the policy. This could be done via the adoption of decentralized teaching mechanisms working in collaboration with the private sector and educational institutions to prescribe certification with value. The paper also identifies data annotation as an area to developed for a large section of the workforce.

In China, there is an estimated shortage of 200,000 workers in industrial robots application, which is projected to increase 20-30% annually. China recognizes the curriculum development and work force development as an urgent R&D need. [45] Vocational educational institutes are developing educational programs in robotics for students. Government in participation with private companies is involved in workforce training. [22] The government is also incentivizing overseas Chinese to conduct research and fund startup companies in China and develop talent.

In USA, the government is creating industry recognized apprenticeship programs. On line education is being promoted. Also, skills in science, technology, engineering and mathematics (STEM) are being developed by providing federal aid and a strategic plan is panned to be announced to coordinate the efforts in STEM education

4.4 Ethics, Privacy and Security, IP framework, Regulatory Mechanism

As a transformative technology, AI has the potential to challenge any number of legal assumptions in the short, medium, and long term. Social, cultural, economic and other factors will determine how law and policy will adapt to advances in AI, and how AI will adapt to values reflected in the law and policy. This is also likely to vary depending upon the jurisdiction. [33]

Grasser and Virgilio [14] propose a layered model for AI governance, as shown in Fig. 5.

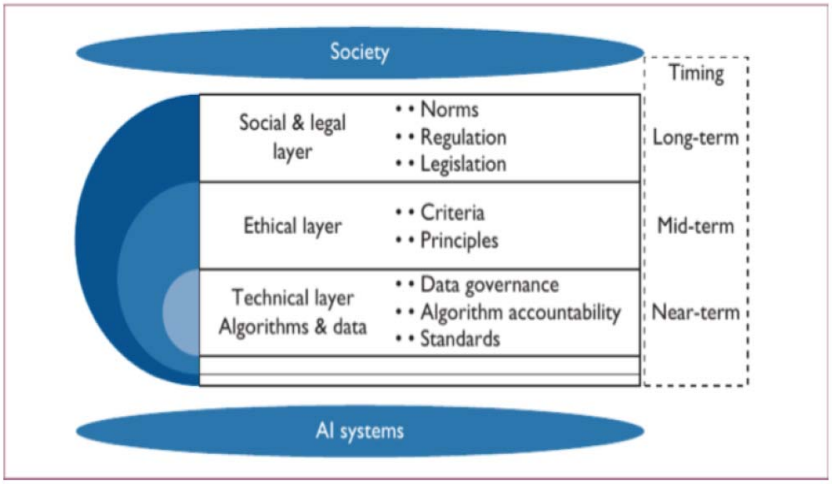


Fig. 5. Layered Model for AI Governance (Source: Grasser & Virgilio, 2017)

The three layers of different governance approaches are:

1. Technical layer – focusing on technical standards and constraints on the collection, use, and management of data by AI algorithms
2. Ethical layer – focusing on ethical and human rights principles; and
3. Social and legal layer – focusing on creating institutions for regulating autonomous systems.

NITI Aayog [32] recommends to set up an ethics council at each center for excellence, which will be responsible for enactment of robust data protection law and formulation of sector specific regulations as per international standards. It recognizes the need for a robust intellectual property framework and that patents law has to be in place for AI so that innovation is not stalled. It suggests establishment of IP facilitation centers to help bridge the gap between practitioners and AI developers and adequate training of IP granting authorities, judiciary and tribunals.

Issues of data privacy and ethics are important and policy makers need to study the same in depth.

State council of China [40] released the plan entitled "Next Generation AI development plan" which recognizes the need to develop framework for laws, regulations and ethics. It encourages research on issues relating to application of AI, legal entity of AI as well its rights, obligations and responsibilities. It envisages to conduct research on behavior science and ethics issues of AI, make a decision-making framework with multi-level ethical and moral choices, and formulate a theoretical framework of human-machine collaboration.

The National Artificial Intelligence Research and Development Strategic Plan released by National science and technology council NSTC [31] of the USA identifies as one of the priority areas in strategy formulation, to understand and address the ethical, legal, and societal implications of AI.

4.5 Telecom Infrastructure

As per GSMA report [16], Intelligent networks, which represent the fusion of 5G, AI and IoT will have a significant impact on individuals, society and industry and will bring highly contextualized and personal experiences.

5. Recommendations.

1) India should carry out basic research in AI apart from concentrating on AI applications for social and economic benefits. It has the unique capability to develop cutting edge innovation using AI as it has a large pool of technically qualified persons.
2) Policy and a framework for innovation dynamics should be created. An ecosystem which supports public private partnership, incentivization for AI research and commercialization of applications should be created. The innovation system has to be decentralized and diverse which should include basic and applied research.
3) AI can give countries a competitive advantage in the 21st century and is a new factor in production over and above the usual factors like capital and labor. AI can be deployed in multiple and varied applications to boost productivity. The policy planners need to take this into account and have a bottom up approach in incentivizing businesses, by way of tax benefits and financing, so that the deployment of AI is encouraged.
4) AI policy should encourage, stimulate and create an ecosystem whereby the general public is educated about the advantages of AI and not allow to have a negative publicity around this technology. Government policy should help in creating an enabling environment for promoting AI and developing an environment of trust and transparency.
5) In order to give boost to R&D, government should provide special incentives to universities, laboratories and industry so that unique applications are developed. There is also a need to do core research in AI and India

should not restrict itself to licensing the technology from abroad. This will give it an edge over China which is also concentrating on developing semiconductor chips.

6) In parallel to the efforts at national level for AI policy, it is necessary that state governments start developing their own plans and policies in tandem with the national policies. Inter-state competition for the advancement of AI development and diffusion should be stimulated.

7) Coordination between center of research excellence, global innovation centres of multinational companies and International centres of transformational AI, should be put in place so that R&D efforts can be focused both at the federal and state level institutions.

8) Development of comprehensive workforce strategies for the fourth industrial revolution, comprising AI, Big Data and IoT. This should include employee reskilling and augmentation. According, to "The future of jobs report 2018, of the World economic forum [43], India requires on an average about 90 days of reskilling program per individual.

9) Changes in our education system should be introduced whereby curriculum is changed to bring the technology awareness at the school level. In colleges and vocational training institutes, we need to create a stronger connection with industry, to manage the unemployability challenge that many Indian engineering graduates face today. Thus, a forward-looking policy and initiatives are required.

10) Governance and regulation of AI is a very important topic. Policy makers need to develop a comprehensive framework for the same, keeping in mind that overregulation can kill the advantage which can accrue with the adoption of this technology.

11) Data is the primary fuel for AI development. Hence the policy should enable creation of a data ecosystem, which addresses multiple issues like data privacy, sharing of data, open access to government and public data, misuse of data, data annotation and cybersecurity laws to ensure digitization of systems and processes.

12) Policies in ethics, privacy and data security to be framed. India's IP system has to be strengthened so that innovations can be patented and will also be an incentive to boost adoption of AI. Legal framework to be in place, and it is essential that the judiciary be educated about AI. Public debate on this sensitive area should be encouraged.

13) India could become the hub for data cleaning around the world. The IT services industry could easily transition into human-trainers of AI. The industrial training institutes and private sector institutes should provide opportunities for reskilling in such areas.

14) Since India's NITI Aayog policy is envisioning India to be the AI garage to 40% of the world, it is important that the government should leverage key bilateral partnerships with other nations to inculcate and encourage mutual discussions and exchange of knowledge, information and regulations pertaining to AI.

15) Public Private Partnerships should be encouraged and policies with incentives need to be framed, so as to increase the investment in AI related projects

16) AI should be able to create social equality and improve people's lives. This requires interdisciplinary research. As such at the policy level, inter-ministerial groups should work cohesively so as to achieve a larger goal for the benefit of the public.

17) Policy for decisions made by AI agents should be made. Machine learning algorithms, are based on data. Hence it is necessary that data quality and biases in data are removed. Safety and security of the AI agent is important as it interacts with the environment.

18) AI can increase the competitiveness of the country and can be a great equalizer for the developing world. Hence it is recommended that a multi-stake holder expert group consisting of academia, industry body, government, law making and enforcing bodies, be formed at the federal and state level to increase the adoption and trust in AI systems.

19) AI can be initially deployed in specific sectors like agriculture, medical, transportation and smart cities, chatbots, where the benefits of AI are immediately visible and the public becomes friendly with these systems. This will help in adoption and acceptability of AI systems.

20) AI is internet enabled technology and hence good telecom infrastructure is must. Telecom companies have to upgrade the infrastructure to 5G and enable high speed data connectivity and the fiber network.

21) It is recommended that a ministerial position be created at the centre and state who can be the in charge for development of digital technology including AI. As an example, in UAE, there is Minister for Artificial Intelligence. This will help to bring focus and effective programs for development and adoption of AI and digital technology

6 Conclusion

India need to take advantage of the fourth industry revolution and can take a dominant position in the world map, in case it acts swiftly to take advantages of AI and disentangles the expansive AI agenda. AI has the potential to promote open and knowledge-based societies and impact every aspect of human life by enhancing social management. There are number of key issues around AI adoption and its use and hence it is necessary that the Indian government puts in place a multi stake holder framework and initiate open discussions between various constituents like industry, academia, public and other agencies responsible for implementing these decisions. As a first step, towards an agenda for AI policy, strengths and weaknesses of the current system should be critically reviewed and the discussion paper laid out by Niti Aayog [32] can be a starting point. The decision makers should be educated about AI and its benefits. Around the world, countries are setting up expert working groups and facilitating industry and government interaction for policy formulation. Extensive campaigns to remove the commonly held misconceptions about AI and its advantages should be undertaken so that the society can develop trust and engage in adopting the same. The industry startup ecosystem can play a vital role in developing AI and building applications which have immediate effect on the economy. Though India has a thriving ecosystem, entrepreneurship has to be further encouraged so that this sector is provided with more investments and the right inputs. China is way ahead of India in the AI domain and there is need to act fast given the talent pool and a young workforce which India possess.

The Indian government think tank, Niti Aayog envisages AI policy for social and economic inclusion and has branded this approach as # AI for All. It also plans to be the AI garage for the developing world. These are good pointers to the national vision towards this transformative strategy and firm action steps should be initiated.

Agenda setting is the most important aspect in policy formulation. In fact, the agenda setting stage is preceded by problem definition. The Niti Aayog [32] discussion paper is a comprehensive document which lays down different problem issues and its subsets. Since agenda setting enables decision making of complex multi actor problems under uncertain circumstances, it is essential that the policy is rational, simple to implement and close to reality.

AI policy should be forward looking and flexible enough to provide for changes as the technology gets developed and diffused in the society and business environment. Citizens should have a constructive role in influencing development of the applications of this technology as it impacts the society. Over regulation should be avoided, as it can affect the competitiveness of the country. Policy intervention is required to reskill the talent for the digital age and AI provides an opportunity to India to be the global country for services around data restructuring and annotation.

There will be numerous challenges and opportunities as the AI policy is implemented and a coordinated effort at the apex and ground level can help to maximize the outcomes.

References

1. Accenture research. : Embracing artificial intelligence: enabling strong and inclusive AI driven economic growth. (2017) Retrieved from https://www.accenture.com/t20171129T061237Z__w__/us-en/_acnmedia/Accenture/next-gen-5/event-g20-yea-summit/pdfs/Accenture-Intelligent-Economy.pdf
2. Allen,J.R., & Husain,Amir. : The next space is Artificial intelligence. Foreign Policy, 3. (2017). Retrieved from https://foreignpolicy.com/2017/11/03/the-next-space-race-is-artificial-intelligence-and-america-is-losing-to-china/

3. Anneke Zuiderwjik, Marjin Janssen & Chris Davis. : Innovation with open data: Essential elements of open data systems. Information polity (2014) 19 (1,2), 17-33.
4. AI for Development Series. : Geneva: International Telecommunication Union. (2018). Licence: CC BY-NC-SA 3.0 IGO. Retrieved from https://www.itu.int/en/ITU-D/Conferences/GSR/Documents/GSR2018/documents/AISeries_IntroductoryModule_GSR18.pdf
5. Barton,D.,Woetzel,J., Seong,J., & Tian,Q. : Artificial Intelligence: Implications for China. *Paper presented at the China development forum. Mckinsey Global Institute*. (2017) Retrieved from https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/China/Artificial%20intelligence%20Implications%20for%20China/MGI-Artificial-intelligence-implications-for-China.ashx
6. Brundage,M., & Bryson,J : *Smart policies for artificial intelligence.* (n.d.) Retrieved from https://arxiv.org/pdf/1608.08196.pdf
7. Carter, W.A., Kinnucan,E., & Elliot, J. : Machine Intelligence strategy for the United Staes. Report of the Centre for strategic & international studies technology policy program, USA. (2018) Retrieved from https://csis-prod.s3.amazonaws.com/s3fs-public/publication/180227_Carter_MachineIntelligence_Web.PDF?CLlXGgQQQoc78akgCk.2StKO7NsrC2J1
8. Credit Suisse : Ecosystem of Innovation and Technology in China. (2016) Retrieved from https://research-doc.credit-suisse.com/docView?language=ENG&format=PDF&sourceid=csplusresearchcp&document_id=1066165961&serialid=wkRU6L5tGd3yH2QmLiClOy6%2Fq%2FdWyyZNsM6JTA55DGs%3D
9. Department for Digital, Culture, Media and Sport. Government of United Kingdom. : Consultation paper on centre for data ethics and innovation. (2018) Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/715760/CDEI_consultation__1_.pdf
10. Duke SciPol. : Artificial intelligence: emerging opportunities, challenges and implications for policy and research.(GAO report). (2018) Retrieved from https://scipol.duke.edu/content/gao-report-artificial-intelligence-–-emerging-opportunities-challenges-and-implications
11. Dutton,T. : AI Policy 101: An Introduction to the 10 Key Aspects of AI Policy. Politics + AI publication. (2018) Retrieved form https://medium.com/politics-ai/ai-policy-101-what-you-need-to-know-about-ai-policy-163a2bd68d65
12. Frantzeskaki,N., De Haan., Kolfschoten,G.L., & Walker,W. : Three challenges, four pitfalls and five actions when teaching conceptual modelling. Paper presented at the International Conference of Education, Research and Innovation, Madrid. (2008) Retrieved from https://repository.tudelft.nl/islandora/object/uuid:4cbc0702-befa-40b5-9f75-f41fb918b429?collection=research
13. Garraud, P. : "Agenda/Émergence," in L. Boussaguet, S. Jacquot and P. Ravinet, Dictionnaire des politiques publiques, Paris, Presses de la Fondation nationale des sciences politiques (2004) pp. 49-56.
14. Gasser, Urs, & Virgilio A.F. Almeida. : A layered model for AI governanace. IEEE Internet Computing (2017) 21 (6) (November): 58–62. doi:10.1109/mic.2017.4180835. Retrieved from https://dash.harvard.edu/bitstream/handle/1/34390353/w6gov-18.-LATEX.pdf?sequence=1&isAllowed=y
15. Gupta.B.: Study-State of Artificial Intelligence in India. Analytics India magazine (2017) Retrieved from https://www.analyticsindiamag.com/study-state-of-artificial-intelligence-in-india-2017/
16. GSMA : Intelligent connectivity; how the combination of 5G, AI and IoT is set to change the Americas (2018) Retrieved from https://www.gsma.com/IC/report/
17. Guilhem ,Fabre. : China's digital transformation. Why is artificial intelligence a priority for Chinese R&D? FMSH-WP-2018-136. (2018) Retrieved from https://halshs.archives-ouvertes.fr/halshs-01818508/document
18. Howlett, M. and M. Ramesh: Studying Public Policy: Policy Cycles and Policy Subsystems, Toronto, Oxford University Press. (2003) Retrieved from https://www.ncchpp.ca/docs/ModeleEtapesPolPubliques_EN.pdf
19. H.R.4625. Future of Artificial Intelligence Act, U.S.A. (2017). Retrieved from https://www.congress.gov/115/bills/hr4625/BILLS-115hr4625ih.pdf

20. Kalyanakrishnan, S., Panicker,R.A., Natarajan,S.,& Rao,S. Opportunities and Challenges for Artificial Intelligence in India. Paper presented at the AAAI/ACM conference on Artificial Intelligence, Ethics and Society Conference (Submission 52). New Orleans, USA. (2018). Retrieved from http://www.aies-conference.com/2018/contents/papers/main/AIES_2018_paper_52.pdf

21. Kewalramani,M. Breaking down China's AI ambitions: Prospects and Challenges. Takshashila working paper. (2018-02). Retrieved from http://takshashila.org.in/wp-content/uploads/2018/10/Chinas-Quest-for-AI-Leadership-Takshashila-Institution.pdf

22. Klorer, E., & Stepan, M. China monitor. Mercator Institute for Chinese studies, No 24. (2015). Retrieved from https://www.merics.org/sites/default/files/2018-01/China_Monitor_24_Vocational_Education_EN.pdf

23. Legg, Shane., & Hutter, Marcus. A formal measure of machine intelligence. In Proc. Annual machine learning conference of Belgium and The Netherlands (Benelearn-2006), Ghent. (2006). Retrieved from http://www.vetta.org/documents/Benelearn-UniversalIntelligence-Talk.pdf

24. Lemieux, V. L'étude des politiques publiques, Québec, Presses de l'Université Laval. (2002).

25. Menon,R.M., Vazirani, M. & Roy,P. Rewire for growth. Accenture research report. (2017). Retrieved from https://www.accenture.com/t20171220T030619Z__w__/in-en/_acnmedia/PDF-68/Accenture-ReWire-For-Growth-POV-19-12-Final.pdf%20-%20zoom=50

26. Marcelo Iury S.Oliveira & Bernadette Farias Loscio. What is a data ecosystem. Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age, Article no 74 ,Delft, The Netherlands. (2018, May30-June 01).

27. Mégie, A "Mise en œuvre," in L. Boussaguet, S. Jacquot and P. Ravinet, *Dictionnaire des politiques* . (2004).

28. Ministry of Finance, Government of India. Economic Survey 2016-17. (2017). Retrieved from https://www.indiabudget.gov.in/es2016-17/echapter.pdf

29. Moor,J.H. The Dartmouth College artificial intelligence conference: The next fifty years. *AI Magazine,* (2006) *27*(4),87–91.

30. Moore, M. Despite mass investment, innovation centers are not making organizations more innovative. Capgemini digital transformation institute. (2017). Retrieved from https://www.capgemini.com/news/despite-mass-investment-innovation-centers-are-not-making-organizations-more-innovative/

31. National Science and Technology Council NSTC. The National artificial intelligence research and development strategic plan. (2016). Retrieved from https://www.nitrd.gov/PUBS/national_ai_rd_strategic_plan.pdf

32. Niti Aayog. Discussion paper on national strategy for artificial intelligence. (2018). Retrieved from http://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-for-AI-Discussion-Paper.pdf

33. Nitish, Desai. The future is here: Artificial Intelligence. Nitish desai associates. (2018). Retrieved from http://www.nishithdesai.com/fileadmin/user_upload/pdfs/Research_Papers/Artificial_Intelligence_and_Robotics.pdf

34. Parthasarathy, R., & Rao, V. Deliberative democracy in India. *World Bank* Policy Research Working Paper. (2017). Retrieved from http://documents.worldbank.org/curated/en/428681488809552560/pdf/WPS7995.pdf

35. Peter,H.D. China is quickly becoming an AI superpower. (2018) . Retrieved from https://singularityhub.com/2018/08/29/china-ai-superpower/#sm.0000btbj2mso9damx4g14ue2qhhzr

36. Russell, S., & Norvig, P. (Ed.). Artificial Intelligence: A modern approach (3rd.ed.). New Jersey Prentice Hall. (2010).

37. Sara,Xia. China data protection regulations (Blog post). (2018, May20). Retrieved from https://www.chinalawblog.com/2018/05/china-data-protection-regulations-cdpr.html.

38. Schwab, K. The global competitiveness report 2015-16. World economic forum. (2016). Retrieved from http://www3.weforum.org/docs/gcr/2015-2016/Global_Competitiveness_Report_2015-2016.pdf

39. Srivastava,S.K. Artificial Intelligence: Way forward for India. Journal of Information Systems and Technology Management, (2018) 15,1-23. Retrieved from http://www.jistem.fea.usp.br/index.php/jistem/article/view/2965

40. State council of China. Next generation of AI development. (2017). Retrieved from https://flia.org/wp-content/uploads/2017/07/A-New-Generation-of-Artificial-Intelligence-Development-Plan-1.pdf

41. Thakur,A.,& Ghosh,D. R&D: In search of next big ideas. Fortune India, August. (2018). Retrieved from https://www.fortuneindia.com/technology/rd-in-search-of-the-next-big-ideas/102343

42. World economic forum China's innovation ecosystem. (2016). Retrieved from http://www3.weforum.org/docs/WEF_GAC_On_China_Innovation_WhitePaper_2016.pdf

43. World economic forum Future of jobs report. (2018). Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf

44. Woetel,J., Madgavkar,A. and Gupta,S. A new emphasis on gainful employment in India. Report, Mckinsey Global Institute. (2017). Retrieved from https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Employment%20and%20Growth/A%20new%20emphasis%20on%20gainful%20employment%20in%20India/Indias-labour-market-A-new-emphasis-on-gainful-employment.ashx

45. Yujia,he. How China is preparing for an AI powered future. The Wilson center. (2017). Retrieved from https://www.wilsoncenter.org/sites/default/files/how_china_is_preparing_for_ai_powered_future.pdf

46. Zinnov. GICs in India Represent a USD 23.1 Billion Industry; India is Emerging as a Top Destination for Digital GICs. (2017). Retrieved from http://www.prnewswire.co.in/news-releases/gics-in-india-represent-a-usd-231-billion-industry-india-is-emerging-as-a-top-destination-for-digital-gics-says-zinnov-616683484.html

Impact of Digitalization in the Process of Globalisation in Airlines Industry

Shamita Garg, and Sushil

Department of Management Studies,
Indian Institute of Technology, Delhi
Vishwakarma Bhavan, Shaheed Jeet Singh Marg,
Hauz Khas, New Delhi – 110016

Abstract: The international competition and market conditions have put the strong challenges and barriers for the Airlines Industry. With this objective, the present study aims to identify the interrelationships among the various determinants in the context of digitalization that have led to the process of globalization in airlines industry. Despite of numerous studies have been conducted for identifying the factors related to Airlines Industry but limited literature is available on factors affecting the globalization process in Airlines industry. The present research work, attempts to fulfil the above gap and to examine the determinants leading to globalization in airlines industry. Total interpretive structural modelling and MICMAC analysis have been used to examine the interplay among the various enablers of digitalization that have impacted the process of globalization in airlines industry. The developed strategic management model is a novel effort in analyzing the impact of digitalization and flexibility in the process of globalization in airlines industry.

Keywords: Total interpretive structural modelling (TISM), MIC-MAC analysis, Digitalization, Airlines Industry

1 Introduction

Digital technologies have changed the business model and open the way for new value-producing opportunities. Digitalization means converting information into digital format. Digitalization can be contended as the automation of processes by the interplay of digital technology, knowledge, and people. This shift to digitization has also revolutionized the aviation sector to a great extent. There is an enormous bundle of opportunities that airlines need to grab up to gain a competitive advantage like developing new business models**,** improving quality of the process, flight optimization, the possibility of differentiation, cost reduction, increasing revenue through better efficiency. Airlines are doing an excellent job and have caught up by implementing digitalized processes. Airlines have already built integrated digital systems like real-time flight information processes for passengers and online check-in. Digitalization has offered new ways to the strengthened customer relationship. Today, most of the customers use a smart phone to book a flight.AmericanAirlines have started using smart "collect, detect, act" system that can analyze almost 150 variables in a client profile, including data from previous destinations to prior purchases in milliseconds. This innovative scheme has increased American Airlines' profits by nearly 15%. Digital revolution has made traveling individualized and comfortable.

Nevertheless, it can be stated that innovative technologies have brought abundant opportunities for the optimization of air travel. Hence, Digitalization is not only important for players in the aviation industry but also beneficial for customers. Flight optimization and new distribution channels have increased profitability and brought new market reach in an airline. It can be summarized that digitalization has accelerated the process of globalization by its innovative methods and enhanced customer experience. In

order to keep pace with the global trend, continuous engagement with the disruptive innovation is the only way around. The present research attempts to:

- Identify the factors that address the impact of digitalization in the process of globalization in the airline's industry.
- Establish strategic relationship among the selected determinants using modified TISM approach.
- Catogarize the variables using MIC-MAC analysis

2 Literature Review

Identification of factors that address the impact of digitalization in the process of globalization in the airline's industry

A comprehensive examination of literature has been done to identify ten factors that discuss the effect of digitalization in the process of globalization in the airline's industry. The identified determinants have been listed in Table1.

3. Methodology:

Modified Total Interpretive structural modeling (m -TISM)

TISM is a total interpretive structural modeling that aids to apprehend the difficult and poorly enunciated problems in a defined form (Dubey and Ali,2014). In the present study modified TISM approach has been applied in order to perform pair- comparison. This will reduce the number of pair - comparisons required to build the model. The modified TISM method assists decision makers to detect the most critical variables and how the following variables influence the other variables in the given hierarchy (Sushil, 2012).

The Basic Steps Involved in TISM Methodology

Step 1: Identification of various factors influencing the impact of digitalization in the process of globalization in the aviation industry (Table1).

Step 2: After that, paired comparison among the selected variables in done (Sushil, 2017).

Step 3: Then pair-wise comparison is made for transitivity check and to avoid duplication. Transitivity aims to represent the indirect relationship among variables.

Step 4: Transitive reachability matrix is developed by substituting ‘1’ in the ‘i-j’ cell if there is ‘Y’ in the knowledge base cell. Otherwise ‘0’ is put in the cell. See Table 2 for the transitive matrix.

Table 1: Factors addressing the impact of digitalization in the process of globalization in the airline's industry

S.No	Factors	Reference
1.	IT infrastructure	Jarach, 2002; Sigala 2003; Shon et al., 2003; Yoon et al., 2005;Mattig and Hausweiler, 2017;Somoskői et al., 2019
2.	Digital literacy	Jarach, 2002; Sigala 2003; Shon et al., 2003; Yoon et al., 2005; Mattig and Hausweiler, 2017; Somoskői et al., 2019
3.	Business Model	Yoon, et al., 2005; Mattig and Hausweiler, 2017

4	Quality of Process	Latrine, 2016; Mattig and Hausweiler, 2017; Somoskői et al., 2019
5	Alliance	Brueckner and Whalen, 2000; Weber 2005; Luzzarini, 2007;
6	Distribution Channel	Connolly et al., 1998; Morrell, 1998 Buhalis et al., 2000;Jarach, 2002; Sigala 2003; Shon et al., 2003; Bilotkach, 2005; Yoon et al., 2005; Somoskői et al., 2019
7	Operating Cost	Jarach, 2002; Shon et al., 2003; Yoon et al., 2005; Mattig and Hausweiler, 2017
8	Flight Optimization	Mattig and Hausweiler, 2017
9	New Market Reach	Mattig and Hausweiler, 2017
10	Globalization of Airlines	Sigala 2003; Mattig and Hausweiler, 2017

Table 2: Transitive Matrix

	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	Driving
D1	1	1	1	1*	1*	1*	1*	1*	1*	1*	10
D2	1	1	1	1*	1*	1*	1*	1*	1*	1*	1
D3	0	0	1	1	1	1	1	1*	1*	1*	8
D4	0	0	0	1	0	0	1	1	0	1*	5
D5	0	0	0	0	1	0	0	1	1	1*	4
D6	0	0	0	0	0	1	0	1	1	1*	4
D7	0	0	0	1	0	0	1	1*	0	1*	5
D8	0	0	0	0	0	0	0	1	1	1	3
D9	0	0	0	0	0	0	0	1	1	1	3
D10	0	0	0	0	0	0	0	0	0	1	1
Dependence	2	2	3	4	4	4	5	9	7	10	

* Indicates transitive relationship

Step 5: After that, Transitive reachability matrix is converted into Reachability matrix .

Step 6 Then, level partitioning is performed to assign each variable to their respective hierarchy (Nasim, 2011). Here, we drive the sets for each factor influencing globalization in the aviation industry**.** The set of a particular element will include the entire selected factors for which the cell entry is given as 1 in the corresponding row that means the factor itself and all the other factors that are being influenced by the factors which are under consideration (Prasad and Suri, 2011).Antecedent set of the particular element will include all the factors for which the cell entry is 1 in the corresponding column that states the factor itself and all the other factors that influence the factor which is under consideration. From the above two sets, an intersection set is formed, that includes all the common elements in the reachability matrix and of the antecedent set**s.** If reachability matrix is same as intersection sets for any element, then that element is placed at level 1. That element is kept at the top of the modified TISM model of hierarchy (Muruganantham et al., 2018)**.** After all first-level elements are identified, remove those elements from the table and repeat the steps until all factors are being defined by their specific levels in the formed model**.** Table 3 shows the partitioning of all factors into their defined levels.

Table 3: List of factors and their levels in TISM

S. No	Factor Code	Factors	Level
1.	D1	IT infrastructure	Level -5
2.	D2	Digital literacy	Level -5
3.	D3	Business Model	Level- 4
4	D4	Quality of Process	Level -3
5	D5	Alliance	Level-3
6	D6	Distribution Channel	Level-3
7	D7	Operating cost	Level-3
8	D8	Flight Optimization	Level-2
9	D9	New Market Reach	Level-2
10	D10	Globalization	Level-1

Step 7: After doing partitioning of all the identified factors, diagraph is formed and Only significant transitive links are retained (Figure 1). Then to depict the relationship among the elements, we connect the factors at various levels by arrows; e.g., if factor 1 leads to factor 2, then an arrow pointing towards two from one drawn. If both factors are going to affect each other, then a bidirectional arrow is used to connect those two factors (Jayalakshmi and Pramod, 2015).

Step 8. Finally conceptual inconsistencies are checked and diagraph is transformed into modified TISM model. The interpretation of established relationship is done to explain the way one variable is influencing another variable.

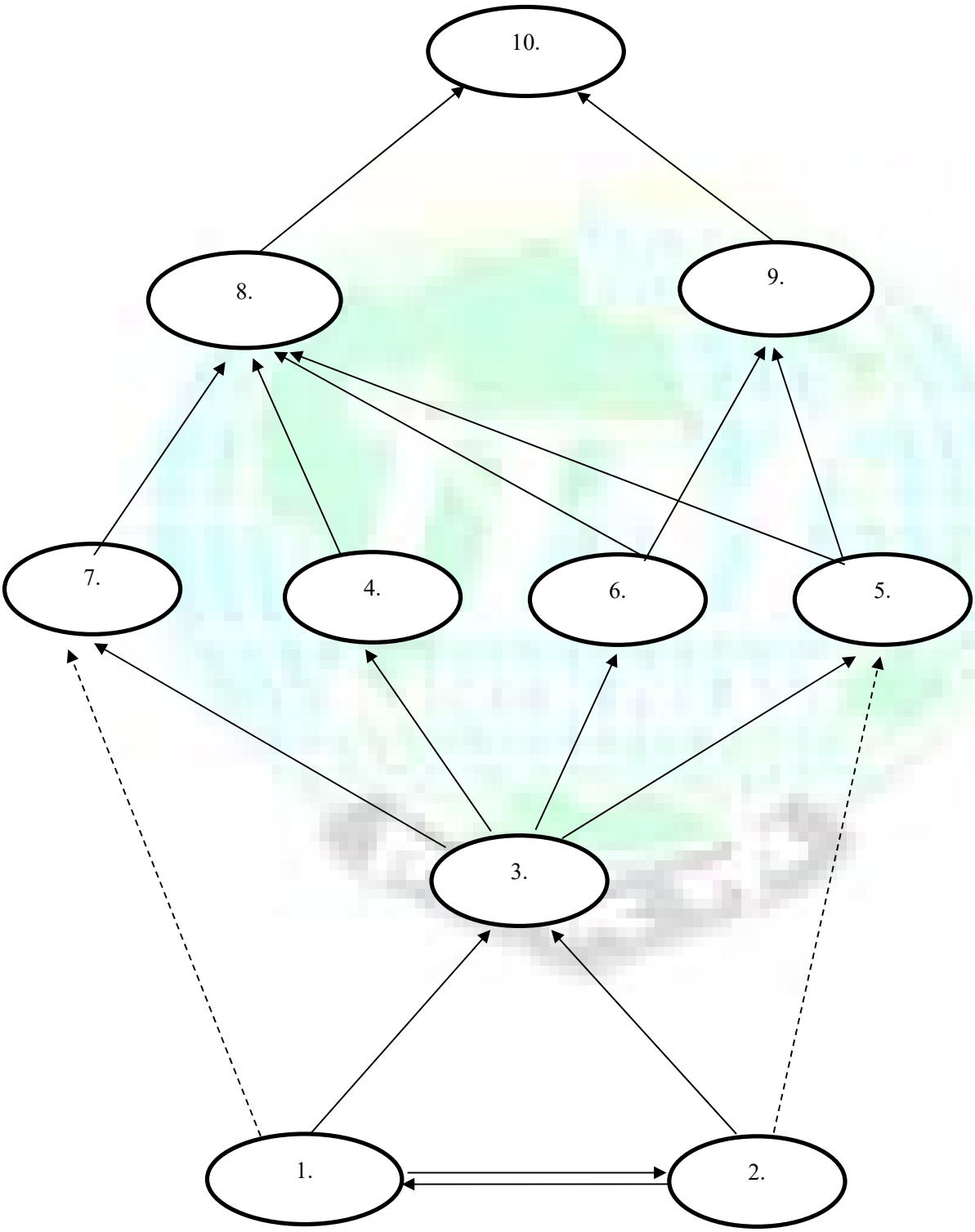


Figure 1: Diagraph

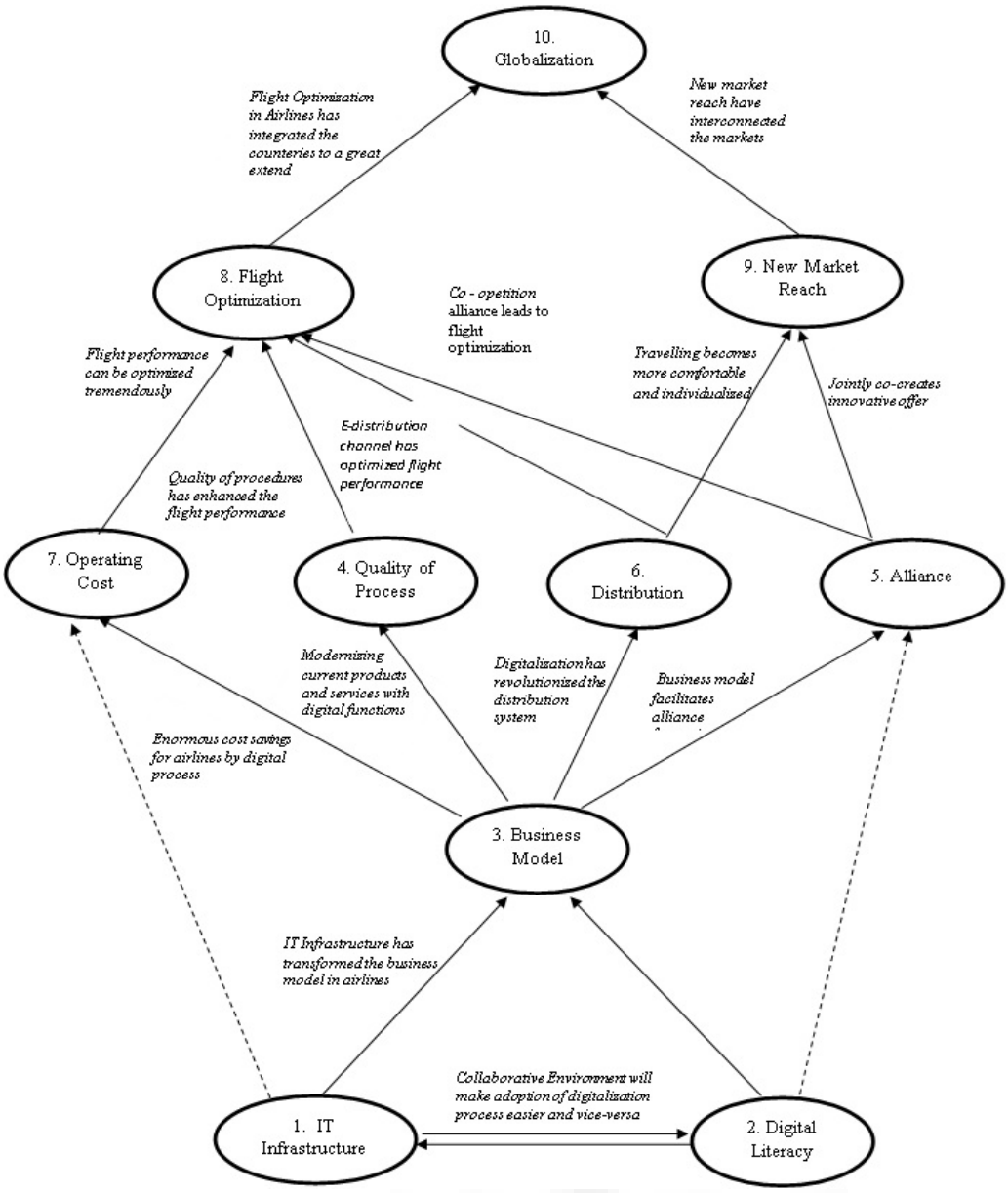


Figure 2: TISM Model

5 MICMAC Analysis

MICMAC helps to scrutinize the factors according to their driving and dependence power.
It results into categorization of 10 determinants into 4 quadrants, namely autonomous elements, dependent elements, linkage elements and independent elements (Shibin et al., 2016). The 'autonomous group' is having weak driving and dependence. The second group is of 'dependent variables' that are having weak driving and strong dependence. The third group is of 'linkage variables' having strong

driving and strong dependence. These variables are very unstable and hence need special attention. The fourth group is of 'independent variables' and are having strong driving and weak dependence (Refer figure 3).

Driving Power												
	11											
	10		D1, D2									
	9											
	8			D3								
	7											
	6											
	5				D4	D7						
	4				D5, D6							
	3							D9		D8		
	2											
	1										D10	
		1	2	3	4	5	6	7	8	9	10	11
	Dependence Power											

Figure 3: Analysis of Driving and Dependence power of

6 Discussion and Managerial Implications

The key objective of this research effort is to study the interrelationship among the identified factors and the globalization process. Modified TISM framework is developed to recognize the variables that need to be stressed if administration has to increase the process of global integration in an airlines industry. In total, 10 determinants affecting the strategic management modeling of Airlines industry have been identified based upon the exuberant literature review and from the brainstorming session of the industry veterans of Airline industry. The selected factors have been placed in hierarchical levels using TISM methodology. The elements placed at the bottom are significant factors for strategic organizational management in Airlines industry and hence, special emphasize should be given to them in decision making. On the other hand, other variables placed at the top of the TISM modeling are having strong dependence power. Then, an attempt is made to group the factors into 4 clusters by their driving and dependence. It is found that factors at the bottom are having the strongest driving power and are independent variables. IT infrastructure, Digital literacy, Business Model, Quality of process and Operating cost are depicted as the driving variables in the developed model. These factors in the given model need to be managed effectively to accelerate the globalization process in an aviation sector. Hence, airlines administration can easily frame the policies by aiming the factors positioned on the bottom of the hierarchy. Distribution channel and Alliance are autonomous variables having low dependence and low

driving. In our analysis, no linkage variable is found. Flight optimization, new market reach, is placed at the top of the hierarchy and hence is dependent variable.

Practical Implications: The developed TISM framework will be a great help to the Airline Management. Top administrators in airline sector should emphasize on digitalization and flexible systems in organizational management to improve the performance of Airlines. With the implementation of developed TISM model in Airline industry, organizations would become more productive and competitive in the market.

7 Scope for future research work:

In the current study, only ten factors that address the impact of digitalization in the process of globalization in an airlines industry are selected.The TISM model developed in this research study is created from the opinion of few experts, and hence a certain extent of biases is possible. This framework can further be validated using structural equation modeling technique.

References

Bilotkach, V. (2005). Price competition between international airline alliances. *Journal of Transport Economics and Policy (JTEP)*, *39*(2), 167-190.

Brueckner, J. K., & Whalen, W. T. (2000). The price effects of international airline alliances. *The Journal of Law and Economics*, *43*(2), 503-546.

Buhalis, D. (2000). Distribution channels in the changing travel industry. *The International Journal of Tourism Research, 2*(5), 357.

Connolly, D. J., Olsen, M. D., & Moore, R. G. (1998). The Internet as a distribution channel. *Cornell hotel and Restaurant Administration Quarterly*, *39*(4), 42-54.https://doi.org/10.1177/001088049803900408

Dubey, R., & Ali, S. S. (2014). Identification of flexible manufacturing system dimensions and their interrelationship using total interpretive structural modelling and fuzzy MICMAC analysis. *Global Journal of Flexible Systems Management*, *15*(2), 131–143. https://doi.org/10.1007/s40171-014-0058-9

Jarach, D. (2002). The digitalisation of market relationships in the airline business: the impact and prospects of e-business. *Journal of Air Transport Management*, *8*(2), 115-120.

Jayalakshmi, B., & Pramod, V. R. (2015). Total Interpretive Structural Modeling (TISM) of the Enablers of a Flexible Control System for Industry. *Global Journal of Flexible Systems Management*, *16*(1), 63–85. https://doi.org/10.1007/s40171-014-0080-y

Laitinen, M. (2016). Developing a Supplier Sustainability Program in ICT Industry.

Lazzarini, S. G. (2007). The impact of membership in competing alliance constellations: Evidence on the operational performance of global airlines. *Strategic Management Journal*, *28*(4), 345-367.

Morrell, P. S. (1998). Airline sales and distribution channels: the impact of new technology. *Tourism Economics*, *4*(1), 5-19. .https://doi.org/10.1177/135481669800400101

Muruganantham, G., Vinodh, S., Arun, C. S., & Ramesh, K. (2018). Application of interpretive structural modelling for analysing barriers to total quality management practices implementation in the automotive sector. *Total Quality Management and Business Excellence*, *29*(5–6), 524–545. https://doi.org/10.1080/14783363.2016.1213627

Nasim, S. (2011). Total interpretive structural modeling of continuity and change forces in e-Government. *Journal of Enterprise Transformation*, *1*(2), 147–168. https://doi.org/10.1080/19488289.2011.579229

Prasad, U. C., & Suri, R. K. (2011). Modeling of continuity and change forces in private higher technical education using total interpretive structural modeling (TISM). *Global Journal of Flexible Systems Management*, *12*(3–4), 31–40. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84866661763&partnerID=tZOtx3y1

Shibin, K. T., Gunasekaran, A., Papadopoulos, T., Dubey, R., Singh, M., & Wamba, S. F. (2016). Enablers and Barriers of Flexible Green Supply Chain Management: A Total Interpretive Structural Modeling Approach. *Global Journal of Flexible Systems Management*, *17*(2), 171–188. https://doi.org/10.1007/s40171-015-0109-x

Shon, Z. Y., Chen, F. Y., & Chang, Y. H. (2003). Airline e-commerce: the revolution in ticketing channels. *Journal of Air Transport Management*, *9*(5), 325-331.

Sigala, M. (2003). *Evaluating the electronic market hypothesis in the airline distribution chain*. na.

Somoskői, B., Spahr, S., Rios, E., Ripolles, O., Dominiak, J., Cserveny, T., ...&Muntés- Mulero, V. (2019). Airline Application Security in the Digital Economy: Tackling Security Challenges for Distributed Applications in Lufthansa Systems. In *Digitalization Cases* (pp. 35-58). Springer, Cham.

Sushil (2012).Interpreting the Interpretive Structural Model. *Global Journal of Flexible Systems Management*, 13(2), 87-106.

Sushil (2017). Modified ISM/TISM Process with Simultaneous Transitivity Checks for Reduced Direct Pair Comparisons. *Global Journal of Flexible Systems Management*, *18*(4), 331-351.

Weber, K. (2005). Travelers' perceptions of airline alliance benefits and performance. *Journal of Travel Research*, *43*(3), 257-265.

Yoon, D. Y., Lee, H. Y., Kim, K. W., & Yoon, M. G. (2005). e-Business Impacts on Distribution Channel in Airlines. *Korean Management Science Review*, *22*(1), 149-165.

APPENDIX

Table 1: Partitioning Matrix (Iteration I)

Iteration 1	Reachability Set	Antecedent Set	Intersection Set	Level
D1	1,2,3,4,5,6,7,8,9, 10	1,2	1,2	
D2	1,2, 3,4,5,6,7,8,9,10	1,2	1,2	
D3	3,4,5,6,7,8,9, ,10	1, 2,3	3	
D4	4,7,8,10	1, 2,3, 4, 7	4, 7	
D5	5,8,9, 10	1,2,3,5	5	

D6	6,8, 9,10	1,2,3,6	6	
D7	4,7,8,10	1, 2, 3, 4, 7	4, 7	
D8	8,9, 10	1, 2, 3,4,5,6,7,8,9	8,9,	
D9	8,9, 10	1, 2, 3,5,6,8,9,	8,9	
D10	10	1,2,3,4,5,6,7,8,9,10,	10	Level -1

Table 2 : Partitioning Matrix (Iteration II)

Iteration 2	Reachability Set	Antecedent Set	Intersection Set	Level
D1	1,2,3,4,5,6,7,8,9,10	1,2	1,2	
D2	1,2,3,4,5,6,7,8,9,10	1,2	1,2	
D3	3,4,5,6,7,8,9,10	1, 2,3	3	
D4	4,7,8,10	1, 2,3, 4,7	4,7	
D5	5,8,9,10	1,2,3,5	5	
D6	6,8, 9,10	1,2,3,6	6	
D7	4, 7,8,10	1, 2, 3, 4,7	4,7	
D8	8,9	1,2,3,4,5,6,7,8,9	8,9	Level -2
D9	8,9	1, 2, 3,5,6,8,9	8,9	Level -2

Table 3: Partitioning Matrix (Iteration III)

Iteration 3	Reachability Set	Antecedent Set	Intersection Set	Level
D1	1, 2, 3,4,5,6,7	1,2	1,2	
D2	1, 2, 3,4,5,6,7	1,2	1,2	
D3	3,4,5,6,7	1, 2,3	3	
D4	4, 7	1, 2,3, 4, 7	4, 7	Level -3
D5	5	1,2,3,5	5	Level -3

D6	6,	1,2,3,6	6	Level -3
D7	4, 7,	1, 2, 3, 4, 7	4, 7	Level -3

Table 4 : Partitioning Matrix (Iteration IV)

Iteration 4	Reachability Set	Antecedent Set	Intersection Set	Level
D1	1, 2, 3,	1,2	1,2	
D2	1, 2, 3,	1,2	1,2	
D3	3,	1, 2,3	3	Level -4

Table 5: Partitioning Matrix (Iteration V)

Iteration 5	Reachability Set	Antecedent Set	Intersection Set	Level
D1	1, 2, 3,	1,2	1,2	Level -5
D2	1, 2, 3,	1,2	1,2	Level -5

Business Statistics based digital ecosystem for organizational sustenance

Udaya Pratap Singh, Ratnesh Mathur

Indian Institute of Management Kashipur - Dehradun Campus
Ministry of HRD Government of India

Office: 135, Vasant Vihar, Opposite FRI, Chakrata Road
Dehradun-248001 Uttarakhand INDIA
0135 2769962
udaya.epgp1828@iimkashipur.ac.in, ratnesh.epgp1821@iimkashipur.ac.in

Abstract. Organizational sustenance necessitates holistic and unified enterprise wide insights for data driven decisions. Companies are investing a lot of time and money in collecting data from internal and external sources, hoping to utilize it for identifying better future trends. The application of Business Statistics on data plays an imperative role in redefining the company's decision making approaches. There is a need for a flexible approach to statistically analyze the data. The paper highlights the building blocks needed to be a data driven digital enterprise and recommends the statistical approaches for achieving informed decisions. The study also outlines the challenges faced during data modeling to building statistical insights and introduces new digital ecosystem to harness the data of the organization. The paper is based on a case study of applying statistical analysis on Automobile majors in India to derive what is working for one and what are the common pitfalls for others. The paper highlights the need to create a digital ecosystem which statistically analyzes the current trends and move towards business agility.

Keywords: Data driven enterprise, Business statistics, Analytics, Digital ecosystem, Organizational sustenance

1 Introduction

It is imperative for organization today to be self-aware about the happenings in the organization and how the external factors affect the organization performance. The organization need to collect the data from different sources which could be an internal data like balance sheets, income statements or external reactions from face book or twitter and then understand and analyze the raw data to make a meaningful insights to have informed and better decisions.
The data can be in various forms like processed/structured data coming from financial statements of the organizations or it can be raw/unstructured data like clickstream data for an advertising campaign.
The organization should have defined landscape for data scoping with interfaces to effectively capture the data and also should have the necessary infrastructure in place to have the ability to process the sometimes huge volume of data from these heterogeneous sources.

The paper outlines:

- Key matrices that an organization should be collecting from predefined sources that help it gauge the performance of the organization with a holistic view.
- Data Analysis using statistical technique of correlation to establish relationship between profitability, asset management, liquidity, financial management.

- Reference architecture for data storage and fast processing with well-defined integration points to get data from various sub units of the organization and then help create a platform for taking data driven decisions.
- Compare the performance of two Auto majors using key business performance metrics

2 Problem Statement

One of most pertaining challenges in building a statistical based decision framework is to select best model for analysis. The digital ecosystem should be holistic in nature addressing all the aspects of infrastructure, storage, data management and statistical requirements. Some of the key problems associated are:

- Getting the best data quality for statistical analysis and processing. How to trust the data used in the analysis and be confident of the output
- How have the right people and processes to comprehend and decide on the quality of the decisions that can be derived from the statistical analysis.
- The ever increasing volume of data that can be structured or unstructured.
- How to ensure relevant data (real-time or historic) for building right models that can be Data modeled with high volume data
- Data Lineage within and across the digital ecosystem for better data management
- Adherence to Data regulation and compliance objectives
- Down streaming the statistical inferences to robust and dependable applications for near real time decision making like smart metering, best routes etc.
- Easy maintenance of the digital ecosystem with continuous real time feeds along with historical information that has ready interfaces.

3 Proposed Solution

The paper outlines a digital ecosystem capable of harnessing statistical models, building relevant analytics to drive the operations and decision making process.

The solution consists of three parts as below

1. Defining the relevant metrics to drive the business decisions
2. Use the statistical technique to establish the relationship between factors which can influence the business decisions
3. Provide a reference architecture for ingesting, integrating, cleansing, modelling and utilizing the statistical techniques to map them with respective business functions for decision support

3.1. Defining the relevant metrics to drive the business decisions

Financial\Operational Ratios	Calculations
Financial Leverage	Total assets/Total equity
Asset Turnover Ratio	Income from operations/Total assets
OPM	EBIT /Income from operations
ROE	Leverage*Asset Turnover Ratio*OPM*Interest Factor*Tax Factor
ROIC/ROCE	(EBIT *(1-Effective Tax Rate))/(Total equity+Total non-current liabilities)
Invested Capital Turnover Ratio	Income from operations/(Total non-current liabilities Total equity)
Inventory Turnover Ratio	Income from operations/Trade receivables
Debtors Turnover Ratio	Income from operations/Trade receivables
Creditors Turnover Ratio	Total Material Consumed/Trade payable
Working Capital Turnover Ratio	Income from operations/Net Working Capital
Cash Cycle	Days Cash+Days Receivables+Days Inventory-Days Payable
Quick Ratio	(Total current assets-Inventories)/Total current liabilities
Current Ratio	Total current assets/Total current liabilities

3.2. Correlation between business factors for Statistical inferences: A Comparative Analysis between two Automobile Majors

Data sampling, collection and analysis

The data has been collected using non – probability sampling technique from sources of secondary data as represented in the Annual Report of the companies, internet, textbooks, journals and articles.

The statistical technique adopted for study is Simple Regression, as it measures the degree of association with two variables. The correlation derived will be analyzed at 10% significance level. The correlation coefficient is defined as below

Correlation Coefficient (r) =

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

Where n = Number of observations
x = Independent Variable
y = Dependent Variable

Data Analysis

Secondary data is collected and presented for two Indian automobile majors and analysis of the financial ratio data, other company data using correlation analysis is done to draw conclusions as below

- Correlation between Asset Management and Profitability
- Correlation between Financial Structure and Profitability
- Correlation between Liquidity and Profitability

Correlation between Asset Management and Profitability

Tata Motors									
Factor	Year					Correlation Coefficient (r)	Hypothesis	Test of Significance	Decision
	2018	2017	2016	2015	2014				
Asset Turn Over Ratio (X)	1.54	1.14	1.18	1.06	1.02	0.214858180 6	H0:Asset Turn Over ratio is positively correlated with profitability, i.e. return on assets (ROA)	. At 2 degrees of freedom, and at 10% level of significance, the critical value of (r) is + 0.900	Since the computed value of (r) is less than the critical value of (r), accept the null hypothesis
Return on Assets Including Revaluations *(Y)*	59.4	62.32	68.51	46.18	59.58				

Source: Researcher's calculation

Maruti Suzuki									
Factor	Year					Correlation Coefficient (r)	Hypothesis	Test of Significance	Decision
	2018	2017	2016	2015	2014				
Asset Turn Over Ratio (X)	2.02	2.03	2.14	2.15	2.05	-0.5569548833	H0: Asset Turn Over ratio is positively correlated with profitability, i.e. return on assets (ROA)	. At 2 degrees of freedom, and at 10% level of significance, the critical value of (r) is -0.900	Since the computed value of (r) is less than the critical value of (r), accept the null hypothesis
Return on Assets Including Revaluations *(Y)*	1382.33	1206.01	989.28	784.7	694.45				

Source: Researcher's calculation

Correlation between Financial Structure and Profitability

Tata Motors									
Factor	Year					Correlation Coefficient (r)	Hypothesis	Test of Significance	Decision
	2018	2017	2016	2015	2014				
Debt Equity Ratio (X)	0.81	0.89	0.61	1.35	0.76	-0.9488570614	H0:Debt Equity ratio is positively correlated with profitability, i.e. return on assets (ROA)	. At 2 degrees of freedom, and at 10% level of significance, the critical value of (r) is -0.900	Since the computed value of (r) is more than the critical value of (r), reject the null hypothesis
Return on Assets Including Revaluations *(Y)*	59.4	62.32	68.51	46.18	59.58				

Source: Researcher's calculation

Maruti Suzuki									
Factor	Year					Correlation Coefficient (r)	Hypothesis	Test of Significance	Decision
	2018	2017	2016	2015	2014				
Debt Equity Over Ratio (X)	--	0.01	--	0.01	0.08	-0.6362461116	H0:Debt Equity Ratio is positively correlated with profitability, i.e. return on assets (ROA)	. At 2 degrees of freedom, and at 10% level of significance, the critical value of (r) is -0.900	Since the computed value of (r) is less than the critical value of (r), accept the null hypothesis
Return on Assets Including Revaluations *(Y)*	1382.33	1206.01	989.28	784.7	694.45				

Source: Researcher's calculation

Correlation between Liquidity and Profitability

Tata Motors									
Factor	Year					Correlation Coefficient (r)	Hypothesis	Test of Significance	Decision
	2018	2017	2016	2015	2014				
Quick Ratio (X)	0.44	0.42	0.41	0.42	0.36	-0.1144278838	H0:Quick ratio is positively correlated with profitability, i.e. return on assets (ROA)	. At 2 degrees of freedom, and at 10% level of significance, the critical value of (r) is -0.900	Since the computed value of (r) is less than the critical value of (r), accept the null hypothesis
Return on Assets Including Revaluations *(Y)*	59.4	62.32	68.51	46.18	59.58				

Source: Researcher's calculation

Maruti Suzuki									
Factor	Year					Correlation Coefficient (r)	Hypothesis	Test of Significance	Decision
	2018	2017	2016	2015	2014				
Quick Ratio (X)	0.31	0.35	0.45	0.41	0.67	-0.8212317603	H0:Quick Ratio is positively correlated with profitability, i.e. return on assets (ROA)	. At 2 degrees of freedom, and at 10% level of significance, the critical value of (r) is -0.900	Since the computed value of (r) is less than the critical value of (r), accept the null hypothesis
Return on Assets Including Revaluations *(Y)*	1382.33	1206.01	989.28	784.7	694.45				

Source: Researcher's calculation

The above correlation analysis depicts how keys metrics like asset turnover ratio, debt equity ratio and quick ratio relate with profitability in the context of automobile majors Tata motors and Maruti Suzuki.

The analysis reflects that most of these ratios are correlated with profitability and hence operational changes to increase the profitability may affect the other areas like inventory management, financial management and delivery cycle and vice versa.

Furthermore the secondary data can also be analyzed to derive inference on company's performance. Below is the sample data comparison of 2017-2018 between two automobile majors and inferences*.

Operational Metrics/Ratios	Tata Motors	Maruti Suzuki	Inference
Financial Leverage	2.44	2.45	With a Lower Financial Leverage Maruti Suzuki (MS) is utilizing the resources better than Tata motors (TAM). Tata motors needs to cut down on debt for finances.
OPM	15%	86%	Operating margin measures how much profit a company makes on a dollar of sales. MS fares again better.
Invested Capital Turnover Ratio	1.62	5.72	MS has a better utilization of invested capital.
Inventory Turnover Ratio	7.01	28.96	MS has better utilization of inventory to sales
Debtors Turnover Ratio	14.85	66.99	MS has a better line of debtors that pays its debts quicker than TAM
Creditors Turnover Ratio	2.60	2.56	Again TAM maintains a better debt payment record than MS
Capital Intensity Ratio	4.00	9.08	A high capital intensity ratio may due to lower utilization of the company's assets or it may be because the company's business is more capital intensive and less labor intensive (for example, because it is automated)
Current Ratio	0.80	0.95	Both the companies need improvement in cutting down on liabilities
Earning per employee	4	20	MS Has better employee utilization w.r.t to total sales

Source: Researcher's calculation

**Disclaimer: Inferences are derived based on researcher's calculation and interpretations only for study and is not indicative of market condition.*

The table above provides a brief overview how business metrics can be utilized for taking operational decisions on statistics collected from internal and external sources.

3.3. Reference architecture-digital ecosystem

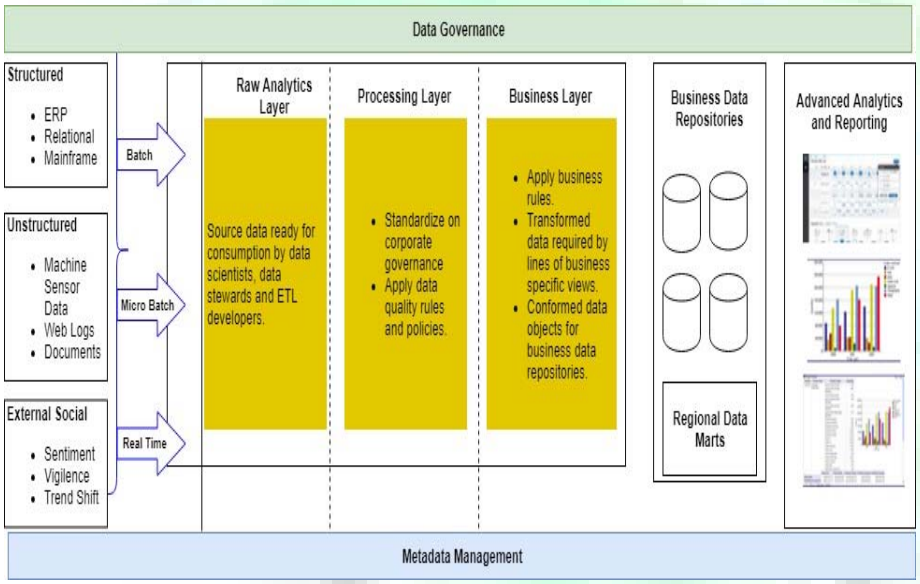
Statistical Analysis requires good quality data to create decision support models. The reference architecture below outlines a digital platform to provide data governance and data management capabilities that an organization requires building such models.

The structured/unstructured and external data from social media platforms, stock market including the data from real time feeds can be processed to ensure data accuracy and conformity. The architecture will have three layers

Raw data Layer is used for statistical modelling and analysis

Processing Layer standardizes the formats and apply data quality rules as required

Business Layer utilizes the processed information and provide inferences for specific business contexts. This layer will be utilized by various business functions like Marketing, HR, and Operations for deriving metrics to gain advantage on making decisions.



Source: Researcher's proposed solution

The proposed digital ecosystem will interface with analytical and cognitive software for building predictive and prescriptive models for contextual decision making.

Conclusion

The paper draws the following conclusions

I. Metrics can be defined for analyzing organization's own performance and further can be utilized for a comparative study among peers in the industry.
II. There is a correlation between metrics like Asset Management, Financial Structure, and Liquidity Profitability. Similar analysis can be done for other operational metrics to see the correlation with business factors and stresses the importance of their study.
III. A digital ecosystem is capable of catering to the data collection requirement and can be harnessed by enterprises for inferential statistics modelling that will aid for long term sustenance of the organization.

Any organization that fails to identify the requirement of being data driven will underutilize the technological advancements and may suffer due to future disruptions.

References

1. David Hawkins, Robert Anthony, Kenneth A. Merchant (2010): Accounting: Texts and Cases Hardcover, Thirteen Edition
2. I. Levin Richard, H. Siddiqui Masood , S. Rubin David (2017): Statistics for Management, Eighth edition
3. Annual reports: Maruti Suzuki 2017-2018, 2016-2017, 2015-2016, 2014-2015
4. Annual reports: Tata Motors 2017-2018, 2016-2017, 2015-2016, 2014-2015

Websites

1. Www.Tatamotors.Com
2. https://www.talend.com
3. https://www.investopedia.com
4. https://xplaind.com
5. www.marutisuzuki.com
6. https://www.iiste.org/Journals/index.php/RJFA/article/view/11414

Generic System Archetypes as Decision Making Tools- Substantiating through Stock & Flow Representation

Anab Kidwai* and Anupam Saraph†

* Indian Institute of Management, Lucknow & Symbiosis International University, Pune
(anab.kidwai@gmail.com, anab_kidwai@iiml.ac.in)
† Symbiosis Institute of Computer Studies and Research (SICSR), Pune
(anupamsaraph@gmail.com)

Abstract

The paper identifies the limitation of causal-loop diagrams of ignoring the accumulation and therefore aims to identify the stocks and flows that exist in causal-loop diagrams. By simulating the totally generic system archetypes, this paper utilizes the ability of stock and flow diagrams to appreciate the patterns of behavior of an accumulation over time and provide an effective mechanism for decision making in complex dynamic systems. System archetypes are causal feedback structures, formed by combination of reinforcing and balancing feedback loops, that exhibit characteristic outcome behavior over time. In order to simplify the classification of system archetypes, Wolstenholme (2003) proposed totally generic two-loop archetypes by reordering the reinforcing and balancing feedback loops into four mutually exclusive ways. This research recognizes the crucial role of accumulation processes in understanding the behavior exhibited through behavior-over-time graphs generated by simulating the corresponding stock-flow diagrams for each of the four archetypes. The approach illustrated in this paper demonstrates stock-flow diagrams as archetypal decision making structures for comprehending the behavior of the generic system under study based on the principles of system dynamics methodology.

Keywords: decision making, system archetypes, feedback loops, reinforcing and balancing, stock-flow diagrams

Introduction

Globalization has accelerated the growth of complex systems that feed into each other to produce extremely complex unpredictable effects (Arnold & Wade, 2015). Systems thinking help delve into the roots of the behavior of complex systems in order to better predict them. Decision making corresponds to assessing and selecting the best alternative by considering its effect on the system or organization. Therefore, decision making in any system intrinsically follows the law of causality, which basically refers to the generation and determination of one phenomenon by another. A system's perspective provides the means to understand the dynamics resulting from the connection between the action and outcome as well as between different actions within the system. Understanding any system in terms of actions leading to results/ outcomes and those outcomes further driving the action involves appreciating the concept of feedback which is invisible at that instant, yet omnipresent and becomes apparent after a delay. Feedback loops describe the growth and goal-seeking behavior of systems by causing output from one node to influence input to the same node. The growth and goal-seeking behavior of feedback loops is identified by their reinforcing and balancing effect. A reinforcing loop feeds on itself to produce growth or decline whereas a balancing loop attempts to move current state to a desired state through some action (Bellinger, 2004). System archetypes are causal feedback structures, formed by combination of reinforcing and balancing feedback loops, that exhibit characteristic outcome behavior over time. Identification of these archetypal feedback structures before taking any alternative course of action in any system/ organization can positively influence decision making. Systems archetypes help understand similar systemic challenges

experienced by many organizations and design effective action plan for addressing them (Kim & Anderson, 1998).

In order to simplify the classification of system archetypes, Wolstenholme (2003) proposed totally generic two-loop archetypes onto which existing system archetypes can be mapped as special cases. These fundamentally reduced set of four two-loop archetypes were achieved by reordering the reinforcing and balancing feedback loops into four mutually exclusive ways.

Causal loop diagram is a qualitative tool for identifying and communicating feedback but the limitation of using CLD is that it ignores the crucial role of accumulation processes. Therefore, it is necessary to expose the accumulation that exist in archetypes, and hence the use of stock-flow diagrams become implicit. Wolstenholme (2004) illustrates the relationship that exist between causal-loop diagrams and stock-flow diagrams in order to identify the stocks and flows that exist in the causal-loop diagrams.

The paper transforms system archetypes, presented as causal-loop diagrams into formal quantitative models using stock and flow diagrams. Hence, this paper demonstrates Stock-Flow diagrams as archetypal decision making structures for comprehending the behavior of the generic system under study based on the principles of system dynamics methodology. The research paper along with appreciating the strategy of condensing archetypal structures to a set of four totally reduced generic archetypes, brings forth the potential of stock-flow modelling as an experimental tool for evaluating planning policies (what-if analysis) (Vlachos, Georgiadis & Iakovou, 2007) and arriving at best decisions.

Purpose of the Paper

The primary objective of this research is to illustrate an approach of modelling the system archetypes, that are presented as causal-loop diagrams by Wolstenholme (2003), using stock and flow diagrams. The paper identifies the limitation of causal-loop diagrams of ignoring the accumulation and therefore aims to identify the stocks and flows that exist in causal-loop diagrams. As the critical role of accumulation is ignored in causal-loop diagrams, by simulating the totally generic system archetypes, identified by Wolstenholme (2003), this paper utilizes the ability of stock and flow diagrams to appreciate the patterns of behavior of an accumulation over time and provide an effective mechanism for decision making in complex dynamic systems.

Systems Approach Catalyzing Organizational Decision-Making

Systems approach brought a breakthrough in organization management by moving away from the classical reductionist-insulation approach of seeing linear cause and effect chain. Systems thinking views the processes of changes as multi-directional and recognizes the structure and mutual relationship among the interactions within a system that drives change (Senge, 1991). Basically, systems are of two types- 'Open Systems' and 'Feedback Systems'. The systems where the outputs just respond to inputs and have no influence on the inputs are characterized as open systems. A feedback system is one where results from past action of a system influence and control future actions (Forrester, 1968). In simpler words, feedback or closed system is influenced by its own past behavior whereas open systems are not. Feedback can be positive or negative. Positive feedback generates growth processes where the result of an action acts as a multiplier of that action and such loops are called reinforcing feedback loops. The second class of feedback systems, where system seeks a goal and responds as a consequence of failing to achieve the goal are negative or balancing feedback loops. Insensitivity to feedback and underestimating the time lags between action and response work as a catalyst in increasing the complexity of problems (Sterman, 1989). Therefore, feedback systems are pertinent for solving complex problems in dynamic systems.

Generic Structures as Theories of Behavior

Generic structures give powerful insights that are applicable and transferable from one system to another. Systems archetypes are a set of well-defined generic structures that illustrate common patterns of behavior reflected by the underlying structure in systems (Kidwai & Saraph, 2016). In organizations, typical structure patterns are repeated and systems archetypes will be helpful in recognizing these patterns (Ligarski, 2018). Any archetype comprises of: Intended Consequence (IC) loop, where the loop is formed by the action done to fulfill the intended purpose of that action, Unintended Consequence (UC) loop, which is generated by the reaction triggered in some other part of the system or outside, Delay which is a time lag before the unintended consequence manifests itself and system boundary that hides the unintended consequence from the initiator. These structures stem from various combinations of reinforcing and balancing feedback loops. As suggested by Wolstenholme (2003), a generic two-loop archetypes formed from four mutually exclusive combinations of reinforcing and balancing feedback loops are the totally generic class of systems to which special cases belong. Understanding generic structures/ archetypes help take correct decisions as the behavior of the archetype, mapped onto the problem, assists in predicting the reaction of the system (Maani & Maharaj, 2004).

Stock-Flow & Causal-Loop Diagrams as Tool for Assessing Behavior

The true power of system dynamics lies in appreciating both qualitative as well as quantitative modelling (Wolstenholme, 1999). However, as System dynamics incorporates the study of the relationship between feedback structure and dynamic behavior, inferring the behavior from the structure is of great importance in understanding the dynamics of a system. Explication of behavior in causal-loop diagrams is perplexing as they obscure the stock and flow structure of systems (Richardson, 1986). CLDs can be used prior to simulation to depict the causal mechanism hypothesized to underlie the reference mode of behavior over time (Binder et. Al., 2004; Randers, 1980; Richardson, 1999). However, the dynamics of the system can be better explored through the patterns of behavior of an accumulation over time. As causal loops ignore the process of accumulation, this important aspect of comprehending the dynamics of behavior is missed. The problem lies in the inability of causal loop diagrams to distinguish conserved flow (rate-to-level links) from information flows. Therefore, stock-flow diagrams offer deeper insights into the dynamics of behavior and are better suited for decision making in complex systems.

Simulation of Systems Archetypes

Simulating systems archetypes is an approach to explore the extent to which the structures behave as expected. Stock and flow diagrams for each archetype make them readily understandable and graphs generated through simulation of systems archetypes show the possible behavior patterns provides a guideline for their use in specific circumstance (Dowling, MacDonald & Richardson, 1995). According to Coyle (1996), turning qualitative models into quantitative simulation models support policy design and McConnell (2010) finds that policy design is the basis of success of any initiative. Therefore, simulating systems archetypes gives us complete solution to any complex dynamic problem by identification of the underlying archetype in any system and understanding the behavior exhibited by the simulation of that archetype. Both the qualitative and quantitative aspect will enable policy makers and decision takers in dealing with complex problems in dynamic systems.

Method

Based on the purpose of the initiative, Wolstenholme (2003) categorized actions and reactions into those improving achievement of a system through reinforcing feedback loops and those controlling problems in a system through balancing feedback loops. Combining these two feedback loops into four mutually exclusive ways resulted into a totally generic set of following four archetypes:

- *Underachievement*, where intended achievement fails to be realized. An action to achieve intended outcome triggers a reaction in another sector that creates the balancing loop which limits the outcome.
- *Out of Control*, where intended control fails to be realized. A balancing loop is initiated in one sector of the organization/ system to control the problem. Reaction from another sector creates a reinforcing loop resulting in further worsening of the problem.
- *Relative Achievement*, where achievement is gained at the expense of another. The two reinforcing loops intend to achieve relative advantage over one another, but their combination forms a zero-sum game.
- *Relative Control*, where control is gained at the expense of another. A balancing loop intends to control a relative outcome, but a reaction in another sector of the system compromises the outcome of the initiator through another balancing loop.

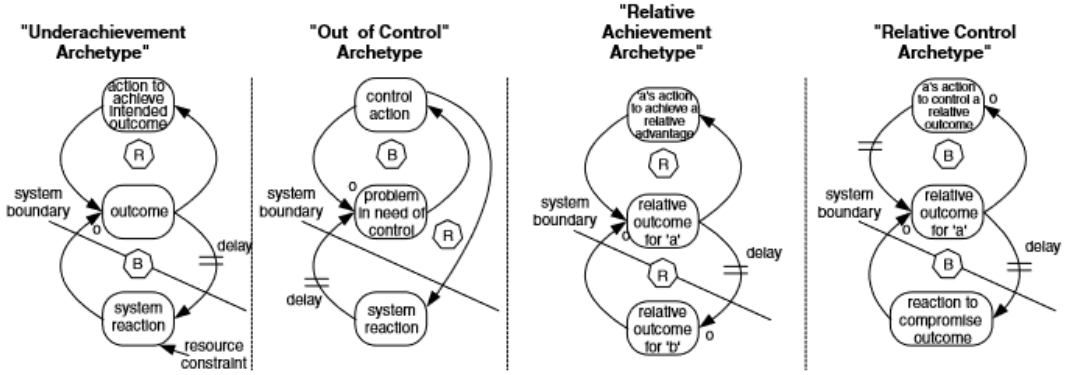


Figure 1- Reduced Set of Generic Archetypes

Causal loop diagrams are an effective tool for communicating system structure (Dowling, MacDonald & Rechardson, 1995) but they obscure the causal relationship between stocks and flows (or rates & levels). Richardson (1986) identified Stock & flow diagramming methodology to be better suited for dynamic systems, due to its ability to provide clear distinction between information links and rate-to-level links. System archetypes help deepen our understanding of systemic challenges faced by organizations and equip us in designing effective action plans for addressing them (Kim & Anderson, 1998). Simulating each archetype using stock and flow diagram help us appreciate the importance of accumulation that exist in archetypes. The stocks & flows that exist in the causal loop diagrams, depicted in fig. 1 in the reduced set of generic archetypes, are identified and modelled using stock-flow diagram. Finally, the behavior of the archetype generated over time is studied through graphs generated by simulation.

Results

The stock & flow representation of each of the totally generic reduced set of archetypes, identified by Wolstenholme (2003) is done and its behavior over time is studied to arrive at an informed decision in

any complex situation. Causal-loop diagrams and corresponding Stock-Flow diagrams are presented for each of the four archetypes. Diagrams are followed by a detailed comparative description of the Intended Consequence (IC) loop and Unintended Consequence (UC) loop in CLD and SFD. The patterns of behavior over time is also depicted by the graphs which are generated by simulating the stock-flow model.

Underachievement Archetype

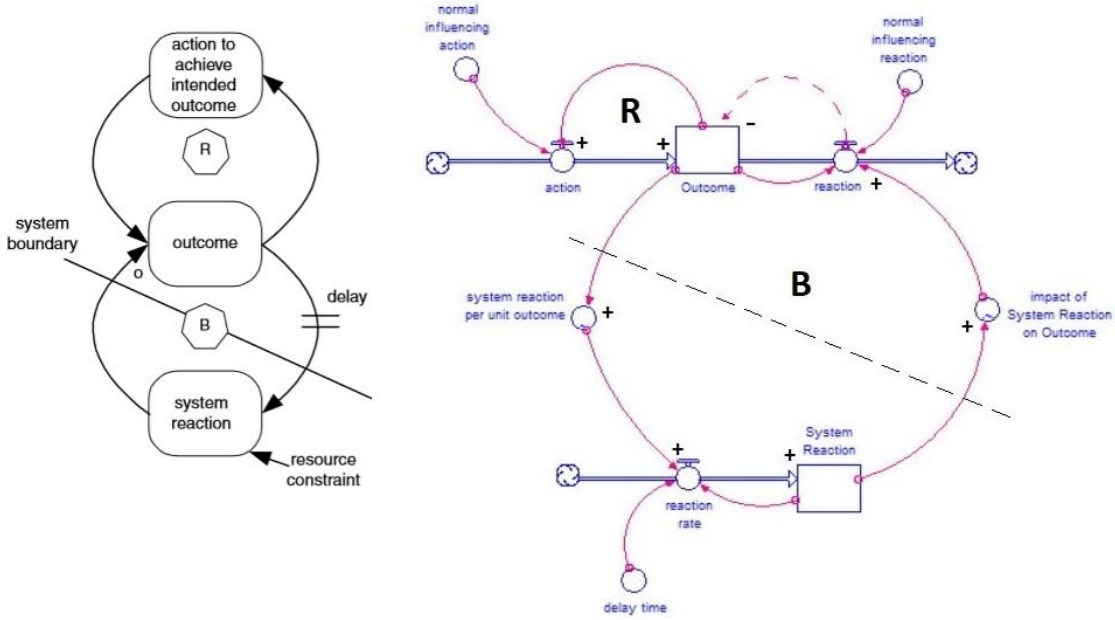


Figure 2- Stock & Flow Diagram of Underachievement Archetype

The underachievement archetype depicted in fig. 2 can be explained step-by-step with a comparative explanation of causal-loop diagram (CLD) and stock-flow diagram (SFD) as follows:

- ***Intended Consequence (IC) Loop***- The objective of this loop is to improve achievement of a system by a reinforcing feedback loop.
    - The intended consequence loop in CLD is understood as "the more the action to achieve the intended outcome, the more the outcome and more the outcome, more will be the action to achieve it". The intention is to create a virtuous cycle which improves the achievement of a system.
    - Correspondingly, in SFD, an 'action' is an inflow to the stock 'Outcome' and the arrow from 'Outcome' back to the 'action' forms a reinforcing feedback loop. It shows that increasing the action will increase the outcome and an increase in outcome will further increase the action.
- ***Unintended Consequence (UC) Loop***- A system reaction in some other part of the system is triggered by the outcome and this unintended consequence loop balances the outcome.
    - UC loop is explained by CLD as "the more the outcome, more will be the system reaction and the more the system reaction, less will be the outcome".
    - SFD show that the stock 'Outcome' increases the stock 'System Reaction' by impacting the inflow (reaction rate) to the stock (System Reaction). The stock 'System Reaction' further influences the outflow (reaction) of the stock (Outcome), thus decreasing the outcome. This creates a balancing loop (shown by the dotted line from reaction to outcome).

The IC & the UC loops show how an action to accomplish an outcome in a system is intended and the outcome triggers a system reaction which reduces the outcome. The behavior over time graph shown in fig.3 is generated by simulating the model in fig.2. helps understand the behavior of the underachievement archetype. Assuming the initial value of 'Outcome' to be 100 units, the model is simulated for 50 years. It can be easily interpreted from the graph, that the outcome starts growing due to the reinforcing loop, but starts declining after some years. The decline is due to the system reaction, which also grows alongside and after some time delay, starts influencing the outcome detrimentally.

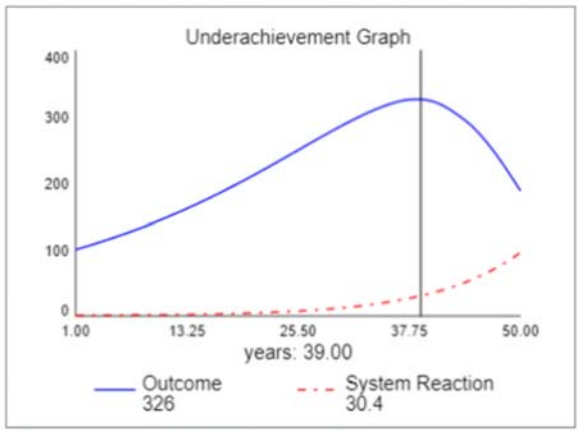


Figure 3- Behavior over Time Graph

Out of Control Archetype

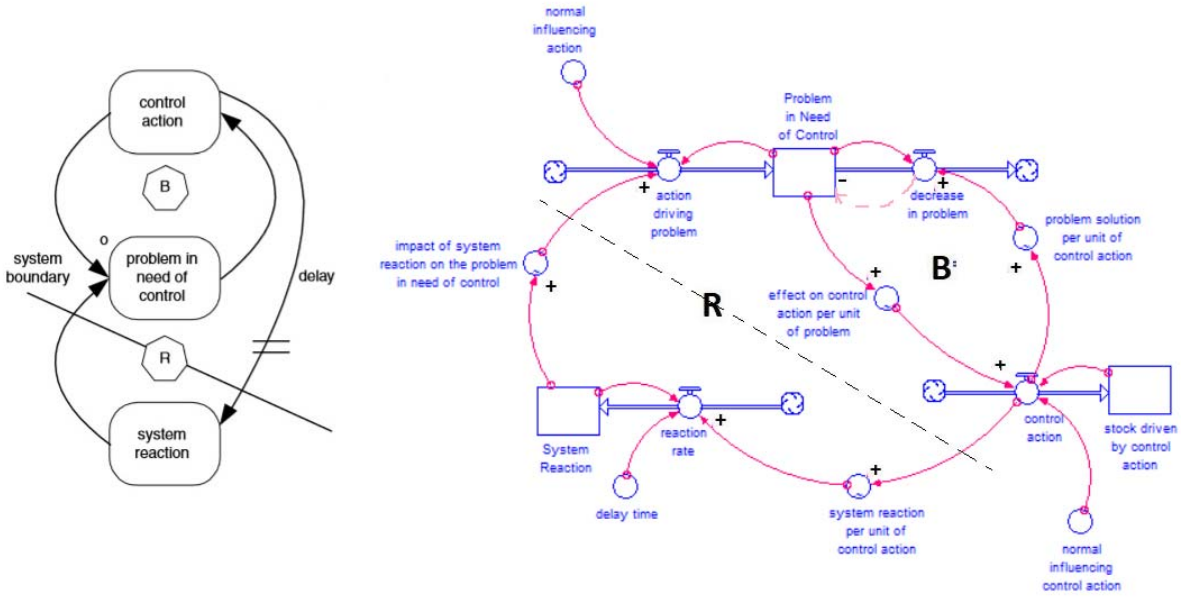


Figure 4- Stock & Flow Diagram of Out of Control Archetype

The Out of Control archetype depicted in fig. 4 is explained as:

- ***Intended Consequence (IC) Loop***- The purpose of this loop is to control a problem in a system through balancing feedback loop. To address a problem in need of control, a control action is taken which reduces the problem.
    - The IC loop can be understood from the causal loop diagram in fig. 4 as 'the more the problem in need of control, more is the control action and the more the control action, less will be the problem in need of control'. So the control action balances the problem.
    - Likewise, it can be comprehended from the stock-flow representation in fig. 4, where the 'Problem in Need of Control' is taken as a stock which is increased by an inflow 'action driving problem' (not explicitly mentioned in the CLD but implicit, as there will be some cause leading to the increase of problem).

- The ‘Problem in Need of Control’ is reduced by an outflow which is driven by a flow ‘control action’. Therefore, the stock ‘problem in need of control’ is impacting the inflow ‘control action’ in a directly proportional fashion and the more the control action is taken, the more is the decrease in problem, which means the less will be the stock ‘Problem in Need of Control’.

- ***Unintended Consequence (UC) Loop***- A system reaction in some other part of the system is triggered by the control action. The impact of system reaction on the problem in need of control creates a reinforcing loop. This is the unintended consequence loop that increases the problem instead of controlling or reducing it. However, there is a delay or time lag before the unintended consequence manifests itself.
  - The causal loop diagram in fig. 4 illustrates the UC loop as “the more the control action the more the system reaction and the more the system reaction, more will be the problem needing control”. Therefore, the control action reinforces the problem, creating an unintended reinforcing loop.
  - Looking at the corresponding SFD, the stock of ‘System Reaction’ is increased by the inflow ‘reaction rate’ which is influenced by the ‘control action’.
  - The stock ‘System Reaction’ further influences and increases the action driving the problem and hence increasing the problem.

The combination of these IC & UC loops complete the archetype ‘Out of Control’. It is interesting to note that the control action provokes the system reaction and instead of controlling the problem, the control action worsens it. The behavior of this archetype can be further described by the following behavior over time graph in fig.5 generated by simulating the model in fig.4. Assuming the initial value of ‘problem in need of control’ be 100 units, the model is simulated for 50 years. The graph clearly depicts that the ‘control action’ is initially able to reduce the problem. The problem continues to decrease and is reduced to half. Alongside, the unintended consequence loop keeps manifesting itself and after a delay, the system reaction starts increasing the problem and the result is that the problem multiplies manifold with time.

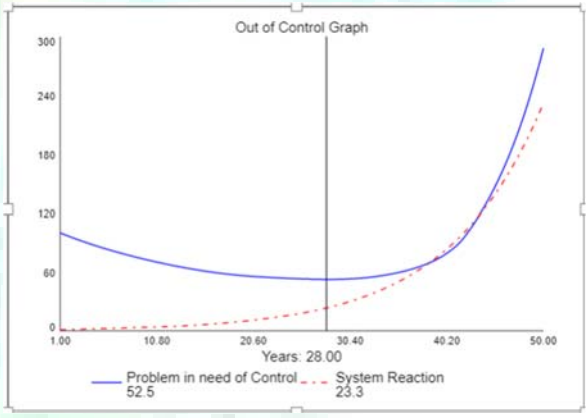


Figure 5 Behavior over Time Graph

Relative Achievement Archetype

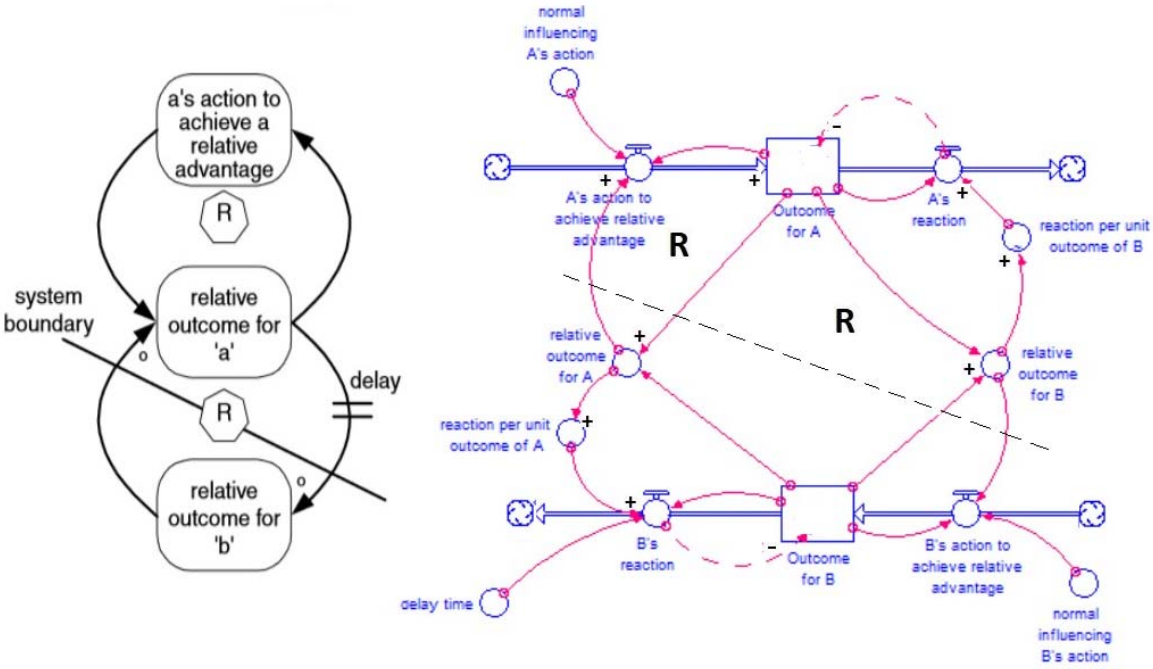


Figure 6- CLD & SFD of Relative Achievement Archetype

The Relative Achievement archetype depicted in fig. 6 is explained as:

- ***Intended Consequence (IC) Loop***- The purpose of this loop is to achieve an advantage from an initiative, but it is gained at the expense of another sector in an organization.
    - The causal loop diagram in fig. 6 explains the IC loop as 'the more the A's action to achieve relative advantage, more is the relative outcome for A and the more the relative outcome for A, more will be the A's action to achieve a relative advantage'. The intention is to create a virtuous cycle to improve the achievement in a system, but the difference from the 'Underachievement' archetype is that the advantage is achieved at the expense of some other sector.
    - Correspondingly, in SFD, 'A's action to achieve relative advantage' is an inflow to the stock 'Outcome for A' and more the 'Outcome for A' more will be the relative outcome for A. The link from 'relative outcome for A' to the 'A's action to achieve relative advantage' forms a reinforcing feedback loop. It shows that increasing the action will increase the outcome and an increase in outcome will further increase the relative outcome for A and in turn the action.
- ***Unintended Consequence (UC) Loop***- A system reaction in other part of the system, say B, on whose expense the advantage is achieved, gets triggered by the relative outcome of A & B. When B tries to achieve advantage at the expense of A, the outcomes get balanced and the two reinforcing loops form a zero sum game. The However, there is a delay or time lag before the unintended consequence manifests itself.
    - The CLD in fig. 6 express the UC loop as "the more the relative outcome for A less will be the relative outcome for B and the more the relative outcome for B, less will be the relative outcome for A". The reinforcing loop where both the parties act against each other's achievement reinforces the decrease in the relative outcome of each other.
    - Looking at the corresponding SFD, we can see that a relative outcome for A as well as is computed by the difference in the stocks 'Outcome for A' and 'Outcome for B'.

- When the relative outcome for A is more than B, the reaction of A on B per unit outcome of A decreases the 'Outcome for B'.
- Similarly, when the relative outcome for B is more than A, the reaction of B on A per unit outcome of B decreases the 'Outcome for A'.
- Both A and B works recursively to decrease each other's achievement, thus forming a vicious reinforcing loop.

The combination of these IC & UC loop complete the archetype 'Relative Achievement'. It is interesting to note that the when two parties try to benefit at the expense of each other, no one actually benefits and the UC loop, yet reinforcing, is degenerative.

The behavior of this archetype can be further described by the following behavior over time graph in fig.7 generated by simulating the model in fig. 6. Assuming the initial value of 'Outcome for A' and 'Outcome for B' to be 100 units each, the model is simulated for 50 years. The upper left and right graphs in fig.7 show that when each party (A/B) try to achieve advantage at the expense of one another, the outcome for the party acting to achieve advantage keeps growing and the other party on whose expense this advantage is achieved is not able to grow. In case when both parties (A&B) try to achieve advantage at the expense of each other simultaneously, the lower middle graph in fig.7 shows us the result where no party is able to achieve growth in their respective outcomes.

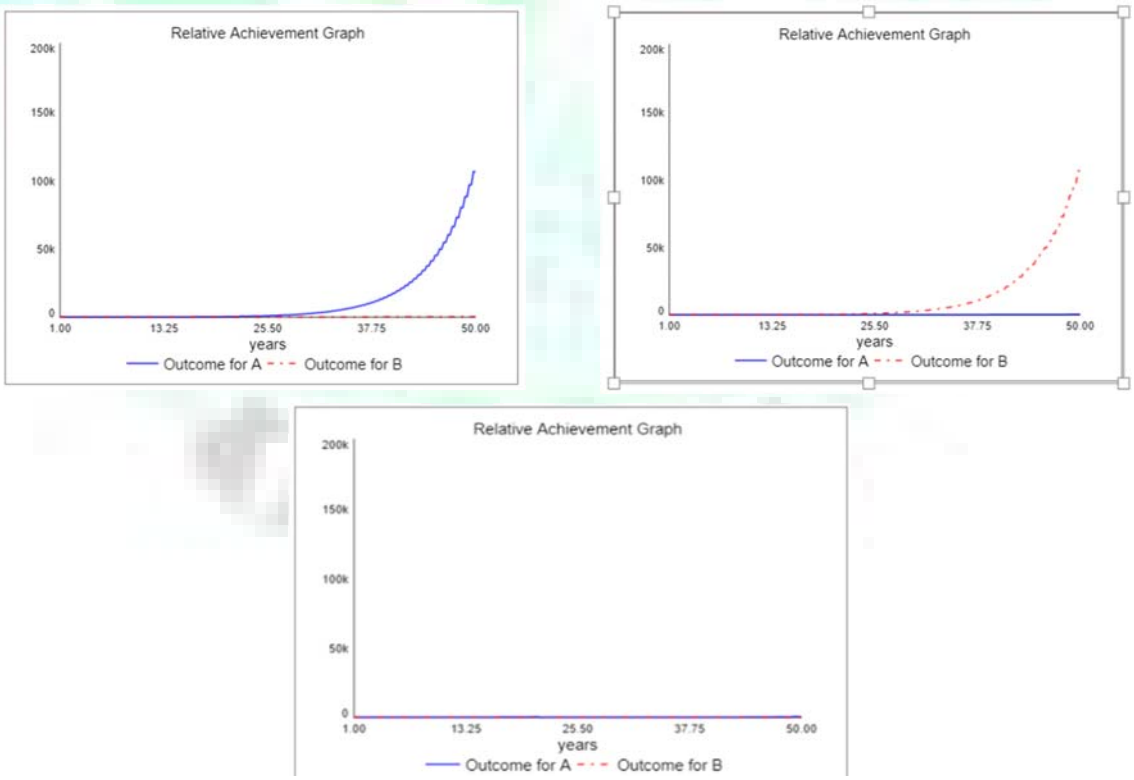


Figure 7- Behavior over Time Graph- Relative Achievement

Relative Control Archetype

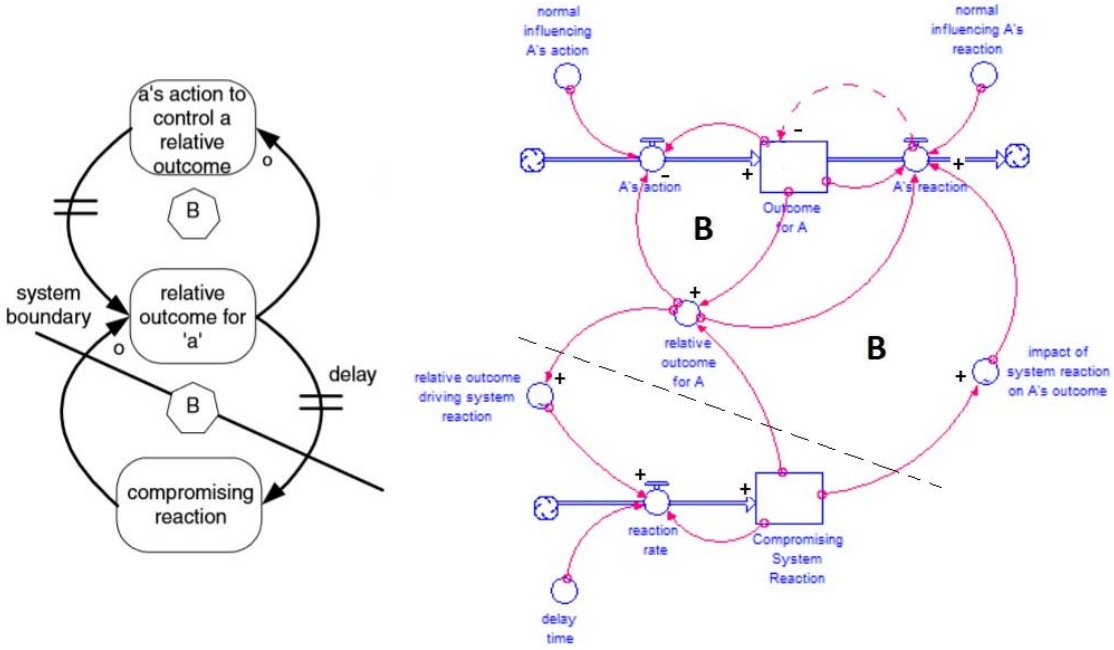


Figure 8- Stock & Flow Diagram of Relative Control Archetype

The Relative Control archetype depicted in fig. 8 can be illustrated as:

- ***Intended Consequence (IC) Loop***- The purpose of this loop is to achieve an advantage from an initiative by controlling a relative outcome.
    - The causal loop diagram in fig. 8 explains the IC loop as 'the more the A's action, more is the relative outcome for A and the more the relative outcome for A, less will be A's action to control the relative outcome'. The intention is to create a cycle to achieve relative outcome in a system, but the difference from the 'Underachievement' archetype is that the advantage is achieved at the expense of some other sector.
    - In the corresponding SFD, 'relative outcome for A' is the difference between the 'Outcome for A' and the 'Compromising System Reaction'.
    - 'A's action' is an inflow to the stock 'Outcome for A' that increases the outcome.
    - The arrow from 'Outcome for A' to 'Relative Outcome for A' shows the increase in the value of the relative outcome proportionately with the increase in outcome.
    - The arrow originating from 'relative outcome for A' to the inflow of the stock 'Outcome for A' forms part of an important decision criteria. The equation of an inflow includes a condition that if the value of relative outcome is positive (i.e., Outcome for A > Compromising System Reaction), the input to the inflow will be 0. In other words, the more the relative outcome, less will be the action.
- ***Unintended Consequence (UC) Loop***- The increased outcome and relative outcome triggers a system reaction that balances the outcome for A. However, there is a delay or time lag before the unintended consequence manifests itself.
    - The CLD in fig. 8 expresses the UC loop as "the more the relative outcome for A, more will be the compromising reaction and the more the compromising reaction, less will be the relative outcome for A".
    - Looking at the corresponding SFD, we can see that the 'Relative Outcome for A' influences the stock 'Compromising System Reaction' by increasing the inflow (reaction rate) to the stock (Compromising System Reaction).

- The stock 'Compromising System Reaction' in turn influences the outflow (A's reaction) of the stock (Outcome for A), thus decreasing the outcome for A.

The combination of the balancing IC & UC loops completes the archetype 'Relative Control'. The following behavior over time graph in fig.9, generated by simulating the model in fig.8, helps us gain a deeper understanding of the archetype. Assuming the initial value of 'Outcome for A' and to be 100 units, the model is simulated for 50 years. It can be easily interpreted that the outcome and the relative outcome is increased till the time compromising system reaction starts increasing. As the system reaction grows the outcome as well as relative outcome for A declines.

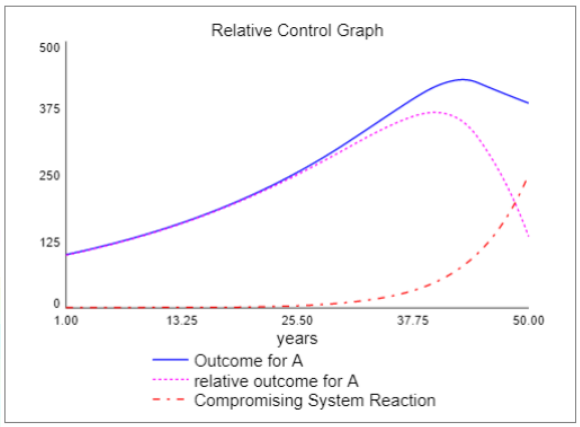


Figure 9- Behavior over Time Graph- Relative Control

Conclusions:

The paper provides an effective tool for decision makers to begin to answer the question as to why do we keep seeing the same problem recur over time. Identifying the archetype by recognizing the patterns of behavior is the first step for proceeding towards the solution of a complex problem. Further, identifying the stocks and flows in the causal loop diagrams and modelling them through stock-flow diagrams give deeper insights into the changes in behavior. The simulation of each model and the graphs accompanying them reflect the possible behavior patterns generated by the structures and the guidelines provided for their use in specific circumstances succor decision making. This helps the decision makers identify the ways to avoid/ reduce the impact of unintended consequences. This paper serves as a demonstration and appreciation of the stock-flow modelling approach for presenting the generic system archetypes.

Scope for Further Research:

While we have focused on using the stock and flow representation in understanding the systems archetypes better and further simulating the problem archetypes to generate behavior over time, it will be helpful in doing the same for solution archetypes for these problem archetypes. Further, it will also be interesting to include an example for each of the generic archetype and understand the behavior of both problem and solution archetypes.

References:

1. Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: a systems approach. *Procedia Computer Science*, *44*, 669-678.
2. Bellinger, G. (2004). Archetypes: Interaction structures of the universe. *Internet: http://www. outsights. com/systems*.
3. Binder, T., Vox, A., Belyazid, S., Haraldsson, H., & Svensson, M. (2004, July). Developing system dynamics models from causal loop diagrams. In *Proceedings of the 22nd International Conference of the System Dynamic Society* (pp. 1-21).

4. Dowling, A. M., MacDonald, R. H., & Richardson, G. P. (1995). Simulation of systems archetypes. In *Proceedings of the 1995 International System Dynamics Conference* (Vol. 2, pp. 454-463). Tokyo.
5. Forrester J. W. (1968). Principles of systems. *MIT Press, Cambridge.*
6. Forrester, J. W. (2013). Economic theory for the new millennium (2003). *System Dynamics Review*, *29*(1), 26-41.
7. Kidwai, A., & Saraph, A. (2016). Use of archetypal structures in urban dynamics. *Systemic Practice and Action Research,* 29(6), 583-595.
8. Kim, D. H., & Anderson, V. (1998). Systems archetype basics. *Waltham, Mass, Pegasus Communications Inc*.
9. Ligarski, M. J. (2018). Methodology of Problem Analysis in the Quality Management System with the Use of Systems Approach. Management Systems in Production Engineering, 26(3), 157-161.
10. Maani, K. E., & Maharaj, V. (2004). Links between systems thinking and complex decision making. *System Dynamics Review: The Journal of the System Dynamics Society*, *20*(1), 21-48.
11. McConnell, A. (2010). Policy success, policy failure and grey areas in-between. *Journal of Public Policy*, *30*(3), 345-362.
12. Randers, J. (1980). Elements of the System Dynamics Method. The MIT Press, Cambridge, MA.
13. Richardson, G. P. (1986). Problems with causal-loop diagrams. *System dynamics review*, *2*(2), 158-170.
14. Senge, P. M. (1991). The fifth discipline, the art and practice of the learning organization. Performance+ Instruction, 30(5), 37-37.
15. Sterman, J. D. (1989). Modeling managerial behavior: Misperceptions of feedback in a dynamic decision making experiment. *Management science*, *35*(3), 321-339.
16. Vlachos, D., Georgiadis, P., & Iakovou, E. (2007). A system dynamics model for dynamic capacity planning of remanufacturing in closed-loop supply chains. *Computers & Operations Research*, *34*(2), 367-394.
17. Wolstenholme, E. F. (1999). Qualitative vs quantitative modelling: the evolving balance. *Journal of the Operational Research Society*, *50*(4), 422-428.
18. Wolstenholme, E. F. (2003). Towards the definition and use of a core set of archetypal structures in system dynamics. *System Dynamics Review*, *19*(1), 7-26.
19. Wolstenholme, E. (2004). Using generic system archetypes to support thinking and modelling. *System Dynamics Review: The Journal of the System Dynamics Society*, *20*(4), 341-356.

Knowledge Management in NGO's: Literature Review and Future Research Scope

Anamika Chawhan and Prof. Rajendra Sonar

SJM School of Management, IIT-Bombay, Maharashtra
anamikakchawhan@outlook.com; rm_sonar@gmail.com

Abstract. Bellardo, Karwan and Wallace suggest that NGOs use systems which assist them in responding to any emergency situation as well as on-going projects. (Bellardo, 1984) Their systems supports in communication, data collection and its analysis, user-friendly interface and decision-making. Yet, it has its weaknesses such real-time response plan, recording past knowledge about successful or failed projects or emergencies, parallel running multiple systems. Hence to invent solutions Jeenex recommends a system which is more comprehensive and responsive model involving improved decision making, facilitating better communication, enhanced collaboration, alleviates information overload. (Jennex, 2006). **Purpose:** To attain competitive advantage among NGOs, efficient use of knowledge through knowledge management (KM) is needed. Systematic literature review of KM in NGOs will prove beneficial in leading a better KM practice among types of NGOs. This review paper is also helpful in removing biasness within KM practices. **Methodology:** This paper conducts a systematic literature review on knowledge management (KM) in the context of NGOs in order to identify research gaps and define a future research agenda. **Findings:** The main findings highlight that, even though there is an increasing number of papers on the topic of KM in NGOs, several issues are still neglected. **Originality:** This paper is an attempt to identify four main gaps in the body of literature. The first gap deals with the socio-political factors influencing the adoption of KM in NGOs. The second gap regards the lack of a comprehensive taxonomy of knowledge management systems (KMSs) that may support the processes of knowledge creation, acquisition, storage, transfer, sharing and application. This second gap allows us to identify a third gap concerning the level of alignment between NGOs strategies and technologies adopted. Finally, the fourth gap deals with the issue of the impact of KM on NGO's performances with regard to social, financial, technological, organizational, and human performance. From these four gaps, three research questions (RQs) have been proposed. These RQs allow us to identify possible areas of analysis to define a future research agenda.

Keywords: Humanitarian sector; factors affecting KM; KMSs; knowledge management; performance; NGOs.

1 Introduction

Majority of the organisations across the globe face common developmental challenges, yet the elucidations to them usually remains restricted – they never get adapted for replication, in fact they are even forgotten. In order to find difference between the organisations who are successful and who fail, identifying their approach towards learning and applying knowledge over the time and situations is mandatory. Enterprise social media is a facilitator of new ways of working along with new forms of knowledge sharing and interactions (Razmerita et al. 2016).
The term NGO was formed at a United Nations conference in 1992, but is now also being used outside the UN context as a collective label for a variety of very different organizations. An internationally agreed definition of NGOs does not exist. (Martens, 2002) define NGOs as "formal (professionalized) independent societal organizations whose primary aim is to promote common goals at the national or the international level" (p. 282). In order to be classified as an NGO under this definition, an organization has to possess some (minimal) organizational structure, its funding

must be independent from the state, its staff must be qualified but not profit oriented, should come from the private sector of society and work for common goals from which the public will benefit.

Knowledge sharing in organisations is not a new topic. It is the conduit through which solutions travel from place A to place B. Well documented knowledge sharing practices have always helped organisations to go uphill in their market performance and competitiveness. But, quite often organisations who do not understand the significance of knowledge sharing practices end up at loosing and forgetting the expert knowledge, best practices and solutions gained from practitioners. Voluntary Organisation's knowledge are mostly left behind, hidden in remote communities or tucked away in the heads of development officials who have been assigned next big movement or projects.

According to the summary sheet on Non-profit organisations published by the Statistics Times, services sector is the largest sector of India. Gross Value Added (GVA) at current prices for Services sector is estimated at 61.18 lakh crore INR in 2014-15. In services sector, India world rank is 11 and GDP is $ 1185.79 billion. And, community, social services are estimated at Rs. 1, 541, 351 crore which comes to 13.34%. Despite these figures, the NGO sector from Indian has not received much attention in the knowledge management literature.

2 Knowledge Management in NGOs

Knowledge management practices in nonprofit companies are generally implemented in similar fashions as for-profit companies. It is important to understand, however, that there are slight practical differences the knowledge management practice takes on in nonprofit companies that make it all the more unique such as legal, regulatory and financial requirements. It is not uncommon to see benefits that are delivered as a result of knowledge management practices to be interrelated, as it is a comprehensive discipline that has an impact on the entire organisation with regards to its people (including organisational culture), processes and technologies.
More specifically for the benefit of nonprofit companies, knowledge management practices can assist in the following, including the for-profit benefits as previously listed (Cullom & Cullom, 2011: 16):

- Able to better meet the needs of the community;
- Ensure the sustainability of programmes and projects running in the nonprofit company;
- Have the ability to harness existing expertise and experience;
- Enhance efficiencies and reduce redundancies; and
- Develop internal competences.

In nonprofit companies the adoption and enforcement of knowledge management practices is extremely limited and informal in nature (Hume et al 2012: 83). There is also the realisation that people are not aware they are engaged in the practice until it is formalised.
As indicated by the benefits above, the nature of knowledge management practices in any organisation should not be overlooked, and sadly it often is.
Many will argue that results of initiatives are difficult to quantify and do not provide a direct value on return on investment. It is important to note here that many knowledge management practices are not profit-adding disciplines but more value-adding disciplines that optimise available expertise and experience throughout the organisation.
Knowledge that is needed to act in complex situations is hard to exchange, but Web 2.0 technologies provide a toolbox to develop a knowledge management strategy.
The paper aims to specify optimal conditions and necessary measures that NGOs should take in order to successfully use Web 2.0 technologies for knowledge exchange.

3 Knowledge Sharing among the NGOs in India

Knowledge management (KM) is a tool which helps in identifying, organising, storing, sharing and supervising the knowledge related activities. KM practices helps in generating values for the organisation, achieving their capabilities and competences. KM helps in understanding content, recording data, interpreting information and extracting, and knowledge to build relationship between context and its patters.

Knowledge sharing helps NGOs to scale-up their competency to complete the projects. In India, 100% literacy is a major challenge, the barriers to achieve this result costs many human resources who are essential for country's growth and development. NGOs in India are facing three challenging KM tasks:

1. Distribution of latest and relevant action-oriented knowledge to its own staffs and volunteers whenever and wherever needed.
2. Preserving organisation's knowledge in an environment of staff turnover and the constant requirement of handling mission based tasks which are critical by nature.
3. Managing the increase in demand of learning from inbound and international team of volunteers and staff.

Hence, in order to address these challenges a systematic approach is needed in following areas:

a) Internally – promoting collaboration, knowledge capturing, and knowledge sharing across teams and departments to solve complex operational challenges.
b) Domestically – extending those efforts to its partner organisations, especially across states.
c) Internationally – strengthening its management of knowledge – sharing requests – which are valuable as an opportunity for both sides to learn and a source of additional partnerships – to take advantage of them without compromising ongoing operations.

Figure 1.2: Three typical knowledge-related problems and knowledge sharing goals for organisations

Knowledge sharing helps organisations in achieving three major goals which are as follows:

a) Become more effective. With access to critical knowledge when and where needed, organisations accelerate operational processes and avoid mistakes.
b) Maintain a high level of institutional knowledge even when key staff members depart.
c) Solve operational problems by continually evaluating and taking to scale what worked in isolated instances and avoiding what didn't.

Knowledge Sharing allows workers to avoid `re-inventing the wheel'; they can learn from others' experiences and improve their own performance as a result", is how (Connelly et al. 2013) summarise the many benefits of knowledge sharing to organisations.

Three of the five key domains, People, Process, and Platform (Technology), have been linked to a concept that is largely accepted by KM practitioners from disciplines ranging from business to organizational learning. The two remaining domains, Partnership and Problem Solving, are informed and guided not only by the literature review but also by K4Health's programmatic experience.

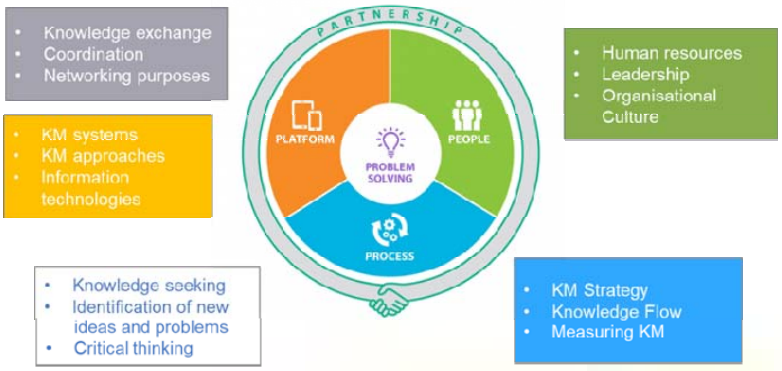


Fig. 2: 5Ps of KM

Together, the 5Ps of KM form a basis for organizations to assess their KM capacity and culture. The 5P approach helps them examine existing skills, needs, and opportunities so that they can identify areas to be strengthened and draft action plans for improvement.

1. People are both contributors and users of knowledge in organizations. This domain covers the following three sub-areas:

    1. resources/human capital required for KM
    2. leadership, which is the organization's senior management support to KM
    3. an organizational culture that supports knowledge sharing and networking

2. Process represents a series of actions or steps learned and applied to achieve KM objectives within organizations. This domain refers to the following three sub-areas:

    1. KM strategy that is aligned with the broader mission of the organization
    2. knowledge flow/cycle of assessing, capturing, generating, adapting, and sharing knowledge
    3. measurement

3. Platform relates to the organization's use of online and offline tools and other supporting mechanisms for systematizing and operationalizing KM activities. While the combination of People, Process, and Technology may be more familiar to some KM practitioners, we prefer Platform, as it is broad and flexible. This domain includes the following three sub-areas:

    1. KM systems
    2. KM approaches
    3. information technologies

4. Partnership can help organizations learn from each other's experiences and expertise, work effectively with stakeholders and other collaborators, and achieve a shared vision together. This domain covers the following three sub-areas:

        1. knowledge exchange

2. coordination

3. networking purposes

5. Problem Solving is an important skill that organizations need for continually connecting knowledge and performance, as problems occur due to changes in the environment and are regular aspects of our work. This domain includes the following three sub-areas:

1. knowledge seeking

2. identification of new ideas and problems

3. critical thinking

4 Role of Social Media for Indian NGOs

Digital technologies transform how non-profits connect with clients and create value with their stakeholders. Digital strategies change how we in the non-profit sector think about our mission and its role in the current marketplace of ideas and services. Most dramatically, digital technologies have exploded how non-profits think about data and innovation. In India, we see a trickle-down effect where the social sector organisations themselves might not transform due to digital innovations but are adopting or integrating among a few. Digital strategy and marketing is still a huge gap in adoption and execution by many NGOs, non-profits in India.

NGOs have features in common, which are not part of the formal definition. Two of these are particularly relevant in the context of knowledge exchange using Web 2.0 technologies:

Voluntariness: The work of NGOs is frequently carried out by volunteers. Many NGOs depend on the private commitment of these volunteers and need a minimum number of contributions from their rank and file in order to be able to carry out their work (Glagow, 1992). Participation: NGOs are democratic organizations based on participation. Decisions are in many cases taken at a grassroot level, using democratic procedures (Brand, 2000). In contrast to many state or profit-based organization, NGOs have flat hierarchies. Differences of status, where they exist, are less formalized and thus more difficult to recognize than in other organizations. In addition, the success of NGOs is defined using criteria that may be hard to measure (e.g., its "good reputation"; Britton, 1998) and have therefore to be socially negotiated and assessed by the community.

NGO volunteers learn their knowledge through observation and are thus socialized into their responsibilities.

In this paper the term knowledge exchange refers to the model of knowledge use in organizations (Kelloway and Barling, 2000) that describes four types of knowledge work: finding knowledge, creating knowledge, packaging knowledge and applying knowledge. Thus, the permanent exchange of knowledge between individuals, groups, and artefacts in an organization is an essential precondition for successful knowledge work and workplace learning (Eraut, 2000; Eraut and Hirsh, 2007). Following the knowledge creation model (Nonaka, 1994; Nonaka and Takeuchi, 1995; Nonaka and Toyama, 2003), the exchange of tacit knowledge between individuals takes places as dynamic process of socialization (share experiences by observation and imitation), externalization (articulate

tacit knowledge), combination (connect explicit knowledge) and internalization (internalize explicit knowledge).

The treasure of what an NGO knows not only consists of factual knowledge, but also of knowledge-in-use (De Jong and Ferguson-Hessler, 1996). The latter is a combination of factual knowledge and so-called procedural knowledge, i.e., knowledge on how to perform an activity. A person who has to handle complex situations will not only need some specific factual knowledge, but also some knowledge on how to do certain things in the best way. Knowledge-in-use on how to integrate new voluntary workers, for ex-ample, will consist of some factual knowledge (e.g., which tasks still need to be fulfilled in the organization) and some procedural knowledge (e.g., how to find out what new volunteers are capable of doing). Knowledge-in-use has become so ingrained by daily routine and practice that it is, in parts, often implicit knowledge. This tacit knowledge (Polanyi, 1966) can hardly be expressed verbally and exchanged with others without own experience.

For example, while explaining how to integrate new volunteers in an NGO, an experienced person might say: "Just find out what they can do, and let them do it!", but a beginner would hardly be able to integrate a new person successfully by acting on the basis of such a guideline.

Characteristics of NGOS	**Characteristics of Web 2.0 technologies**	**Boundary conditions for the successful use of Web 2.0 in NGOs**
High number of volunteers	Strong voluntariness in participation	Contact between members -Internal motivation -Organizational identification
Participation on democratic principles	Democratic participation of users	Security about quality criteria
Strong ties between personality and one's work	Strong ties between personality and one's contribution	Strong motivation to gain prestige -Low fear of losing face -Low fear of personal feedback
Uniformalised training of volunteers	Unformalized writing and publishing procedures	Few differences in prior knowledge

Table 2: Adopted from Christina Matschke, Johannes Moskaliuk, 2012

Characteristics of Social Media	NPOs or NGOs

Table 3 NGOs' use of social media for Knowledge sharing

Openness	Tapping into knowledge and voices of the South (Masetti-Zannini, 2007, Owiny et al., 2014). Social media may contribute to human-centred development (Carlman, 2010) NGOs have become effective infomediaries (Graham and Haarstad, 2011).
Participation	NGOs struggle to build effective participation mechanisms in the developing world (Masetti-Zannini, 2007). Social media empower NGOs by enabling participation and knowledge aggregation (Punie, 2011). Social media transforming patterns of work and interactions (Suarez, 2009). Non-profits likely to share their own information (Lovejoy et al., 2012). NGOs will need to produce more high-quality content to attract and engage audiences (Rockefeller Foundation, 2014)
Conversation	Auger (2013)suggests non-profit organisations use different social media for different purposes. Non-profit organisations are primarily using Twitter to convey one-way messages, as a means of sharing information instead of relationship building Waters and Jamal (2011). Informing the public and communicating with stakeholders (Waters et al., 2009b).
Conversation	Connecting via social networks (Zuniga and White, 2009). 'Networked non-profit organisation' (Kanter and Fine, 2010). The effects of social media on organisations and individuals (van Alphen, 2009, Blom, 2009, Waters, 2009)Low-cost solution for engaging with and obtaining information from the public (Lutu, 2015).
Connecters	Attention to the notion of 'communities' in the development sector. (Ballantyne and Addison, 2000). Non-profits likely to share their own information (Lovejoy et al., 2012). NGOs will need to produce more high-quality content to attract and engage audiences (Rockefeller Foundation, 2014).
Community	Attention to the notion of 'communities' in the development sector. (Ballantyne and Addison, 2000). Information -sharing and mutual learning as string motivation for networking among NGOs (Holmén, 2002). Online development networks may contribute to knowledge sharing between development organisations (Cummings et al., 2006).

A study by Brown et al.(2013), in a service organisation in Canada, found that individuals will seek knowledge from people they know, regardless of the company's KMS. This is true particularly for new employees as they build upon their relationships (Wenger et al., 2002).Brown et al.(2013) stressed the importance of the nature and the structure of individual social networks as elements for "knowledge-sharing practice" in organisations. They expected knowledge to be shared on a person-to-person basis, assisting a knowledge transfer outside a formal KMS. However, the results were contrary to their expectations, as they found that codified knowledge had no significant influence on KMS in a person-to-person knowledge sharing process, particularly for those who had been in post for a long time. Brown et al.(2013)claim that the complexity of the task may increase interaction in person-to-person knowledge sharing. They emphasise the role of social networks in this sharing process. Moreover, Brown et al.(2013)wonder if the codified knowledge in KMS did affect person-to-person knowledge sharing. They suggest that it would be important for further investigations to understand the meaningful relationship between the two.

While there can be a divergence between the effectiveness of technology in transferring and sharing tacit knowledge within a company, and how such sharing or transferring is actually done, this divergence occurs because people may avoid relying on technology(e.g. KMS) and use their own social networks to acquire knowledge (Hansen and von Oetinger, 2001). This opinion is supported by Wenger (2004), who argues that companies do not use KM unless they encourage people to use knowledge actively in the process. His argument is based on the fact that, while technology is used for information flow within an organisation, people (who are the main knowledge sources) decide what knowledge needs to be documented and what should be possessed tacitly. Hansen and von Oetinger (2001) argue that direct personal contact is missing in information technology. They suggest an approach such as T-Shaped Management, which helps liberate one from the traditional company hierarchy to share knowledge freely and encourage participation and collaboration across the company. The central issue observed here is that some KM initiatives could consider using technology to enable knowledge sharing.
A study by Brown et al.(2013), in a service organisation in Canada, found that individuals will seek knowledge from people they know, regardless of the company's KMS. This is true particularly for new employees as they build upon their relationships (Wenger et al., 2002).Brown et al.(2013)stressed the importance of the nature and the structure of individual social networks as elements for "knowledge-sharing practice" in organisations. They expected knowledge to be shared on a person-to-person basis, assisting a knowledge transfer outside a formal KMS. However, the results were contrary to their expectations, as they found that codified knowledge had no significant influence on KMS in a person-to-person knowledge sharing process, particularly for those who had been in post for a long time. Brown et al.(2013)claim that the complexity of the task may increase interaction in person-to-person knowledge sharing. They emphasise the role of social networks in this sharing process. Moreover, Brown et al.(2013)wonder if the codified knowledge in KMS did affect person-to-person knowledge sharing. They suggest that it would be important for further investigations to understand the meaningful relationship between the two. As Brown et al. (2013) studied an organisation in the service sector that may differ from the non-service sector, more research is needed in the non-service sector.'' Technology inhibits transfer of tacit knowledge and results in a loss of direct human interaction.

Social Media / Web 2.0 : A range of technologies

Technologies	Description	Primary Contribution	Examples
Wikies, commenting, shared work spaces	Facilitates co-creation of content across large, distributed set of participants.	Broad collaboration	Wikipedia, Wikispaces
Blogs, micro blogs, podcasts, photo and video sharing	Offers individuals a way to communicate / share information with a broad set of other individuals	Broad communication	Blogger, Twitter, Flickr, YouTube
Prediction markets, polling, information markets	Harnesses the collective power of the community and	Collective estimation	Inkling, Intrade

	derives a collectively derived answer.		
Social bookmarking, tagging, ratings, Really Simple Syndications (RSS)	Adds additional information to primary content to prioritize information or make it more valuable.	Metadata creation	Delicious, Digg, Google Reader, Newsgator
Social Networking, network mapping	Leverages connections between people to enhance participation, collaboration and offer new applications. An online social network brings people together and enables them to find others who share common interests and/or activities.	Community and Social Graphing	Facebook, MySpace, LinkedIn, Ning

While there can be a divergence between the effectiveness of technology in transferring and sharing tacit knowledge within a company, and how such sharing or transferring is actually done, this divergence occurs because people may avoid relying on technology(e.g. KMS) and use their own social networks to acquire knowledge (Hansen and von Oetinger, 2001). This opinion is supported by Wenger (2004), who argues that companies do not use KM unless they encourage people to use knowledge actively in the process. His argument is based on the fact that, while technology is used for information flow within an organisation, people (who are the main knowledge sources) decide what knowledge needs to be documented and what should be possessed tacitly. Hansen and von Oetinger (2001) argue that direct personal contact is missing in information technology. They suggest an approach such as T-Shaped Management, which helps liberate one from the traditional company hierarchy to share knowledge freely and encourage participation and collaboration across the company. The central issue observed here is that some KM initiatives could consider using technology to enable knowledge sharing.

5 Conclusion

Based on these studies following literature gap has been identified:Unsure about the effects of using Facebook as the communication tool while running a project based on a social cause. Very few studies, if any, have focused on comparing blogs and Facebook in terms of their effectiveness in facilitating knowledge management and cultivating a knowledge sharing culture while implementing or running a project.

This leads to identifying the purpose of research study i.e. to examine the incorporation of social media into a project run for social cause by NGOs for sharing knowledge. On the basis of research purposes following three research questions are derived: How do volunteers and employees users use social media for knowledge management? Is social media a better tool in facilitating knowledge management activities such as knowledge sharing? Is social media a better tool in cultivating knowledge sharing culture?

Harjanti and Noerchoidah (2017) have revealed that social capital has effected on both knowledge collecting and donating. Social capital becomes a valuable mechanism for universities to enable knowledge sharing. For that reason, it is suggested that universities should intensify the trust, networks, and norms among lectures to facilitate the knowledge sharing. Through such a solid relationship, knowledge sharing process could be accelerated.

According to Niall Corcoran and Aidan Duane (2018) there is a growing awareness amongst practitioners and researchers that the implementation of social media in organisations has given a new impetus to KM. However, limited research has been conducted on applications of social media for organisational knowledge sharing.

References

1. Bellardo, S. K. (1984). Managing the Response to Disasters. Interfaces, 14 (2), 29-39.
2. Connelly, C. E., Zweig, D., Webster, J., & Trougakos, J. P. (2012).Knowledge hiding in organizations. Journal of Organizational Behavior, 33(1), 64-88.
3. Cullom, Charmayne and Cullom, Richard S. (2011) "Knowledge Management for Nonprofits: A Strategy for Organizational Sustainability," Communications of the IIMA: Vol. 11: Iss. 2, Article 2.
4. Dhyah Harjanti and Noerchoidah (2017) The Effect Of Social Capital And Knowledge Sharing On Innovation Capability, JMK, vol. 19, no. 2.
5. Hume, C, Pope N & Hume, M (2012), KM 100: Introductory Knowledge Management for Notfor-Profit Organisations, pp. 56-71 .
6. Jennex. (2006). Open Source Knowledge Management. International Journal of Knowledge, 2 (4),iiv.
7. Kevin Kelloway and Julian Barling (2002) "Knowledge Work as Organizational Behavior, International Journal of Management Reviews 2(3):287 - 304
8. Martens, K. (2002). Mission Impossible? Defining Nongovernmental Organizations. Voluntas: International Journal of Voluntary and Nonprofit Organizations, pp 271–285.
9. Niall Corcoran and Aidan Duane, 2018 " Using Social Media to Enable Staff Knowledge Sharing in Higher Education Institutions" Australasian Journal of Information Systems Duane & Corcoran, Vol 22.
10. Nonaka, I 1994 ‘The Knowledge-Creating Company’, Harvard Business Review, vol. 69, pp. 96-104.
11. Razmerita, L., Phillips-Wren, G. and Jain, L. (2016), "Advances in Knowledge Management: An Overview", in Razmerita, L., Phillips-Wren, G. and Jain, L.C. (Eds.), Innovations in Knowledge Management, Springer Berlin Heidelberg, pp. 3-18.
12. Susan A. Brown, Alan R. Dennis, Diana Burley, and Priscilla Arling,(2013) "Knowledge sharing and knowledge management system avoidance: The role of knowledge type and the social network in bypassing an organizational knowledge management system" Journal of the American Society for Information Science and Technology ; 64(10)

Power of Cultural Intelligence – Analysing its Effect in Managing Organizational Change

Namita Mangla
Research Scholar at Faculty of Management Studies, Delhi, India.
Email Id: namita.nitr@gmail.com

Abstract

Due to globalization and digital revolution, the organizations are experiencing a high workforce diversity. The high diversity brings in broad range of ideas and intellectual capital. At the same time, it becomes difficult for leaders to manage the diverse workforce and other stakeholders due to the difference in view about the situations and ideas at workplace. In an environment of change, the management has a massive challenge to manage the diverse people who might react differently towards the change. However, a workforce high on Cultural Intelligence (CI) is extremely adaptive to face the changes occurring in the organization. The leadership does not have to worry about managing the people ranking high in CI. The article seeks to analyse the impact of Cultural Intelligence by focusing on the change management process and identifying the correlation between them.

Keywords: Cultural Intelligence, Change, Culturally Intelligent Workforce

Introduction

The speed of transformation is increasing exponentially with organizations expanding from being in one city to multiple cities in a country and to becoming multinational. Boundary less organizations are characterized by high workforce diversity. Diversity brings with it positive as well as negative effects to the organizations. It is in the hands of organizations on how to protect selves from negative effects and get the best out of diversity. The high diversity brings in broad range of ideas and intellectual capital. At the same time, it becomes difficult for leaders to manage the diverse workforce and other stakeholders due to the difference in view about the situations and ideas. Researchers suggest change leaders to learn how to manage stakeholders across different cultures (Ilyas & Hassan, 2015; Hamidianpour et al, 2016; Gladden, 2017). Cultural Intelligence allows individuals to work effectively in multi-cultural situations (Gooden et al, 2017). Individuals with high CI are adaptable towards different situations (Brislin et al, 2006) enabling them to go with the change taking place in the organization. High CI of employees does not exert pressure of managing workforce during change. Rather change becomes a smooth process as people easily adapt themselves towards the coming change. Rather the culturally intelligent workforce will work towards the benefit of organization to manage the external stakeholders. Organizations can employ strategies at different levels for building a culturally intelligent workforce

People side of Change Management:

Change in an organization takes place due to various factors like adoption of new technology, new initiatives, process improvement, problem solving and restructuring. Employees are the one's that gets affected and affect organization the most (Porsci, n.d.). For a change initiative to be successful, the transitions of the employees from one state to another need to be successful. The transition of moving from one state to another is also disussed by Lewin (1947) in its three step change process- Unfreeze, Change and Refreeze. The landscape of managing change has shifted from leaders to a more distributed employee group (Higgs & Rowland, 2005). Success of any initiative depends upon the people working on it. Therefore it is necessary to align people with the change. Good communication and backing of senior management are highlighted by researchers as important factors to make a change effort successful. It is necessary to have top-level commitment to ensure commitment from employees (Sirkin et al, 2005). Sometimes managers feel they have communicated to the required extent. The employees take on the same is the less

communication from management. Sirkin et al (2005) that one should communicate the change initiative three times more than one need to.

Adkar Model given by Hiatt (2006) highlights the importance of individuals in sailing through a smooth change in an organization while bringing out effectiveness. The model is based on goals that guides an individual through organizational change. ADKAR expands into five dimensions or outcomes- awareness, desire, knowledge, ability and reinforcement. And the five dimensions of the ADKAR model are experienced in its sequence.

Awareness

Role of awareness and communication is evident in making a change initiative smooth and successful. Awareness is an individual's knowledge of why and how's of a change initiative. Employees should be aware of the results of the initiative and also what's the benefit for them and for the organization. Awareness helps people to overcome their perceptions about change and see the real picture.

Desire

Desire is a person's willingness and energy towards the change effort. Desire is not generated by creating awareness. It is necessary to understand an individual's personal motivating factors.

Knowledge

The necessary skills required for the change that might be inherent or could be acquired through training and mentoring. It also includes the knowledge of people, process and product.

Ability

Employees should be capable enough to implement their knowledge for the change implementation while bringing out the desired productivity.

Reinforcement

Reinforcement is related to sustaining the change. This factor is well highlighted by Lewin through the refreeze state. The necessary actions required for the change to sustain. Actions might be to motivate people through rewards and recognitions

Cultural Intelligence:

Cultural Intelligence was first defined by Early & Ang (2003) as a process that allows individuals to work effectively in culturally diverse situations. CI refers to the adaptability of individuals in different cultural environments (Brislin et al, 2006). Thoeries of CI revolve around four factors (Mangla, 2018)- Cognitive, metacognitive, motivational and behavioural. Cognitive CI means acquiring knowledge about a culture that includes the prevalent norms. practices (Early & Ang, 2003) and understanding of cultural universals and differences. Cultural Universals are traits or practices that like in all cultures. Cultural Differences have impact on an individual's behaviour and this understanding is developed through CI (Thomas & Inkson, 2009). Metacognitive CI is the mindfullness of an individual to reflect upon their mental maps and modify them according to their interactions (Livermore, 2011). The influence of this factor is so high that it increases the creatvity of people with high metacognitive CI in cross cultural situations. Desire is the root of all successful activities. If a person desires to do a task, the task will be performed effectively. Motivational CI is an individuals desire to participate and perform effectively in culturally diverse situations. Ng & Early (2006) argues that motivation CI can allow individuals to adapt in new environments.

Most essential part of CI is to apply these skills effectively in interactions. Behavoural CI enhances these interactions by modifying individual behviour (Ang & Van Dyne, 2008).

Impact of CI on Change Management:

We are trying to analyse the factors that drive a successful individual change in the light of CI. We will try to find out whether the skills that an individual gain while being high on CI become the factors to achieve the five outcomes of ADKAR model thereby ensuring an easy and smooth change. Table1 contains dimensions of ADKAR model for change management and theoretical justification through CI literature.

S.No.	Change Dimensions	CI
1.	Awareness – Of the need for change	People with high CI are associated with conciousness and awareness about the surroundings. CI also allows individuals to adapt easily to the different situations and modify their mental maps (Livermore, 2011).
2.	Desire –To be a part of change	Motivational CI pays attention to the innate desire of a person to be invovlved in multicultural interactions and metacognitive CI allows individuals to adapt themselves according to the environment. CI increases the desire of an individual to change themselves.
3.	Knowledge- On how to bring the change	CI allows individuals to understand the environment through conciousnss and mindfullness. One may understand what knowledge is required, however required knowledge acquisition through trainings and other factors would still be required.
4.	Ability- Required skills/behaviour to change	CI allows individuals to understand the differences and increases one's ability to adapt to different situations.
5.	Reinforcement- To reinforce change	Reinforcement is not impacted by CI

Methodology:

With this study we are trying to analyse the impact of CI on Change. To undestand the impact of the interplaying factors clearly we will use Total Interpretive Structural Modelling (TISM). TISM is an extension of interpretive structural modelling (ISM). Structural Modelling is a statistical technique that includes vairous statistical methods to analyse structural relationships among variables. The difference between TISM and ISM is that TISM interprets both nodes and links while ISM interprets only nodes (). TISM technique follows a series of steps:

1. **Identifying Variables:** The first step involves identification of variables for analysis. ADKAR model provides five variables for change management and CI would be the factor as we are trying to test the factors of change management and CI.
   E1: CI
   E2: Awareness
   E3: Desire
   E4: Knowledge

E5: Ability
E6: Reinforcement

2. **Determining Relationship between Variables:** There are four contextual relationships possible between variables and we have to identify the type of relationship that exist between them. Below are the depiction of relationship:

   V- i --> j : The contextual relationship is represented with V if the variable i has impact on variable j.

   A- j--> i : The contextual relationship is represented with A if the variable i has impact on variable j but j does not impact i.

   X- i<-->j : The contextual relationship is represented with X if the variable i has impact on variable j and variable j also impacts i.

   O- i<-/->j : The contextual relationship is represented with O if the variable i has no impact on variable j and j also has no impact on i.

   After determining the mutual relationship among variables, we will replace all V and X by 1 and all A and O by 0.

3. **Interpretation of Relationship:** We interpret the relationship of one variable with the other variable and try to understand the dynamics. Relationships are interpreted through knowledge base.
4. **Pairwise Comparison of all Variables:** Structural Similarity Index Matrix (SSIM) is developed by entering the values for relationships of all variables with one another.
5. **Initial Reachability Matrix (IRM):** Reachability Matrix (RM) contains '1' if the relationship exists between two variables and '0' if the relationship does not exist between the variables. For this all the 'V' and 'X' are replaced with '1'and all 'A' and 'O' are replaced with '0'. Table 2 represents SSIM.

Table 2: IRM

V- i --> j j A- j--> i X- i<-->j O- i<-/-> i	1	2	3	4	5	6
E1	1	1	1	1	1	0
E2	1	1	0	1	1	0
E3	1	1	1	1	1	1
E4	1	1	0	1	1	0
E5	1	1	0	0	1	0
E6	0	0	0	0	0	0

6. **Final RM:** In final RM, we try to find out if any transitive relationship exists between the variables. We will mark all transitive relation with '1*'.

Table3: Final RM

V- i --> j j A- j--> i X- i<-->j O- i<-/->i	1	2	3	4	5	6
E1	1	1	1	1	1	0
E2	1	1	1*	1	1	0
E3	1	1	1	1	1	1
E4	1	1	0	1	1	0
E5	1	1	1*	1*	1	0
E6	0	0	0	0	0	0

7. **Level Determination:** According to the final RM, three sets namely reachability set, antecedent set and intersection set are prepared for every variable. Reachability set is prepared based on the number of 1's for a variable in its row and antecedent set is prepared based on the number of 1's for that variable in its column. And intersection set is simply the intersection of the reachability and antecedent set. Variables are now ranked based on the similarity in their reachability and interaction set. Remaining variables after first iteration are subject to iteration 2. The iterations are proceeded till all the variables are assigned a level. The six variables are divided into three levels and are shown in Tables 4, 5, 6 and 7.

Table 4: Iteration 1

Enabler	Reachability Set	Antecdent Set	Intersection Set	Level
E1	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5	1
E2	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5	1
E3	1,2,3,4,5,6	1,3	1,3	
E4	1,2,4,5	1,2,3,4	1,2,4	
E5	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5	1
E6	6	3,6	6	1

Table 5: Iteration 2

Enabler	Reachability Set	Antecdent Set	Intersection Set	Level
E3	3,4	3	3	
E4	4	3,4	4	2

Table 6: Iteration 3

Enabler	Reachability Set	Antecdent Set	Intersection Set	Level
E3	3	3	3	3

Table 6: Level Partitioning

Enabler	Reachability Set	Antecdent Set	Intersection Set	Level
E1	1,3,4	1,3,4	1,3,4	1
E2	1,2,4,5	1,2,3,4,5	1,2,4,5	1
E3	3	3	3	3
E4	4	3,4	4	2
E5	1,2,5	1,2,3,4,5	1,2,5	1
E6	6	3,6	6	1

8. **Prepare Diagraph:** Before the preparation of graphs, we go back to literature and reflect upon the transitive links. Hiatt (2006) clearly describes that awareness and desire are different. Creating awareness doesnot assure desire is created. Hence we remove that trasitive link. The other two transitive links are ability to desire and ability to knowledge. Both these links are valid. If one has capability and skills to execute a task, one would be willing to do that task. Being capable means having the knowledge and skills. Based on this, preparing the diagraph.

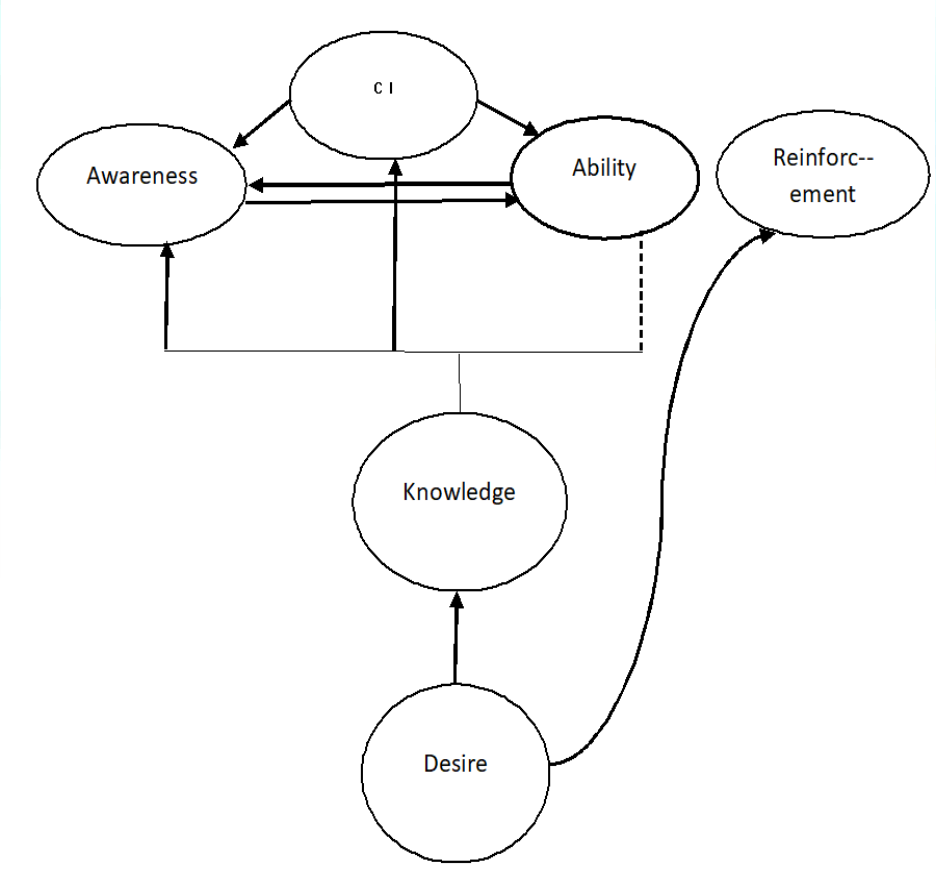


Figure 1: Diagraph

MICMAC (Matrice d'Impacts Croises Multiplication Applique an Classment) Analysis: MICMAC analysis means cross impact matrix multiplication when applied to classification. Driving and Dependence power are plotted on a graph and graph is further divided into four quadrants namely autonomous, dependent, linkage and independent. The variables are placed based on their driving and dependence power.

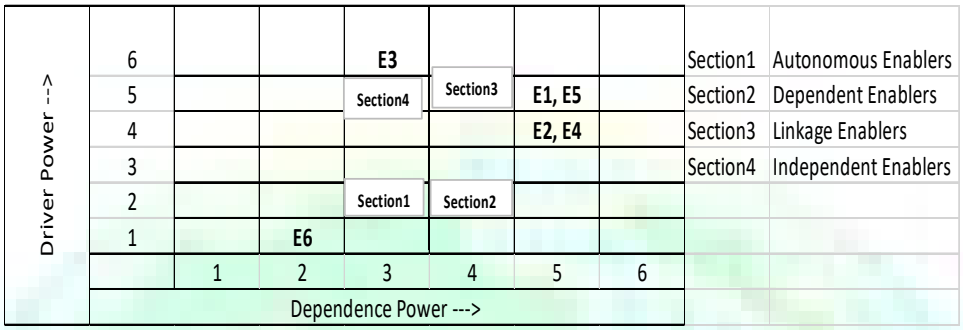


Figure 2: MICMAC Analysis

Autonomous Variables: The autonomous variables have weak dependence as well as weak driving power. Reinforcement have a weak dependence and driving power for the other five variables.

Dependent Variables: These variables have high dependence power but weak driving power. None of our variables lies in this region.

Linkage Variables: These variables are strong enablers and possess high driving as well as high dependence power. Four of our variables lies in this region i.e. CI, Knowledge, Awareness and Ability.

Independent Variables: Variables lying in this quadrant have high driving power while are low on dependence power. Desire has come out to be a strong enabler that drives the other variables with the highest driving power.

Conclusion:

Livermore (2011) said that the most important thing that lies at the heart of cultural intelligence strategies is the willingness to undergo transformation. Desire lies at the root of the diagraph and has come out to be the strongest factor in terms of driving power. A strong CI involves the strengthening of desire or motivation of an individual. According to the analysis, CI possess a high driving as well as dependence power which means it is has correlation with the other variables that are the individual change management variables. The high driving power will allow CI to ease out the change process. The results clearly indicate that the presence of high level of CI will ensure a smooth change process. The culturally intelligent workforce will work towards the benefit of organization to manage the external stakeholders.

References

Ang, S., & Van Dyne, L. (2008). *Handbook of Cultural Intelligence: Theory, Measures and Applications.* Armonk: M.E. Sharpe.

Bogilovic, S., & Skerlavaj, M. (2016). Metacognitive and Motivational Intelligence: Superpowers for Creativity in a Culturally Diverse Environment. *Economic and Business Review, 18*(1), 55-76.

Brislin, R., Worthley, R., & Macnab, B. (2006). Cultural intelligence: understanding behaviors that serve peoples goals. *Group & Organization Management, 31*(1), 40-55.

Early, P. C., & Ang, S. (2003). *Cultural Intelligence: An analysis of individual interactions across cultures.* Stanford, CA: Stanford University Press.

Gladden, R. (2017, 08 21). How to Tailor Change Management to Different Cultures. *International Association of Business Communicators*.

Gooden, D. J., Creque, C. A., & Chin-Loy, C. (2017). The Impact Of Metacognitive, Cognitive And Motivational Cultural Intelligence On Behavioral Cultural Intelligence. *International Business & Economics Research Journal, 16*(3).

Hamidianpour, F., Esmaeilpour, M., & Zarei, R. (2016). The Effects of Cultural Intelligence and Transformational Leadership Style of Managers on Employee Resistance to Change. *Mediterranean Journal of Social Sciences, 7*(5).

Hiatt, J. (2006). *ADKAR: A Model for Change in Business, Government, and Our Community.* Loveland, Colorado, USA: Prosci Learning Center Publications.

Higgs, M., & Rowland, D. (2005). All changes great and small: Exploring approaches to change and its leadership. *Journal of Change Management, 5*(2), 121-151.

Ilyas, M. A., & Hassan, M. K. (2015). Culturally intelligent change management. Paper presented at PMI® Global Congress 2015. *Newtown Square, PA.* EMEA, London, England: Project Management Institute.

Lewin, K. (1947). *Frontiers in Group Dynamics.* Bobbs-Merrill, College Division.

Livermore, D. (2011). The Cultural Intelligence Difference: Master the one skill you cannot do without in today's global economy. *AMACOM Div American Management Association*.

Mangla, N. (2018). Cultural Intelligence: A Conceptual Study.

Ng, K., & Early, P. (2006). Culture and Intelligence: Old Constructs, New Frontiers. *Group Organization Management, 31*(1), 4-19.

Porsci. (n.d.). *What is Change Management?* Retrieved from Porsci: https://www.prosci.com/resources/articles/what-is-change-management

Sirkin, H. L., Keenan, P., & Jackson, A. (2005). The Hard Side of Change Management. *Harvard Business Review*.

Thomas, D. C., & Inkson, K. C. (2009). *Cultural Intelligence: Living and Working Globally.* Berrett Koehler Publishers .

Talent management: A strategy towards sustainable competitive advantage

Hinadi Akbar[1], Ahmad Faraz Khan[2] and Parvaiz Talib[3]

[1]Research Scholar,
Address-Department of Business Administration,
Frank & Debbi Islam Management Complex,
Aligarh Muslim University, Aligarh 202002
Contact No. *9696401439*

Email Id: hinadiakbar20@gmail.com

[2]Assistant Professor,
Address-Department of Business Administration,
Frank & Debbi Islam Management Complex,
Aligarh Muslim University, Aligarh 202002
Contact No. 8755069065
Email Id: ahmadfk1@gmail.com

[3]Professor,
Address-Department of Business Administration,
Frank & Debbi Islam Management Complex,
Aligarh Muslim University, Aligarh 202002
Contact No. 94122742
Email: parvaiztalib@gmail.com

Abstract

Purpose – This paper attempts to substantiate talent management as a source of sustainable competitive advantage. It links talent management with HR functions, Ambidexterity and Firm Performance using resource-based view of the firm.

Design/methodology/approach – This article is based on a review of the academic literature related to strategic management and talent management.

Findings – In recent times, human resource is classified as a critical resource for the organizations. From a Resource-based view (RBV), sustainable competitive advantage can be achieved by converting human resources into a valuable, rare and non-imitable resources. An important measure of firm performance which results in competitive advantage is ambidexterity which focuses on *alignment* and *adaptability* simultaneously. In this regard, talent management processes such as i*dentifying critical positions, competence training, development* and *reward management* can be instrumental into linking traditional human resource functions of *planning*, *recruitment, selection, training, development, performance appraisal* and *compensation* with organizational performance. This process can be influenced by organizational context such as *discipline, stretch, support* and *trust*.

Practical implications – This model establishes linkages of HR functions, Talent Management Processes and Performance measure such as Ambidexterity. It incorporates the influence of proximal variables such as organizational context. Both practitioners and academics shall be able to comprehend the complex linkages in the context of this model. This is expected to enrich their understanding of the strategy of the firm. It shall also provide a theoretical base to future researchers.

Originality/value – The article shall be valuable in understanding talent management from the perspective of resource-based view (RBV). It shall help evolve a comprehensive understanding of the phenomenon through the model crystallised.

Keywords: Talent Management; Resource—based view (RBV); Ambidexterity

Paper type: Conceptual

1. Introduction

In modern era firms are moving towards knowledge intensive work. This indicates the criticality of HR performance as a key differentiator. Human resource has become the most valuable and indispensable factor of an organization (Mosadragh, 2003). These resources can be best utilized when they are motivated through the bundle of HR practices. Available literature identifies several HR practices, such as *planning*, *recruitment, selection, training, development, performance appraisal* and *compensation* (Schuler, 1992). These practices have a bearing on firm performance. Organizations are moving from reactive to proactive approach to harness talent. Many HR professionals reported talent management as a key ingredient to achieve competitive advantage and desired firm performance (Collings and Mellahi, 2009; Cascio & Boudreau, 2016; Meyers & Van Woerkom, 2014). Further, it has been noted that talent management processes have evolved out of traditional HR functions. In this context, the key talent management functions are *identifying critical positions, competency training, development and reward management* (Jayaraman, Talib & Khan, 2018). Several performance measures have also been noted in the available literature. One such measure is *ambidexterity* (Gibson and Birkinshaw, 2004) which proposed that firm performance can be improved by developing "a carefully selected set of systems and processes that collectively define a context that allows the meta-capabilities of *alignment* and *adaptability* to simultaneously flourish, and thereby sustain business unit performance". Concepts of HR practices and talent management have been of great interest for both practitioners and academic researchers. Therefore, many studies have been conducted separately to investigate their impact on organizational performance. The present review takes a stock of available literature on HR practices and talent management and how they impact organizational performance.

In recent times, human resource is classified as a critical resource for the organizations. From a Resource-based view (RBV) sustainable competitive advantage can be achieved by turning human resource into a valuable, rare and non-imitable resource. The article shall be valuable in understanding talent management from the perspective of resource-based view (RBV) and having a comprehensive understanding of the phenomenon. According to Hoskisson, Hitt, Wan & Yiu, 1999, the field of HR proved to be instrumental in development of RBV theory, because of the shift in RBV approach from external factors (such as market position) towards internal factors sources such as competitive advantage. Another important aspect which has been largely ignored by HR researchers while studying this relationship is organizational context. We build our argument on the organization context literature, in the light of Ghoshal and Bartlett's (1994) framework for organizational effectiveness. The framework highlights the way in which the four behavior developing attributes of discipline, stretch, trust and support were created and reinforced by managers throughout the organization. In the subsequent section we shall discuss the impact of organizational context on the relationship between TM and firm performance.

2. HRM Typology

Human resources are the non-substitutable assets of an organization. Wright and McMahan (1992), driving from Barney's RBV of the firm, stated that human resources can be a source of firm's sustainable competitive advantage if they are rare, imperfectly imitable and add value to firm's production. They pointed out the potential of human resource in achieving competitive advantage. But the issue is how to utilize these resources when employees habitually perform below their maximum potential (Bailey 1993). He further advocated that HRM practices clubbed with suitable organizational context can influence employees towards better performance. Wright and McMahan (1992) in their study presented RBV as one of the perspectives in support of how firms can achieve sustainable competitive advantage through human resources. With the development of subject knowledge of human resource management various aspects have been attributed to HR practices. Researchers have identified different HR practices that have a direct or indirect impact on firm performance. Some practices have high bearing on firm performance while others influence moderately. Commonly used HR practices identified by Schuler (1992), that influence firm performance are planning, staffing, appraising, compensating, training and development. Whether these practices influence the firm performance in equal magnitude or not is still debatable. Some researchers have argued that the bundle of HRM practices collectively have more impact on firm performance (Laursen (2002). Whereas, some researchers focused on the impact of individual HR practice such as compensation (Balkin & Gomez-Mejia, 1984); performance appraisal (Gerhart & Milkovich, 1992); training (Bartel, 1994) and staffing (Becker & Huselid, 1992). This leads to an argument that the right blend of the HRM practices is of outmost importance for organizational performance.

2.1. Aspects of HRM Typology

As discussed earlier HRM typology consists of six different aspects that are universally accepted. For our study we shall consider HRM typology given by Schuler (1992). First, *Planning* in HRM is to forecast workforce demand, evaluate supply and resolve demand and supply quandary in a systematic manner while scanning external

environment. Second, *Staffing* activity can be further divided into two parts recruitment, is attracting the large number of qualified applicants (both internal and external) to apply for the vacant positions and selection, it is choosing the applicant with relevant qualification to fill in the jobs (Becker & Huselid, 1992). Selection tries to strike a happy balance between applicant's offer and organization's requirement. Third, *Training* is the act of enhancing the abilities, skills and knowledge of an employee to perform the task in better way. In today's corporate jungle, organizations that constantly invest in upgrading skills and abilities of their employees can only survive and flourish (Bartel, 1994). Fourth, *Development* is different from training in that it is the outcome of experience and maturity that comes with it and has long run bearing. Development enhances executive's ability to handle diverse jobs and prepare them for future challenges. Fifth, *Performance appraisal* is the method of evaluating quantitative and qualitative aspects of job performance. It is the process of providing feedback to employees on their performance and formulating a plan of improvement. Sixth, *Compensation* is what employee get in return, from the employer, for their hard work. Compensation is designed in a manner to attract, motivate and retain key employees and at the same time cost effective for the organization (Balkin & Gomez-Mejia, 1984).

There is an emerging consensus among human resource professional that HR practices, if appropriately implemented, contribute to firm performance. Milgrom and Roberts (1995), in their study stated that interactions within firm's HRM practices and between HRM practices and competitive strategy can have a positive bearing on firm performance. Delery and Doty (1996) in their study on US banking sector concluded the positive relationship between HR practices and firm performance. Similarly MacDuffie (1995) studied auto assembly lines and established strong linkage between HR practices and firm performance. Although much of the research work on HR practices directed towards progressive firm performance, but debate is still open whether HR practices themselves are sufficient for this positive relationship.

Proposition 1: A foundation of HR practices (that includes planning, *recruitment, selection, training, development, performance appraisal* and *compensation) influence firm's performance.*

3. Talent Management Process

The talent problems of individuals, organizations and the society are interwoven. Organizations search for required skills to exploit in a way they can afford. Individuals look forward for career advancement. The society at large hopes for profound competencies in management. These problems gave rise to talent management practices. There is a dispute among scholars whether the concept of TM process is merely a re-packaging of HRM process. In our study instead of calling it "an old wine in a new bottle", we have considered HRM as base for TM process. With the developments in organizational structures, size and change in demographics within the organizations, HR functions have become more operational in nature with the objective of smooth functioning of the organization. Na Fu et al., (2017) advocated that as per RBV rare and non-imitable resources leads to the firm's competitive advantage. He further added that HR practices are not a direct cause of competitive advantage. Rather, competitive advantage is achieved by the contributions of people hired, trained, appraised and developed through such practices. This conclusion further raised an argument whether entire human resources of the organization contribute to competitive advantage or it's an effort of a few talented and key position holders. Traditionally in HRM all the employees of an organization are part of the developmental process whereas in contemporary TM only the "talented pool" of an organization make it to the process. This argument is supported by the definition given by Cappelli (2008), "Talent management is the systematic attraction, identification, development, engagement/ retention and deployment of those individuals who are of particular value to an organization, either in view of their 'high potential' for the future or because they are fulfilling business/operation-critical roles." If we look at talent management function per se with the definition of Collings and Mellahi (2009), they identified key positions as a major contributor in firm's competitive advantage and to fill these positions high- performing talent pool needs to be developed. This shows that talent management is more strategic in nature which has ultimate objective of gaining competitive advantage.

For the purpose of our study we have taken talent management approaches, (*such as identifying critical positions, competency training, development and reward management*) identified by Jayaraman, Talib & Khan (2018). Firstly, *identifying critical positions* involves constructing talent pool, recognizing critical jobs and positions and discerning them on the basis their contributions towards firm success (Collings & Mellahi, 2009; Becker & Huselid, 2006). Secondly, *competence training* involves continuous investment of time and money for talents to enable them to acquire specific competencies for current and future jobs (Collins & Clark, 2003; Lepak, 2006; Sun, Aryee & Law, 2007). Thirdly, development involves creating multiple career paths to meet the identified talent expectations according to their capability and performance (Collins & Clark, 2003; Locke & Latham, 1990). Fourthly, *reward management* consist of both intrinsic and extrinsic rewards. Intrinsic rewards include career growth, feeling of self-esteem and challenging and supportive work environment (Mahaney & Lederer, 2006; Hongi- Haftel & Martin, 1993; Mottaz,

1985). Despite of inordinate influence on firm performance talent management functions can only be possible if HR functions are in place.

Proposition 2: Talent management process comprises of identifying critical positions, competence training, development and reward management positively impacts the firm performance.

4. Organizational Context

Substantial and tangible management actions mould the organizational context. And thereby influence the activities of all the elements within the organization. Mason and Mitroff (1973) identified structure and people as two parts of the organizational context. Earlier researchers (like, Bower, 1970; Burgelman, 1983) defined "organizational context as a process variables which were regarded as being shaped by making variations merely in structure and system". They have flouted the impact and interactions of various individual events (like work force demographics, retrenchment and lay off procedures, etc.) Undoubtedly change in structure and system have bearing on the organizational context, so too the behavioural changes have. Therefore we build our argument on the organization context literature, in the light of Ghoshal and Bartlett's (1994) framework for organizational effectiveness. The framework highlights the way in which the four behavior developing attributes of discipline, stretch, trust and support were created and reinforced by managers throughout the organization.

4.1. Discipline

Discipline is an attribute of organization's context that persuades its people to voluntarily push themselves for meeting all expectations produced by their expressed or unexpressed commitment. Researchers in the organizational behavior field have emphasised on discipline as a significant attribute of organizational context. Authors have also advocated that discipline in organizational context is developed through mechanisms such as establishment and acceptance of clear performance standards (Litwin and Stringer, 1968), robust internal feedback system (Pascale, 1985) and implementation of consistent sanctions (Gordon and DiTomaso, 1992).

4.2. Stretch

Hamel and Prahalad (1993), have defined stretch as, "an environment in which employees voluntarily stretch their own standards and expectations". Stretch being a significant element of the internal environment, managers can influence the aspiration echelons of employees. The environment of stretch is collectively built upon the three attributes such as shared vision (Denison, 1990), collective identity (Allaire and Firsirotu, 1984) and personal meaning (Johnston, 1976; Hackman and Oldham, 1980 and Thomas and Velthouse, 1990).

4.3. Trust

McGregor (1960), suggested that competence is a prerequisite for trust. For organizations engaged in specialized activities, individual level competence is important for creating an environment of mutual trust. Apart from competence researchers have identified two other important factors in developing trust i.e., fairness and equity in decision making processes (Abbey and Dickson, 1983; Alston, 1986; Folger and Konovsky, 1989) and participation in core activities (Johnston, 1976; Denison, 1990; Kim and Mauborgne, 1993).

4.4. Support

Support act as a means for developing a feeling of empowerment and commitment among organizational members. Earlier research work on organizational context has been carried out in relatively large, divisionalized corporations and from the top management perspective. In such organizations, at the time these studies were conducted, roles of senior managers inclined towards control rather than on support (Peters, 1992). On the other hand organization theorists such as Walton (1985), in his study emphasized "the significance of support between superior and subordinate relationship in the vertical interactions as well as among functional managers in the horizontal interactions within the organization." Mechanisms that allow actors to access resources available (Kanter, 1988), autonomy (Calori and Sarnin, 1991; Deci, Connell, and Ryan, 1989; Denison, 1990), mentoring (Marcoulides and Heck, 1993) contribute to the establishment of support.

As suggested by the literature, organizations that are able to institute these four discipline, stretch, trust and support as attributes of their context can motivate employees to achieve individual as well as organizational objectives. It also instigate conducive work culture for setting up of human resource ambidexterity in the form of alignment and adaptability of HR activities.

Proposition 3: Organizational context influence the relationship between talent management process and firm performance measure such as ambidexterity.

5. Firm Performance

Persistent performance is the ultimate aim of any organization because only through performance, organizations are able to nurture and progress. Positive performance is arguably the most important indicator of organizational health. Moreover it is also important to identify those factors that should be treated with an increased interest in order to improve the firm performance. Researchers have identified various factors that contribute to the organizational performance like human resources, marketing strategies, financial management, CSR activities, etc. The most crucial and important factor above all is the *human resource,* the building block of any organization. A range of financial and non-financial measures have been identified by human resource professionals to quantify firm performance. These have included ROA and sales growth (Snell & Youndt, 1995; Batt, 2018); firm profit growth (Kim & Ployhart, 2014); employee turnover and profit per employee (Guest, Michie, Conway & Sheehan, 2003); high-involvement and commitment (Ramsay, Scholarios & Harley, 2000); job burnout (Lee & Ashforth, 1996); job satisfaction (Hoque, 1999); competitive advantage (Sheehan, 2014); degree of innovation and social climate (Razouk, 2013); and organizational citizenship behavior (Tsui, Pearce, Porter & Tripoli, 1997). Despite of diversified outcomes and operational issues Paauwe, Guest, and Wright (2013) conclude that HRM and diverse measures of firm performance shares a positive relationship.

Another important measure of firm performance recently adopted by organizational theorist is organizational ambidexterity. Being an important measure of firm performance it results in competitive advantage by focusing on *alignment* and *adaptability* simultaneously. Gibson and Birkinshaw (2004) proposed that firm performance can be improved by developing "a carefully selected set of systems and processes that collectively define a context that allows the meta-capabilities of alignment and adaptability to simultaneously flourish, and thereby sustain business unit performance". Gibson and Birkinshaw (2004) further linked Ghosal and Bartlett's (1994) work on elements of organizational context (such as stretch, discipline, support, and trust) as a predictor of behavioral model of ambidexterity, labelled it as contextual ambidexterity. As per this perspective, charismatic leadership, formal organization structure or even strong culture are not sufficient enough to deliver superior firm performance. Rather, it is achieved by building a set of systems and processes which collectively develop a context that allows the capabilities of alignment and adaptability to flourish simultaneously, and subsequently sustain firm performance. According to Gibson and Birkinshaw (2004) alignment activities are focused on improving performance in the short run through discipline and stretch (like open feedback system and clear performance standard). Adaptability activities are focused on improving performance in the long run through support and trust (like job autonomy and job security). Thus, business unit cannot concentrate on one activity at the expense of the other, else it will adversely affect firm performance. HR ambidexterity which balances out alignment and adaptability is becoming need rather than means.

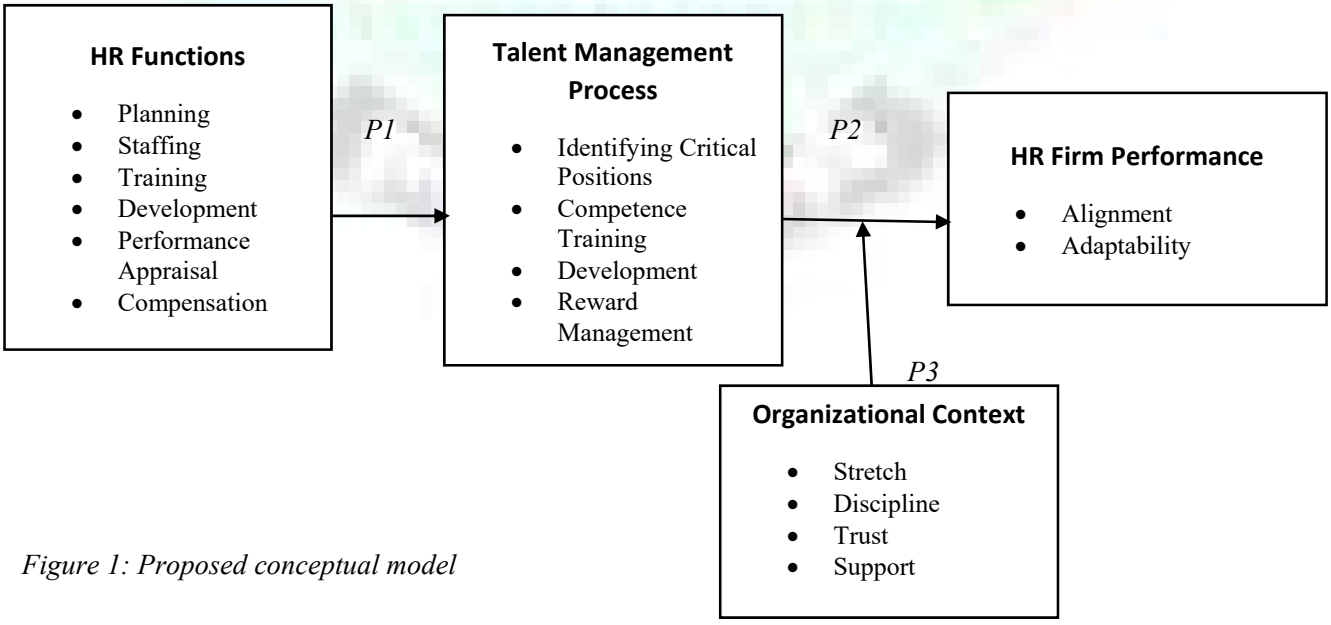


Figure 1: Proposed conceptual model

6. Discussion

In recent times, human resource is classified as a critical resource for the organizations. From a Resource-based view (RBV) sustainable competitive advantage can be achieved by turning human resource into a valuable, rare and non-imitable resource. After reviewing available literature a proposed conceptual model was created. This model clearly provides linkages of HR functions, Talent Management Processes and Performance measure such as Ambidexterity. It also incorporates the influence of proximal variables like organizational context. Our study explored the following issues:

1. Impact of HR practices and talent management on firm performance.
2. Effect of organizational context on relationship between talent management and firm performance measure such as ambidexterity.

On the basis of available literature, this review paper suggest that an important measure of firm performance which results in competitive advantage is ambidexterity that focuses on *alignment* and *adaptability* simultaneously. In this parlance, talent management processes such as i*dentifying critical positions, competence training, development* and *reward management* can be instrumental into linking traditional human resource functions of *planning*, *recruitment, selection, training, development, performance appraisal* and *compensation* with organizational performance. This process can be influenced by organizational context such as *discipline, stretch, support* and *trust*.

This research paper shall also bring a theoretical grounding for future researchers. Practitioners and academics alike shall be able to comprehend the complex linkages in order to enrich the strategy of the firm. By grounding TM in a strategic framework and empirically testing developed conceptual model that demonstrate the varied impacts of talent management researchers can significantly expand the quality of talent discussions in organizations.

7. References

1. Ein-Dor, P., & Segev, E. (1978). Organizational context and the success of management information systems. *Management Science*, *24*(10), 1064-1077.
2. Schuler, R. S., & Jackson, S. E. (1987). Linking competitive strategies with human resource management practices. *Academy of Management Perspectives*, *1*(3), 207-219.
3. Bird, B. (1988). Implementing entrepreneurial ideas: The case for intention. *Academy of management Review*, *13*(3), 442-453.
4. Benson, P. G., Saraph, J. V., & Schroeder, R. G. (1991). The effects of organizational context on quality management: an empirical investigation. *Management science*, *37*(9), 1107-1124.
5. Ghoshal, S., & Bartlett, C. A. (1994). Linking organizational context and managerial action: The dimensions of quality of management. *Strategic management journal*, *15*(S2), 91-112.
6. Snell, S. A., & Youndt, M. A. (1995). Human resource management and firm performance: Testing a contingency model of executive controls. *Journal of Management*, *21*(4), 711-737.
7. Huselid, M. A. (1995). The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of management journal*, *38*(3), 635-672.
8. Delaney, J. T., & Huselid, M. A. (1996). The impact of human resource management practices on perceptions of organizational performance. *Academy of Management journal*, *39*(4), 949-969.
9. Lee, R. T., & Ashforth, B. E. (1996). A meta-analytic examination of the correlates of the three dimensions of job burnout. *Journal of applied Psychology*, *81*(2), 123.
10. Huselid, M. A., Jackson, S. E., & Schuler, R. S. (1997). Technical and strategic human resources management effectiveness as determinants of firm performance. *Academy of Management journal*, *40*(1), 171-188.
11. Tsui, A. S., Pearce, J. L., Porter, L. W., & Tripoli, A. M. (1997). Alternative approaches to the employee-organization relationship: Does investment in employees pay off? *Academy of Management journal*, *40*(5), 1089-1121.

12. Hoque, K. (1999). Human resource management and performance in the UK hotel industry. *British Journal of Industrial Relations*, *37*(3), 419-443.

13. Ramsay, H., Scholarios, D., & Harley, B. (2000). Employees and high-performance work systems: testing inside the black box. *British Journal of industrial relations*, *38*(4), 501-531.

14. Batt, R. (2002). Managing customer services: Human resource practices, quit rates, and sales growth. *Academy of management Journal*, *45*(3), 587-597.

15. Wright, P. M., Gardner, T. M., & Moynihan, L. M. (2003). The impact of HR practices on the performance of business units. *Human resource management journal*, *13*(3), 21-36.

16. Guest, D. E., Michie, J., Conway, N., & Sheehan, M. (2003). Human resource management and corporate performance in the UK. *British journal of industrial relations*, *41*(2), 291-314.

17. Datta, D. K., Guthrie, J. P., & Wright, P. M. (2005). Human resource management and labor productivity: does industry matter? *Academy of management Journal*, *48*(1), 135-145.

18. Hayton, J. C. (2005). Promoting corporate entrepreneurship through human resource management practices: A review of empirical research. *Human resource management review*, *15*(1), 21-41.

19. Gibson, C. B., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of organizational ambidexterity. *Academy of management Journal*, *47*(2), 209-226.

20. Lewis, R. E., & Heckman, R. J. (2006). Talent management: A critical review. *Human resource management review*, *16*(2), 139-154.

21. Cappelli, P. (2008). Talent management for the twenty-first century. *Harvard business review*, *86*(3), 74.

22. Subramony, M. (2009). A meta-analytic investigation of the relationship between HRM bundles and firm performance. *Human resource management*, *48*(5), 745-768.

23. Ait Razouk, A. (2011). High-performance work systems and performance of French small-and medium-sized enterprises: examining causal order. *The International Journal of Human Resource Management*, *22*(02), 311-330.

24. Kehinde, J. (2012). Talent management: Effect on organization performances. *Journal of Management Research*, *4*(2), 178-186.

25. Patel, P. C., Messersmith, J. G., & Lepak, D. P. (2013). Walking the tightrope: An assessment of the relationship between high-performance work systems and organizational ambidexterity. *Academy of Management Journal*, *56*(5), 1420-1442.

26. Mellahi, K., Demirbag, M., Collings, D. G., Tatoglu, E., & Hughes, M. (2013). Similarly different: a comparison of HRM practices in MNE subsidiaries and local firms in Turkey. *The International Journal of Human Resource Management*, *24*(12), 2339-2368.

27. Kim, Y., & Ployhart, R. E. (2014). The effects of staffing and training on firm productivity and profit growth before, during, and after the Great Recession. *Journal of Applied Psychology*, *99*(3), 361.

28. Sheehan, M. (2014). Human resource management and performance: Evidence from small and medium-sized firms. *International Small Business Journal*, *32*(5), 545-570.

29. Collings, D. G., Scullion, H., & Vaiman, V. (2015). Talent management: Progress and prospects.

Mohammed, A. (2016). The Impact of Talent Management on Employee Engagement, Retention and Value Addition in Achieving Organizational Performance. *International Journal of Engineering and Management*, *1*(12), 142-152.

30. Benders, J. (2017). The later, the more deceptive? A patagon dated 1628 from Chateau-Regnault with a Brabantian reverse. *Numismatic Chronicle*, *177*, 413-417.

31. Glaister, A. J., Karacay, G., Demirbag, M., & Tatoglu, E. (2018). HRM and performance—the role of talent management as a transmission mechanism in an emerging market context. *Human Resource Management Journal*, *28*(1), 148-166.

Assessment of Effectiveness of Recreational Facilities at the Workplace and Need for Flexible Approach for their Design

Dhanshyam Mahavadi

Research Scholar, Indian Institute of Management, Lucknow – 226013, India

fpm19017@iiml.ac.in

Abstract: The RoI of the human capital – the most important asset of organizations - depends primarily on the life quality of the individuals, represented by their performance levels, motivation towards work and work-life balance. The advancement of fast and competitive business world accompanies increased working hours, which stress the employees further. To remain competitive, companies try to maximize the productivity of employees through recreational & wellness programs, which require high initial investment and significant costs to maintain. Thus, it is essential to assess their adequacy, effectiveness, and their actual role in the life quality of employees. Extant literature focuses on positive effects of the recreational programs, but the actual benefits accrued to the final customers (employees) remains doubtful.

Through this study on Indian IT industry, the author assesses the effectiveness of these programs using four indicators. The results expose the inadequacies, emphasizing the need for flexible approach in designing such programs.

Keywords: recreational facilities, employee wellness, stress, work-life balance, effectiveness, Performance index, Life Quality Index, Motivation index

1 Introduction

Employees are probably the most important resource and asset for any organization and the heights an organization reaches are directly related to the amount and quality of work put in by them. This high quality and amount of work, in turn, is directly related to employees' satisfaction with their work and their social life within the workspace.

The burden of maintaining a work-life balance in the modern world is becoming increasingly more and more challenging in most of the organizations. The pressure to achieve targets at office and the obligation to spend quality time with family is taking its toll on today's working professionals.

As a solution to this problem, many organizations worldwide have now made it mandatory in their policies to implement recreational activities at the workplace many times in a year.

1.1 Importance of Recreational Activities

- *Higher productivity:* If employees are stuck in their cubicle all day, their productivity is bound to fall. Recreational activities provide refreshments to brain leading to a more focused and productive employee.
- *Unlock Creativity:* When the work environment is fun, it gives the brain a boost to think differently and come up with out-of-the-box ideas.
- *Stress and Health:* The strict HR policies and rules can cause a lot of stress and health issues in the work force which is unhealthy for the organization. Having a lighter work environment and creating a fun corner will help in keeping the work stress levels low and productivity high.
- *Teamwork and co-operation:* Having a recreational area is one of the best ways of managing employees and improving team morale in work place. It makes work fun and breaks the ice between them, eventually building a strong workforce.
- *Improves Employee-Boss Relationship:* Creating a recreational area at workplace will improve the work culture in the organization. Managers and supervisors will appear to be more approachable and that will mean employee performance will be bettered and organization will be a more cohesive unit.

The advantages of recreational activities are countless and there are no questions about their impact on the organization's productivity. But, as most of the policies that are drafted at the higher management level get diluted when implemented at lower level of the organization, recreational activities may also face the same fate. Implementing recreational activities at different organizational levels productively is one of the most critical challenges that organizations faces today. Most of the organizations, especially in India, organize recreational activities probably just

for the sake of complying with HR policies. Employees seemingly do not participate very actively in the recreational activities conducted at their office/organization. Apparently, the perception of employees towards recreational activities is also very casual in nature.

All the above-mentioned points kindle an important question of *whether these recreational activities are at all beneficial for organization's productivity/output?*

2 Literature Review & Background:

Gungaphul, M., *et al* (2012), in their paper, have stressed the importance of promotion of leisure and recreation in the workplace with some focus on the recent trends in workplace recreation. Modern organisations are increasingly realising the value of employee health, well-being personal and professional growth and their linkage to the wellness programmes. The advantages like increased productivity, enhanced work-life balance, platform to socialise, improved motivation and betterment of professional behaviour of the employees provided by the recreational activities is driving the organisations to invest heavily and encourage the employees take active part in the same.

Candice, M.B., *et al* (2011), through their case study, have examined a workplace recreation-based programme using a social and ecological approach to wellness. The study highlights leadership, social support and bonding as the primary benefits of the workplace recreation, even while the constraints related to job responsibilities, returning to work after perspiring and limitations of physical space act as challenges in actual implementation of the recreational activities. They have established that the recreational activities improve the degree of identification of ownership that the individuals feel.

In a detailed study conducted on the effects of workplace recreation on employee performance, at Kenya Utalii College, Mokaya, *et al.* (2012), discovered that the major reasons for engaging in workplace recreation were relaxation of mind, stress reduction, confidence building and improvement of health of employees. They have found a positive correlation between the recreational facilities at workplace and the employee performance variables like job satisfaction, quality of service and customer satisfaction and enhanced productivity. Most employees view recreational activities as intrinsic reward mechanism, wherein staff parties serve as a platform to obtain informal feedback on the employee performance and for recognising one's achievements and gaining cognizance of their shortcomings, thus helping them meet their social needs that are otherwise constrained by the hectic schedules. By offering recreational facilities to employees, organisations boost the productivity of employees by meeting their physical and psychological needs, which in turn reduces their absenteeism, sick leaves and medical costs, and acquire returns in the form of reduced turnover, improved working hours and greater productivity. They further recommend that in order to achieve the desired results and performance, however, the recreational activities have to be carefully designed considering the different tastes, genders, age and other cultural factors of the demographics.

Realising that physical inactivity is the fourth most leading reason for deaths globally (Kohl *et al.,* 2012) and that inactivity increases the risk on non-communicable diseases like cardiovascular disorders and diabetes, Amber V., *et al*, in 2016, have conducted a research on the faculty and staff of a small private University located in the Pacific Northwest of the US, with the hypotheses that Workplace and Environmental settings have a positive effect on health status and promote increased quality of life, reduce stress and improve overall employee satisfaction. To this effect, Kohl, *et al* (2012) call for a systematic approach for capacity and infrastructure to design creative work environments. Morrison and MacKinnon, 2008, have defined essentials for workplace wellness programmes that include stakeholder engagement, employee participation and involvement, positive organisational culture, ability to reduce direct medical economic expenses resulting out of stress and effects on humanistic outcomes. In their study, Amber, *et al.* have found that workplace recreation have contributed to changing social norms at the University by developing a culture of health and wellness. They have addressed the primary problems of identification of indicators of work-related quality of life, identification of the recreation needs of the faculty and the staff and identification of current trends for the usage of available recreational facilities. They found that the participants of the wellness programme felt very healthy and full of energy. However, while around 75% of the participants had planned to use the recreational facilities on being opened, only 46.7% reported to have actually been using them at least once a week, post their installation. Despite the non-active use, the respondents emphasised on the need of such facilities at their workplace. But at the same time, on post-test, 86% of the participants had reported that the new recreational facility had little influenced their approach to work. Additionally, their findings reported that the current facilities fail to address many aspects of health. As such, a lot of refinement has been suggested in the available recreational facilities to enhance participative health efforts among the faculty and staff. Their findings had further emphasised the importance of components recommended by Morrison and MacKinnon (2008) as essential to the success of workplace wellness programmes.

In a study conducted on the managerial and non-managerial staff of The World, Shopping mall at the city of Bhubaneshwar (India), Samantaray (2014) has found that the work environment, recreational & refreshment facilities at the workplace, fun at the work initiatives, health and safety facilities at the work place are essential to develop inter-personal relationships and overcome fatigue, boredom and the associated stress resulting from the job. The characteristics of an effective work environment include trust, mutual respect, mindfulness, openness to diversity and cooperation, which are strengthened by recreational activities. Organisations should aim at generation of a work environment which ensures easing of the effort and stress, while eliminating the causes of frustration, anxiety and worry. Creating healthy workplaces to foster a positive work environment requires detailed planning and good implementation. This may involve changes in the organisational structure, culture, systems and practices, if required. Morrison and MacKinnon (2008) have done extensive review of the literature and interviews regarding Workplace Wellness Programmes (WWPs) at Canada and other places. The employers, who employ more than 50% of Canadian population are in prime position to take initiatives to impact health of their employees. The new millennium WWPs focus on organisational stress, including work-life balance and morale issues by integrating a comprehensive approach to wellness. The success of Employee Assistance Programmes (EAPs) shows that a WWP with personalised health counselling-based needs would improve the utility and consumption of the initiatives. The organisations must foster a culture wherein wellness must be a core business process and should be integrated with the strategy to achieve optimal results. Findings support that workplace wellness programmes have a substantial effect on the indirect costs of the organisations, with significant impact on absenteeism and productivity. Besides, properly structured wellness programmes enhance the corporate image of the organisations and improve employee retention and engagement.

In her study, Caroline (2013) has tried to determine the effect of workplace recreation on the well-being and performance of employees at the Commission for University Education (CUE), Kenya. Trying to separately analyse the impacts of different aspects of the recreation, viz. the physical fitness programmes, mental health programmes, and workplace entertainment programmes, the study was conducted on 66 employees of staff at varied organisational levels of CUE. The results show a strong positive correlation of employee well-being with physical fitness and mental health while the correlation with entertainment programmes has been found less significant. Lack of time, inadequate recreational facilities and distrust in the employer have been found as major deterrents in the positive participation of the individuals in the activities. The researcher emphasises on the need of organisations to evaluate their recreational schedules so that the employees may be allowed to participate in the activities on a part-employee, part-company time basis. Among major challenges faced by the organisations in implementation of the recreational activities, the problem in being unable to quantify benefits from the recreational programmes and getting employees to participate in the same.

3 Objectives

From the above discussion, it has been discovered that the recreational activities are really important. However, there is very little evidence from these studies about the real effectiveness in the scenario of Indian IT companies. Hence, a need has been felt to address the proposed research question.

An attempt has been made to formulate well worked-out questionnaire for surveying employees working in IT organizations in India to know about the actual impact of recreational activities held at their respective workplaces. The survey provided insights into the actual effectiveness of recreational activities and the impact these activities have on employees' satisfaction level and whether these recreational activities are helpful in improving the employee productivity or not. To summarize, answers and insights have been sought for the following research question:

"Are the recreational activities really recreational at the workplace?"

After consolidating the data and concrete opinions of employees, the results have been presented with the help of representative and inferential statistics, followed by some insightful recommendations.

3.1 Rationale

- As organizations spend a fortune on recreational activities for its employees, it becomes essential to realize the actual benefits of implementing these recreational activities.
- As already mentioned, the employees' satisfaction level largely depends on the environment in which he/she works. An employee who might be going through all the recreational activities available in his/her office may claim to have a low satisfaction level and dull/boring workspace.

- The effectiveness of recreational activities has a great impact on an individual employee's stress level and overall health. The measure of the effectiveness of recreational activities might provide the actual intensity of stress and pressure that an employee handles in an organization.
- Most of the books and a plethora of widely available researches in the area claim positive impacts of recreational activities on organization's productivity but if employees do not participate in these activities willingly and intensively, the benefits of these activities for those employees might not be significant.
- To know the actual trend and how employees actually perceive these recreational activities.

4 Research Design & Methodology

4.1 Nature of Research

The research undertaken is a descriptive research based on primary data backed by secondary data obtained from literature review.

4.2 Research Design

An attempt has been made to evaluate the impact of recreational activities at the workplace on aspects such as employees' individual performance, team performance, motivation and life quality.

For this purpose, the impact assessing questions were categorized into individual heads, viz., Individual Performance Index, Team Performance Index, Motivation Index and the Life Quality Index. The mean of responses for the respective questions (as per the categories mentioned in the Inferential Analysis Section) have been used to estimate and analyse the respective indices. These indices have been analysed with respect to the frequency of usage, which is the determining variable of the effectiveness of the available facilities.

The research model may be represented as follows:

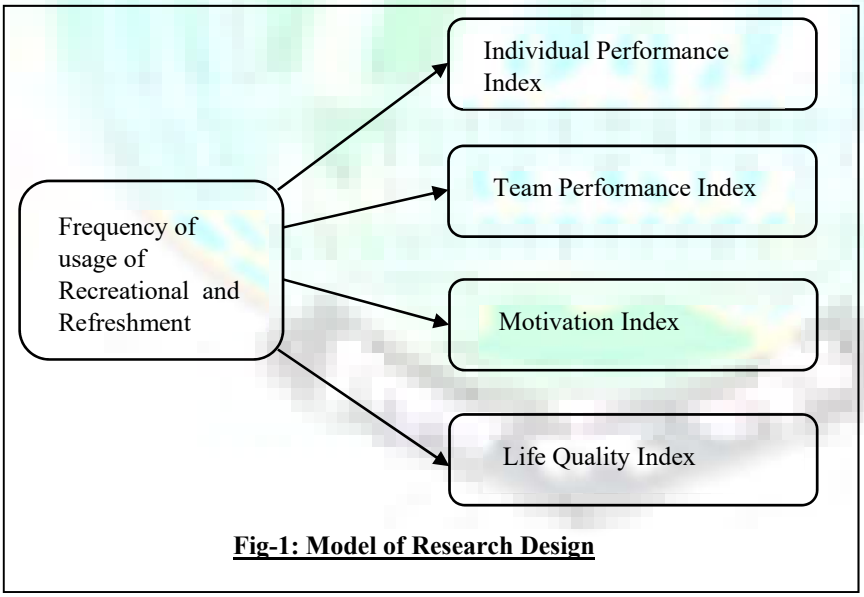


Fig-1: Model of Research Design

Quantitative tools have been used to analyze the relation between the recreational activities at the workplace and the above-mentioned aspects.

4.3 Sample Design and size

The sample for the research constitutes the employees from different age groups, gender and positions held in their organisations. The study has been limited to the Indian IT sector, which happens to be the largest private sector employer. Further the dynamic nature of IT Sector may lead to increased workplace challenges and thereby higher stress levels implying the increasing need for the recreational activities at the workplace.

An approximate sample size between 100-150 was considered for the representative analysis. The objective was to ensure adequate representation of the target population. A total of 138 responses have been collected and analyzed.

4.4 Pilot Study

The pilot study done through the designed questionnaire was tested with responses from 20 employees. The Cronbach's alpha value of 0.85 proved the reliability of the questionnaire and set further stage for the full-fledged research.

4.5 Data Collection

Data has been collected from primary and secondary sources. The primary source of data has been the questionnaires whereas the secondary sources of data include research papers and online information databases. The questionnaire method was used to collect data largely due to the simplicity and convenience in circulation and data management. Responses were sought using google forms.

The questionnaire comprised a mix of general demographic data, questions specific to the field of research and a detailed impact-evaluating question on the 5-point Likert scale. An open-ended question seeking suggestions for improvement in the existing practices has also been included.

Apart from demographic factors like Age, position in the organization and duration of service, various other factors like the type of recreational activities provided by the organization, adequacy level of recreational activities, time and frequency of engagement in recreational activities by employees, employee motivational factors to participate and not to participate in recreational activities, most preferred workforce recreational activity by employees, company's priority towards recreational activities and consideration of employee engagement in recreational activities for Performance management system (PMS) have been considered as part of research.

The questionnaire has been optimized to clearly identify the impact of recreational activities at the workplace on employee morale, job satisfaction, motivation on the scale of 'Highly Negative Impact, Slightly Negative Impact, No Significant Impact, Slightly Positive Impact and Highly Positive Impact'. A statement assuring them the confidentiality of the information provided was included.

4.6 Data Analysis

Quantitative Analysis tools like MS Excel, IBM SPSS, etc. and techniques like charting and correlation analysis have been used to analyze the data collected from the questionnaire. The analysis largely involved the use of descriptive statistics and inferential statistics. An attempt has been made to stratify the data in various strata depending on certain parameters, for instance, level of management. The objective of data analysis was to extract the information in the most meaningful and self-explanatory manner and to facilitate inferences and conclusions.

4.7 Ethical Considerations

Utmost care has been taken to adhere to the ethical considerations and address ethical issues that may arise during the research. It has also been ensured that none of the members of the research group have compelled the respondents to participate. The respondents have provided the information by exercising their free will.

4. 8 Limitations of the Study

The research has been limited to the Indian IT Industry only. Also, the sample size of 138 makes it difficult to generalize the study to the entire population. However, sufficient care has been taken to obtain the data and analyse it in the most objective manner possible.

5 Results & Analysis

The primary data that has been collected through questionnaire consisting of 17 questions, from 138 respondents and analysed using appropriate tools, the salient findings of which have been summarized.

5.1 Descriptive analysis

- The descriptive analysis is based on the general and specific information collected from the survey. A total of 138 valid responses have been collected (where recreational facilities were available).
- A significant 35% of the responses were from employees in significant decision-making positions of the respective organisations, whereas a good 44% of the responses were from employees who have been working in the organisations for more than three years. This gave good insights across all the categories and verticals of the organization.

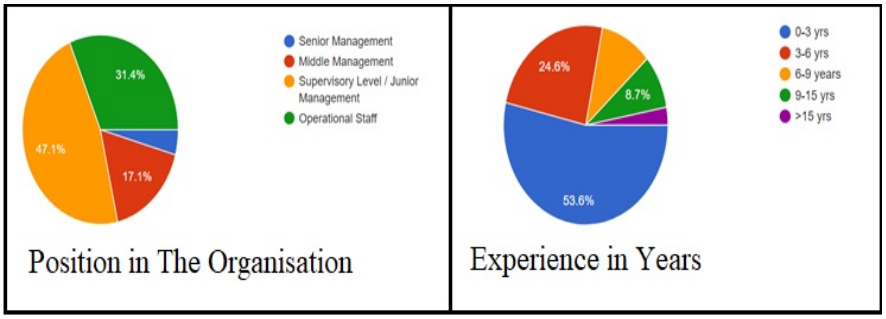


Fig-2: Demographics

- Few intriguing facts have been unfolded about the perception of adequacy of recreational facilities as 45.7% responses report just adequate and only 8.6% responses report highly adequate.
- Indoor recreational activities have the lion's share in the type of recreational facilities provided by organizations with indoor games accounted to 79.4% responses followed by staff parties and Gymnasium with 58.8% and 55.9% respectively. Travel has least share with mere 5.9% responses.
- It is clearly evident from the survey that the motivational factor for employees to use the recreational activities is to reduce stress which accounted for 48.5% responses and the reason not to make use of recreational activities is lack of time which accounted for 60.3% responses. The top two preferred recreational activities among employees is found to be team building exercises and Physical fitness activities which shared 60% and 55.4% of responses each.
- Around 50% responses stated that the organizations are giving moderate priority to the recreational activities at workplace, which shows a lack of systematic approach and significant weight attached to the activities.
- From the employees' perspective, it could be very well noted that the major reason for non-utilisation of the facilities turned out to be lack of time. It is quite surprising to note that 72.5% responses reported that organizations are not taking employee participation in recreational activities into account in their performance evaluation system. The organisations care little about the use, nor do they let employees create some time for the same. Resultantly, the frequency of usage is very low among employees.
- The following table summarizes the various indicators used to develop further detailed insights on the sample data:

Indicators	**Mean**	**Std. Deviation**
Frequency of Usage	2.59	1.129
Impact on Individual Performance and Productivity	3.28	.998
Impact on Individual Work Quality	3.33	1.080
Impact on Individual Job Satisfaction	3.06	1.136
Impact on Group Participation and Engagement	3.38	.987
Impact on Commitment and Team Performance	3.33	.918
Impact on Communication and Confidence	3.71	.842
Impact on Absenteeism and Motivation to work	3.10	1.214
Impact on Morale	3.43	1.022
Impact on Stress and Anxiety	3.26	1.120
Impact on Mental Capability and Alertness	3.39	.958
Impact on Work-life Balance	3.10	1.059

The mean score of 2.59 for the frequency of usage with a standard deviation of 1.13 indicates that the employees do not use the available refreshment facilities in a very productive way. The reasons, from the results of other questions, is mainly because of the lack of time during the work-time and lack of interest of the employers.

The mean scores of impact of usage on different parameters is barely above 3, with a standard deviation of 1+, which further indicates that there is no significant positive impact on the employees by making use of the existing recreational facilities.

5.2 Inferential analysis

The impact on different indicators has been further analyzed with the help of Refreshment Performance Indices, which have been obtained by clubbing and obtaining the means and standard deviations of the parameters, above. The indices have been classified as Individual Performance Index, Team Performance Index, Motivation Index and Life Quality Index. Each of these performance indices are discussed below:

5.2.1 Individual Performance Index (IPI). This represents the impact of the recreational activities on the performance of the individual employees. It takes into account the following parameters:

- Impact on Individual Performance and Productivity
- Impact on Individual Work Quality
- Impact on Individual Job Satisfaction

5.2.2 Team Performance Index (TPI). This represents the impact of the recreational activities on the performance of the individual employees in their teams and workgroups. It takes into account the following parameters:

- Impact on Group Participation and Engagement
- Impact on Commitment and Team Performance
- Impact on Interpersonal Communication and Confidence

5.2.3 Motivation Index (MI). This represents the impact of the recreational activities on the motivation levels of the employees. It takes into account the following parameters:

- Impact on Absenteeism and Motivation to work
- Impact on Morale

5.2.4 Life Quality Index (LQI). This represents the impact of the recreational activities on the parameters determining the quality of life of the employees. It takes into account the following parameters:

- Impact on Stress and Anxiety
- Impact on Mental Capability and Alertness
- Impact on Work-life Balance

The following table and figure summarizes the impact of refreshment activities as the respective indices:

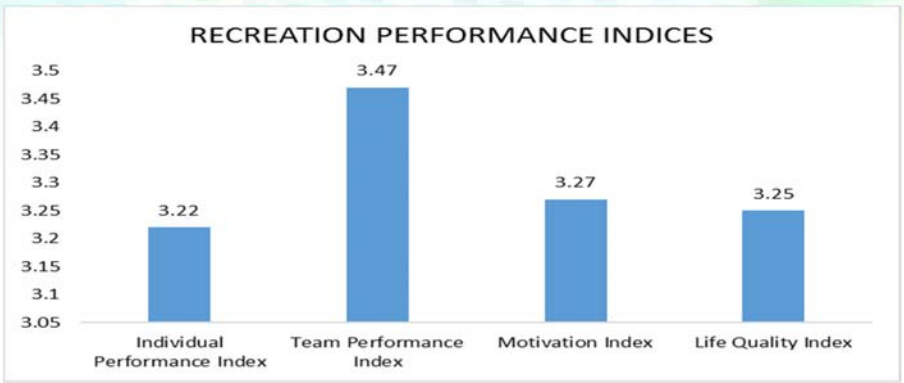


Fig-3: Recreation Performance Indices

The above results with means below 3.5 and standard deviation between 0.75 to 1 show that the impact of the recreational activities on improvement of the performance, motivation or life quality has not been significant.

5.3 Correlation Analysis

The relation between the impacts of the recreational activities on different parameters has been analyzed with the help of Pearson's correlation obtained using statistical analysis tool- IBM SPSS Statistics 22. The correlation has been found between the frequency of usage of the recreational facilities and its impact on the individual performance index, team performance index, motivation index and the life quality index. The results are as tabulated:

Variable-1	Variable-2	Pearson's Correlation	Remarks
Frequency of Usage	Individual Performance Index	0.207	Insignificant correlation
Frequency of Usage	Team Performance Index	0.213	
Frequency of Usage	Motivation Index	0.291	
Frequency of Usage	Life Quality Index	0.194	

The Pearson's correlation co-efficient of less than 0.3 in each of these indicates that there is no significant linear correlation between the usage of existing recreational facilities and performance of the employees. The correlation is least for the Life Quality Index, which means that there has been no improvement in the quality of life of individual employees, which is the very purpose of the introduction of recreational facilities in the organizations.

6 Conclusions and Recommendations:

From the findings it can be observed that most of the workplaces do provide recreational activities at work and employees also find them as adequate or more than adequate.

The corporate organizations are providing recreational activities at work in order to reduce the stress of work in them, help them in socializing with each other, developing skills like leadership, interaction and communication in them which in turn would boost the productivity of employees by improving their physical and mental strength and thus will lead to improved organizational efficiency and profitability. But even after all such improvements in the organization the employees are still not participating in those activities and the major reason which could be established from our study is the lack of time. Even though at Management level it is important that the employees should be motivated to improve their work performance but at the sub-level the culture which is followed is more towards achieving the targets at work rather than providing sufficient avenues / opportunities to let the employees participate in the recreational activities. Thus it should be understood by the management level that even though they could provide all the tools for recreational activities those will be of little use if they are not adequately utilized by the employees. Thus the recreational activities should be well planned and managed in order to get the real outputs from them.

These recreational activities can be implemented in a more effective method by following some basic steps. Firstly, since each individual is different therefore it would be much better if an organization could know the hobbies of their employees and have those recreational activities which are more inclined to their hobbies. Secondly, the organization should encourage participation of employees in those activities. These can be done by giving them a day off from their work or by putting a hold on all the work at that time so that the employee will have only one choice and that to participate in those activities. The supervisors should make sure that the work of their subordinates is in line with those activities so that the work doesn't hinder the participation of employees in their recreation. The organisations should explore the opportunities for bottom-up approach while designing their recreational frameworks in order to use them as profit-centers rather than the cost-centers.

By following these basic steps an organization can fully acquire all the benefits which the recreational activities can confer on them otherwise instead of having a positive impact these activities end up being just the cost centers, providing little benefit to the organization.

To summarise, the organisations in the Indian IT industry have invested in recreational and refreshment activities in order to improve their employees' productivity, motivation and life quality. However, the present framework is not completely compatible with the design of their jobs, which is leading to under-utilisation of the facilities. Among those who use the facilities, there is no significant impact on their performance or life quality. Thus, the existing recreational framework may not be sufficient and the organisations need to review and redesign their frameworks to match to the requirements of the employees, so as to enhance the effectiveness of the facilities and positively impact the employee performance and work-life balance. As such, our very research question – "Are recreational activities really recreational at the workplace?" needs further exploration.

7 Scope for Future Research

Thus, this study challenges the effectiveness of the recreational framework in the Indian scenario and provides a framework for further research into this area.

For the aspiring researchers, this study may provide a platform to explore the scenario in other industries including manufacturing and service sectors. A cross-sectoral comparison of the approaches of managements towards recreation and employee well-being could reveal many more interesting facts. The difficulties in design, customization and implementation of the recreational activities could be good area to delve into. If specific organizations could be accessed more formally, many more insights could be obtained. Further, some models could be designed and tested on pilot basis to help understand the behavior and aspirations of the Indian employees across sectors.

For the organisations, this study may serve as a mirror and provide food-for-thought for their betterment. Organisations may conduct much deeper internal analysis to find out specific reasons and factors and help resolve them and restructure their policies for the proper utilization of their resources. By trying to customize their organization-specific requirements, they might actually turn their human capital into their competitive advantage.

For the regulatory authorities and analysts, the study may help in understanding the differences across countries – Why is the Indian scenario different from other countries, where the recreational activities have proven (as per the previous researches) to have a net significant positive impact. This may help in the policy-making decisions.

References:

1. Aga Khan Development Network (2013). Quality of Life Assessment Programme. Retrieved from http://www.akdn.org/quality_of_life/AKDN_QoL_brochure.pdf Accessed on 29.07.2018
2. Akmal, F. & Ghazali, Z. (2012). Recreational Programme and Its Association with Job Performance. *Asian Social Science, 8*(13), 172-180
3. Aldana, S., and Hager, R. (2005). Financial Impact of a Comprehensive Multisite Workplace Health Promotion Programme. *Preventive Medicine, 40*, 131-137
4. Amber, V., Kala, A.M. (2016). Workplace Related Quality of Life: Effect of Available Recreation Facilities on Physical Activity and Nutrition. *Virginia Henderson Global Nursing e-Repository.*
5. Candice M.B., Christopher V., Kathryn M., Warren P., Karla A.H. (2011). A case study of a workplace recreation-based physical activity program. *Leisure*. Vol. 36, 2012
6. Caroline, M.M. (2013). Effect of Workplace Recreation on Employee Well-being and Performance: A Case of the Commission for University Education (CUE). *Project Submitted for the Master of Business Administration (HRM) of Kenyatta University*. Aug 2013.
7. Goetzel, R., Guindon, A., Tursehn, I. and Ozminkowski, R. (2001). Health and Productivity Management: Establishing Key Performance Measures, Benchmarks, and Best Practices. *Journal of Environmental Medicine, 43*(1), 10-18
8. Gungaphul, M., Kassean, H., Ramnarain, T. (2012). Promoting recreation and leisure in the workplace. *African Journal for Physical Health Education, Recreation and Dance.* Supplement 4, Dec 2012, pp: 86–94. ISSN 1117–4315
9. Kohl, H.W., Craig, C.L., Lambert, E.V., Shigeru, I., Alkandari, J.R., Leetongin, G., Kahlmeier, S. (2012). The Pandemic of global inactivity : global action for public health. *The Lancet*. Vol 380, Issue 9838, 21-27 July-2012, 294-305
10. Mokaya, S. and Gitari, J. W. (2012). Effects of Workplace Recreation on Employee Performance: The Case of Kenya Utalii College. *International Journal of Humanities and Social Science, 2*(3), 176-183
11. Morrison, E., MacKinnon, N.J. (2008). Workplace Wellness Programs in Canada : An Exploration of key issues. *Healthcare Management Forum.* March 1, 2008. ISSN: 0840-4704. doi: https://doi.org/10.1016/S0840-4704(10)60126-3.
12. Parks, K. and Steelman, L. (2008). Organisational Wellness Programmes: A Meta-Analysis. *Journal of Occupational Health Psychology, 13*(1), 58-68
13. Samantaray, P. (2014). Strategy to develop an Effective Workplace Environment. *International Journal of Language and Linguistics.* Vol. 1, No. 1, June 2014.
14. Varatharaj, V. and Vasantha, S. (2012). Work Life Balances A Source Of Job Satisfaction: An Exploratory Study on the View Of Women Employees in the Service Sector. *International Journal of Multidisciplinary Research, 2*(3), 450-458
15. Wattles, M. and Harris, C. (2003). The Relationship between Fitness Levels and Employee's Perceived Productivity, Job Satisfaction, and Absenteeism. *Journal of Exercise Physiology, 6*(1), 24-32

Inclusive hiring practices vis-a-vis Persons with Disabilities: A case study of Café Coffee Day

Farah Hashim[1], Nazra Khatoon[2], Feza T Azmi[3]

[1&2] Research Scholar, Department of Business Administration, Aligarh Muslim University, Aligarh

[3]Associate Professor, Department of Business Administration, Aligarh Muslim University, Aligarh

{hashim.farah92, nazra101, Feza T. Azmi } @gmail.com

Abstract. In the recent years the CSR activities of companies have grown rapidly, consequently hiring of Persons with Disabilities has become a topic witnessing more and more research. The past researches and studies in the area show contradicting results vis-à-vis attitude of employers towards hiring of PwDs. However, relatively fewer researches have enlightened the inclusive hiring intentions of businesses in retail industry particularly in Indian context. The current study addresses this knowledge gap by exploring how India's largest coffee chain, Café Coffee Day is practicing and promoting inclusive hiring. The findings reveal the challenges and potential benefits on the business of differently hiring practices. The study makes three important contributions to the CSR literature. It provides empirical evidence of the benefits and challenges of hiring of PwDs in retail industry by studying the case of India's largest coffee chain. It states the importance of diversified and inclusive hiring practices, it also accentuates the prospective competitive advantage that hiring of disabled employees create for businesses and customer responses towards the same.

Keywords: Inclusive Hiring, Persons with Disabilities, Café Coffee Day

1 Introduction and Literature Review

Corporate social responsibility (CSR) has evolved with time and is now a significant component of corporate decision making. There are several definitions of CSR. The most suitable definition of CSR in this context is the one given by the European Commission that is 'the responsibility of enterprises for their impacts on society'. On an academic level early notion of CSR started in 1960s. Carroll (1991) gave a multi-layered concept of CSR that consists of four interrelated aspects: economic, legal, ethnic and philanthropic responsibilities. To analyse the dimensions of CSR Carroll proposed a pyramid. This pyramid starts with first set of responsibilities that is the economic responsibilities as the companies are established to make profit by providing goods and services to the public. This is the base of the pyramid upon which other three responsibilities rest. The second level is the legal responsibility of a company. Third level consists of the ethical responsibility. The top most level is the philanthropic responsibility.

Recently we have witnessed an upward movement in the charts of organizational CSR drives, generating more employment opportunities for the persons with disabilities (PwDs). However, the reality seems to be different from the painted picture, particularly in Indian scenario, owing to the government's regulations and laws, corporates are ostensibly portraying themselves as inclusive hiring organizations. As per the data of Washington times (2005), globally in developing countries, 80% to 90% of persons with disabilities of working age are unemployed, whereas, for industrialized countries the figure comes down to 50% to 70%. According to Indian census 2001, 21.9 million people or 2.13% of the country's population are persons with disabilities (The Economic Times, 2005). Out of this percentage 74% persons with physical disability and 94% mentally disabled persons are unemployed (Regional Report of Asia, 2005)

The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act in India, 1995 mandates a 3% quota (which was later increased to 4%) for differently-abled in all government jobs, for positions that are both directly selected, or through promotion. Three sections of the PwD Act or Persons with Disabilities Act

address the issue of employment of the PwD. These regulations and acts were introduced in order to ensure that the disabled people develop a more secure sense of self and social belonging. However, a Report from Economic Times in 2015 stated that Public Sector Companies (PSUs) were falling short of this 3% reservation in their work force

Apart from a disheartening picture from the majority of Indian companies, few service sector companies are taking initiatives towards inclusive employment. The companies like Lemon Tree Hotels, Capgemini, Costa Coffee, Café Coffee Day, Tata Group of Industries, Accenture India, Landmark Group etc., have been making efforts towards making their employee roles more inclusive by hiring and retaining people with disabilities (India Times, 2018)

Stevens (2002) reported that when asked about the challenges or obstacles faced by the large to medium sized companies, concerning hiring of persons with disabilities, the companies considered them as good as anyone else, as long as they the required skills for the job. Whereas, when asked from a smaller firm, they exhibited reluctance as they considered the company to be too small to risk taking on board anyone who is disabled. This attitude imply that disabled people are considered to be risk and liability for the organization rather than effective team members.

There are a number of researches that also highlight the customer's responses towards the businesses that hire persons with disabilities. The researches also state the responses of customers when they come across a frontline disabled employee. Until now, the only positive response has been witnessed in the hospitality domain, where the benefits of hiring frontline disabled employees have been highlighted. Gröschl (2013) found out that there are hotel customers who purposefully seek out properties with disabled employees working with them.

Similarly, as per a study conducted in Marriott (Houtenville and Kalargyrou, 2012) it was found that, disabled customers staying at the hotel appreciated the opportunity to interact with disabled employees. It created a positive image of the hotel for them as commonalities (disability in this case) play an important role in building relationships. Thus, it was evident from the conducted researches that customers' service quality judgment is affected by his attitude towards the hiring of disabled employees, which consequently benefits the image of the businesses as a whole.

As per the social servicescape model the employees represent environmental stimuli to which the customers respond. They influence customers' decision to approach or avoid a product/service and also play an important role in service convenience (Rosenbaum and Massiah, 2011). Similarly, the study by Kim and Kim (2012) professes that retail shoppers have a cognitive, emotional and also behavioural response towards a sales associate's physical attributes i.e. his dress, physical attractiveness, age gender etc. And in the same study the effect of non-verbal cues, such as smiles, politeness etc. were also picked up.

2 Objective of the study

The objective of this case study is to understand the role of big retail organizations in hiring of persons with disabilities, the study also throws light on the challenges faced by these organizations in the course of hiring and training programs for PwDs. This study accentuates the experiences and attitude of employers, trainers as well as the co-workers vis-à-vis working with persons with disabilities. The study also throws light on the attitude and views of customers in retail industry when they come across a front desk differently abled employee. It is attempted to understand the changing face of hiring in the neoliberal era, and to promote the hiring of disabled employees by presenting a motivational case of organisation involved in the same.

3. Methodology

Research methodology can be described as the science of studying how research is to be carried out. It is the step by step procedure that is designed and followed for the purpose of doing research work.

3.1 Research Design

This study is an intent to examine the recent trend of hiring young lower to middle-class deaf and mute workers in Indian cafés by taking the case of Café Coffee Day. This research work follows a descriptive research design, of a conclusive nature and is based on a single case study. The case of India's biggest coffee chain i.e. Café Coffee Day is taken up for the study. The population for the study are the employees working with CCD and the customers who visit the café. The sample frame consists of the Human Resource (HR) managers due to their involvement in the whole hiring process, the Learning and Development (L&D) managers because they train and provide the required skills to the workers and are directly in contact with them, the co-workers of the disabled employees as they are a part of the work environment and the peer group, they share the day to day task and activities with the differently abled workers hired by CCD and the regular customers of the cafés in the Delhi NCR region to know their views.

The major reason behind selecting CCD as the case for this study is its geographical expansion all over India, with over 1500 cafeterias it also has become India's largest coffee chain. CCD not just has outlets in major metro cities but also in smaller districts, therefore this study can provide more ethnographically appropriate results.

- **3.2 Data Collection Approach**

The data for the study is collected by means of both primary and secondary sources. The primary data collected for the study is qualitative and is gathered by means of personal interviews and telephonic interviews. The interviews of the HR and L&D managers were conducted preponderantly in the corporate office of CCD based in Okhla, New Delhi. Whereas the interviews of the disabled employees and their co-workers were administered in various CCD outlets based in the region of Delhi NCR. Telephonic interviews were conducted to get responses of the employees based in other regions that are, Lucknow, Mathura, Agra.
Secondary data was collected from the websites, reports, articles and other documents.

4 The case of Café Coffee Day

In 2018 India Times enlisted 11 Indian Businesses That Hire Differently-Abled people, among these 11 companies is the name of India's largest coffee chain; Café Coffee Day. Café Coffee Day, owned by the holding company Coffee Day Enterprises Ltd, is already the market leader when it comes to coffee in India. It has more than 1,500 cafes in 200 cities and towns across the country, including 191 in Bangalore and 185 in Delhi. It is also the largest producer of Arabica beans in Asia exporting to various countries including USA, Europe and Japan. Café Coffee Day was started as a retail restaurant in 1996. The first CCD outlet was set up on July 11, 1996, at Brigade Road, Bengaluru, Karnataka. It rapidly expanded across various cities in India adding more stores. In 2007 Café Coffee Day won the Times Food Award under the category of "Best Coffee Bar" from Times of India. In 2012 Café Coffee Day was ranked as 26th Most Trusted Service Brand in India and as 2nd Most Exciting Brand under the category of "Food Services" in India under a survey done by Brand Equity (Economic Times).

4.1 Inclusive Hiring Policies

CCD has been hiring candidates with disability and creating a special induction program for the speech and hearing impaired. CCDs hiring policy includes employing the differently-abled people and providing them with the required training and development programs for their career advancement. Coffee Day Global has tied up with NGOs like 'Enable India' to work out avenues to employ more number of disabled employees. Apart from providing employment to Deaf and Dumb individuals or D&Ds as they call it CCD also has provision of vocational training for them. In 2013, CCD received the 'Shell Helen Keller Award' in the Role Model Companies category. The award by the National Centre for Promotion of Employment for Disabled People (NCPEDP) recognised CCD's contribution towards the improvement of lives of persons with disabilities by encouraging change in recruitment attitude. These programs and efforts on the part of Coffee Day Enterprises Ltd. make it a strong case for a study like this.

4.2 The Silent Brew masters

According to CCDs human resource executive, CCD was originally approached by an NGO for hiring disabled workers for its headquarters. The organization did not rush into the decision to present token efforts, instead the corporation's HR executives thought critically about their needs and how disabled workers can be accommodated in to the day to day task of the company. They realised that due to the low-skill set the potential applicants possessed, the jobs in the headquarters weren't feasible for them and therefore they should rather be placed in the coffee outlets where they can work based on the training provided as per the job requirement. Another issue was to make sure the disability of the worker doesn't make him feel less capable for the job, which is why hiring a physically disabled workers wasn't a viable option. In addition, hiring blind workers did not make sense either, as they would face difficulty in navigating cafés crowded with people table and chairs. As such, deaf workers, to be trained as brewmasters, made the most sense. Consequently, the 'silent brewmasters' program came into being.
The hearing and speech impaired employees hired by CCD are given the tag of "Silent Brewmasters" who brew coffee behind the counter. Since they possess a heightened sense of smell and vision, they ensure their coffees are served with perfection. This program is designed to aid the use of their strong sense of smell, vision and taste effectively. CCD has recruited and trained over 150 people with disabilities to date. Their Silent Brewmasters are a testament to CCD's continuous dedication for the cause.

4.3 Silent Brewmasters and their managers

Drawing from the ethnographic fieldwork and interviews conducted in the CCD outlets of Delhi NCR region it can be argued that the representation of speech and hearing-impaired employees have been as of immobile workers who add value due to their immobility. They add diversity in the workforce of the organization and they make the workplaces seem more caring and noble. The Human Resource managers had a favourable opinion towards hiring of disabled employees and considered it a 'diversity issue' they added that it gives a good social parameter to the business.
According to the frontline store managers hearing and speech impaired employees did not involve in chit-chats or spend their time idling during work hours and were more dedicated comparatively. They are fully invested in the task at hand –if it is making cappuccino, they make the best cappuccino and they work fast. The managers said that they in fact are differently abled and are quick learners, they tend to be prompt and more work oriented.
One of the managers at CCD said "Silent brewmasters have a heightened sense of smell and vision which ensure the most appealing taste and visual presentation of coffees. They value the position they have been given and do not take things for granted. We are very happy to see the enthusiasm with which they contribute to bringing satisfaction to our customers."
In an interview, the president of marketing at Café Coffee Day said that they do CSR from the heart. At CCD corporate responsibilities have three broad spokes i.e. employability, education and hunger, and CCD is doing relevant work in all these aspects. He also stated that the team is proud of the 'silent brewmasters', despite of being differently abled employees they have a strong sense of smell that enhances their work as coffee brewers and make them fantastic brewmasters and CCD has identified that strength.
CCD has a vocational training college in Chikmagalur where the youth from tough circumstances are trained and are provided with free training, accommodation and food to make them employable in the hospitality industry. This initiative made the management aware of the fact that they are adding values to the lives of the underprivileged people. And therefore, more focused efforts were made for the disabled individuals as well to benefit them from the Coffee Day's CSR programs.
The managers agree to the fact that the hearing and speech impaired employees are quick learners and their sense of loyalty to the brand and the customers is incredible. One of the regional managers at CCD stated that he was particularly impressed by disabled workers' ability of understanding and adapting to the requirements of the regular customers. "There are instances where the silent brewmaster (speech and hearing impaired) would prepare coffee exactly the way a customer would want it to be, the moment they see them in the café. Some customers are impressed by such a personalised service."
Apart from all the good notion that prevails about having on board a disabled employee, sometimes the managers face challenges too. As per one of the managers based in a café in Lucknow, not everybody is trained to the sign

language which causes communication gap among the hearing and deaf employees. This communication lapse also comes in picture when a customer has to interact with a disabled employee, besides the efforts from both the delivering and the receiving end of such communication both the customer as well as the employee are left with confusion and self-doubts. This becomes demotivating for the hearing and speech impaired employee and also puts the customers in fluster.

There is increased responsibility on the part of managers having a team that includes a disabled individual, but the managers firmly believe that even though they have to put in extra efforts from their side, yet the silent brewmasters make it all worth. It gives a feeling of noble work, and a sense of satisfaction when they see their underprivileged subordinates doing good and getting great responses by the customers.

"There is this guy I have seen working in one of the CCDs in Lucknow, and I believe apart from listening and hearing he can do every task possible in the best way you can imagine. He has magical energy and enthusiasm that lightens up the environment, he is bright as any of us, and he does not let his disability pull him down" says a Lucknow based HR manager at CCD. Persons with Disability bring in diversity in the workplace and also makes the business look good.

With increasing attrition, employing workers with disabilities is becoming a new source of value for corporations. Workers with disabilities are believed to be immobile and therefore are retained longer and also they put forth a positive image of the organization. But it comes with added responsibility for the managers, they have to ensure equal development and promotion opportunities for all the employees. Also they have to look after special and appropriate orientation programs to be organized for the deaf employees, they should get proper on job training and shouldn't lack behind from other employees due to their disability.

4.4 Experiences of the silent brewmasters

The hearing and speech impaired workers at CCD believe that communication is not a problem, these workers like their job. As per a worker, initially she was afraid of her disability being a drawback in a "hearing-speaking corporate world", especially in a place like a coffee shop, where success is majorly based on communication and customer relationship. But she feels it's not making her lag behind anymore, "Our other senses are tuned to what the customer wants and we anticipate those needs -be it somebody wanting a glass water or a menu or like their brew a particular way, we anticipate it and be ready" For her communication is all about being sensitive and observant.

Every 'silent brewmaster' of CCD had a different story to share, most of them consisted of how they aimed to be at some place else career-wise when they started, but structural forces resulted in their placement at CCD. They added that they were satisfied working at the café, the job provides them with self-actualization and gives them a feeling of being an equal part of the society.

The disabled employees at CCD were glad to be treated with respect and equality while working there. They had good relationship with their hearing co-workers and enjoyed their work. Most of the workers were placed in CCD with the help of NGOs working towards employment of persons with disabilities. One of the deaf workers in the café said that she enjoyed working in the café, she not only brews coffee but also sometimes bring them to the customers and operated the cash register. She was a known face for the regular customers of the café and they often requested her coffee and commented that she made the best coffee that they had ever had, this has helped in boosting her enthusiasm that was lost for a long time.

But the views of the deaf and mute workers in these cafes have been ambivalent, because these jobs are viewed as temporary and not life long. The opportunities for promotion is very less, there were lesser chances for advancement within the corporations because very few disabled workers had the written and oral skills required to be the managers. The employees also find less scope of social and financial development in this profile of job. The competition is very high and most of the hearing and abled workers leave soon for better jobs which leaves the underprivileged in distress at times. Apart from this, usually hiring of a silent brewmaster is limited to 1 worker per café, therefore it forecloses the possibility of camaraderie with coworkers.

One of the big concerns of the disabled workers was the age cut off in CCD hiring policy, they are extremely skeptical about what the future holds for them. While the hearing workers use their experience to discover newer

avenues or expect promotion within the organization, the deaf workers are restrained from the same due to the structural and educational barriers.

As far as the relationship with the customers is concerned, the silent brewmasters claim that they come across more of 'happy customer' faces rather than arrogant and insensitive ones. They have comparatively lesser grievances about issues with customers. They say that the customers, once they realise they are interacting with a hearing impaired employee, they mellow down and their body language changes, they are politer and tend to behave with respect and amicability.

- **4.5 Attitude of customers towards the 'silent brewmasters'**

Customers interaction is more with the employees of a company involved in hospitality and retail. When asked from the customers how they find interacting with the silent brewmasters, they said they very much appreciated them, they appeared to be more committed than the other workers. To some customers visiting a café with a disabled employee seemed like a noble deed too, they said they felt they were doing more than just having coffee, it gave an experience of social contribution.

The customers admire the initiative of the organization for employing persons with disability. When asked from a dining customer about their views regarding coming across a hearing and speech impaired employee, she said "it always gives a positive image of the place they are working in, its good to see the corporate world taking steps towards issues like unemployment of the disabled people."

A group of college students said that they don't get many opportunities to be a part of social activities; coming across a disabled employee, encouraging them and admiring them for their work or even getting involved in a conversation with them gives a feeling of satisfaction. The customers also said that after coming across a disabled employee and interacting with them, they felt an urge to contribute towards benefaction of PwDs.

Though the customer responses were majorly lined on the positive side, yet the customers expressed a sense of hesitation when interacting with a PwD. One of the customers of the café said that he often was concerned whether or not he will be able to elucidate his words to the deaf worker in sign language. He added that most of the customers, in fact majority of them aren't trained in sign language and thus they are unsure of how they will communicate with a worker who cannot speak or hear. The customers do not want to put the disabled workers in an uncomfortable situation and therefore rather preferred to talk with a hearing employee. Some customers admitted that despite of admiring the work of disabled employees, they often waited for the hearing employee to take charge of the cash counter to place their orders, to avoid being marked as a gauche.

Almost all the customers interviewed has positive outlook for a company hiring disabled individuals, the customers respected the workers and said that these workers are somehow motivating and inspiring them too. Such interactions not only bring up one of the major issues prevailing in the society of unemployment of PwDs, but also puts a person in self assessment of their contribution towards it.

5 Discussions

This study analysed how "silent brewmasters" of CCD and other disabled employees, are underrepresented and are considered as immobile workers. However, they add value to the corporations that employ them and create a competitive advantage for the business yet to some extent it is noted that hiring of a disabled employee is more of a 'benefitting the corporate image' activity rather than a social activity. They bring novelty in the experiences of the workplaces, and also improve the brand image, making corporations look more concerned of social welfare.
The admiration that the corporations receive from the customers' end is impelling them to hire the disabled employees. Though the management agrees that the disabled employees particularly the 'silent brewmasters' in this case are quick learners and are more devoted to work but the latters weak educational background limits the the level of job they are being offered. Though there have been efforts from the part of various corporations towards providing employment to disabled employees but there also is a requirement of providing them with strong educational background to support their career advancement.

It’s the job of the management of the company supporting diverse employment, to make sure that disability is not treated as a special issue or set of issues, rather, it should be incorporated well into overall workforce diversity management plans. The disabled employees should not feel alienated in their workplace. Corporations now are not considering hiring of PwDs as charity any more but rather like a business decision; employment of disabled workers create affective economies where non-disabled workers and the customers of the business feel inspired, invested and ultimately committed. Disability is becoming a non-threatening diversity through which differences are celebrated and considered inspirational. From customer responses to managerial experiences, the thought-process around hiring of disabled employees is changing rapidly. The ‘silent brewmasters’ coming out as the favourite coffee makers for the customers and ideal employees for the organization are exemplifying this change in the overall scenario of disability and employment. Though there still aren’t ‘real’ opportunities for the disabled people yet, a step forward is the silver lining for them.

References

1. A.B. Carroll, ‘The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders’, 1991 Business Horizons 34, no. 4, pp. 39-48.
2. European Commission, Communication from the Commission to the European Economic and Social Committee and the Committee of the regions: A renewed EU strategy 2011-14 for Corporate Social Responsibility, COM (2011) 681 final, p. 6
3. Gröschl, S. (2013), “Presumed incapable: exploring the validity of negative judgments about persons with disabilities and their employability in hotel operations”, Cornell Hospitality Quarterly, Vol. 54 No. 2, pp. 114-123.
4. Houtenville, A. and Kalargyrou, V. (2012), “People with disabilities: employers’ perspectives on recruitment practices, strategies, and challenges in leisure and hospitality”, Cornell Hotel Quarterly, Vol. 53 No. 1, pp. 40-52.
5. Kim, J. E., and Kim, J. (2012), “Human factors in retail environments: A review”, International Journal of Retail and Distribution Management, Vol. 40 No. 11, pp. 818841.
6. Rosenbaum, M. S. and Massiah C. (2011), “An expanded servicescape perspective”, Journal of Service Management, Vol. 22 No. 4, pp. 471-490.
7. Stevens, G. R. (2002). Employers' perceptions and practice in the employability of disabled people: a survey of companies in south east UK. Disability & Society, 17(7), 779-796.

Adaptive organizational flexibility with sustainable knowledge management – an innovative human resource management solution

István Fekete PhD[1], Tamás Hartványi PhD[2]

[1] ICG Integrated Consulting Group Kft., Senior Consultant, Sas utca 10-12, 1051 Budapest, Hungary
[2] Széchenyi István University, associate professor, Egyetem tér 1, 9026 Győr, Hungary

[1] fekete.istvan.pic@gmail.com
[2] hartvanyi@sze.hu

Abstract. The organization, as the network element of the global value chain, tries to successfully adapt to VUCA (volatile, uncertain, complex, ambiguous) environment. The complex, multipartite network structure of the organization is affected by external and internal perturbations of different magnitude in space-time. The flexible adaptation can be supported by creating nested plasticity at different systems-hierarchical levels of the organization in the right form, right extent, with the right timing. In our current material we focus on the man-subnetwork of the organization. We explain on a concrete industrial example how to classify the perturbations and how to determine the corresponding nested plasticity in that organization so that the built-in 5-10% adaptive flexibility of lower hierarchical level creates 50-60% adaptive flexibility at the level of the organization.

Keywords: adaptation, flexibility, innovative human resource management, network degeneracy, network science, organizations, plasticity-rigidity cycles, VUCA environment

1 Introduction

The highest order network on the Earth contains all the viable networks and non-viable ones, like biochemical, biological, ecological and man-made networks, including demand supply network (DSN) and the global value chains (GVC). In that highest order network, the organizations are one of the network element types [5]. The world-trade-web of Serrano and Boguna corresponds to the coarse-grained representation, where the nodes are the countries and the directed links are the import and export activities [21]. At mid-grain representation companies, organisations – as network elements – form network and network modules of higher connectedness, like clusters and overlapping value-adding webs [19], [20]. At all those representation levels, we detect the characteristics of the complex networks – scale-freeness, small-worldness, with high clustering – as a result of those dynamics what are widespread in viable networks: preferential attachment, network aging, diffusion and resistance, saturation, cooperation and competition driven modularization, etc. [1], [11]. The complex, embedded structure of the global value chains and the increasing interconnectedness of the building network elements and modules substantially contribute to the emergence of VUCA environment [18]. In our current article we focus on direct value chains of Sushil and introduce a proven organizational and process solution what successfully anticipates the perturbations of volatile, uncertain and complex characteristics [22].

2 Network Perturbation, Stress and Resilience

In network science terms, perturbation is the interactions between the network and its environment and among the different parts of the network (nodes/network elements, modules, motifs, etc.). During network relaxation the perturbation is distributed over various parts of the network causing change in their state and by time the network returns to its original or new equilibrium. The perturbations generated internally in the network are called intrinsic noise/perturbation – corresponding to processual structure of Dementeyev [7], while those of external origin are called extrinsic – reflecting to the functional structure of Dementeyev [2], [5].

Stress occurs when the network either does not have the adaptive response to a large, disruptive perturbation – Ambiguity of VUCA environment [18] – or does not have enough time to mobilize the already existing adaptive response. There is a negative correlation in energy and stress levels, i.e. as the available energy decreases in the network the stress level increases. If the perturbations in the network can not be dissipated smoothly then the relaxation of the network becomes restricted. Due to that the tension in the network builds up, and it will reach the status of self-organized criticality, after which an avalanche-like relaxation and/or cascading failure take place. Csermely calls this phenomenon as 'netqauke' – on the analogy of earthquakes, as the earthquakes and often other 'netquakes' also follow scale-free distribution both in terms of probability and spatiotemporal extent [3], [21], [16], [14], [8].

Resilience and stability have (slightly) different meanings and definitions in the literature but describing similar capability of leading to successful survival of the network [5], [17]. The network's stability may be manifested in its structural, functional and parameter stabilities. Resilience is the capability of the network to preserve its integrity, giant component, and percolation. That is the system's structural stability, since it does not fall apart to subgraphs. The functional network stability means that the network is able to keep its functionality, the changes are statistically negligible when removing nodes/network elements or links from the network. That manifested often in parameter stability as well. In his definition of 'netsistance', Csermely gives a dynamic and generally usable definition on stability and resilience: The network keeps its integrity against minor structural changes caused by environmental and network perturbations and is able to dissipate the large perturbations through fast and efficient relaxation returning to its previous equilibrium state or going into a new one [5]. In fact, Sushil's sustainability and flexibility determines network resilience in global value chain context [22].

3 Perturbations in the Multipartite Network of Organisation

The organization itself is also a network (the bottom network of the global value chains) with multipartite complex nested structure. The real networks contain a number of subnetworks of the same magnitude but built up by more monomer network elements. In case of organizations those are the subnetwork of man, machine, material and processes [5], [11], [22]. The main resources forming the important subnetworks of the organization are illustrated in Fig. 1.

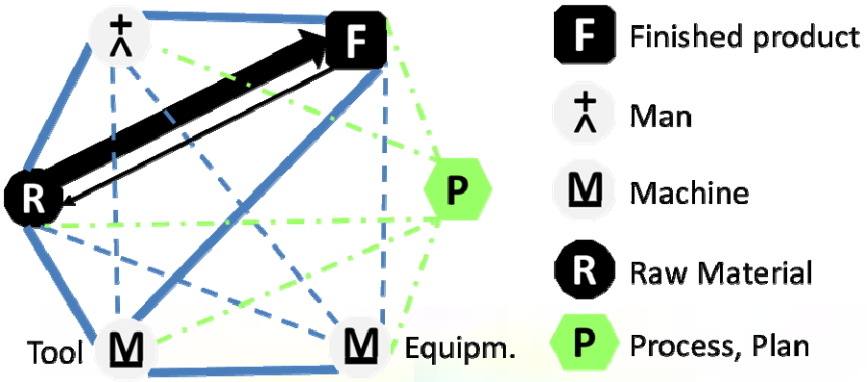


Fig. 1. Multipartite structure of the organization

The materials are converted into finished products with the help of men and machines. Therefore, the links between the material and finished products nodes are directed, while between those latter ones and the man and machine nodes are symmetrical. Sometimes it is reasonable to distinguish separately the more generic equipment from the more product specific tools in our investigations. In such a case, as a rule, the tool has stronger, more intensive interaction with the finished product and/or material than the generic equipment – like the product specific mould and the more generic press equipment. Solid line links emphasize the strong dependence between the nodes (network elements) – the thicker the link the stronger the dependence is. Dashed line links are usually more transient or indirect, e.g. the interaction runs between man and tool only at the tool change. The process-subnetwork describes the interactions between the network elements of the abovementioned subnetworks.

In DSN/GVC the extrinsic perturbations are the requirements of value or finished product. The product (value) we supply to our customer can be perceived as accumulated energy frozen in material form as a generalization for all man, machine, and material resources. Following Csermely we use perturbation in general terms, while noise to describe the large number of distracting small irregular perturbations in an organization [5]. Signals are the large enough regular usual perturbations, to which the network needs to develop and utilize well defined adaptive responses – to what the organization must/can be optimized, sometimes over-optimized [8]. The large irregular perturbations I call disruptions against what we want our organization to become more resilient. Trent emphasizes the quick adaptive response of our supply chain to risks/disruptions, though without distinguishing whether those are known or unknown ones [23]. Melnyk et al call the unprecedented disruptive events as uncertainty [17] – well in line with VUCA definitions [18], while the known ones as risks. Based on such distinction they define the investment directions in building resilience at the DSN level. The reigns of signal, noise and disruption are important discriminating factors in our combined quantity-irregularity graphs analyses [10].

In case of large IT-telecom organization the perturbations were classified in line with its multi-partite network structure and according to distribution patterns of the perturbations in network space-time (Fig. 2), i.e. four classes respectively (A, B, C, and D). A, B and C classes identify external (or extrinsic) perturbations, while D class describes the internal (or intrinsic) ones.

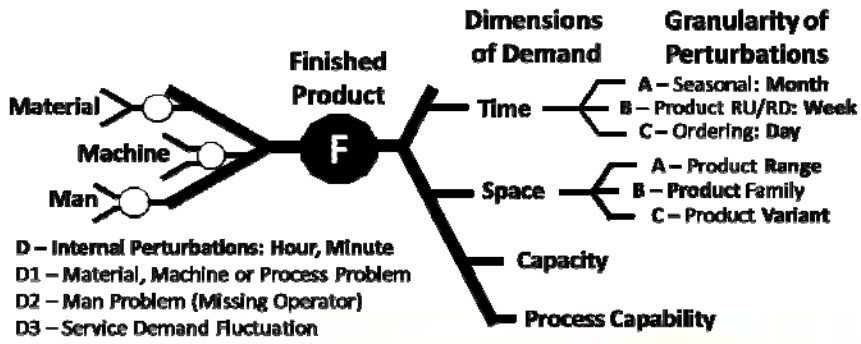


Fig. 2. Granularity of perturbations in the organization

4 Nested Granularity in the Sub-networks of the Organization

In that large organization of several thousands of employees we had to integrate few thousand newcomers within weeks. In the same time, the shortening product life cycles required 1-2 week-long ramp-ups and quick reallocation of the capacity in a magnitude of several hundreds of employees. In early 2000 the classical approach was used of keeping the employees of higher value creation capability in the organization and reallocating as individuals to other functions (e.g. fork-lift driver, SMT-operator), while for the simpler functions we hired from the street. The newcomers joined individually a team and were expected to catch-up quickly. That caused frictions between the newcomers and the old workers. The frequent product portfolio changes, on the other hand, bombarded off the old teams too. As consequences, we faced alienation, fragile quality and efficiency, especially at product ramp-up phases and during seasonal factory ramp-ups.

As Csermely underlines [5]: in an expanding world and at increasing complexity our only escape is to redefine and segregate a small-world for us, otherwise we are lost and alienated. Dunbar highlighted the reasons, why we have very close tights/links only in small number of about 5 (family nucleus), and we can handle more-and-more relationships only with weaker-and-weaker links – like approx. 15, 35, 80, and 150 respectively [9]. The latest number corresponds to the ancient village size. Stable teams require frequent interactions, cyclical synergetic processes, like gossiping (vocal grooming), rituals, etc. – and these activities stabilize the teams in return.

Therefore, counterbalancing the changes due to VUCA environment and targeting the network stabilizing small-worldness, we identified intermediate systems-hierarchical levels in all important subnetworks of the organization with appropriate plastic, rigid or dual behaviours. In Fig. 3 the entities in “Man”, “Machine/Cell” and “Machine/Tool” columns written by white letters with black background are accountable for rigid behaviour, while the entities written by black letters with white background represents plastic behaviour. The entities written by white letter with grey background expressing alternating behaviour. Materials are not described in this table as it had been already explained how to build nested plasticity-rigidity in material-subnetwork in our previous publication [12], while plasticity-rigidity cycle theory of Csermely is detailed in his article [6].

Response	Finished Product	Man	Machine/Cell	Machine/Tool
A = **Month**	Factory's Product **Range**	**Groups**: DGr, SGr, PGr, XGr	**Flex** Cells, **Cells in Streets**	**Purchase to** Order Tools
B = **Week**	Product **Clusters**	**Teams**: PT=Production, ST=Service, NT=Newcomer	Cells of **one Street**	**Extra** Tools
C = **Day**	**Product** Families		**Cell Group** in a Street	
D = **Hour**, ¼ Hour	Product **Variants**	Operator, Leader, Key Operator, New	Multi-product **Cells**	**Built-in** Tools in Cell

Fig. 3. Nested structure of the organization anticipating to the identified perturbations

Please note, both that at most of the systems organisational levels both plastic and rigid entities were created.

The population of the man-subnetwork was grouped into four **groups** (large man-subnetwork module) serving either the rigidity (dedicated group of production and service functions) or the plasticity (newcomers and pool) of the organization. The two rigid groups have also embedded plasticity (white dot), what will be explained later. When we zoom in the groups we can realize that their smaller modules (teams) and the network elements of man-subnetwork (employees) contribute differently to plasticity or rigidity – Fig. 4

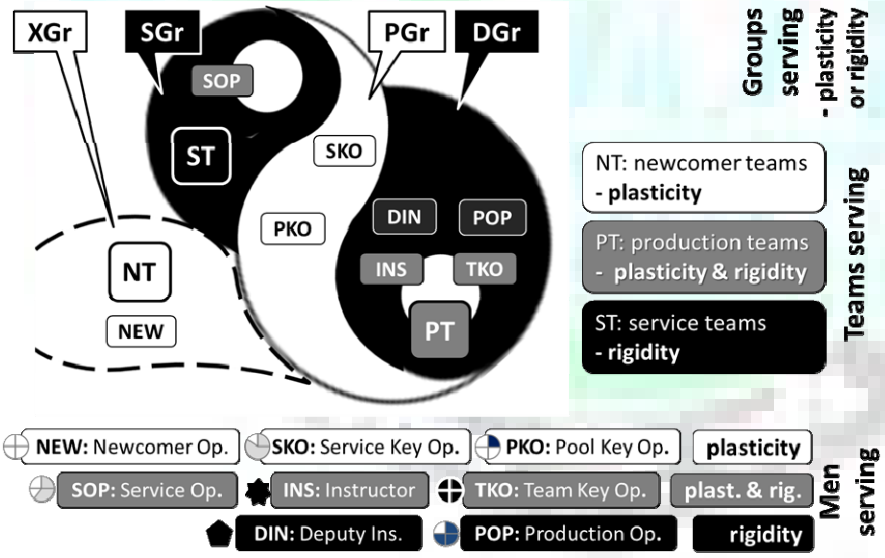


Fig. 4. Nested plasticity at elementary and at two modular levels in the organisation

Pool group (PGr) does not have teams. Its lower level is the network element itself, i.e. the pool key operators (PKO) and the service key operators (SKO), who contribute to plasticity of the organization individually and reallocated on daily or even hourly basis. The group of externals is other plasticity serving group (XGr) of the newcomers (NEW), who are integrated into the organization as monomer teams of newcomers (NT), not as individuals. So, people of Dunbar-team-size start and work together for several months. In that case, both the network element-level and the network module-levels contribute to plasticity.

The rigidity supplying group of services (SGr) consists of smaller network modules (teams). Service teams (ST), like quality, logistics, test technician, maintenance, etc. are rigid and dedicated for years (technology driven structures). The embedded plasticity in the service group (SGr) is delivered not by network modules (ST) but by the network elements (service operators: SOP), when they have to work as production operators (POP) during the low season.

The rigidity supplying group of production (DGr) consists of network modules (teams) as well. The production operators (POP) in a team of about 20 people work together for several quarters under the leadership of an instructor (INS), but time-to-time – as a team – they have to learn new products and move to another product family. Therefore, the position of the network element (team member) in the module (PT) is quite rigid/dedicated, but the team itself contribute to plasticity and rigidity of the organization upon demand. The instructor (INS) and the team key operator (TKO) individually contribute to the organization's plasticity as well through supporting ramping-up newcomer team (NT) or other production team (PT) when that team has to learn a ramping-up product family of the helping TKO and INS. I.e. authentic support from both a product expert (TKO) and from a team leader (INS).

Although in such nested plastic-rigid half-cycles the actors of plastic network segments (network elements or modules) and time segments (of alternating behaviour) sacrifice their stability-need and predictable-environment-need, that sacrifice significantly differs from self-destructive cooperation of bacteria and of human heroism [4], since a limited fragment of the human population (10+/-5%) even prefers such dynamically changing working environment. The individuals were offered to choose additional value creation upon their preference and then they were naturally selected. Since they substantially contributed to the organizational adaptive flexibility, they were additionally rewarded and remunerated.

5 Nested Plasticity-Rigidity Cycles of Different Granularity Create Scalable Organisational Adaptive Flexibility of Large Extend

How the designed embedded plasticity anticipated the identified perturbations?

At large seasonal fluctuations the key plasticity supplying entities of man-subnetwork are at group levels with embedded rigidity – Fig. 5. Service group (SGr) delivers plasticity through individuals who work in production during low season. We can down-size the service functions to the lower production size so that the valuable specific knowledge is not lost. The service teams (ST) remain rigid, as well as the reallocated service key operators (SKO) work several weeks in stable production teams. Pool key operators (PKO) also work several weeks in stable production teams during low season and only a smaller pool (PGr).

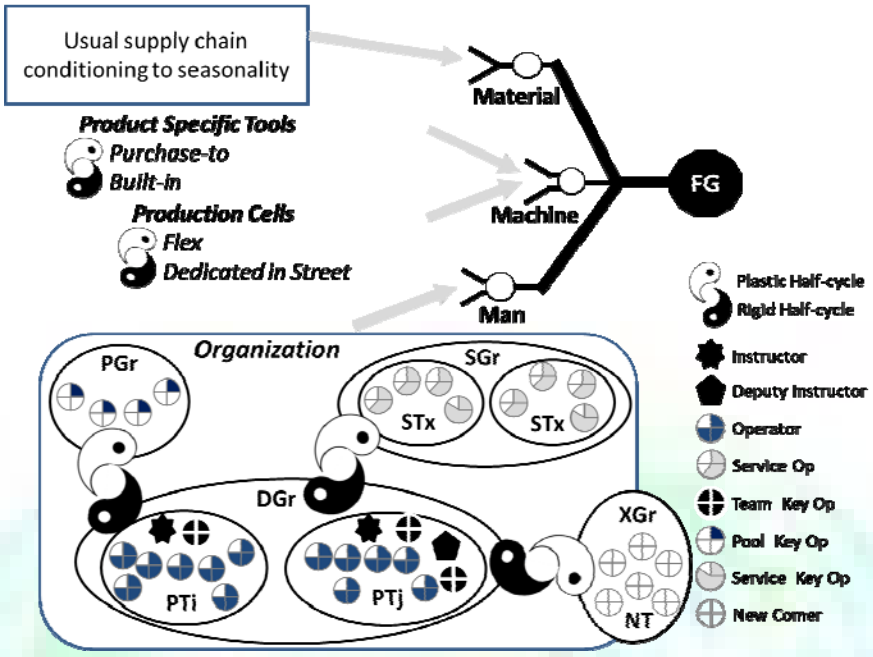


Fig. 5. Nested plasticity anticipating seasonal perturbations (A)

During scaling-up to high season both the pool (PGr) and the service functions (SGr) have to be scaled up gradually to the increasing headcount and increasing volatility and uncertainty due to large number of newcomers (thousands of NEW). The black dot in XGr's plasticity symbol accounts for stable teams of newcomers (NT) working several months together.

The rigidity symbol of the dedicated production group (DGr) also has white dot symbolizing the plasticity delivering instructors (INS) and team key operators (TKO) who temporarily support the newcomer teams (NT) or production teams (PT) learning new product family.

In the machine-subnetwork clear distinction of rigidity and plasticity serving tools and equipment assures smooth alignment the seasonal fluctuations.

In case of product family ramp-up or ramp-down (see Fig. 6) the main plasticity rigidity cycle (half-cycle pair) is within the production (DGr), where the team of wide and deep complex knowledge stability landscape (PTj) can offer instructor (INS) and team key operator (TKO), with their product family knowledge who will support several days the ramping up teams.

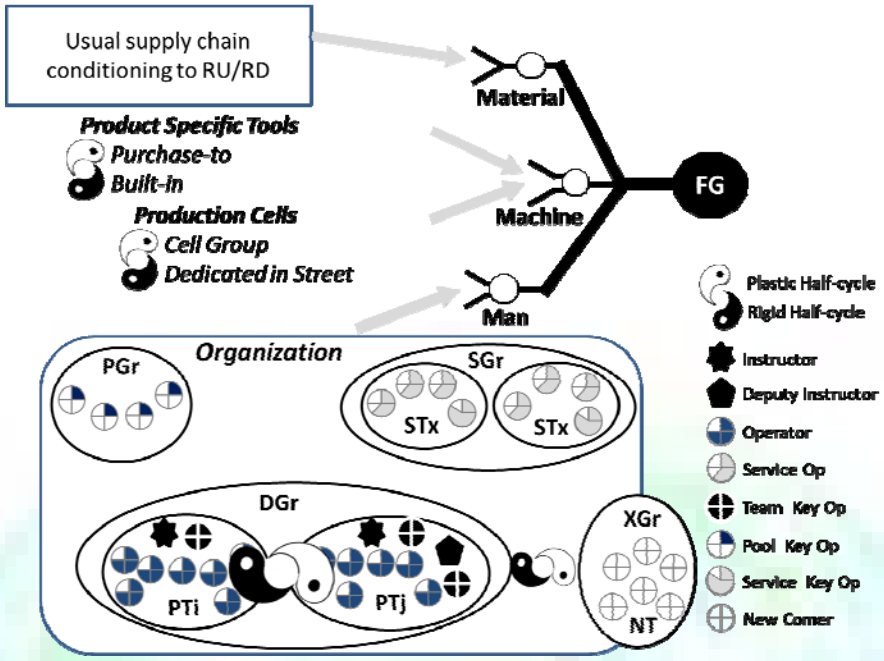


Fig. 6. Nested plasticity anticipating ramping up/down perturbations (B)

The pool (PGr) has another key mission dissipating perturbations due to demand fluctuations, demand-supply mismatches during order-fulfilment (Fig. 7). Demand fluctuations and uncertainties were covered mainly by time-bank or by reallocating a team of lower demand product family (PTi) to a product family of higher demand of longer wave.

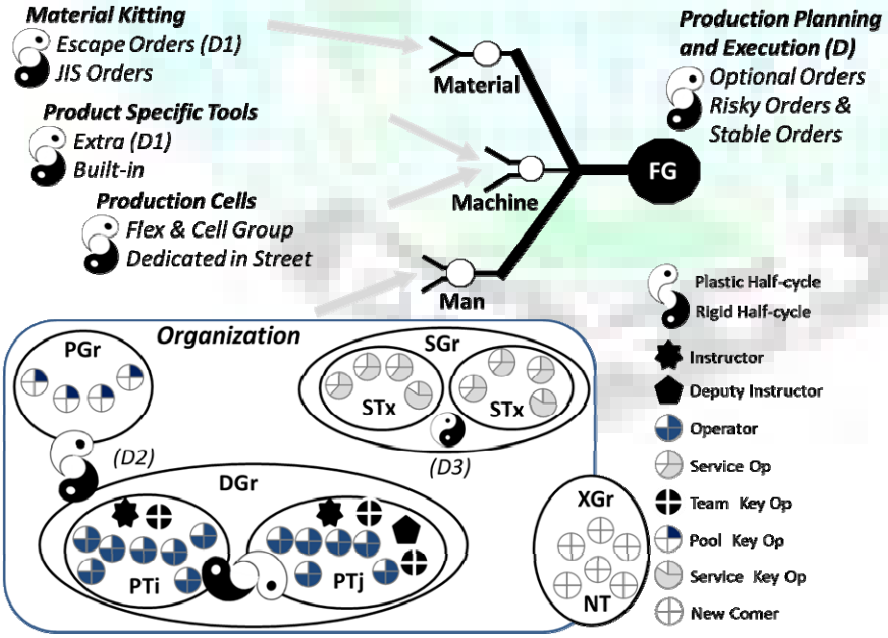


Fig. 7. Nested plasticity anticipating order fulfilment perturbations (C, D)

Intrinsic perturbations were dissipated by several alternatives, like pre-kitted escape orders or the service Kanban with 10 minutes lead time, or clear distinction among optional, risky and stable orders. Due to space limitation we cannot detail those solutions in this article.

6 Organisation Stabilized by the Degeneracy of Man-subnetwork

The network degeneracy substantially contributes to network's resilience, adaptability and evolvability [24]. Both the specialist of deep-narrow knowledgebase and the generalist of shallow-wide knowledgebase correspond to simple Lyapunov-stability landscapes at individual level – rigid or plastic respectively. On the other hand, the knowledgebase of the cooperating individuals form complex knowledge stability landscape offering several alternative optima and more sophisticated, but quick adaptive response at the organization level, i.e. the system level emergent plasticity-rigidity. In Fig. 8 is shown the emerging degenerative redundancy (network-elements of different knowledge structure are fulfilling the same function) following from the above described structure and function: embedded plasticity-rigidity cycles.

The plasticity serving network elements (SKO, PKO, NEW) are structurally different from POP network element, from the key value creating function what they also can fulfil. E.g. the NEW has often no adequate knowledge at all, PKO has deep general process knowledge (g) and shallow product one (d), while SKO has deep service knowledge (s), and only shallow general process and product knowledge (gd). That knowledge structure of SKO differs from both network-elements (SOP, POP) s/he can substitute. Those alternative contributions are visualized with dashed line arrows in Fig. 8. That is the degeneracy by definition – structurally different network-elements are functionally identical.

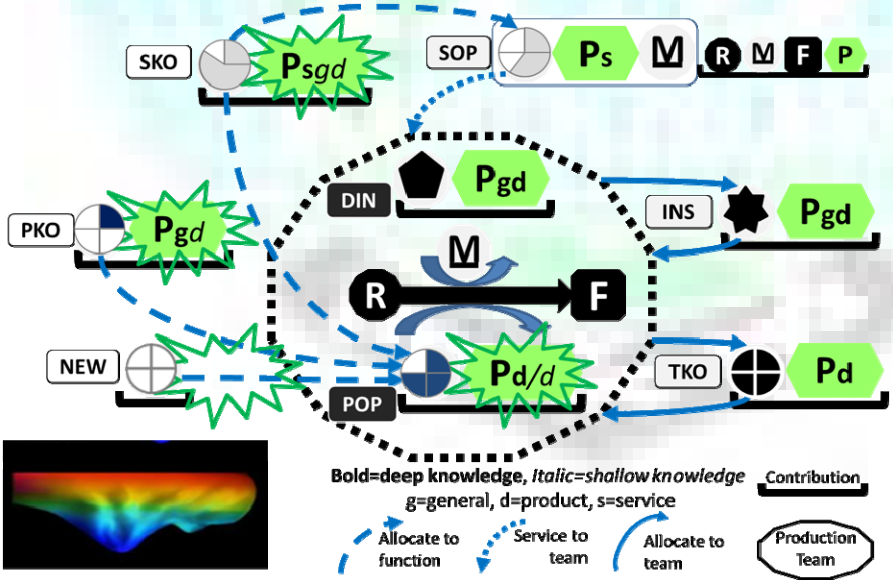


Fig. 8. Degeneracy (degenerative redundancy) in man-subnetwork creates a great number of solution alternatives to perturbations of different scale

The 'structural holes' in the required knowledge of a newcomer team (NT) or of a team learning a new product (PT) are filled in by supporting TKO and managed by INS, who have already that knowledge and are allocated temporarily to such learning team (full line arrows).

7 Conclusion

In the current article we introduced further network science termini and put them into organisational context. The already established structural and functional analogies with other viable networks enabled us to classify the perturbations an organisation may face. Due to different scale of perturbations in space-time, our dissipating solutions had to create scalability. The subnetworks of the organisation were functionally aligned to each other but with different spatiotemporal extent and different plasticity-rigidity cycles. The dissipating structural and functional solutions span from fraction of man-hours to hundred thousand man-days, creating unprecedented resilience, adaptive flexibility and operational stability.

Acknowledgments. Current research was supported by the following project "EFOP-3.6.1-16-2016-00017 Internationalization, initiatives to establish a new source of researchers and graduates, and development of knowledge and technological transfer as instruments of intelligent specializations at Széchenyi University."

References

1. Axtel, R.L. (2001): Zipf Distribution of U.S. Firm Sizes. Science, Vol. 293, Sep. 2001, pp. 1818-1820

2. Barabási A.-L. et al (2004): Hot spots and universality in network dynamics. Eur. Phys. J. B 38, DOI: 10.1140/epjb/e2004-00022-4, pp. 169–175.

3. Carreras, B.A. et al (2004): Evidence for Self-Organized Criticality in Electric Power System Blackouts. Hawaii International Conference on System Sciences, January 2001, Maui, Hawaii. p. 5.

4. Csermely P. et al (2008): Ageing as a price of cooperation and complexity. DOI: 10.1002/bies.200800224

5. Csermely P. (2009): Weak Links. The Universal Key to the stability of Networks and Complex Systems. Springer-Verlag Berlin, Heidelberg. p. 404.

6. Csermely P. (2015): Plasticity-rigidity cycles: A general adaptation mechanism. http://arxiv.org/abs/1511.01239

7. Dementeyev, L. F. (1988): Sistemnye issledovaniya v neftegazopromyslovoy geologii – Systems analyses in hydrocarbon geology. Nedra, Moscow, 1988.

8. Dobson, I. et al (2007): Complex systems analysis of series of blackouts: Cascading failure, critical points, and self-organization. DOI: 10.1063/1.2737822. American Institute of Physics. pp. 026103/1-13

9. Dunbar, R.I.M. (1993): Co-evolution of neocortex size, group size and language in humans. Behavioral and Brain Sciences 16 (4), pp. 681-735.

10. Fekete I., Hartványi T. (2012): Value Chain Stabilization with Combined Quantity-Irregularity Graphs. In International Conference on Value Chain Sustainability ICOVACS 2012, Izmir, Turkey, 13-15 December 2012, ISBN 978-975-8789-50-4 (Publising Date: March 2013), pp. 179-187.

11. Fekete I. et al (2016): Multi-Partite structure of Demand-Supply Network Element. Acta Technica Jaurinensis . DOI: 10.14513/actatechjaur.vX.nY.000

12. Fekete I., Hartványi T. 2018: Innovative Inventory Management for Flexible Adaptation. In Global Value Chains, Flexibility and Sustainability. ISSN 2199-8493. Flexible Systems Management ISBN 978-981-10-8928-2. https://doi.org/10.1007/978-981-10-8929-9. pp. 119-132

13. Fronczak, P. et al (2005): Interplay between network structure and self-organized criticality. http://arxiv.org/pdf/cond-mat/0509043v1, p. 4

14. Gutenberg, B., Richter, C.F. (1956): Magnitude and energy of earthquakes. Ann. Geofis. 9. pp. 1-15.

15. Janssen, M.A., Jager, W. (2003): Simulating Market Dynamics: Interactions between Consumer Psychology and Social Networks. Massachusetts Institute of Technology Artificial Life Vol. 9. 2003, pp. 343–356.

16.Johansen, A., Sornette, D. (2008): Finite-time singularity in the dynamics of the world population, economic and financial indices. Physica A 294 (3-4), (15 May 2001). arXiv:cond-mat/0002075v4, pp. 465-502.

17.Melnyik, S. et al (2014): Understanding Supply Chain Resilience. Supply Chain Management Review, Jan/Feb 2014. pp. 34-41.

18.Raghuramapatruni, R., Kosuri, S. r. (2017): The Straits of Success in a VUCA World. International conference on the VUCA World, 17th Feb, 2017. Research Gate.

19.Rohde, S., Royer, S., BURGESS, J. 2018: Exploiting Locational Resources in a World of Global Value Chains. In In Global Value Chains, Flexibility and Sustainability. ISSN 2199-8493. Flexible Systems Management ISBN 978-981-10-8928-2. https://doi.org/10.1007/978-981-10-8929-9. pp. 15-32

20.Newman M. (2010): Networks. Oxford University Press, New York, p. 772.

21.Serrano, A., Boguna, M. (2008): Topology of the World Trade Web. http://arxiv.org/pdf/cond-mat/0301015v1, Phys. Rev. E Vol 68. p. 5.

22.Sushil (2018): Valuation of Flexibility Initiatives Along the Value Chain. In Global Value Chains, Flexibility and Sustainability. ISSN 2199-8493. Flexible Systems Management ISBN 978-981-10-8928-2. https://doi.org/10.1007/978-981-10-8929-9. pp. 3-14

23.Trent, R. (2015): Managing Risk Through Supply Chain Flexibility. Supply Chain Management Review, May/June 2015. pp. 20-25.

24.Whitacre, J. (2010): Degeneracy: a link between evolvability, robustness and complexity in biological systems. BMC Journal of Theoretical Biology and Medical Modelling. arXiv:0910.2586, p. 14.

Modeling the factors of digital innovations fostering startups

Kamala Kannan Dinesh[1], Sushil[1]

[1] Department of Management Studies,
Indian Institute of Technology Delhi
Vishwakarma Bhavan, Shaheed Jeet Singh Marg,
Hauz Khas, New Delhi 110016, India

{kdinesh.iitd, profsushil}@gmail.com

Abstract. Startups are increasing everywhere across the globe, and each startup germinates from an innovative idea. Innovations are the key subject when we discuss startups. In this particular era of digitalization, many organizations are encouraged and confident to do digital business. Innovations through the digital mechanism are inseparable nowadays from new age startups. In a way, digital innovations are needful for startups to leverage their core competency and sustain in their competitive environment. This study will examine and analyze the various factors of digital innovations fostering entrepreneurship. This study will give insight towards research potential for future research. This study will benefit startups for enhancing strategic planning of digital innovations in their respective firms. Factors of digital innovations related to digital business are identified from the literature. These factors are modeled into a hierarchical structure using TISM. The hierarchical structure will hint at the base and driving factors for digital entrepreneurship.

Keywords: Digital innovation, Startups, Total interpretive structure modeling (TISM), Entrepreneurship.

1 Introduction

India as an emerging economy on the global level shows a positive future for entrepreneurs and budding (small and medium-sized enterprises) SMEs in India (Sheth, 2004). Almost all successful firms have a strong commitment towards continuous innovation in order to make themselves fit for the business competition. There is an excellent opportunity for Indian firms to go international in this digital era with the help of information technologies (Todd & Javalgi, 2007). Innovations are key for entrepreneurs and SMEs (Beaver & Prince, 2002) and go parallel along with their core business operations. Entrepreneurship, innovation, and economic growth has a positive mutual connection among themselves thus affect each other emphatically (Stephens, Partridge, & Faggian, 2013). Entrepreneurship traps innovation for boosting competitive advantage with strong efforts to outrun competitors (Duane Ireland & Webb, 2007). With lots of scope of growth for startups with the support of digital innovations influences to look for relevant factors of digital innovations. This sparks the motivation for this research, which is specific to startups.

The key objectives of this research are:

i) To identify the factors of digital innovations specific to startups
ii) To catch the interaction amidst identified factors using modified total interpretive structure modeling (TISM) approach; and
iii) To examine and discuss the indication of this study.

TISM (Sushil, 2012) with modified approach (Sushil, 2017) is utilized to frame model for factors of digital innovations specific to startups. This model would be helpful for startups in handling and improving digital innovation-related programs to foster their growth in terms of product innovation and competitiveness.

The next section of this paper covers the review of literature along with the recognition of factors of digital innovations from the literature. This is then followed by a brief description of the TISM methodology used. Then the TISM model is developed using the identified factors and their interactions among themselves with reference support

from the literature. Finally, the results and various insights from the model are discussed in the discussion section with the implications of this study. This is then followed by the conclusion of this research.

2 Literature Review

The digital innovation process is widely considered as key for firms in this rapidly changing business environment. Global innovation ecosystem provides favorable circumstances for entrepreneurship to explore and exploit various innovation activities and processes (Zahra & Nambisan, 2011). Framework for digital innovation strategy proposed by (Nylén & Holmström, 2015) focuses on the digital technological perspective but does not include the in-house innovation processes with respect to new product development or product/service innovation. According to (Sushil, 2016b) strategic flexibility is a significant contributor to innovations. The understanding of the concept of digital innovation co-exists in the practice of innovation management in firms (Svahn & Henfridsson, 2012). The factors identified from the literature are mentioned below.

2.1 Pervasive Digitization

Pervasive digitization causes extensive changes to the organization, and it can be both favorable and unfavorable. Digital technologies are pivotal for pervasive digitization, and an increase in the pervasiveness of the elements of digitization generates more business opportunities (Turber, Brocke vom, & Gassmann, 2015). Digitization in the organization's operations proposes more chances of innovations along with new product development and knowledge creation (Lyytinen, Yoo, & Boland, 2016). Innovating new product architecture for new product development comes from pervasive digitization (Yoo, Henfridsson, & Lyytinen, 2010).

2.2 Entrepreneurial Cognition

Entrepreneurial cognition includes a set of attributes in an individual or organization, which not only represent entrepreneurial personality but it incorporates a cognitive perspective to that (Mitchell et al., 2002). Entrepreneurial cognition at organization level discusses risk perception of CEOs in strategy planning and execution (José Acedo & Florin, 2006). Similarly, managerial cognition plays a vital role in the organization's strategic capabilities like quick responsiveness and risk management (Acedo & Jones, 2007). Creative industries require entrepreneurial cognition and orientation for firm's stiffness in a challenging environment (Chaston & Sadler-Smith, 2012).

2.3 IoT

IoT is envisioned as the future of computing focusing on smartness and automation with the help of smart sensors and cognitive technologies (Gubbi, Buyya, Marusic, & Palaniswami, 2013). Currently, the IoT application domain is cloud-centric and serves in homes and enterprises. Incorporation of IoT based products and services in enterprises can add value to the customers (Lee & Lee, 2015). Internet platform has become a prerequisite for e-business and digital enterprises. Enabling IoT in the enterprise may help in redesigning traditional business models (Zhang & Wen, 2017).

2.4 Digital Infrastructure

The infrastructure of an organization delivers the capability to manage the complexities of an enterprise (Henfridsson & Bygstad, 2013). Nature of digital infrastructure is associated with information technologies (Tilson, Lyytinen, & Sørensen, 2010) and mostly termed under digital technologies. Digitizing infrastructure is a never-ending process, and an organization must keep on customizing and upgrading their infrastructure (Henfridsson & Bygstad, 2013).

2.5 Innovative Workforce

A skilled workforce is an element which can follow the envisioned roadmap of an organization. Employees of an organization are the key assets, and their valuable ideas and feedbacks are vital for attaining competitiveness (Unsworth & Parker, 2003). Creative employees draw a direct link to the innovations in an organization (Unsworth & Parker, 2003) and each individual of an organization is equally important. The talent for creative and skilled employees contributes heavier to the organization's knowledge pool (Hunter, Cushenbery, & Friedrich, 2012).

2.6 ICT

Computers are nowadays affordable and assist in many ways. Similarly, computers have outperformed in computational operations and being used for business activities as a tool to ease the operations (Brynjolfsson & Hitt, 2000). Information technology serves an additional advantage to enterprises. (Powell & Dent-Micallef, 1997) highlights that information technology helps the firm to achieve sustainable production advantage. Elements of information technology like data intranets and computer assistance has improved the effectiveness of worker's productivity (Bloom, Garicano, Sadun, & Van Reenen, 2014). Research by (Kossaï & Piget, 2014) has highlighted that ICTs has positive effects on performance in well-developed nations. ICT offers more options and high speed while interacting with systems (Sushil, 2016c).

2.7 E-Learning

Usage of technologies for the purpose of knowledge gathering and dissemination is e-learning (Uden, Wangsa, & Damiani, 2007). With the expansion of the internet, e-learning as changed the learning culture especially in aid with online courses (Schweizer, 2004) and knowledge sharing. Internet being disruptive in nature has revolutionized the learning culture. Organizations need basic infrastructure to support e-learning, and it is advantageous to train managers and employees (Sanderson, 2002). E-learning in different modes such as computer-based education and distance education can fill the knowledge gap in an organization (DeRouin, Fritzsche, & Salas, 2005).

2.8 Digital Marketing

Digital marketing is so relevant for the enterprises in this digital economy of the 21st century (Wymbs, 2011). Digital marketing can fulfill the marketing needs of current generation organizations (Ryan & Jones, 2009). Similarly, customer's behaviors change with time. Thus digital marketing helps firms to quickly adapt to changes and reach them with a better understanding of their needs (Tiago & Veríssimo, 2014).

2.9 Product/Service Innovation

New product development is a key game for every product or service based company (Hart, 1995). (Takeuchi & Nonaka, 1986) compares new product development to a rugby game where the firm should stick to the basics as well as should adapt to changes slowly. According to (Verhees & Meulenberg, 2004) SMEs need to concentrate more on product/service innovations. Service is though intangible in nature but carries equal importance as that of a product and innovations in service is quite an important determinant for firm's performance (Lusch & Nambisan, 2015). All identified factors which are explained briefly from the literature are listed below along with the references is given in table 1.

Table 1. List of factors identified from the literature.

Factor code	Factor name	References
D1	Pervasive digitization	(Turber et al., 2015), (Lyytinen et al., 2016), (Yoo et al., 2010)
D2	Entrepreneurial cognition	(Mitchell et al., 2002), (José Acedo & Florin, 2006), (Acedo & Jones, 2007), (Chaston & Sadler-Smith, 2012)
D3	IoT	(Gubbi et al., 2013), (Lee & Lee, 2015), (Zhang & Wen, 2017)
D4	Digital infrastructure	(Henfridsson & Bygstad, 2013), (Tilson et al., 2010)
D5	Innovative workforce	(Unsworth & Parker, 2003), (Hunter et al., 2012)
D6	ICT	(Brynjolfsson & Hitt, 2000), (Powell & Dent-Micallef, 1997), (Bloom et al., 2014), (Kossaï & Piget, 2014)
D7	E-learning	(Uden et al., 2007), (Schweizer, 2004), (Sanderson, 2002), (DeRouin et al., 2005)
D8	Digital marketing	(Wymbs, 2011), (Ryan & Jones, 2009), (Tiago & Veríssimo, 2014)
D9	Product/service innovation	(Hart, 1995), (Takeuchi & Nonaka, 1986), (Verhees & Meulenberg, 2004), (Lusch & Nambisan, 2015)

3 Research Methodology

TISM is the methodology used to frame a hierarchical structure for a particular collection of variables. Basically, the model showcases the inter-relationships between the factors which in turn helps to understand the model in a better way. TISM also caters the justification for 'what,' 'why' and 'how' which are the constitutional questions of any study. TISM methodology is incorporated for this study considering the advantages and robustness of this method. TISM methodology has been

TISM methodology adopts the interpretive matrix for providing justification for the interpretation of the inter-variable links. Those interpretations add the justification for the interrogation for "why there is a relationship between the factors?" There are nine steps involved the process of framing the model with TISM method, and all nine steps are explained briefly.

Step 1: Identify and define element

The factors of digital innovations in context to startups or small business firms are identified and defined from the literature.

Step 2: Define contextual relationship

The relationship between the factors must be defined in order to develop the structure. The contextual relationship between the factors (say X & Y) defines whether "Factor X will influence or enhance Factor Y."

Step 3: Interpretation of relationship

This is the innovative step which makes this one step ahead of ISM. This step provides better and clear understanding of the contextual relationship between factors by interpreting the relationship as "In what way Factor X influence or enhance Factor Y?"

Step 4: Carry out pair comparisons and develop of reachability matrix and check transitivity simultaneously

TISM uses an interpretive matrix where each factor undergoes paired comparison with every next factor till the last factor. Pair-wise comparison between factors tells us whether there exists a relationship between the two or not. If there exists a relationship between the elements, then it needs further interpretation for that relationship. The whole pair-wise comparison is followed subsequently by simultaneous transitivity check. The responses of paired comparisons in the interpretive logic-knowledge base are translated into reachability matrix by marking 1 for 'Yes' and 0 for 'No.' Table A1 in the appendix demonstrates reachability matrix. Transitivity rule is used to check for transitivity between relationships of factors. Simultaneous checking of transitivity subsequently after developing reachability matrix is a merged step in modified process in order to reduce time (Sushil, 2017). Table A2 shown in appendix section is the reachability matrix with transitive links.

Step 5: Carry out hierarchical partition on reachability matrix, prepare digraph of hierarchical relationships and translate into interpretive model

This step sets up the level of the hierarchy to the factors. Digraph of reachability matrix is developed prior to this step as shown in figure 1. Level partitioning is executed similarly to that of the ISM. Table A3 in the appendix section clearly illustrates the level partitioning of the factors. Table A4 in the appendix section shows the levels of each element in the hierarchy. The factors partitioned into various hierarchical levels takes the shape of a directed graph with factors leveled in their respective level with established links. Meaningful transitive links are incorporated in the digraph. Figure 2 shows the digraph evolved from the reachability matrix after level partitioning.

Step 6: Interaction matrix

Matrix is refined by translating the evolved digraph, where 1 is marked for all the direct links and significant transitive links. From here interpretive matrix evolves, where the interpretation of the relationship between elements is added in the matrix. Table A5 and A7 in the appendix section illustrates the interaction matrix.

4 TISM Model

Total interpretive structure model (TISM) of the factors of digital innovations in context to startups is framed with the aid of literature providing the factors instrumental for digital innovations in concert to small business firms or startups. The model is developed by following all steps in which few are merged as per the modified process of TISM. Pair comparisons are converted into reachability matrix followed by simultaneous transitivity check which reduced time and ensured correctness of the model (Sushil, 2016a). Initial digraph is developed from the fully transitive reachability matrix which does not include hierarchical partitioning of elements.

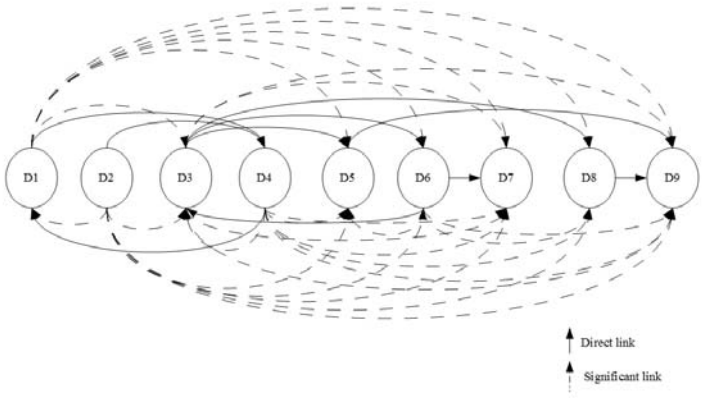


Fig. 2. Digraph developed from fully transitive reachability matrix with direct and transitive links as per modified process.

Figure 1 demonstrates fully transitive reachability matrix with direct and transitive links. Figure 1 evolves after following the steps of modified process of TISM which merges few steps of traditional TISM process. As it is clearly visible in figure 1 that there are many transitive link (arrows with dashes).

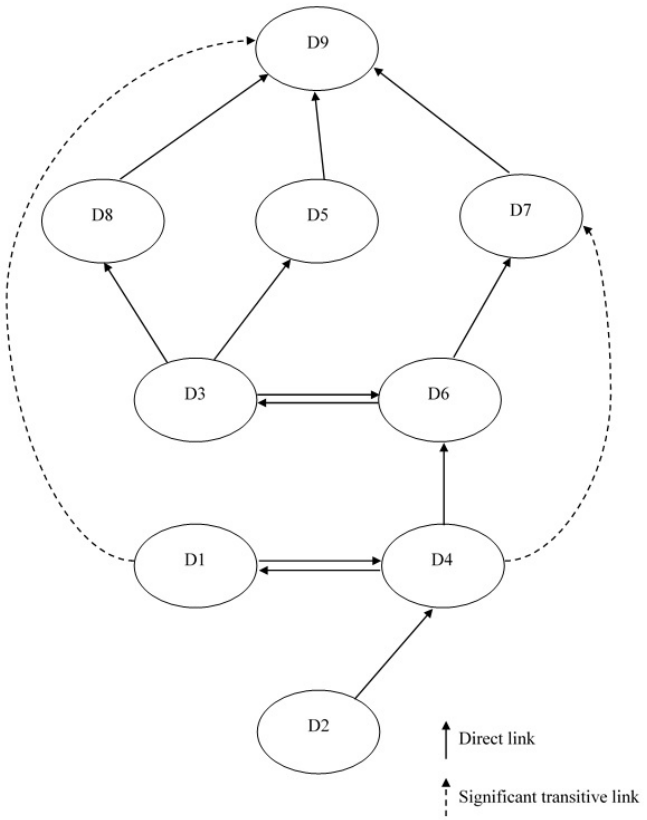


Fig. 2. Digraph after level partitioning.

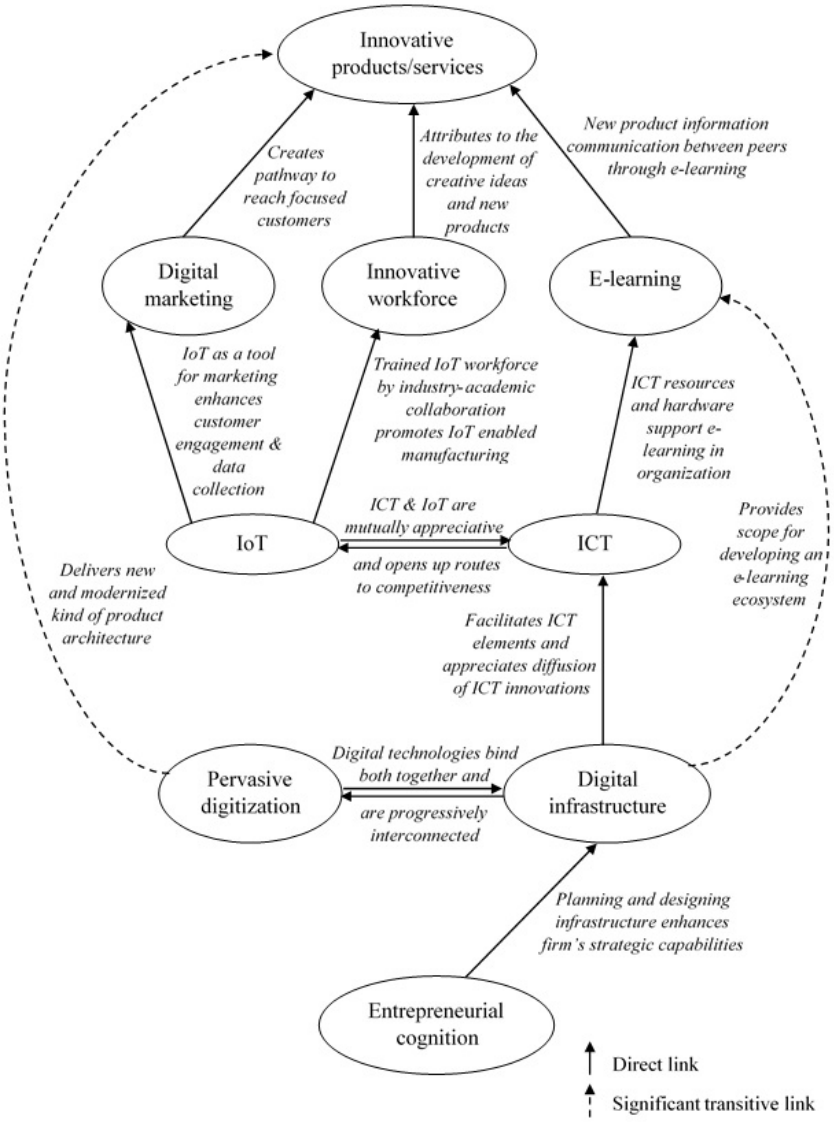


Fig. 3. TISM for digital innovation factors fostering startups.

Figure 2 shows digraph after level partitioning. In figure 2 only, significant transitive links are considered for the model, rest all the remaining transitive link are dropped which does not carry any meaningful relationship. Figure 3 shows the TISM model of digital innovation factors fostering startups incorporating all the interpretations of both the direct and significant transitive link. Table A6 in the appendix is the list of all the interpretation of direct links and significant transitive links with reference from the literature.

5 Discussion

This study showcases a model of digital innovation factors related to startups. The factors in the context of digital innovation and startups are found and taken from the literature. The TISM model shown in figure I clearly demonstrates the factors at different levels in the hierarchy and their relationship with the other remaining variable with proper justification. The relationship between the factors of digital innovations fostering startups brings better

understanding and crucial insights from this study. The overall model demonstrates how the factors of digital innovations foster startups and help them perform better in terms of innovations.

Startups by default take strong relationship with innovations and similarly the term entrepreneurship is mostly associated with innovations and creativity. Thus innovation becomes an essential component of their success and continuous growth in this competitive space.

TISM is shown in figure I highlights the ultimate importance of innovation in products and services for continuous and sustainable growth. Other remaining factors in subsequent levels promote innovation activities. The innovative workforce consists of creative employees who contribute their creative ideas to produce new products or services. Besides innovative workforce, there are two more factors at the same level namely digital marketing and e-learning. The model highlights that digital marketing creates an easy pathway to spread out new innovative products or services to focused customers and in a way also helps to promote their products or services. On the other hand, e-learning helps in sharing and communicating information with the peer groups and partners. Thus e-learning factor is considered vital for the organization's knowledge management. IoT and ICT factors are placed in level III, considered core digital factors. IoT and ICT are interconnected to each other operationally and provides mutual support to each other. Both IoT and ICT together helps the organization to stay technically updated and explores opportunities for advantage over competitiveness. IoT influences digital marketing as well innovative workforce, as connectivity over the internet and usage of internet technologies acts as a tool to excel the various core organizational operations and activities. IoT in relation to digital marketing aids in customer engagement and data collection where the digital platform becomes an easy medium to reach out customers and receive feedback. Skilled individuals specially trained in IoT skills are utilized in digital enterprises. For example, skills in cloud computing and big data are most common in IT-based enterprises. ICT elements are utilized for many purposes in the organizations, and especially the hardware and elements support e-learning. At level II, pervasive digitization and digital infrastructure exist. The changes in infrastructure which are influenced by digitization are pervasive in nature. Few digitization changes or up gradation happens with time; those irresistible changes influence the organization to update digitally. The TISM model also highlights that digital technology acts as a binding agent for digital infrastructure and pervasive digitization. There is a significant transitive link between digital infrastructure and e-learning, it shows that digital infrastructure is responsible for the creation of a favorable environment and ecosystem in the organization to support e-learning. Similarly, there is another significant transitive link between pervasive digitization, and innovative products/services explain the role of pervasive digitization in the innovation of products or services. Pervasive digitization provides a modernized framework and product architecture to work on so as to deliver new products or services. The factor at the last level is entrepreneurial cognition which talks about entrepreneurial mindset and orientation. Entrepreneurial cognition is linked to digital infrastructure which highlights planning and designing of firm's infrastructure to maximize their strategic capabilities.

6 Conclusion

This study showcased TISM of factors of digital innovations related to startups which included their hierarchical structure and highlighted their interrelationships among the factors. TISM methodology has been used in this study which can be utilized by more academicians for modeling and theory building. This study is focused on digital innovations in context to startups; different factors capture the unique role for startups performance or growth. Insights from the study will be useful for practitioners and as well as academicians. Practitioners especially startup founders and high-level employee involved in startup organizations may find the insights from this study useful. The insights from the model will suit well for new age startups, and these insights can assist high-level employees of startups in decision making. Similarly, from the point of the research perspective, this study contributes significant knowledge to the startup and entrepreneurship related literature.

References

1. Acedo, F. J., & Jones, M. V. (2007). Speed of internationalization and entrepreneurial cognition: Insights and a comparison between international new ventures, exporters and domestic firms. Journal of World Business, 42(3), 236–252.
2. Åkesson, M., & Thomsen, M. (2014). Digital Innovation and Social Dilemmas. Creating Value for All Through IT; IFIP WG 8.6 International Conference on Transfer and Diffusion of IT, TDIT 2014, Aalborg, Denmark, June 2-4, 2014. Proceedings, 49–61.

3. Beaver, G., & Prince, C. (2002). Innovation, entrepreneurship and competitive advantage in the entrepreneurial venture. Journal of Small Business and Enterprise Development, 9(1), 28–37.
4. Bloom, N., Garicano, L., Sadun, R., & Van Reenen, J. (2014). The Distinct Effects of Information Technology and Communication Technology on Firm Organization. Management Science, 60(12), 2859–2885.
5. Brynjolfsson, E., & Hitt, L. M. (2000). Beyond Computation. Source: The Journal of Economic Perspectives, 14(4), 23–48.
6. Chaston, I., & Sadler-Smith, E. (2012). Entrepreneurial Cognition, Entrepreneurial Orientation and Firm Capability in the Creative Industries. British Journal of Management, 23(3), 415–432.
7. Del Giudice, M. (2016). Discovering the Internet of Things (IoT) within the business process management: A literature review on technological revitalization. Business Process Management Journal, 22(2), 263–270.
8. DeRouin, R. E., Fritzsche, B. A., & Salas, E. (2005). E-learning in organizations. Journal of Management, 31(6), 920–940.
9. Duane Ireland, R., & Webb, J. W. (2007). Strategic entrepreneurship: Creating competitive advantage through streams of innovation. Business Horizons, 50(1), 49–59.
10. Edelman, D. C. (2010). Branding in the digital age: You're spending your money in all the wrong places. Harvard Business Review, 88(12).
11. Gong, W. (2016). The Internet of Things (IoT): What is the potential of the internet of things (IoT) as a marketing tool ? IBA Bachelor Thesis Conference, 1–13.
12. Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems, 29(7), 1645–1660.
13. Harpaz, I., & Meshoulam, I. (2010). The meaning of work, employment relations, and strategic human resources management in Israel. Human Resource Management Review, 20(3), 212–223.
14. Hart, S. J. (1995). New Product Development. In Marketing Theory and Practice (pp. 171–181). London: Macmillan Education UK.
15. Henfridsson, O., & Bygstad, B. (2013). The Generative Mechanisms of Digital Infrastructure Evolution. MIS Quarterly, 37(3), 907–931.
16. Howard, P. N. (2007). Testing the leap-frog hypothesis: The impact of existing infrastructure and telecommunications policy on the global digital divide. Information Communication and Society, 10(2), 133–157.
17. Hunter, S. T., Cushenbery, L., & Friedrich, T. (2012). Hiring an innovative workforce: A necessary yet uniquely challenging endeavor. Human Resource Management Review, 22(4), 303–322.
18. José Acedo, F., & Florin, J. (2006). An entrepreneurial cognition perspective on the internationalization of SMEs. Journal of International Entrepreneurship, 4(1), 49–67.
19. Kossaï, M., & Piget, P. (2014). Adoption of information and communication technology and firm profitability: Empirical evidence from Tunisian SMEs. Journal of High Technology Management Research, 25(1), 9–20.
20. Lee, I., & Lee, K. (2015). The Internet of Things (IoT): Applications, investments, and challenges for enterprises. Business Horizons, 58(4), 431–440.
21. Lusch, R. F., & Nambisan, S. (2015). Service innovation: A service-dominant logic perspective. MIS Quarterly, 39(1), 155–175.
22. Lyytinen, K., Yoo, Y., & Boland, R. J. (2016). Digital product innovation within four classes of innovation networks. Information Systems Journal, 26(1), 47–75.
23. Mahanta, D., & Ahmed, M. (2012). E-Learning Objectives, Methodologies, Tools and its Limitation. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 2(1), 46–51.
24. Mitchell, R. K., Busenitz, L., Lant, T., McDougall, P. P., Morse, E. A., & Smith, J. B. (2002). Toward a Theory of Entrepreneurial Cognition: Rethinking the People Side of Entrepreneurship Research. Entrepreneurship Theory and Practice, 27(2), 93–104.
25. Nylén, D., & Holmström, J. (2015). Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation. Business Horizons, 58(1), 57–67.
26. Powell, T. C., & Dent-Micallef, A. (1997). Information technology as competitive advantage: the role of human, business, and technology resources. Strategic Management Journal, 18(5), 375–405.
27. Radhakrishnan, S., & Kamarthi, S. (2016). Convergence and divergence in academic and industrial interests on IOT based manufacturing. Proceedings - 2016 IEEE International Conference on Big Data, Big Data 2016, 2051–2056.
28. Ryan, D., & Jones, C. (2009). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation. Kogan Page.
29. Sanderson, P. E. (2002). E-Learning: strategies for delivering knowledge in the digital age. The Internet and Higher Education, 5(2), 185–188.
30. Schweizer, H. (2004). E-learning in business. Journal of Management Education, 28(6), 674–692.
31. Sheth, J. (2004). Making India globally competitive. Vikalpa, 29(4), 1–9.
32. Stephens, H. M., Partridge, M. D., & Faggian, A. (2013). Innovation, entrepreneurship and economic growth in lagging regions. Journal of Regional Science, 53(5), 778–812.
33. Sushil. (2012). Interpreting the interpretive structural model. Global Journal of Flexible Systems Management, 13(2), 87–106.
34. Sushil. (2016a). How to check correctness of total interpretive structural models? Annals of Operations Research, 1–15.
35. Sushil. (2016b). Strategic Flexibility in Ecosystem. Global Journal of Flexible Systems Management, 17(3), 247–248.
36. Sushil. (2016c). The Inflexibility of Technology! Global Journal of Flexible Systems Management, 17(4), 341–342.

37. Sushil. (2017). Modified ISM/TISM Process with Simultaneous Transitivity Checks for Reducing Direct Pair Comparisons. Global Journal of Flexible Systems Management, 18(4), 331–351.
38. Svahn, F., & Henfridsson, O. (2012). The dual regimes of digital innovation management. Proceedings of the Annual Hawaii International Conference on System Sciences, 3347–3356.
39. Takeuchi, H., & Nonaka, I. (1986). The new new product development game. Harvard Business Review, 64(1), 137–146.
40. Tiago, M. T. P. M. B., & Veríssimo, J. M. C. (2014). Digital marketing and social media: Why bother? Business Horizons, 57(6), 703–708.
41. Tilson, D., Lyytinen, K., & Sørensen, C. (2010). Research Commentary —Digital Infrastructures: The Missing IS Research Agenda. Information Systems Research, 21(4), 748–759.
42. Todd, P. R., & Javalgi, R. R. G. (2007). Internationalization of SMEs in India: Fostering entrepreneurship by leveraging information technology. International Journal of Emerging Markets, 2(2), 166–180.
43. Turber, S., Brocke vom, J., & Gassmann, O. (2015). Designing Business Models in the age of Pervasive Digitization. Academy of Management Proceedings, 2015(1), 11600.
44. Uden, L., Wangsa, I. T., & Damiani, E. (2007). The future of E-learning: E-learning ecosystem. In 2007 Inaugural IEEE-IES Digital EcoSystems and Technologies Conference (pp. 113–117). IEEE.
45. Unsworth, K., & Parker, S. (2003). Promoting a new workforce for the new workplace. The new workplace: A guide to the Human Impact of Modern Working Practices. John Wiley & Sons.
46. Verhees, F. J. H. M., & Meulenberg, M. T. G. (2004). Market Orientation, Innovativeness, Product Innovation, and Performance in Small Firms. Journal of Small Business Management, 42(2), 134–154.
47. Welsh, E. T., Wanberg, C. R., Brown, K. G., & Simmering, M. J. (2003). E-learning: emerging uses, empirical results and future directions. International Journal of Training and Development, 7(4), 245–258.
48. Wymbs, C. (2011). Digital marketing: The time for a new "academic major" has arrived. Journal of Marketing Education, 33(1), 93–106.
49. Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). Research Commentary —The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. Information Systems Research, 21(4), 724–735.
50. Zahra, S. A., & Nambisan, S. (2011). Entrepreneurship in global innovation ecosystems. AMS Review, 1(1), 4–17.
51. Zhang, Y., & Wen, J. (2017). The IoT electric business model: Using blockchain technology for the internet of things. Peer-to-Peer Networking and Applications, 10(4), 983–994.

Appendix: TISM development process for digital innovation factors fostering startups

Table A2. Reachability matrix.

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	1	0	0	1	0	0	0	0	0
D2	0	1	0	1	0	0	0	0	0
D3	0	0	1	0	1	1	0	1	0
D4	1	0	0	1	0	1	0	0	0
D5	0	0	0	0	1	0	0	0	1
D6	0	0	1	0	0	1	1	0	0
D7	0	0	0	0	0	0	1	0	1
D8	0	0	0	0	0	0	0	1	1
D9	0	0	0	0	0	0	0	0	1

Table A2. Reachability matrix (with transitivity).

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	1	0	1*	1	1*	1*	1*	1*	1*
D2	1*	1	1*	1	1*	1*	1*	1*	1*
D3	0	0	1	0	1	1	1*	1	1*
D4	1	0	1*	1	1*	1	1*	1*	1*
D5	0	0	0	0	1	0	0	0	1
D6	0	0	1	0	1*	1	1	1*	1*
D7	0	0	0	0	0	0	1	0	1
D8	0	0	0	0	0	0	0	1	1
D9	0	0	0	0	0	0	0	0	1

Note: *Transitivity

Table A3. Partitioning matrix.

Factor code	Reachability set	Antecedent set	Intersection	Level
(a): Iteration 1				
D1	1,3,4,5,6,7,8,9	1,2,4	1,4	
D2	1,2,3,4,5,6,7,8,9	2	2	
D3	3,5,6,7,8,9	1,2,3,4,6	3	
D4	1,3,4,5,6,7,8,9	1,2,4	1	
D5	5,9	1,2,3,4,5,6	5	
D6	3,5,6,7,8,9	1,2,3,4,6	3	
D7	7,9	1,2,3,4,6,7	7	
D8	8,9	1,2,3,4,6,8	8	
D9	**9**	**1,2,3,4,5,6,7,8,9**	**9**	**I**
(b): Iteration 2				
D1	1,3,4,5,6,7,8	1,2,4	1,4	

D2	1,2,3,4,5,6,7,8	2	2	
D3	3,5,6,7,8	1,2,3,4,6	3	
D4	1,3,4,5,6,7,8	1,2,4	1	
D5	**5**	**1,2,3,4,5,6**	**5**	**II**
D6	3,5,6,7,8	1,2,3,4,6	3	
D7	**7**	**1,2,3,4,6,7**	**7**	**II**
D8	**8**	**1,2,3,4,6,8**	**8**	**II**
(c): Iteration 3				
D1	1,3,4,6	1,2,4	1,4	
D2	1,2,3,4,6	2	2	
D3	**3,6**	**1,2,3,4,6**	**3,6**	**III**
D4	1,3,4,6	1,2,4	1	
D6	**3,6**	**1,2,3,4,6**	**3,6**	**III**
(d): Iteration 4				
D1	**1,4**	**1,2,4**	**1,4**	**IV**
D2	1,2,4	2	2	
D4	**1,4**	**1,2,4**	**1,4**	**IV**
(e): Iteration 5				
D2	**2**	**2**	**2**	**V**

Note: Bold – attained a level

Table A4. Level matrix.

Factor code	Factor name	Level
D1	Innovative products/services	I
D2	Digital marketing	II
D3	E-learning	II
D4	Innovative workforce	II
D5	ICT	III

D6	IoT	III
D7	Digital infrastructure	IV
D8	Pervasive digitization	IV
D9	Entrepreneurial cognition	V

Table A5. Interaction matrix (binary matrix).

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	-	0	0	**1**	0	0	0	0	*1**
D2	0	-	0	**1**	0	0	0	0	0
D3	0	0	-	0	**1**	**1**	0	**1**	0
D4	**1**	0	0	-	0	**1**	*1**	0	0
D5	0	0	0	0	-	0	0	0	**1**
D6	0	0	**1**	0	0	-	**1**	0	0
D7	0	0	0	0	0	0	-	0	**1**
D8	0	0	0	0	0	0	0	-	**1**
D9	0	0	0	0	0	0	0	0	-

Note: Bold - direct links, italic* - Significant transitive links

Table A6. Interpretation of relations.

Comparisons	Reference	Interpretation
D1-D4	(Tilson et al., 2010)	Digital technologies bind both together and are progressively interconnected
D4-D1	(Tilson et al., 2010)	Digital technologies bind both together and are progressively interconnected
D1-D9	(Åkesson & Thomsen, 2014)	Delivers new and modernized kind of product architecture
D2-D4	(Chaston & Sadler-Smith, 2012)	Planning and designing infrastructure enhances firm's strategic capabilities

D3-D5	(Radhakrishnan & Kamarthi, 2016)	Trained IoT workforce by industry academic collaboration promotes IoT enabled manufacturing
D3-D6	(Del Giudice, 2016)	ICT & IoT are mutually appreciative and opens up routes to competitiveness
D6-D3	(Del Giudice, 2016)	ICT & IoT are mutually appreciative and opens up routes to competitiveness
D3-D8	(Gong, 2016)	IoT as a tool for marketing enhances customer engagement and data collection
D4-D6	(Howard, 2007)	Facilitates ICT elements and appreciates diffusion of ICT innovations
D4-D7	(Uden et al., 2007)	Provides scope for developing an e-learning ecosystem
D4-D9	(Harpaz & Meshoulam, 2010)	Attributes to the development of creative ideas and new products
D6-D7	(Mahanta & Ahmed, 2012)	ICT resources and hardware support e-learning in organization
D7-D9	(Welsh, Wanberg, Brown, & Simmering, 2003)	New product information communication between peers through e-learning
D8-D9	(Edelman, 2010)	Creates pathway to reach focused customers

Note: Bold – significant transitive link

Table |A7. Interaction matrix (interpretive matrix).

	D1	D2	D3	D4	D5	D6	D7	D8	D9
D1	-			Digital technologies bind both together and are progressively interconnected					*Delivers new and modernized kind of product architecture*
D2		-		Planning and designing infrastructure enhances firm's strategic capabilities					
D3			-		Trained IoT workforce by industry-academic collaboration promotes IoT enabled manufacturing	ICT & IoT are mutually appreciative and opens up routes to competitiveness		IoT as a tool for marketing enhances customer engagement and data collection	
D4	Digital technologies bind both together and are progressively interconnected			-		Facilitates ICT elements and appreciates diffusion of ICT innovations	*Provides scope for developing an e-learning ecosystem*		
D5					-				Attributes to the development of creative ideas and new products
D6			ICT & IoT are mutually appreciative and opens up routes to competitiveness			-	ICT resources and hardware support e-learning in organization		
D7							-		New product information communication between peers through e-learning
D8								-	Creates pathway to reach focused customers
D9									-

Note: Italic - significant transitive links

Flexible Enterprise - Managing in Quantum way

Nirmal Kundu

Associate Professor,
Sanskriti University,
Chhata, Delhi Mathura Highway, Mathura, Pin-244001 India,

E-mail: nkundu97@rediffmail.com

Abstract: The world is changing very fast and the quantum of changes, at many of the times, overtakes imagination. As Science is progressing and technology is closely following science, managing business process in high tech Quantum age has become far more difficult. It makes one often confused to see that even meticulous planning is not bringing the intended results. In an increasingly volatile, uncertain, complex and ambiguous (VUCA) business landscape, flexibility is essential for business. Conventional business style is giving way to future flexible enterprises which demand not only a high tech machine but a quantum thinking and mindset - adept at preparing, responding and recovering from unprecedented, unexpected, indeterminist and chaotic disruptions whilst maintaining the continuity of business operations. In this Quantum environment, a quantum leap in thinking process, mindset and approach are needed for managing business in present age that is to leap forward by moving in Quantum way.

Key words: Flexible, Enterprise, Quantum age, Quantum Way, Quantum Management

1. Introduction

Change is the only constant in life and society. Sometimes the quantum of changes bewilders imagination. The quantum of changes and variability of changes in social and business life make one often confused. Life expectancy is increasing but life killing diseases are starting at an early age, material comfort is increasing but mental peace is totally eroded, profit is increasing but little concern for plant and people, motion is tremendous but emotion is trivial. It is becoming increasingly difficult to predict how the future will turn out when so many events in the present are so disturbing. It seems that the changes are much more profound than it has been seen in the past and "the script that is unfolding has a different set of characteristics than those with which we are familiar with" [1]. "The rules of the games seem to have changed: they no longer work either to explain or to help us adapt to the change …!". [2].

Not only in social life but the same issue is prevailed in business environment also. Around the living kingdom, there are continuous and conscious efforts for innovation to adapt. The twenty-first-century organization is faced with the apparent dilemma of being efficient and innovative, lean and flexible, hierarchical and flat. The seemingly contradictory characteristics are extending into every organizational system, from culture to strategy and from people to technology. Flexibility and Adaptation are the important factors for survival and succeed. In this scenario, one has to find certainty out of uncertainty, linearity out of nonlinearity, order from disorder, and harmony from chaos for sailing through the business turbulent water. It should be our endeavor to find stability out of instability. The flexible organization must embrace and cultivate seemingly opposites. The organization should recognize opposites as opportunities for inventiveness and synthesis and not a dilemma that requires a choice between opposites [3]. This is in contrast to a more traditional organization that either chooses one principle over its apparent opposite or adopts an engineering perspective that optimizes something between opposites. The new organizations, in contrast, will synthesize opposites into something unique and new.

Present volatile situation has lead to the concept of "Chaos" in Management and has lead to the famous saying "When

butterfly flaps its wings at Tokyo, there is tornado at Toronto" [4]. Chaos does not mean random or clueless. It is the limitation of the existing knowledge, frame of mind or perception that lead to term it as chaos. When someone fails to explain the phenomenon logically (a characteristics of Newtonian thinking), he stops thinking intuitively and happy to explain everything as Chaos to be in his comfort zone. However, it may not solve the problem and will lead to nowhere. **"**The framework of laws governing the universe whose unfamiliar features such as uncertainty, quantum fluctuations & wave particle duality become most apparent on the microscopic scales of atoms & sub nuclear particles**."** [5].

Business process has traveled a long way from mass manufacturing to customized manufacturing, from resource based manufacturing to sustainable manufacturing, The objective of business has changed from 1P concept of business (profit) to 3P business (profit, planet and people) concept. The traditional management principle is based on four principles: planning, organizing, directing, and controlling. These are simply inadequate for leading in The Quantum Age. The classical way of doing business has failed to yield the result and prompts for flexibility.

Flexibility can be thought of as an ability of the enterprise to effectively and efficiently respond to changes and to bring new products and services quickly to the market place; The paradigm of flexibility in general and strategic flexibility in particular provides the philosophical basis and acts as fountainhead for channelising the flowing stream strategy framework [6], [7]. "Flexibility is the exercise of free will or freedom of choice on the continuum to synthesize the dynamic interplay of thesis and antithesis in an interactive and innovative manner, capturing the ambiguity in systems and expanding the continuum with minimum time and efforts" [8].

Till yesterday in relatively slow-moving machine age, this mechanical understanding of the activities worked, but now, in the 21st century, when technology is changing at a faster rate and competing with our dreams and wish lists, managing high levels of technology and in fast changing business scenario need a whole new set of skill and approach – a Quantum approach.

2. Research objectives

As the world enters a new age, the experience (Quantum environment) is different and the requirement of knowledge, skill set, mind set and strategy to manage changes get redefined in the new age. Management concept has come a long way from Scientific management to Chaos theory of Management and to Quantum theory of management. Enough evidence is there that present way of managing is not yielding result. Time has come to shift from conventional management style to quantum management style. When most of the parameters are uncertain, the deterministic style of decision making needs a change to probabilistic decision making

The objectives of the research are (1) to highlight that there are changes and the changes are very fast which forces the business enterprises to be flexible. (2) to understand the characteristics of present age (Quantum age) is quite different from past, (3) to establish that the classical way of thinking and managing enterprise will not yield result, (4) to develop a framework for managing enterprises in Quantum way, (5) to develop an effective strategy of managing enterprises in Quantum age.

3. Research methodology

The research methodology used in this study is a combination of Literature review, Case study and Key informant interviews. The literature review includes both published and unpublished sources of literature. Information available from the websites of the progressive business enterprises is also used. Case studies and examples are taken from Telecommunication, Electronics, Computer and Banking industry where the effect of technological changes and flexible managing are more pronounced. These examples will give an insight what generally go wrong in managing enterprises in the present way and also suggest how the same can be avoided in future. In case of key informant

interviews, informal telephonic discussions have been carried out with the key executives of the progressive organizations who are actively engaged in the process of managing changes. The discussion is mainly focused on flexible framework and strategy needs for achieving success in managing business in present age (Quantum age).

4. Literature Review

4.1 What is Flexible Enterprise?

When dealing with a volatile, uncertain, complex and ambiguous business environment (VUCA), it is imperative to leverage flexibility and increase capabilities to execute expected timelines on time. According to Sushil [9], the concept of flexibility is associated with various connections depending on different situations - environmental adaptation, positive response to change, openness in thinking and versatile action taking to deal with various situations. Peters and Waterman [10], In their study of excellent organizations have noticed a combination strategy of encouraging simple fluid structures with high levels of autonomy coupled with tight short-term financial control. An interplay of individual initiative and enterprise with central organizational intention and control exhibits natural flexibility in excellent organizations.

Flexible systems management is not new and the same is in-built in the ancient Indian philosophy in the form of 'detached attachment' so as to obtain 'unity in diversity' and transcend to 'freedom'. It considers reality to be ambiguous, dynamic and all embracing, and thus proposes to take a holistic view of it and integrate, interact, interplay or innovate, capturing its fuzziness. This helps to handle managing dilemmas, paradoxes and conflicts. Such a systemic concept of positive flexibility is pragmatic as well as ideal, and overcomes the traditional concept of negative flexibility, i.e. lack of commitment, soft work culture and lack of conviction. It is more challenging and spiritually orientated, such practice demands higher individual and organizational development. The spirit of flexible systems management is very aptly reflected in Bhagvat Gita:

"All actions take place in time by the interweaving of the forces of Nature, but the man lost in selfish delusion thinks that he himself is the actor. But the man who knows the relations between the forces of Nature and actions, sees how some forces of Nature work upon other forces of Nature, and becomes not their slave" [11].

4.2 What is Quantum age?

"The nineteenth century was known as the machine age, the twentieth century will go down in history as the information age. I believe the twenty-first century will be the quantum age." Paul Davies, Professor Natural Philosophy – Australian Centre for Astrobiology. [12]. "The modern era encompasses a period that technologically could be called The Quantum Age" [13].

In fact, the Quantum Age started even before the onset of twenty first century. When de Broglie propounded his famous theory of Wave - Particle dualism in 1923 by stating that light follows dual nature, or Heisenberg's Uncertainty principle says that if the position of sub atomic particle is certain, then momentum will be uncertain, it has shaken altogether the Newtonian philosophy of thinking and basic premises of scientific attitude. The concept of uncertainty and dualism has shaken the scientific beliefs. The whole concept has changed since then from "exactness" to "expectedness", from deterministic to stochastic.

Since the time of de Broglie and Heisenberg, science has changed. Technology is also no longer in behind. It is closely tracking the development in Science. Quantum Physics [14], Quantum Chemistry [15], Quantum Biochemistry [16], Quantum Biology [17], Quantum metrology [18] have been followed by Quantum computer [19], Quantum laser [20], Quantum cryptography[21] have become very common. Application of Quantum theory in the arena of healthcare [22] sports [23], Modern Portfolio Theory [24] - all have become reality. In recent times, attempts have been made to

ascribe the quantum mechanical properties to mind, brain, and consciousness [25],[26].[27],[28],[29,[30].

Quantum mechanics provides an understanding of the mind-brain connection that is not only completely in accord with intuition and common sense, but that also describes the way in which mind-brain process act to fashion the activities of our brains in the service of our ideas. Application of Quantum way in business solution is thus becoming inevitable.

These above discussion and literature reviews suggest that there was a sea change started happening from the early twentieth century when Newtonian physics started loosing its supremacy to Quantum mechanics and lot of developments happened on this thought thereafter. Hence present age which is characterized by uncertainty can be called as Quantum age.

4.3 Why Quantum way?

"Quantum mechanics is the study of subatomic particles in motion"[31]. However, subatomic particles are not material things; rather, they are "probability tendencies--energy with potentiality". According to quantum theory, "the universe is basically a set of signals or a field of information. It is much more like a great thought than the great machine metaphor of the Newtonian paradigm [32]".

Newtonian philosophy is based on causal effect. Causal effect is well understood and imbibed in the action. The world is accustomed to think that nothing happens without any cause and same cause will always result in the same outcome. This results to exactness or certainty. However the same is not always true in real life and creates confusion when experience mismatches with our pre conception. If events are described in terms of causes and effects, these manifest a sense of dynamics that classical science has established. Mental properties have no causal role in the determination of physically described actions. Our thought processes are not parts of the causal structure [33].

Although humankind may primarily be viewed as a material being but there is also an intangible, nonmaterial dimension (mind, consciousness or spirit) that gets affected by quantum principles [34],[13]. Classical mechanics describes the dynamics of machines, whereas, Quantum mechanics describes 'the dynamics of ideas! A great characteristic of the present age is not hardware dependent, but software embedded, not interactions of machines, but interplay of ideas.

"Some aspects of the human behavior can be explained by quantum mechanical equations, but not by the classical mechanics. It may be noted that classical mechanics and quantum mechanics differ ideologically as well as mathematically; and for macro-systems the approximate form of mathematical equations of quantum mechanics agrees with the equations of classical mechanics" [35].

Classical mechanics describes the dynamics of machines, whereas, Quantum mechanics describes 'the dynamics of ideas! A great characteristic of the present age is not hardware dependent, but software embedded, not interactions of machines, but interplay of ideas. There was a sea change started happening from the early twentieth century when Newtonian physics started loosing its supremacy to Quantum mechanics and lot of developments happened on this thought thereafter. Hence present age which is characterized by uncertainty can be called as Quantum age.

A key characteristic of quantum physics is that if there is a possibility for something happening, given enough time it does happen. Disappearing from one place and appearing on the other side of universe is indeed a quantum possibility, Analogous to this concept is issue in business management of right execution which inflates the ultimate bottom-line. Any strategy has execution risks. If there is a probability for a risk to happen, it can happen. The main thrust of managing business in Quantum age is to manage risks so that the highest probable outcome remains the one that meets objective. The risk happens because of the uncertainty. To deal with this uncertainty, it demands a different set of knowledge, mindset, skill set, strategy and action plan which the classical and conventional attempt and approach is not able to meet with. In the quantum age, focus should be on ideas rather than fact, approach needs to be changed to probabilistic approach from deterministic approach, from information based decision making to intuition based decision making, to learn to deal with expectedness rather than exactness, learn to discuss open ended question rather

than close ended question, develop intuitive power, imagination and not afraid of being exposed to 'not knowing'. That will lead to great strategy and execution which is required in quantum age.

4.4 How flexible enterprises manage business in Quantum way?

The traditional value system what the humankind was nurturing and preserving with utmost care over the ages has now become irrelevant and obsolete. These qualities have no taker today. Efficiency, action, loyalty, rigidity, collaboration has no place in today's world and being replaced by effectiveness, result, adaptation, flexibility and competition. The root cause is uncertainty. Causal knowledge can be readily understood. Chaos is not causal and not transparent. So it needs special skill set to understand but can never be disregarded as irrelevant.

The issue today is that a society that leads to act largely upon mechanistic ideas: the conventional thinking and action based on any rational approach must be transformed and compatible with the new principles and findings of science, and that these principles need to be applied in real life problem solving in managing technology.

The new developments in mathematics dealing with uncertainty, ambiguity and chaos, particularly fuzzy set theory, have acted as an inspiration to develop the flexible systems management paradigm, keeping in view the availability of necessary mathematical tools that can handle systemic flexibility. The development of creativity concepts, models and tools, and their increased use in management in the framework of systems methodology, has given impetus to the evolution of the flexible systems management paradigm.

Flexible systems management is a natural process, which is otherwise lost in artificial fixations under ignorance. The main aim of flexible systems management is to facilitate the actor in liberation from ignorance by understanding the dynamic interplay of forces and exercising free will in a detached manner so as to regain the natural organic order of the inseparable whole, resonating the internal and external flexibilities and orchestrating dynamically, spontaneously and dialectically. While it is justified to believe in scientific certainty, it is prudent to admit, a lot of what passes for management wisdom is unquestioned dogma masquerading as unquestionable truth.

What is needed is to develop and create a culture and pass on to people around us are the skills of Inquiry: of asking open ended questions, not-easily-answered questions which leads to exploring, or discovering. 'Inquiry' then becomes a process and tool for engaging the 'discovering' paradigm. The people should be honoured and rewarded for the courage of their questions rather than the brilliance of their answers. They should develop comfort with questions leading to more questions. They should celebrate the ability to stay in the realm of 'not knowing'.

An apparently "Wrong "outcome is as significant as "Right "outcome. In the chaos of change, it is equally important to know the wrong to understand or make the thing right. In Quantum age 'knowing' is not a paradigm that is sought for. It is the unknowing, curiosity and the willingness to be in search for are the prized traits. It is the willingness to be in a perpetual state of 'discovering'. These are the qualities which will lead the road to success for this century.

Case study 1: Google Corporation- Creating quantum environment

Google was founded in 1998 by Larry Page and Sergey Brin while they were Ph.D. students at Stanford University in California. Google is the most valuable brand in the world as of 2017, Alphabet (Google's parent company) is valued at $739 billion.

Google's top team doesn't spend a lot of time trying to cook up grand strategies. Instead, it works to create an environment that spawns lots of "Googlettes": small, grassroots projects. Google looks for recruits who have off-the-wall hobbies and unconventional interests—people who aren't afraid to defy conventional wisdom and encourages them to work in Quantum environment. Few companies have worked as systematically as Google to broadly distribute the responsibility for strategic innovation (Quantum strategy). Its experience suggests that the conventional view of the CEO as the strategist in chief is just that: a convention. It's not entirely wrong, but it's a long way from being

totally right. This Quantum philosophy has brought a tremendous fillip in their business result and showed a quantum jump in profit [36].

Case study 2: Bangladesh's Grameen Bank - Nurturing quantum philosophy.

The example of Bangladesh's Grameen Bank is another spur to Quantum philosophy. The bank's mission is to turn the poorest of the poor into entrepreneurs. Muhammad Yunus was inspired during the Bangladesh famine of 1974 to make a small loan of US$27 to a group of 42 families as start-up money so that they could make items for sale, without the burdens of high interest under predatory lending. Yunus believed that making such loans available to a larger population could stimulate businesses and reduce the widespread rural poverty in Bangladesh. To that end, it makes micro loans to five-person syndicates with no requirement for collateral and little in the way of paperwork. Borrowers use the funds to start small businesses such as basket weaving, embroidery, transportation services, and poultry breeding. Ninety-five percent of the bank's loans go to women, who against the conventional thinking and beliefs have proven to be both creditworthy borrowers and astute business people. Micro credit gives these women the chance to improve their families' well-being and their own social standing.

As of 2017, the Bank had about 2,600 branches and nine million borrowers, with a repayment rate of 99.6% and 97% of the borrowers were women. The Bank has been active in 97% of the villages of Bangladesh. The success has inspired similar projects in more than 40 countries around the world, including a World Bank initiative to finance Grameen-type schemes. This is an example where desperately poor woman in a developing country has an easier time getting capital to fund an idea than the conventional way of creating the entrepreneur. If Grameen Bank can make millions of unsecured loans to individuals who have no banking history, the unconventional thinking in quantum way have much more possibility to become a near and clear reality.[37]

5. Development of Frame work for flexible management

The problem is that there's little room in traditional organizations for passion, ingenuity, and self-direction. The system puts an upper limit on what individuals are allowed to bring to their jobs. To build an organization that unshackles the human spirit, it is needed to reinvent some decidedly unconventional management principles. If the goal is to escape the straitjacket of conventional management thinking, it helps to study the practices of organizations that are decidedly unconventional.

Ideas and conceptualization are becoming the basis of managing technology .Ideas have undeniable consequences not only in the way human beings change the way they behave but also in the way the organizations run. Rothenberg [38] states that in order to enhance and extend the way we lead manage and develop organizations and to develop sustainable competitive advantage, we need to generate progress and harness ideas. Ideas need to be developed and to be deployed rapidly. Hence the efficient development and deployment of pertinent new ideas are now focal points of Technology Management. So the theoretical models that essentially ignore the ideas, or treat them as causal "zeros" or as mysterious, gratuitous will be inappropriate and inadequate in these days**.** [33]

Managing enterprise demands understanding of Quantum environment of present age and developing Quantum Philosophy for the organization which will be followed and nurtured with extreme care and patience.. Quantum management principle starts with understanding of new business environment (Quantum environment) which is characterized by uncertainty, probability and chaos. Understanding and appreciation of Quantum Environment result in developing Quantum Attitude to cope with the situation. Once quantum attitude is developed, changing to Quantum mindset automatically starts. Training is needed at this stage to learn for Quantum skill sets. Quantum strategy is formulated based on Quantum Mindsets and Quantum skill sets and they help building Quantum Strategy and subsequently in Quantum Philosophy for the organization. This is the most prized possession in Quantum age. Following Quantum philosophy, the flexible enterprises achieve success in Quantum way. This is shown in figure.

Quantum philosophy

Quantum management is not classical, conventional or traditional management philosophy.

It is Probabilistic management not Deterministic management.

Cause and effect and linear assumptions have limited applicability here.

It is based on Get it right even at the last time.

Result is only important, not the way how it is achieved.

Quantum strategy

The strategy is to build synergy in diversities.

The strategy is to honor and reward for the courage of asking unconventional questions rather than the brilliance of conventional answers

The strategy is to explore possibilities.

Flexible strategy is to integrate, interact, interplay or innovate appropriate strategy.

Quantum attitude

Living in potential not living in actual

Lateral thinking approach not linear thinking approach

Focus on outcome not on process

Acceptance of ambiguity

Tolerance of conflict

Use results to drive planning

Effectiveness is important, not efficiency

Approach is to find out the clue for differences not to search for uniqueness

Quantum skill set

Focus on continued learning not conventional learning

Focus on inquisitiveness

Develop Willingness to cooperate and create synergy

Inculcate openness

Asking answer for open ended question not close ended question

Quantum mindset

Chaos is the norm

Welcome changes

Focus on intuition not logical thinking

Emphasize on Flexibility not on Fixedness

Focus on differentials not on consensus

Uncertainty is the rule of the game

Work through heart, not by head only

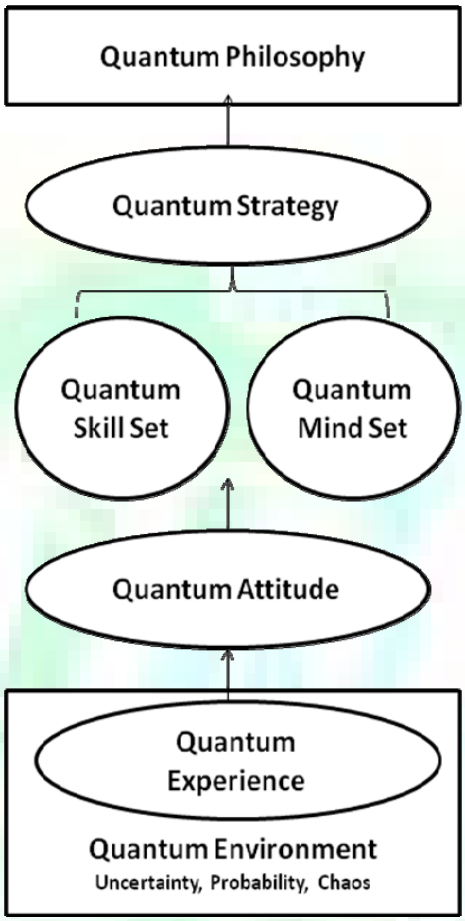


Fig. 1. Framework of Enterprise management in Quantum way [39]

6. Managing strategy in quantum way

The classical way of managing enterprises do not work and it will be proven more futile day by day. Based on Newtonian idea, we are habituated to think that cause and effect bear a linear transformation relationship. Identical causes will result identical events innumerable times. These do not happen in reality especially in sub atomic range or fast changing high technology domain. This necessitates development of an effective approach for managing business based on Quantum thinking and Quantum acting.

Managing also need to change from intelligence or information based to intuition concentric that spreads a shockwave in our classical thinking process. "It is being recognized that some experiments related with the human decision making processes could not be explained by the conventional classical decision theory but the same could be explained by the models based on quantum mechanics. It is now recognized that we need quantum mechanics in psychology as well as in economics and finance." [40].

When there is quantum leap, it requires quantum changes of mindset to adapt to the changed scenario. The power that was adored in Stone Age was muscle power, in agricultural age it was money power. Similarly in the industrial age, the sought-after powers were knowledge and information power. Similarly in this new quantum age, another set of quality and power are required for success. The power required in this quantum age is intuitive power and the qualities required are survival with uncertainty and living in imagination.

In Quantum age 'knowing' is not a paradigm that is sought for. It is the unknowing, curiosity and the willingness to be in search for is the prized traits. It is the willingness to be in a perpetual state of 'discovering'. These are the qualities which will lead the road to success for this century. Quantum managing means to be comfortable with and calm of not having the right answer.. It also teaches to be exposed to 'unknowing' publicly; and to share ideas with others. Quantum Innovation expects high levels of emotional intelligence. Managing enterprises demands Quantum skill sets and Quantum mind sets which include Quantum thinking and Quantum Acting.

Knowing' how to link every opportunity to the bottom line result is a highly prized ability in business. It is the unknowing, the curiosity, the willingness to be in search of that drives for the economy is to be linked to bottom line now.. It is the willingness to be in a perpetual state of 'discovering' which infuses all aspects of the Quantum Leadership leads to the road of successful innovation. Passion convinces to declare ideas, overcome fears and reach for that which has so far remained elusive, innovative, and transformational.

7. Managerial Implications

Management Leadership has been in effect for generations. We have a deep and rich understanding of how to work with it and how to develop our skills in each of its dimensions. The challenge for each of us is to recognize that these Management Leadership dimensions are insufficient for all we have to accomplish. We must also embrace and engage the capacities of Quantum Leadership. That means to expose our 'unknowing' publicly; and to share our growth as people with others. Quantum Leadership demands high levels of emotional intelligence. To grow our emotional intelligence we must overcome our discomfort of exploring the deeply personal arenas which Quantum Leadership requires.

The challenge of Quantum Leadership for organizations is acknowledging that every employee, regardless of where they fall in the hierarchy, needs these skills. It is no longer sufficient to 'train' executives and senior managers. Executives must give themselves permission to take the time for the personal exploration required. They must de-mask to themselves, their employees, their peers, and their boards. The paradox of our 21st experience of organizational life is that it is only as we give ourselves permission to move beyond having all the answers, to be okay with not knowing, that we invite the exploring and discovering that creates the elusive results we're after!

Quantum thinking encourages always challenging oneself, his beliefs, and his working models, to rediscover one's true possibilities. The most important thing is that one should not be guided by any preconditioned mind set. Randomness and unpredictability is woven into the fabric of the universe and nothing to be fearful about. To embrace it requires energy and effort – and great execution.

8. Conclusions

Most organizations around the world have been built on the same handful of time-tested management principles like capital budgeting, strategic planning, and leadership development vary slightly from one company to another. Every organization has more than a bit of dinosaur DNA lurking in its management processes and practices. In the corporate ecosphere, there are rambunctious toddlers and tottering oldsters. But no company can escape the fact that with each passing year, the present is becoming a less reliable guide to the future. There is also a great deal that will need to change. So far, management in the twenty-first century isn't much different from management in the twentieth century.

In a world swarming with new management challenges, it is needed to be even more inventive and less tradition bound than all those management pioneers who came before.

The classical way of handling issues in quantum environment will not yield effective result. To cope up with the fast changing technology and its management, a high degree of knowledge, skill set, attitude and appropriate strategy are needed. This knowledge is not the conventional knowledge; rather it is an exploration of ideas, application of emotional intelligence. Similarly for skill set, it is a whole new way of thinking, believing and acting. It is the high time to ponder, introspect, and make appropriate strategy and start taking action. Still there is time to take lesson, make up and tune to right course of action.

9. Scope of further work

Quantum Leadership means to be comfortable with and calm of not having the right answer; to be exposed to 'unknowing' publicly; and to share ideas with others. Quantum Leadership expects high levels of emotional intelligence. To grow emotional intelligence one must overcome the discomfort of exploring the deeply personal arenas which Quantum Leadership requires [41].

Managing in a quantum way is quantum jump in thinking process which needs time and study. The concept needs to be familiar with and to become acceptable. Lot of studies (especially Delphi study) is recommended among the thought leaders so that a more refinement of Quantum way comes in place.

References:

1. Beneveniste G. : The Twenty-First Century Organization, Jossey-Bass Publishing, San Francisco, CA, 1994
2. Carlson, L.K. : From garden peas to global brains', Healthcare forum Journal-. 1994; 37(3):24-28. (1994)
3. Takeuchi, H., Nonaka, I. (2004) : Hitotsubashi on Knowledge Management, John Wiley & Sons (Asia) Pte Ltd, Singapore
4. Billie G. Blair, : What is Chaos theory and how does it apply to your organisation http://www.changestrategists.com/productgraphics/ What isChaos theory .pdf,
5. Greene, B, : The elegant universe: Superstring, Hidden Dimensions and the quest for ultimate theory, W W Norton, 1999
6. Sushil (2005): A flexible strategy framework for managing continuity and change. Int J Glob Bus Competitiveness 1(1):22–32
7. Sushil (2012a),: Flowing stream strategy: leveraging strategic change with continuity, Springer, New Delhi
8. Sushil (1999), :Flexibility in management, Global Institute of Flexible Systems Management. Vikas Publishing House, New Delhi
9. Sushil (1997) :Flexible systems management – an evolving paradigm. Syst Res Behav Sci 14(4):259–275
10. Peters, T.J. and Waterman, R.H. (1982) : In Search of Excellence: Lessons from America's Best-Run Companies. Harper & Row, New York.
11. Bhagvat Gita, Ch. 3, Verses 27–28
12. Anthony, J. G. Hey and Patrick Walters.: The New Quantum Universe, Cambridge University Press, 2003
13. Shelton, C. K & Darling ,J. R., : The Quantum skill models in management : a new paradigm to enhance effective leadership' ,Leadership and Organizational Development Journal, 22(6),264-273, 2001.
14. Robert Eisberg & Robert Resnick, :Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Willey & Sons, 1985
15. Szabo, Attila; Ostlund, Neil S., : Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory. Dover, 1996.
16. Pullman, Bernard; Pullman, Alberte. :. Quantum Biochemistry. New York and London: Academic Press. 1963
17. Jim Al-Khalili, & Johnjoe McFadden, **:** Life on the Edge: The Coming of Age of Quantum Biology, Bantam Press, 2014
18. Sergienko, A. V, : Quantum metrology with entangled photons", Proceedings of the International School of Physics "Enrico Fermi" Course CXLVI, T. J. Quinn, S. Leschiutta and P. Tavella (Eds.), IOS Press, Amsterdam 2001
19. Feynman, R. P. : Simulating physics with computers. International Journal of Theoretical Physics 21 (6), 1982, 467–488.

20. Kohki Mukai et al : Quantum-dot Lasers Fabricated with Self-assembled Microcrystals", FUJITSU Sci. Tech. J., 34,2, .1998, pp.223-234
21. Bennett, C.H. and G. Brassard, : Quantum cryptography: Public key distribution and coin tossing In Proceedings of IEEE
International Conference on Computers, Systems and Signal Processing, volume 175, page 8, New York, 1984.
22. Porter-O"Grady, T.: Quantum Leadership: A resource for health care innovation. Jones and Bartlet Publishers, London, 2007
23. Razavi M. H, : Study and comparison the rate of applying quantum skills in sports organizations in Iran, International
Research Journal of Applied and Basic Sciences, Vol., 4 (7), 1828-1832, 2013
24. Curtis, G : Modern portfolio theory and Quantum Mechanics, The journal of wealth Management, . 2002 Winter pp 1-7
25. Chalmers, D. :The conscious mind. Oxford University Press, Oxford, 1996
26. Lockwood, M.. : Mind, Brain and the quantum. Basil Blackwell, Oxford. 1989
27. Penrose, R. : The emperor's new mind. Oxford University Press, Oxford, 1989
28. Penrose, R., A. Shimony, N. Cartwright, S. Hawking. :The Large, the Small and the Human Mind. Cambridge University Press, .2000
29. Pessa, E., G. Vitiello, :Quantum noise, entanglement and chaos in the quantum field theory of mind-brain states;. Mind
and Matter 1(1), 2003, 59–79.
30. Satinover, J. :The quantum brain. Wiley, New York. . 2001
31. Shelton, C. : Quantum Leaps, Butterworth-Heinemann, Boston, MA, 1999.
32. Shelton, Charlotte D, Darling, John R, : Using new science concepts to create learning organizations, The Learning Organization ,Volume 10, Number 6 · 2003 · 353-360
33. Neuro leadership Summit,(2007), : Quantum Mechanics and 21st Century Business Management Asolo, Italy, May 14-16
34. Dyer, W. W. : Your Sacred Self. New York: Harper-Collins. IHM Research Update ,Boulder Creek, CA: Institute of Heart
Math, 1(1). (1995).
35. Yukalov, V. I., and D. Sornette.. : Processing information in quantum decision theory. Entropy 11(4) , 2009, 1073-1120.
36. https://en.wikipedia.org/wiki/Google
37. https://en.wikipedia.org/wiki/Grameen_Bank
38. Rothberg, G.,: Accessing ideas to develop leadership and organization, Leadership & Organisation Development Journal, 26(6), 476 -491, 2004
39. Kundu, N et al ,: Managing Innovation in Quantum Age:, Proceedings of national conference on Governance of traditional
knowledge and contemporary innovations, March13-14,2015
40. Paras M. Agrawal and Ramesh Sharda : Quantum Mechanics and human Decision Making , William S. Spears School of
Business, Oklahoma State University, Institute for Research in Information Systems, Stillwater, Oklahoma 74078, USA, 2012
41. Gwen McCauley : Leadership in a Quantum Age www.WEL-Systems.com. .

A case study on sustainability for SMEs (IT industry) in North Eastern Region with respect to their core competency

Bhargav Deori[1] and Rinalini Pathak Kakati[2]

[1] Research Scholar, Department Of Business Administration, Gauhati University

[2]Professor, Department Of Business Administration, Gauhati University

Abstract: In today's competitive market it's very important for a firm to identify its core strengths and align them with its competitive strategy. This study undertakes case study regarding sustainable competitive advantages of 17 SMEs of Assam (North Eastern India). It explores into use of unique resources and capabilities of a SME's internal environment and linking to strategic competitiveness. It has been found that most of these SMEs are relying on network effect and personal contacts along with Government tie-ups for redefining customer value to avail competitive advantage in the market. Further service quality, flexibility in structure, cost competiveness by performing multitasking and locations are found to play important role in influencing competitive advantage whereas technical and financial resources have ranked to be critical.

Key words: SMEs (small and medium enterprise), sustainability, core competency, flexibility

Back ground of the Study

Firm's competitiveness is the ability and performance of a firm to sell and supply goods and services in a given market capturing the awareness of both the limitations and challenges posed by firm's competition for the scarce resources. A firm is said to be competitive when it delivers products or services at a lower cost or higher quality than that of its competitors, or when it has unique characteristics that cannot easily be replicated elsewhere. Firm's competitiveness inspires firms to excel and exceed expectations. If a company is competing with another company, they will produce more quality products at unbeatable prices. How a firm is organized and how it uses its resources and capabilities to create unique, better or lower cost products or services determines its ability to develop a competitive advantage, become an industry leader and create excellent value for its customers and higher profits for itself.

If SME want to achieve a sustainable competitive advantage, then that advantage must result from the applying several strategies, with the focus on internal capabilities (knowledge, skills), business processes and innovations. Innovations based on products enable achieving competitive advantage, and innovations based on services can provide a sustainable competitive advantage.

Literature review

A company has competitive advantage whenever it has an edge over its rival in securing customer and defending against competitive forces (Thompson and Strickland, 2002). Barne (2001) suggests that a firm is said to have a competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors. He added that for competitive advantage to have meaning, customers must perceive a difference between one firm's products or and those of competitors resulting from a capability gap between the firm and its competitors and theses afore mentioned difference in attributes and capability gap are expected to endure overtime.

Business competitiveness of companies can be tested from the side of the factors affecting competitiveness on the one hand, and, from the side of results (ex post approach), on the other hand. The results are clearly linked to the company's performance but the affecting factors can come from the company's macro environment (national economy or level of integration), external (outside the company) or internal (within the company) micro environments.

(Webb and Schlemmer and Levy and Powell, 2003)suggest achieving competitiveness through strategic management.(Flodstrom, 2006) explains the role of strategic management through activities of identifying the competitive environment, identifying and developing competitive strategies, identifying competitive factors, managing changes and strategic alignment.

According to Kotler-Keller (2006) the elements of macro environment are:

- Demographic environment
- Economic environment
- Social and cultural environment
- Ecological environment
- Technological environment
- Political and legal environment

For the internal parameters (Andrea Rangone, 1999) suggested Resource Based Study (RBS) approach can be adopted to judge a SME's sustainable competitive advantage.

Empirical research based on 14 case studies of SMEs (Andrea Rangone, 1999) in different industries has produced a model of an SME's sustainable competitive advantage based on three basic capabilities:

• Innovation capability: that is a company' ability to develop new products and processes, and achieve superior technological and/or management performance (e.g., development cost, time-to-market, etc.);

• Production capability: that is the ability to produce and deliver products to customers, while ensuring competitive priorities, such as quality, flexibility, lead time, cost, dependability, etc.;

• Market management capability: that is a company's ability to market and sell its products effectively and efficiently.

The supporters of formality have argued that SMEs need to improve their organizational capabilities by formalizing their structures and systems in order to become more efficient (Bessant and Tidd, 2007; Prakash and Gupta, 2008).While the supporters of informality, however, argue that SMEs do not need to formalize their structures and systems due to the limited range of products that they develop for niche markets. They base this argument on the premise that flexible structures are a significant source of SMEs' competitive advantage over large firms (Fiengenbaum and Karnani, 1991; Appiah-Adu and Singh, 1998; Narayanan, 2001; Qian and Li, 2003). This contradiction gives rise to a theoretical tension between formality and informality for SMEs. This tension needs to be explained by identifying the elements of formal and informal structures that have an effect on SMEs' competitiveness and why these are important

Reviewing the literature it has been found that one of the basic differences in the organizational structure between a corporate firm and a SME is the degree of formality in structure, administrative hierarchy, decision making procedures and standard operating process. While one is governed by a predefined set of rules and regulation which help the corporate firm achieve a desired level of quality assurance and timely completion of project the flexibility component associated with the SMEs help them in tailoring of resources as per the requirement of the market and align their core competencies to the market needs.

Based on these background the study wants to explore to examine level of flexibility, sustainability and core competency in a few selected IT based startup firms operating in Guwahati. A case study approach involving interview, discussion and observations techniques have been used in the study.

Brief about the IT industry in India (Source : Indian Brand Equity Foundation , www.ibef.org)

India's IT industry contributed around 7.7 per cent to the country's GDP. It employs nearly 3.97 million people in India of which 175,000 were added in FY17. The industry added around 1, 05,000 jobs in FY18 and is expected to add over 100,000 jobs in FY19. The IT industry is ranked 3rd in India's total FDI share and accounts for approximately 37 per cent of total Private Equity and Venture investments in the country. The computer software and hardware sector in India attracted cumulative Foreign Direct Investment (FDI) inflows worth US$ 29.825 billion between April 2000 and December 2017, according to data released by the Department of Industrial Policy and Promotion (DIPP).

Brief about the IT industry in Assam (Source :Strategic paper for development of IT industry in Assam: Amtron)

In comparison to the rest of India, IT industry in Assam is nascent. Proliferation of IT related activities centred on research & development activities and PSU industries in the state. However, it was towards the late nineties, when Internet was introduced in the State in few selected towns and cities, that IT industry got a much needed impetus. Government however was the main user of IT Technology and tools and the IT industry in the State remained dependent on the inputs in terms of services and support from rest of India.

Methodology

Case sample selection criteria:

We have taken the firms operating in IT industry for our case study as most of the startup operating in Assam is providing IT enabled services as their major offerings. In our initial study we have tried to collected data from 23 firms out of which 17 have responded.

To have a homogeneous sample for comparable performance evaluation we have created certain predefine criteria for our study

- The firm has to be operational for the last three financial years
- The average annual turnover of the firm has to be more then ₹10,00,000.00
- Total number of employees (Including the founders) should be more than 10 numbers

After filtering the firms on the basis of the above criteria we are left with 5 firms. A detailed interview was conducted with the founders and senior management of these firms where they were questioned on the different parameters

Analytical Matrix

According to Hitt (1997) a sustainable competitive advantage is achieved when firms implement a value creating-strategy that is grounded in their own unique resources, capabilities, and core competencies. This is based on the resource based model which suggests that the unique resources and capabilities of a firm's internal environment are the critical link to strategic competitiveness. Firms achieve strategic competitiveness and earn above-average returns when unique competencies are leveraged effectively to take advantage of the opportunity of the external environment.

In our questionnaire we tried to evaluate the competitiveness of the firm on the basis of the following parameter

Cost competitiveness:

India being a price sensitive market, cost competitive plays a vital role in acquiring new client as well as harnessing the earlier ones. In the cost reduction strategy, firms typically attempt to gain competitive advantage

by being the lowest cost producer (Schuler and Jackson, 1987) whereas Porter (1985) argues that cost advantage will result in above average performance only if the firm can sustain it.

Research and Development Capabilities and Intellectual property rights

A firm can gain a strong competitive advantage in its industry if it has strong research and development capabilities. Strong research and development reflects in the company products development processes. Firms with strong research capabilities often lead the market with innovation (McGee, 2002) as can be seen in the technology driven market segments such as the IT and IT enabled services

Another source of competitive advantage a business can exploit is the holding of an intellectual right which can exist in form of trademarks, trade names, copyright, patents, company reputation and brand. Holding exclusive re-selling or distribution rights is a great source of competitive advantage. When a company holds exclusive rights to a product within a given territory, that product can only be sourced from the distributor or holder of such rights (Ajaero, 2010) article on sources of sustainable competitive advantage.

Product / Service uniqueness and exclusivity

Some businesses have gained competitive advantage because the entry in their industry has been limited by surrounding circumstances, this may be due to government regulations or it be achieved by having important attributes of the firm as rareness, value, inability to be imitated, and inability to be substituted (Barney, 1991).

Marketing capabilities and networking effects

For firms today, the strength and marketing power of an Institution's brand is rapidly becoming one of the critical levers for differentiation and success. Chandler & Hank suggest that a firm should use capabilities based on the resources like brand names and reputation in order to gain and keep competitive advantages (Chandler & Hanks, 1994).These give a business a competitive edge.

Network effects or network externality refers to how easy is it for new customers to adapt to your product or service. When a lot of people use a particular product or service, the product or service becomes more valuable and thus increase in value thus creating competitive advantage.

High Switching cost

High Switching costs are the penalties a customer pays when they change from an existing product, supplier or brand to another. These penalties or negative utility are often monetary, but can also come in the form of time, effort, or social pressure. This dynamic is especially useful in competitive markets where there is little differentiation amongst options and creating incentives for customers to stay with you is essential for survival. According to (Rishi, 2010) a firm can create switching costs through transaction costs where the incumbents levy penalties for switching such as bank account closure fees. Another way is quality uncertainty where the familiarity with the existing product creates fear, uncertainty, or doubt in the quality of the new brand. Switching cost creates an advantage to the business so that one can retain customers because it would cost them some time or money to switch to another product or service

Redefining customer value

Redefining customer value is going beyond planning, to delivering good customer satisfaction levels across all the customer segments. It involves assessing customers' perceived values and their relative importance and determining how best a firm should position itself to deliver services that match customers' perceived value in order to gain a competitive edge(MCgee,2002).To redefine customer value, a firm needs to profile customers, identify value elements, spot high value customers and also develop delivery strategies.

Firms that continuously realign their business strategies in line with the emerging customer needs may not only retain their existing customers, but also gain unique competitive advantages in the industry.

Questionnaire design

The questionnaire is segmented into four sections. In the first section general information regarding the firm, founder's profile, and employees detail are asked. It consists of 6 sets of questions where the individual has to fill the details in a subjected as well as objective manner.

In the second section of the questionnaire we try to evaluate the competitive advantage of the firm on the basis of the above set parameters. A seven point ranking scale is used to guide the responded in selecting and quantifying the particular parameter contributes towards their firm competitive advantage.

In the third section of the questionnaire in order to evaluate fish bien model two sets of questionnaire were designed compromising of industry competiveness in relation to importance of that parameter to the firm

In the fourth section the performance evaluation of the firm is determined on the basis of their financial as well as strategic goal achievement. Moreover feedbacks regarding their project execution were asked from the related clients and investors. They were also asked to describe in a subjective manner how being a more flexible and agile organization they were able to cater to the changing market needs.

Analysis :

Section1: General Information

Company profiles:

The firms taken in our case study can be categorized as IT and ITES based startups which have started operation from 2014-15 onwards.

Founder profiles:

It is found that the average age of the founding member / director is around 27 years. The age variation can be seen among the firms as lowest age of one of the founder happens to be 21 who have started his venture right after graduating as an engineer to the oldest one at 45 who happens to be a serial entrepreneur. Baring one firm the rest has industry exposure of 2 years or above. In almost all the cases, at least one of the founding members is an engineering graduate and claim to be specialist in his domain area.

Employee profiles:

The number of permanent employees including the director and founders are confined to less than 10 numbers in almost all the firms, the other employees are hired on a need basis depending on the availability of the projects and client requirement. As can be seen in other startups the core team has to do multitasking which included product development, marketing and sales, key client account handling and also to take care of company finances.

Services and offerings: Although most of the firms claims to have a lot of products and service offering including IOT, Big data mining, Industry automation and ERP packages, their current client profile shows that web hosting and data base management is a major chunk of the revenue. We have also observed that a majority of the firms are working on developing an ERP based product targeting the educational institutes and the health care sector. This can be contributed to the fact that Guwahati being the local market for them the availability of a large number of educational institution and private hospital shows a good market potential in this product category. Some of the other innovative service offerings observed was automated voice telephonic calling for election champagne, mobile app development for local news agencies, digital marketing, training and workshop on network security and ethical hacking.

Cliental:

A common trend which can be observed in most of the firms studies was at least one of the major client is a Government department or institute. The ticket size varies between a few thousands (for a website hosting project)

to more than twenty lakhs (for a speech based development project). Baring one or two firm the market territory is confined to the geographical location of Assam and in most of the cases to the city of Guwahati.

Section2: Competitive Advantage:

When they are asked to rank the factors which they felt gave their firm a competitive advantage in the market the response was as follows

A 7-Point Scale was used, where 1= Not at all and 7= Very great extent

Table 1: Competitive advantage of five SMEs

Competitive Advantage	1	2	3	4	5	6	7
Cost competitiveness			2	3			
Uniqueness in Product / Service			1	4			
Having strong R & D Capabilities		4	1				
Holding IP right / exclusive selling rights		2	3				
Network effects and personal contacts				1	1	3	
Government tie-ups and Liasoning				2	3		
Brand value and marketing capabilities	1	4					
High Switching costs			2	3			
Redefining customer value				3	2		

From the table above following it can be seen as network effect and personal contacts along with Government tie-ups and redefining customer value are the only factors which the firms believe have given them a competitive advantage in the market. This can be attributed to the existing market conditions of the IT industry catering to North East India, and Guwahati in particular.

As compared to the product / service customization to the needs of the specific client is a relevant practice that is followed by all the firms it does not give any competitive edge over the others. However certain uniqueness due to which switching to other product or services puts an additional penalty cost to the client helps in retrieving the existing customer base. The costing of the project is done on the basis of the resource allocation and as such although there is a difference in pricing mechanism of the firms the cost to the custom falls in the same bracket.

The IP rights obtained by the firms are very few and ones which were obtained are not commercialized yet. The R&D capabilities of the firms are also limited to initial stages of product development

After sales service and having a local service point near the client location are the two major factors which helps the firm to redefine the customer value. Although the IT product and services can be provided by the MNCs and the firms located in Bangalore or Kolkata it is the high cost of providing after sales services which make the market non lucrative for those firms, whereas after having a sizeable number of projects in the same location the local firms can allocate the same resource to cater to various clients. If we look at the client

base of these firms one of the common attribute that has been observed is almost all the firms have at least one big ticket size Government order which contributes to more than 30% of the total sales volume. In the absence of big private clients the Government department and institutes provides a low profit but stable customer base for these firms.

Section 3

Table 2: Industry and Firm specific competitive advantage factors

Sum product of industry score (1 to 7 scale) and company score (1 to 3 score)

Factors influencing competitive advantage	Total score company 1	Total score company 2	Total score company 3	Total score company 4	Total score company 5
Being the low cost provider	10	18	15	15	12
Service Quality offered	18	10	21	12	18
Location	15	10	10	10	18
An embedded customer base	8	10	10	10	10
Support structure Financial	8	12	18	10	10
Support structures Technical	8	10	8	8	10
Total	67	70	82	65	78

*The score have been obtained by fish bein model as per the questionnaire (Annexure I, section 3)

From the responses of the firms it is observed that service quality, cost competiveness and location plays an important role in influencing the firm's competitive advantage. In terms of technical and financial resources although the firms acknowledge their importance in respect to the industry norms but in terms of their own firm's scoring matrix they have ranked it as a mediocre indicator. This is in contrary to the existing literature (Andrea Rangone, 1999) resource based study which evaluates the competitive advantage of the firm on the basis of its internal resources.

Section4: Performance evaluation of the firms

Client feedback

When we approached some of the existing clients of these firms and asked them to rank the performance of their IT vendor it was found that baring the government and a few institutional client work orders no service level agreement was signed with the small private parties. In absence of a formal contract of deliverables the service quality rating cannot be documented but in most cases the firms were able to resolve any troubleshooting within 2 to 5 days from the date of ticket raised for it. The customer satisfaction can also be gauzed from the fact that more than half of the private customers are repeat orders and of the new customers more than 20% are through referrals.

Financial Performance

Most of these firms are based out of individual space or small office setup as they have not invested much in infrastructure based over heads. The major cost that can be seen in the balance sheet is salary and allowances, client acquisition cost. As the founding members have taken a salary cut in the initial years the overall Profit and Loss accounts shows a positive figure. The financial performance can also be seen in the compounded annual growth rate of the sales turnover which have been seen a positive growth trajectory. In case of one of the firms the growth rate has been observed to be more than 200% in the last 3 consecutive years.

Strategic goal achievement:

In this section we see a variation of response among the firms. Where two of the firms are focusing on their product development and the present operations are only to meet the company expense the rest of the three firms are focusing on market expansion with their present offerings and their product development is limited to a few customization changes with additional features. The common goal that can be seen in all the firms is employee retention as the trained resources are considered to be the most valuable assets for an IT based startup.

Conclusion:

From the case analysis, we can see that the existing IT based SMEs operating in Assam has used the local in house service centre location and after sales service as the major aspects of redefining the customer value perception. In context of our case study, it is also observed that although the startups lack the financial resources, technical knowhow and a brand image as compared to their corporate counter parts, they are still able to sustain in the local market due to certain competitive advantages such as flexibility in structure, and cost reduction strategy. As skilled manpower is the major cost component in case of IT service sector, most of the new firms are able to cut down the cost by performing multitasking by the core team. The overhead cost component associated with office space and other logistic is also curtailed which give them a best-cost strategy to adopt a business model that has very low fixed costs and overhead relative to the costs that big corporates competitors are bearing.

References

Andrea Rangone, 1999 A Resource-Based Approach to Strategy Analysis in Small-Medium Sized Enterprises, Small Business Economics

Appiah-Adu K, Singh S. 1998. Customer orientation and performance: a study of SMEs.

Management Decision 36(6):

Barney J, 1991Firm resources and sustained competitive advantage. Journal of Management

Bessant J, Tidd J. 2007. Innovation and Entrepreneurship Wiley: Chichester, UK.

Chandler, G.N., and Hanks, S.H. 1994. Market attractiveness, resource-based capabilities, venture strategies, and venture performance. Journal of Business Venturing

Fiengenbaum A, Karnani A. 1991. Output flexibility: a competitive advantage for small firms. Strategic Management Journal 12(2):

Flodström R, 2006.: Framework for the Strategic Management of Information Technology, Thesis No. 1272, Linköping Studies in Science and Technology,

Hitt, M., Ireland, D. and Hoskisson (1997). Strategic management: Competitiveness and globalization. West Publishing Company.

Levy, M. and Powell, P. (2003) 'Exploring SME Internet Adoption: Towards a Contingent Model, Electronic Markets

McGEE, Jeffrey & Love, Leonard & Rubach, Michael(1992). Sources of competitive advantage for small independent retailers: lessons from the neighbourhood drugstore

Narayanan VK. 2001. Managing Technology and Innovation for Competitive Advantage.

Prentice-Hall: Upper Saddle River, NJ.

Porter ME. 1985. Competitive Advantage: Creating and Sustaining Superior Performance.

Prakash Y, Gupta M. 2008. Exploring the relationship between organisation structure and perceived innovation in the manufacturing sector of India. Singapore Management Review 30(1):

Qian G, Li L. 2003. Profitability of small- and medium sized enterprises in high-tech industries: the case of the biotechnology industry. Strategic Management Journal 24(9):

Rishi Dean (2010). Journal of Sources of Durable Competitive Advantage 25th July 2010.

Schuler and Jackson, 1987: Linking Competitive Strategies with Human Resource Management Practices

Thompson and Strickland, 2002. Strategic management: concepts and cases

Kotler-Keller (2006) Marketing Management 14E

Webb B.; Schlemmer F, 2008.: Information Technology and Competittive Advantage in Small Firms

Annexure:

SECTION 1: GENERAL INFORMATION

36. What is your position in the firm ……
37. How long have you been with the firm……
38. Age of firm?

3.4 Less than 1 year
3.5 1-3 years
3.6 4-5 years
3.7 More than five years

39. Number of employees in the FIRM

3.8 Permanent……..
3.9 Casual / contractual……..
3.10 Volunteers……

40. In which of the following category does your firm operate

3.11 System integrator
3.12 Web developer
3.13 ERP service provider
3.14 Others, kindly specify ……..

41. Educational qualification of the founding member

viii. B.E / B.Tech
ix. M.Tech
x. MBA
xi. Doctorate
xii. Others (Non-Technical Graduate)

Section 2

To what extent does your firm have each of the following competitive advantages?

Use a 7-Point Scale, where 1= Not at all and 7= Very great extent (Tick in the appropriate column)

Table 1:

Competitive Advantage	1	2	3	4	5	6	7
Cost competitiveness							
Uniqueness in Product / Service							
Having strong R & D capabilities							

Holding IP right / exclusive selling rights							
Network effects and personal contacts							
Government tie-ups and liasoning							
Brand value and marketing capabilities							
High Switching costs							
Redefining customer value							
Total							

Section 3:

To what extent is the industries competitive advantage influenced by each of the following factors?
Use a 7-Point Scale, where 1= Not at all, and 7= Very great extent (Tick in the appropriate column) and a 3 point scale to mark Firm's point of view

Table 2:

	From industry point of view							From firm's point of view			
Factors influencing competitive advantage	1	2	3	4	5	6	7	Not important (1)	Somewhat important (2)	Most Important (3)	**Total score**
Being the low cost provider											
Service Quality Offered											
Location											
An embedded customer base											
Support											

Structure Financial											
Support structures Technical											
Total											

Section 4:

Firm's performance measurement

1. How flexibility has helped to convert market opportunity

……

2. Customer response/ feedback for the firm

……

3. External Investor response / feedback for the firm

……

4. Performance measure for the firm

1 Strategic goal achievement
2 Financial performance

A Study on Corporate Social Responsibility with reference to the Corporations associated with Social Media

Lucky Mishra and Varimna Singh

SomLalit Institute of Business management
SLIMS Campus, St. Xavier's Corner, University Road
Navrangpura, Ahmedabad- 380009

{luckyeco@gmail.com ,Varimna.s@gmail.com}

Abstract: Corporate Social Responsibility is a stream of study which has gone through many a transition phases. Business managers and many a stakeholders have recognized the evolution of CSR, which is indispensable for the growth of the corporate and for the development of the countries.This paper is a work to find out that up to what extent the social problem which is being created, can it be solved by the CSR activities of the corporations associated with social media. The question which is going to be analyzed in this paper is that- 'who will take the responsibility of all these deeds which are being spread through social media and having a negative impact on the society as a whole, for example- lynching, dangerous games for kids etc.

1 Introduction

With the passage of time and the experiences of many a transition phases economies grow and develop. There are many a strategies which are adopted for a smooth and sustainable development of the countries and there are many a challenges as well which an economy faces while being on the path of development. Corporate Social Responsibility is a stream of study which has gone through many a transition phases. Business managers and many a stakeholders have recognized the evolution of CSR, which is indispensable for the growth of the corporate and for the development of the countries.

In the early ages CSR was associated with the religious and cultural practices and then was connected with the ethical and philanthropic practices. Legal responsibility of the corporate towards the society (Companies Act- 2013- Section 135, Schedule VIII), has become the economic responsibility of the corporate towards the society.

India has the world's richest tradition of Corporate Social Responsibility (CSR). The term CSR may be relatively new to India, but the concept dates back to Mauryan history, where philosophers like Kautilya emphasized on ethical practices and principles while conducting business. CSR has been informally practiced in old times in form of charity to the poor and deprived. Indian scriptures have at several places mentioned the importance of sharing one's earning with the deprived section of society.

Religion also played a major role in promoting the concept of CSR. Islam had a law called Zakaat, which rules that a portion of one's earning must be shared with the poor in form of donations. Merchants belonging to Hindu religion gave alms, got temples and night shelters made for the poorer class. Hindus followed Dharmada where the manufacturer or seller charged a specific amount from the purchaser, which was used for charity. The amount was known as charity amount or Dharmada. In the same fashion, Sikhs followed Daashaant.

The corporations are doing the CSR activities with the objectives and keeping in mind: People, Planet, Profit (PPP) benefits and upliftment strategies. Corporations are getting a positive recognition also in the society because of their deeds. The country like India where there is too much inequality in distribution of income can be improved up to some extent through these efforts of CSR activities towards the society.

Development comes with many a changes and challenges. Sometimes the economy and the society cope up with these challenges and sometimes become very difficult especially in the case of many a fold disparities. There are many a physical gaps in the economy which are being filled by the CSR activities, but there are some problems which are getting enlarged due tofast expansion of information, news and stories. There is a right to information according to

the Indian constitution. As there is inequality and physical disparity in the country likewise due to lack of education and rationality the mob or the population can also be divided or segregated in to clusters. Some anti- social organizations or people research and target the group of the people whose minds can be diverted for doing the destruction for the societies. Which results in to the loss of freedom, unity and many a times lives of the people. This is the question that who will take the responsibility of these all miss-utilization of social media. Indian Media has started taking the initiative to search on the authenticity of the viral videos, but this is done after the information is spread. In the recent news Government has instructed the social sites not to spread the news which can have a negative impact or any sort of political influence, 48 hours before the voting.(*FB, Twitter to help Election Commission check fake news; internet major Google and social media giants Twitter and Facebook have assured the Election Commission that they will not allow their platform to be used for anything which effects the purity of polls during campaign period….sourc: The Times of India, Monday, October 1,2018*) But this is not enough to solve the problem. The social media sites platform is being used to target the soft minds and to scatter the spirit of the societies.

The present paper is the study to find out a meaningful solution for the problem that who should take the responsibility of the fake news, information and stories etc, which are killing the childhood of the children, diverting the minds of the youth to get the freedom from their own nation and declaring the female who is already in a pitiable conditions- a *witch*.

This has been tried to connect the problem with CSR, because CSR activities are having a positive results to find out the solutions. The corporations which are connected to social media sites are doing many social activities, but there must be some meaningful solution from these corporation's efforts so that a negative impact on the society could be minimized. The user himself is also responsible but there is a lack of rationality due to lack of education in the country.

The information has been collected through the secondary as well as the primary sources. A questionnaire has been developed to collect the information. There are 120 respondents between the age group of 21- 24 years and all are educated and rational. For collecting the secondary data news papers, magazines and authentic web sites have been referred. Many a statistical tools have been applied to find the objectives of the study.

2 Objectives of the study

- Evolution and different models of CSR.
- Influence of CSR over consumer's buying decisions.
- Negative impact of social media on the society through analyzing some milestone cases.
- CSR activities of corporations associated with social media.

3 Review of literature

Hamidu, Haronand Amran*(2016),* reviewed the three stages of CSR transformation from philanthropy, regulated/beyondPhilanthropy, and instrumental/Strategic stage. The first stage is voluntarism or fully altruistic in nature and the second stage is shaped by a form of CSR that is regulated while the final stage is the utilization of CSR to achieve organizational objectives. The last part of this paper touched on models explaining the priory placement between different CSR dimensions. Three models were reviewed and the universal model was the most preferred because of highlighting the factors to be considered before prioritization of responsibility and hence the reduction of vagueness or ambiguities present in both the Carroll's and Visser's models.

AgrawalGautam (2013) this research work addresses the lack of theoretical framework for examining the factors influencing consumer purchases behavior with regards to socially desirable products. The objective of this study is to assess the influence of CSR product features on consumers' behavior. This work tries to find out the marginal willingness to pay for social attributes. In this experimental study, based on Auger et al. (2006), creation of different kinds of products with different levels of functional attributes and social attributes will force consumers to make tradeoffs, allowing measurement of the trade-offs they make.

NevineEshra andNohaBeshir (2017) in their study they have enhanced the literature about the theory of consumer perception of CSR and its impact on consumer buying behavior.Thisis the study of the impact of CSR on consumer's buying behavior in Egypt. The results showed that Egyptian consumers are adequately aware of CSR concept, but, at

the same time, all CSR elements have insignificant relation to consumer behavior. This means that the Egyptian consumers do not think about any of CSR elements when they take their buying decision.

Shwu-Ing Wu &Hsin-Feng Lin (2014) explores the impact of the consumer's perception of a company's CSR on brand trust, brand satisfaction, brand attachment, and current and future buying behavior as well as probe into the differences between different generational groups. Consumers belonging to different generation groups exhibit slightly different correlation patterns as far as the perception of CSR is concerned.

India CSR Outlook Report 2018, published by NGOBOX, is an annual research publication on CSR, which publishes the previous year data on CSR, spent by the big companies. The report shows and analyzes the data of CSR expenditure which the 359 big companies have disclosed on mandatory basis.

4 Evolution of Corporate Social Responsibility

In the world during 1950-60 the focus was there on the businesses doing the good for the societies. That was the era of revolutionary changes and people, events and ideas were the drivers of these changes. During 1970's the thinker like Calrrol ensured the changes in the thoughts and emphasized that the businesses are having the responsibilities towards the societies including economic, legal, ethical and discretionary. During 1980's, according to Donaldson and Dunfee, there should be a formal contract between the firms and the societies, and it ought to be characterized by the responsibilities towards the stakeholders. During 1990's, according to the stakeholder's theory of Freeman, CSR became the strategic issue. It was correlated with the current CSR explanation which sees it as a concept where companies integrate social and environmental importance with their business operations and interaction with their stakeholders.

If we explore the evolution of CSR with Indian perspective, it can be segregated within the time period like before independence (before 1947), post-independence and the era of post liberalization, globalization and privatization. Before 1947, most of the cases it was associated with the strong religious sentiments. The concept manifested itself through charity that was carried out by businessmen and philanthropists.Post 1947, the PSU's were the most important elements which were fulfilling the development agenda. Though it was the phase of unbalanced growth strategy through which private investment was being attracted while investing by the public sector in key investment areas. The period of post 1991, in which through globalization, competition and challenges for the local players also enhanced, and therefore the world class standards of CSR motivated the local players to become more responsive towards the stakeholders and enhance their brand value. Post 20th century India became the first country to mandate CSR and it happened in the line of giving the importance towards the corporate governance and sharing the global information system (source; www.finavation.co.in). The companies Act 2013 have become the landmark in Indian legislation that has made India the first country to mandate and quantify CSR expenditure.

Table: 1

STATEs/UT- WISE CSR PROJECTS UNDERTAKEN DURING FY 2015-16		
S.No.	**States**	**CSR Expenditure (in Cr.)**
1	Maharashtra	1138
2	Karnataka	408
3	Andhra Pradesh	379
4	Gujarat	338
5	Uttar Pradesh	322
6	Rajasthan	285
7	Tamil Nadu	261
8	Delhi	237
9	Odisha	231

10	Madhya Pradesh	215
11	West Bengal	170
12	Haryana	169
13	Chattisgarh	168
14	Jharkhand	128
15	Telangana	105
16	Kerala	84
17	Bihar	78
18	Assam	52
19	Uttarakhand	50
20	Punjab	42
21	Jammu & Kashmir	37
22	Arunachal Pradesh	20
23	Himachal Pradesh	10
24	Dadra & Nagar Haveli	8
25	Goa	6
26	Meghalaya	3
27	Manipur	2
28	Pondicherry	2
29	Daman & Diu	1
30	Chandigarh	1
31	Tripura	0
32	Lakshadweep	0
33	Nagaland	0
34	Sikkim	0
35	Andaman & Nicobar	0
36	All India*	4871
	Total Amount	**9822**
	Number of Companies for which data compiled	**5097**

Source: Ministry of Corporate Affairs, Government of India

The above table shows the expenditure on CSR activities in the year 2015-16 in different states and Union Territories. Total Rs9822crore have spent on CSR activities in India, which is a significant amount and having a significant impact on the development of the economy.

Table: 2

Development Sector Wise CSR expenditure for 2015-16

Sectors	2015-16 CSR exp.(In crores)
Health/ Eradicating Hunger/ Poverty and malnutrition/Sage drinking water / Sanitation	3117
Education/ Differently Abled/ Livelihood	3073
Rural development	1051
Environment/ Animal Welfare/ Conservation of resources	923
Swachh Bharat Kosh	355
Any other Fund	262
Gender equality / Women empowerment / old age homes / reducing inequalities	213
Prime Minister's National Relief Fund	136
Encouraging Sports	95
Heritage Art and Culturee	90
Slum area development	9
Clean Ganga Fund	3
Other Sectors (Technology Incubator and benefits to armed forces and admin overheads and others*)	497
Total Amount	**9822**
Number of Companies for which data compiled	**5097**

*** not specified**

Source: Ministry of Corporate Affairs, Government of India

Table: 3

Development Sector wise CSR Spend by 359 big Companies

Theme/ Sectors	2015-16	2016-17	2017-18
Poverty Alleviation, wash and Healthcare	2142	2131	2385
Education and skill development	2073	2973	3121
Environmental sustainability	559	795	961
Rural development	771	1091	1004
Sports and Rural Sports	159	181	140
PM Relief Funds and Similar Funds	162	132	35
National Heritage Arts and Culture	83	190	274
Women Empowerment	167	146	158

Source: India CSR Outlook Report 2018, published by NGOBOX

The above two tables show the different areas of development where through CSR activities the path of development is being secured. Table: 1 showing the expenditure made by 5097 companies in different areas in the year 2015-16. Table: 2 is showing the year wise expenditure in INR Cr in different themes by the 359 big companies which are sharing ¾ of the total CSR spend. Trend shows that in many themes CSR expenditure is increasing except 2-3 themes.

Table: 4

Prescribed and actual CSR spent by 359 big companies in the year 2017-18 in INR Cr.

Prescribed CSR budget	9543.51
Actual CSR spend	8875.93
Actual CSR to prescribed CSR	93%
Change from the previous financial year	+2%

Source: India CSR Outlook Report 2018, published by NGOBOX

Table: 5

2017-18 Top 10 companies by actual CSR spend in INR Cr

Company Name	Actual CSR Spend in 17-18
Wipro Ltd	187
TATA Steel Ltd	232
NTPC Ltd	242
ITC Ltd	291
Infosys Ltd	313
Indian Oil Corporation Ltd	331
HDFC Bank Ltd	375
TATA Consultancy Services Ltd	400
ONGC Ltd	503
Reliance Industries Ltd	745

Source: India CSR Outlook Report 2018, published by NGOBOX

The above tables and data shows the present picture of CSR spends in the country and the trend is also positive. Through CSR activities the public and the private partnership towards the development of the society and the economy get strengthened.

It is mandatory to spend a specific amount of the profit on CSR activities by the Indiancompanies which are registered under Companies Act 2013. But the foreign companies can not be forced to return to the societies. It is not so that these companies are not spending towards the societies. Many articles in the magazines and newspapers show their contributions and charity towards the society. There is no doubt about it. The corporations which are associated with

social media sitesmust spend for the upliftment of the area through which their businesses grow. The above discussed data and analysis of CSR expenditure in to different sectors of the economy by the privatesector of India show that it is trying to strengthen the core of the society and on the next hand there are many negative impact of social media on the society which is making the society hollow are being discussed as follows:

In a news by Josh K. Elliotte (July 16, 2018), India isshacked with a deadly fake news problem.Rumors on whats app have inspired the mobs to rely on the fake news regarding to swarm visitors for being accused of child kidnappings. At least 20 individuals have been lynched or beaten to death in incidents across India. Authorities' say the killings are being inspired by text messages and videos shared on WhatsApp. The encrypted messaging system is very fast and difficult to monitor and stop. The viral messages suggest that kidnappers are abducting children and harvesting their organs.

Law enforcement officials say there is no truth to the rumors, and that all of the victims have been innocent.India's ministry of electronics and information technology characterized the messages as "irresponsible and explosive". One popular video in the WhatsApprumor claims to show child abduction captured on security camera. However, the clip is only part of a longer video produced by the charity Roshni Helpline, which seeks to spread the word about child abductions in Pakistan.

Roshni Helpline posted the original video on its YouTube page on June 14, 2016, with the title: "This child went out to play #cricket with his friends. What happened next is terrifying…"

The clip circulating on WhatsApp does not include the end of the Roshni video, so that it appears as if the motorcycle riders have truly abducted the boy.The Indian government has urged WhatsApp to take action against the spread of fake content on its platform.WhatsApp responded with a series of newspaper advertisements aimed at fake news. The company also introduced labels to flag messages that have been forwarded from other users.

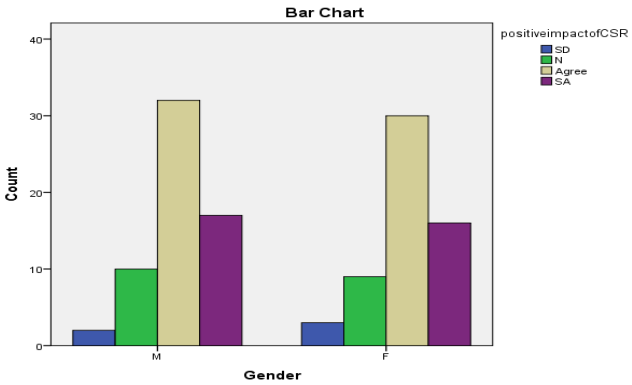
"We are starting an education campaign in India on how to spot fake news and rumors," a WhatsApp spokesperson said in a statement.Internet policy experts say WhatsApp isn't legally accountable for the way people use its service. "But the platform is responsible for enabling anonymous sending forwards," said Nikhil Pahwa, a digital rights activist and founder of a portal that covers technology and social media policy in India.Pahwa said it's impossible for WhatsApp to track and assess billions of messages being sent each day using its platform.

PavanDuggal, a cyber-expert and an attorney, said WhatsApp needs to comply with Indian laws and also adopt a "more sensitive and customized approach" for the country to reap the benefits of the vast Indian market.

There are the other cases related to targeting the soft minds of the children like Blue Whale, Momo Challenge, Pokaemon Go, Kiki challenge…etc. which are equally dangerous and provoke the user to take the challenge and change the mindset of the user to commit suicide. Spread by the social media sites.

The recent case of Gujarat related to reservation riots is also an example where whatsapp was having its significant impact. Keeping in mind the discrepancies, the authorities instruct the service providers to stop providing the mobile internet services in the case of vulnerability.

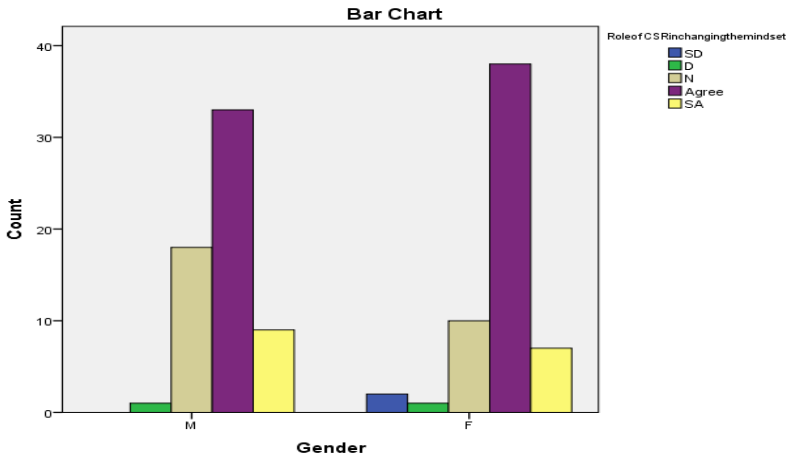
It is a platform being used for changing the images of the political parties and politicians as well.

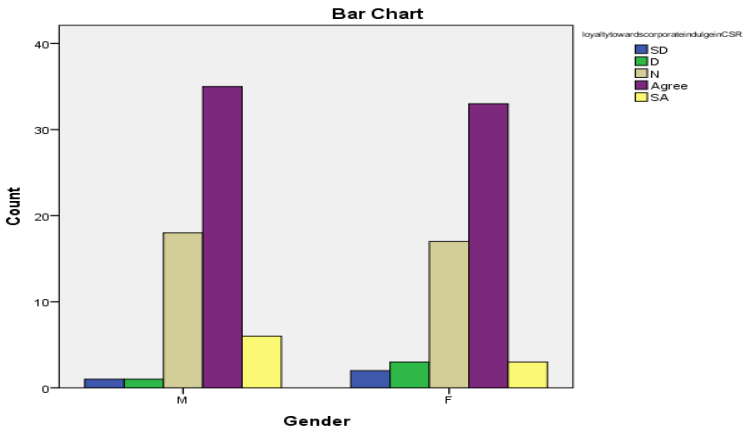


Data Analysis and Findings

It is observed from the responses received that there is no significance difference in the opinion of male and female respondents (51% Male and 48.7% Female). 52% of them (26.9) Male and 25.2% Female) agree with the fact that there is a positive impact of CSR activities adopted the corporate.

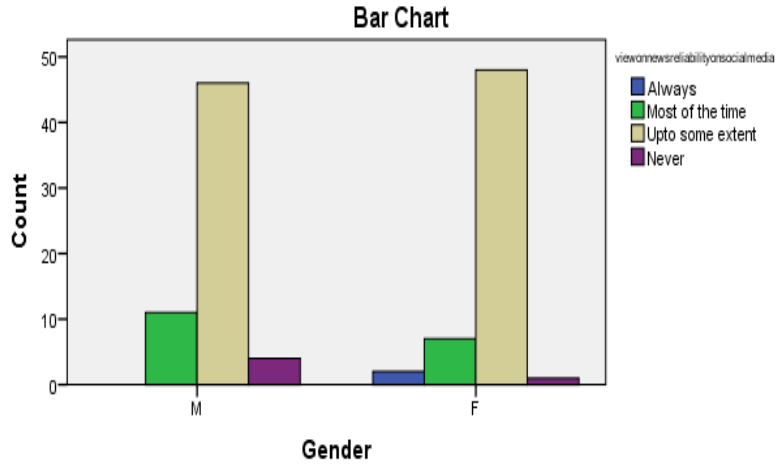
At the same time 59.7% respondents (31.9 females and 27.7 males) agree on that CSR can play an important role in changing the mindset of the people. A good number of male respondents remain neutral on the question.





57.14% (29.4% males and 27.7% females) feels the loyalty towards the corporate indulge in the CSR activities.

Section B: who should take the responsibility of deadly fake news spread by social media?



Count

		Who should be responsible				Total
		Corporate	User	Govt	Media	
	SD	2_a	0_b	$0_{a, b}$	$0_{a, b}$	2
	D	1_a	1_a	0_a	0_a	2
RoleofCSRinchangingthemindset	N	6_a	17_a	1_a	4_a	28
	Agree	11_a	46_a	1_a	13_a	71
	SA	1_a	13_a	1_a	1_a	16
Total		21	77	3	18	119

Count

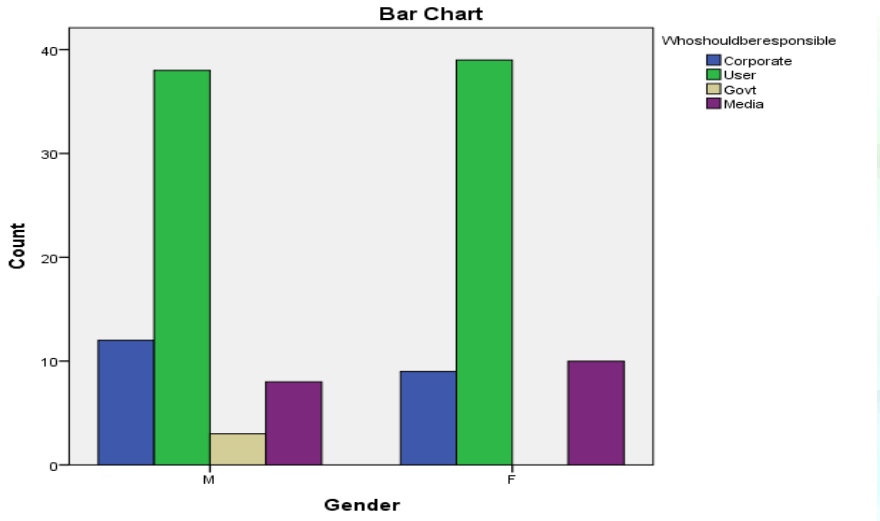
		View on news reliability on social lmedia				Total
		Always	Most of the time	Upto some extent	Never	
	SD	1_a	$0_{b, c}$	0_c	$1_{a, b}$	2
Role of CSR in changing the mindset	D	$0_{a, b}$	2_b	0_a	$0_{a, b}$	2
	N	0_a	6_a	21_a	1_a	28
	Agree	$1_{a, b}$	$8_{a, b}$	61_b	1_a	71
	SA	0_a	2_a	12_a	2_a	16
Total		2	18	94	5	119

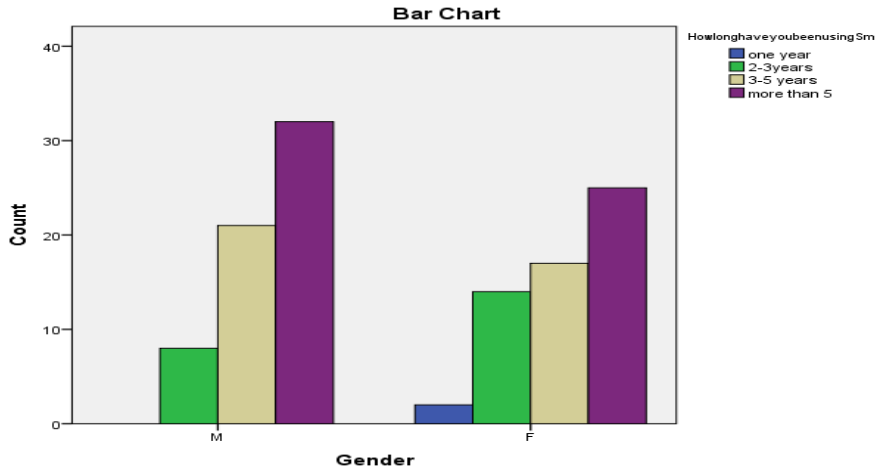
In a very interesting finding, approximately 79% respondents (38.6 %Males and 40.2% Females) believed that the news flashing on social media sites are reliable only up to some extent. However at the same time 51% also believe that CSR plays an important role in changing the mindset.

Only 16% feels that news flowing on social media is reliable most of the time.

It is also interesting to observe that 64.7 % (males and females equally) of them believe that users are themselves responsible for spreading the news on social media without verifying the authenticity. Among them 38.65% do agree that role of CSR helps in changing the mindset of people. While 14.28% remains neutral on the role of CSR but do agree that users should take the responsibility for spreading the news.

17.6 % feels that social media organization should be responsible. Only 2% feels that government should be responsible for these. Approximately 15% feels that the corporations associated with social media should also be responsible for spreading the fake news.





68% of the respondents say that yes their purchase of products is motivated by the involvement of the corporate into CSR activities.

Count

		loyaltytowardscorporateindulgeinCSR					Total
		SD	D	N	Agree	SA	
RoleofCSRinchangingthemindset	SD	2_a	$0_{a,b}$	0_b	0_b	0_b	2
	D	0_a	0_a	0_a	2_a	0_a	2
	N	1_a	2_a	5_a	18_a	2_a	28
	Agree	0_a	$2_{a,b}$	30_b	35_a	4_a	71
	SA	$0_{a,b}$	$0_{a,b}$	0_b	13_a	3_a	16
Total		3	4	35	68	9	119

29.4% respondents are agree with the fact that CSR can play an important role in changing the mindset of people as well as they also feel loyal towards the organizations who are indulge in CSR activities. However, 25% do agree with that CSR can change the mindset of people but prefer to remain neutral about the loyalty towards the organizations involved in CSR activities.

Statistics

		Twitter	facebook	whatsapp	Pintrest	instagram
N	Valid	118	119	119	118	119
	Missing	1	0	0	1	0
Mean		4.07	2.97	1.34	4.31	2.30
Mode		4	3	1	5	2
Std. Deviation		.985	.818	.628	.920	1.225
Sum		480	354	159	508	274

Respondents were asked to rank the social media as per the frequency of usage. Where 1 represented most frequent and 5 represented rarely used. What app has got the average rating of 1.34 with mode 1 which makes it most frequently used app among the respondents. Instagram takes the 2nd position with a average score of 2.30 with mode 2 followed by facebook (avg 2.97 with mode 3). Pint rest is the rarely used site among most of the respondents with average rating of 4.31 with mode 5 while twitter has got the average rating of 4.07 with mode 4.

5 Conclusion

CSR activities are contributing significantly for the development of the economy. Through the efforts of these activities the basic areas are also getting the solutions of many problems. There are many positive and negative impacts of social media on the society. Corporations are taking from the society so it is the responsibility of the corporations to give back to the society. Corporations which are associated with social media are also responsible for the society in to which these are performing. There is a requirement of a filter segment in to the social media which can find some reasonable solutions for the expansion of fake news. This could be associated with the CSR activities of these corporations.

References:

1. CaramelaSammi (2018) 'What is Corporate Social Responsibility?' www.businessnewsdaily.com

2. Thorpe Davin (2018), 'Why CSR? The Benefits Of Corporate Social Responsibility Will Move You To Act' www.forbes.com

3. BansalSangeeta, KhannaMadhu& Jain Sonakshi (April 7, 2018), vol LIII No 14, 'Corporate Social Responsibility Rules in India', Economic and Political Weekly.

4. Nevine Eshra and Noha Beshir (Mrch 2017), work title: Impact of Corporate Social Responsibility on Consumer Buying Behavior in Egypt, published in, World Review of Business Research Vol. 7. No. 1. March 2017 Issue. Pp. 32 – 44

5. AminuAhmaduHamidu and Md. HarashidHaron and AzlanAmran (2016), 'Corporate Social Responsibility Stages of Transformation, Drivers and Dimensional Models: A Review', International Postgraduate Research Conference (IPRC) 2016 Universiti Sultan ZainalAbidin, Gong Badak Campus, 21300 Kuala Terengganu, Malaysia 8th – 10th October
6. Shwu-Ing Wu & Hsin-Feng Lin (2014), title: The Correlation of CSR and Consumer Behavior:A Study of Convenience Store, published in International Journal of Marketing Studies; Vol. 6, No. 6; 2014 ISSN 1918-719X E-ISSN 1918-7203, Published by Canadian Center of Science and Education
7. Visser, W. (2006) Revisiting Carroll's CSR pyramid: An African perspective, In M. Huniche& E.
8. R. Pedersen (Eds.). Corporate citizenship in developing countries: New partnership perspectives, Copenhagen Business School Press, pp. 29–56
9. Ali, I 2011, 'Influence of corporate social responsibility on the development of corporate reputation and customer purchase intentions', Romanian Review of Social Sciences, No.1, pp. 19-26.
10. Carroll, A &Shabana, K 2010, 'the business case for corporate social responsibility: A review of concepts, research, and practice', International Journal of Management Reviews, Vol.12, No.1, pp.85-105, https://www.researchgate.net/publication/228118692_The_Business_Case_for_Corporate_Social_Responsibility_A_Review_of_Concepts_Research_and_Practice, viewed 15 January 2016.
11. India CSR Outlook Report 2018, published by NGOBOX
12. www.mca.gov.in, Ministry of Corporate Affairs, Government of India

Learning, Innovation and Flexibility for Entrepreneurship

Sumant Kumar Bishwas[1], and **Sushil**[2]

[1]National Institute of Industrial Engineering, Mumbai

skb.dmsiitd09@gmail.com

[2]Indian Institute of Technology Delhi, New Delhi

Abstract: Current business environment has been defined as highly uncertain, complex, and competitive. Fast changing technology, informed customers, and availability of skilled employees have catalyzed this complexity, especially in last two decades. To satisfy this diverse and changing customers' demands, organizations need to act in a different and quick way than its competitors. Organization with entrepreneurial orientation can act in a better way to strengthen itself for future survival and growth. Learning, innovation and flexibility have emerged as some of the vital processes that may affect the entrepreneurial perspective, and survival and growth potential of organization. This study has explored the integration aspect of learning, innovation, and flexibility with entrepreneurship. This empirical study has been done based on the survey conducted on IT and Automobile industry in India. Univariate, Correlation and Step-wise regression methods have been used to explain the significance of these four processes and interrelations of learning, innovation, and flexibility with a focus on entrepreneurship in the organization. The final model reflects the effects of the three processes on Entrepreneurship aspects.

Keywords: Entrepreneurship, Flexibility, Innovation, Integration, Learning

Introduction

Entrepreneurial orientation and enabling entrepreneurial culture to improve the vitality of the organization.[1] Organizations with high vitality act as a social entrepreneur and work towards people awareness about what they do.[2] Corporate entrepreneurship is vital for organizational survival and continuous performance.[3],[4] Entrepreneurial knowledge has been explained as one important aspect for organization survival.[5] Entrepreneurship and strategic management process in the organization contribute to growth and success.[6] Decisions by entrepreneurs play an important role in deciding about where and how to move and what should be the growth path.[7] Entrepreneurial management process has been defined as more efficient than professional management process with respect to organizational performance.[8] Importance of entrepreneurship has been further explained by one of the study that described the changing scenario in the Asian companies and explained the increasing level of innovation and entrepreneurship culture that lead to continuous growth for these companies.[9]

Significance of learning for survival, growth, and performance has been discussed by various management thinkers.[10],[11],[12],[13] Innovation has been defined as another key requisite for organizational survival and growth.[14],[15],[16] Similarly, importance of flexibility[17],[18],[19] and entrepreneurship[3],[4],[16] with respect to survival, growth, performance, and customer orientation have been acknowledged in previous studies.

System theory describes organization as a system including various sub-systems; a unified view of which will benefit to get the competitive position. Living System Theory (LST) could be useful for organizational studies, organization management, and operation efficiency, accounting, and information systems analysis.[20] Modern organizational theory also says that the only meaningful way to study organization is by considering it as a system through identification and interrelationships of the critical processes.[21]

The four critical processes from the literature have been identified as learning, innovation, flexibility, and entrepreneurship. This study is focusing on micro level analysis of these four processes. Effect of learning, innovation, and flexibility factors on entrepreneurship factors have been analyzed and discussed.

Organizational Vitalization Processes and Entrepreneurship

Entrepreneurial mindset in the organization can change the uncertainty in the environment into opportunity. It has been explained as a way of thinking to capture the benefits from uncertainty in the environment that helps in discovering and exploiting future opportunities.[22],[23] It is positively linked with organization's profit and is critical for survival and growth.[3],[24],[25] Resource management with entrepreneurial orientation is important aspect to exploit the opportunities (inputs) and creating new ventures.[26] Characteristics of the entrepreneur and accessibility of resources are two major factors for higher growth of some ventures than their competitors.[27] Risk taking mindset is another dimension to decide about the entrepreneurial initiative in organization.[7],[28]

Quantitative measurement of entrepreneurship can be done with entrepreneurial intensity which emerges from entrepreneurial grid.[29] The author has measured the entrepreneurial action of the Kibbutzim community over time and developed an input-output framework to describe the intensity at the individual and organizational level. Trust between organizational members and entrepreneurs, with participative decision-making process, lead to a healthy culture in the organization.[30]

In the current state, organizations' survival and growth depend on how fast it can develop the learning process in the organization than its competitors.[31] Significance of learning have been explained stating that within the next 10 years timeframe merely those organizations would be able to survive that would succeed in developing learning process.[32] This has been defined as one of the essential process for success.[33] It develops the capacity for renovation and adaptation of the changes.[34] Continuous learning process is one of the vital things for growth and helps to be at the better position in the competition.[35] It has been considered as one of strategic capability that strengthens organization to manage the changes and positively affects performance and growth.[36] Learning develops a common understanding and direct towards a cohesive action for organizational benefits.[37]

Effectiveness of learning process can be decided with a mix of organizational learning, work learning, learning climate, and learning structure in the organization.[38] Continuous learning enhance creativity leading to innovation. Learning, idea sharing, creativity, collaboration, and developing trust among members have been defined as some of the constituents of innovation.[39] Similar findings were discussed in one of the study which states that focus on learning significantly affect innovation.[40] Knowledge gained through learning processes drive innovation that helps in competition. Continuous learning grows and develop entrepreneurial aspects and enable knowledge-intensive organizations to engage in strategic rethinking.[41],[42]

Ability to offer novel products with higher value strengthens organization for long-term survival and growth.[34],[43] Importance of innovation can be understood by findings of one of the studies which says that successful companies make 75 per cent of revenues from novel offerings, which were in non-existence five years back.[15] Innovation and entrepreneurship has been explained as complementary to each other, and integration of these two processes are crucial for organizational success in fast changing environment.[31] Further, the author has developed an integrated framework to explain the interrelationships between innovation and entrepreneurship. Innovation and entrepreneurship are strongly link with economic growth, especially economies with opportunity-driven entrepreneurship.[16] Similarly, entrepreneurial strategy matrix describes the interrelationships between innovation and entrepreneurship, considering innovation and risk as independent variables.[44]

Collaborative environment may enhance innovation level through idea sharing in the organization. Lack of collaborative environment is one of the reasons for few innovation due to difficulty in knowledge sharing process.[45] Access to resources and facilities is another reason for increasing or decreasing level of innovation in the organization.[46] Entrepreneurship and innovation are strongly interrelated and the former one stipulated the later.[28] Entrepreneurial mind-set encourages risk taking that promote innovation and organizational performance.[47] Growth has been defined as a function of the entrepreneurial decisions. Five factors linked with entrepreneurial performance are: i) autonomy; ii) proactiveness; iii) risk taking; iv) competitive aggressiveness; and v) innovativeness. In current uncertain environment, integrating innovation process with flexibility aspects make easier to manage the changes.[48] Innovation and flexibility are the two crucial processes for organizational survival and growth.[49]

Current business era, which is driven by accelerating change, flexibility dimensions are critical along with entrepreneurial thinking. A proper fit between organizational initiatives and its environment need to be maintained. Highly uncertain environment means higher concern of flexibility aspects.[50] Flexibility has been as a mean of having higher control in a stormy environment. Further, the 'flexibility mix' concept classified flexibility in terms of operational, strategic, and structural types.[51] Flexibility increases the responsive capacity of the organization.[52]

Firms, which are small, are usually more flexible in the initial stages while the moment they reach to intermediate position the level of flexibility decreases due to the difficulty in making a balance between attraction of new customers and continuation of the quality service required.[53] This indicates that continuity with flexibility is one of the important issues that need to be managed. Flexibility with lack of stability results in chaos.[54] "Flowing Stream Strategy" helps in managing the change and continuity forces simultaneously.[43],[55] Concept of "super flexibility" also discusses this issue of managing change and continuity simultaneously (proceed with balanced approach on what to change and what to continue).[56]

Labor flexibility is an important aspect for dealing with uncertainty and changes.[57] Dealing with labor demands with respect to time has been discussed to reflect the significance of labor flexibility for organizations.[58] Strategic flexibility is another important concern in flexibility area.[59] Strategic flexibility increases the chances of organizational survival.[60] It has been described as managers' capability to realize the consequences of the uncertain environment and to react speedily.[61]

Entrepreneurial orientation with flexible approach has been seen as the key issue for competing in future.[62] Risk taking attitude, support from the top, and higher degree of flexibility increases entrepreneurship and lead towards the objectives achievement.[63] Increase in flexibility stimulates entrepreneurship in the organization.[43] Technical infrastructure, knowledge, organizational flexibility and entrepreneurship have been defined as an integrated aspect to be on high growth path.[64]

Methodology

This empirical study is based on the survey conducted on select IT and Automobile industries in India. The questionnaires for the survey have been selected from [65], [66], and [67]. Non probability sampling methods have been used for the study. Univariate, Correlation, and Step-wise regression analyses have been done for explaining importance of the selected processes and the inter-relations between learning, innovation and flexibility factors with entrepreneurship. SPSS 20 software package has been used. Table 1 summarizes respondents details used for the survey.

Table 1: Respondents Details

		IT		***Automobile***	
Industry (n=225)		116 (51.55 %)		109 (48.45%)	
Average Work Experience	***Total***		***Within current Organization***		
	10.75 yrs.		6.47 yrs.		
Gender			***Qualification***		
Male	Female		Graduate	Post graduate	Doctorate
198 (88%)	27 (12%)		69 (30.66%)	142 (63.11%)	14 (6.22%)

From Table 1, it can be concluded that the respondents have significantly good experience (average work experience > 10 years), and highly qualified professionals who are associated with the selected processes and have expertise to enrich the outcome of the study.

Results and Discussion

The outcomes of the statistical analysis have been discussed. Final integrated model reflects the interrelationship between learning, innovation, and flexibility factors with factors of entrepreneurship. Univariate, correlation, and step-wise regression analyses have been discussed in detail.

Univariate Analysis

Table 2 provides summary result of Univariate analysis on micro variables of the four processes.

Table 2: Univariate Analysis of Micro Variables

Univariate Analysis (N=225)								
	Micro Variable Code	**Mean**	**Median**	**Mode**	**Std. Deviation**	**Variance**	**Minimum**	**Maximum**
Learning	VPL1	4.145	4.000	4.000	0.638	0.407	1.00	5.00
	VPL2	3.562	3.500	4.000	0.909	0.826	1.00	5.00
	VPL3	3.369	3.333	4.000	0.877	0.769	1.00	5.00
Innovation	VPI1	3.665	4.000	4.000	0.800	0.640	1.00	5.00
	VPI2	3.454	3.667	3.670	0.806	0.650	1.00	5.00
	VPI3	4.187	4.000	5.000	0.797	0.635	1.00	5.00

Flexibility	VPF1	3.484	3.667	4.000	0.870	0.758	1.00	5.00
	VPF2	3.588	3.750	4.000	0.877	0.768	1.00	5.00
	VPF3	3.505	3.500	4.000	0.844	0.712	1.00	5.00
Entrepreneur Ship	VPE1	3.561	3.667	4.000	0.880	0.774	1.00	5.00
	VPE2	3.285	3.333	3.330	0.798	0.637	1.00	5.00
	VPE3	3.143	3.000	3.000	0.863	0.744	1.00	5.00

(VPL1: Work Learning; VPL2: Organizational Learning; VPL3: Learning Structure; VPI1: Collaborative Environment; VPI2: Access to Facility and Resources; VPI3: Skills Variety; VPF1: Strategic Flexibility; VPF2: Flexible Resource Usage; VPF3: Adaptive Capacity of Leadership; VPE1: Proactiveness; VPE2: Risk Taking Orientation; VPE3: Entrepreneurial Intensity)

Result of Univariate Analysis (Table 2) shows that overall learning, innovation and flexibility have been considered as relevantly more important than entrepreneurship in the organization. Work learning (VPL1), organizational learning (VPL2), collaborative environment (VPI1), skills variety (VPI3), flexible resource usage (VPF2), adaptive capacity of leadership (VPF3), and proactiveness (VPE1) are the micro level variables with higher mean values (>3.5) which means that are considered significantly more critical for the organization.

Comparative Analysis of Micro Variables

As the survey includes respondents from two different industries, differences with respect to the importance of the variables were expected at initial level. The comparative mean value analysis between the IT and Automobile industry experts reflect the perception about these processes in the industries. Results show that automobile industry is having a slightly higher mean value in two learning factors that indicates a little higher learning focus of Automobile industry over IT. Further, automobile industry is having higher reflections in two factors of innovation and flexibility. From figure 1, it is clear that strategic flexibility is little bit lower in automobile industry than the IT industry which signifies that any changes or rethinking of strategy in automobile industry may incur higher cost as compared to IT industry. Further, with respect to entrepreneurship concern, the analysis shows that entrepreneurship perspective is slightly less reflected in automobile industry as compared to IT industry.

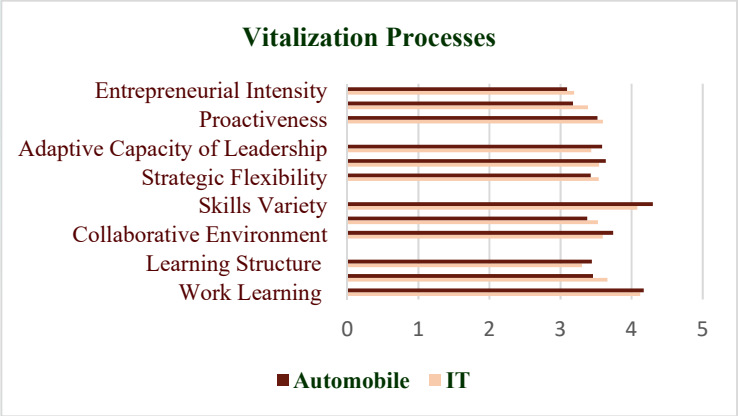


Figure 1: Comparative Micro level Analysis of IT and Automobile Industry Data

Correlation Analysis

Table 3 gives the summary of correlation analysis between the micro level factors of learning, innovation, flexibility, and entrepreneurship. Correlation analysis results on micro level factors reflect that there is significant correlation between the factors of all the four processes. Organizational learning (VPL2) is significantly related with access to facility and resources (VPI2) and proactiveness (VPE1). Learning structure (VPL3), collaborative environment (VPI1), and entrepreneurial intensity (VPE3) are significantly related with 6 other micro factors; flexible resource usage (VPF2) and adaptive capacity of leadership (VPF3) are related with 7 other micro factors significantly. Further, Access to facility and resources (VPI2), strategic flexibility (VPF1), and proactiveness (VPE1) are the factors that are strongly correlated with 8 other micro factors considered for this study.

Table 3: Correlation Analysis between Micro level Factors

		VPL1	VPL2	VPL3	VPI1	VPI2	VPI3	VPF1	VPF2	VPF3	VPE1	VPE2	VPE3
Work Learning	VPL1	1											
Organizational Learning	VPL2	.314**	1										
Learning Structure	VPL3	.262**	.469**	1									
Collaborative Environment	VPI1	.341**	.492**	.652**	1								
Access to Facility and Resources	VPI2	.247**	.608**	.596**	.671**	1							
Skills Variety	VPI3	.457**	.102	.200**	.379**	.192**	1						
Strategic Flexibility	VPF1	.305**	.475**	.619**	.660**	.703**	.257**	1					
Flexible Resources Usage	VPF2	.309**	.321**	.621**	.683**	.629**	.411**	.782**	1				
Adaptive Capacity of Leadership	VPF3	.314**	.397**	.688**	.616**	.595**	.353**	.723**	.689**	1			
Proactiveness	VPE1	.338**	.571**	.592**	.602**	.649**	.312**	.749**	.720**	.632**	1		
Risk Taking Orientation	VPE2	.216**	.532**	.526**	.477**	.668**	.167**	.618**	.506**	.571**	.729**	1	
Entrepreneurial Intensity	VPE3	.206**	.478**	.538**	.514**	.572**	.182**	.606**	.577**	.574**	.651**	.724**	1

Model Discussion

Three step-wise regression models have been developed considering the three factors of Entrepreneurship as dependent variables one by one (in a separate manner) and factors of other processes as independent variables (details provided in appendix). Table 4 provide the step-wise regression analysis results (details in Appendix).

Table 4: Regression Results Summary

Dependent Variable	Independent Variable	B-Value	R^2	SEE	Significance
Proactiveness (VPE1)	Strategic Flexibility (VPF1)	.172	0.741	.45177	.006
	Risk taking orientation (VPE2)	.341			.000
	Flexible resource usage (VPF2)	.350			.000
	Organizational Learning (VPL2)	.196			.000
Risk Taking Orientation (VPE2)	Proactiveness (VPE1)	.440			.000
	Entrepreneurial intensity	.399			.000

	(VPE3)				
	Access to facility and resources (VPI2)	.297	.693	.44646	.000
	Flexible resource usage (VPF2)	-.228			.000
	Risk taking orientation (VPE2)	.526			.000
Entrepreneurial Intensity (VPE3)	Flexible resource usage (VPF2)	.276	.592	.55454	.000
	Organizational learning (VPL2)	.109			.032

Figure 2 presents summary of regression models considering entrepreneurship factors as dependent variable (s). Learning (organizational learning- VPL2), flexibility (strategic flexibility- VPF1, and flexible resource usage-VPF2), and entrepreneurship (risk taking orientation-VPE2) factors are having significant effect on *Proactiveness (VPE1)* factor. Similarly, *Risk taking orientation (VPE2)* is affected by innovation (access to facility and resources- VPI2), flexibility (flexible resources usage-VPF2), and entrepreneurship (proactiveness-VPE1, and entrepreneurial intensity-VPE3) factors whereas *Entrepreneurial Intensity (VPE3)* is determined by flexible resource usage (VPF2), organizational learning (VPL2), and risk-taking orientation (VPE2) factors.

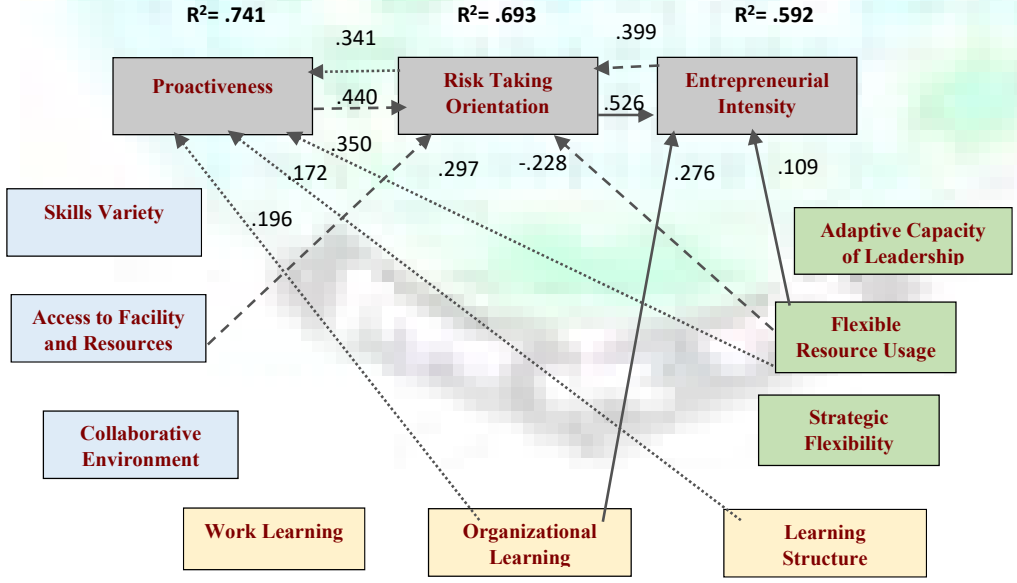


Figure 2: Summary of Step-wise Regression Models using Entrepreneurship Factors as Dependent Variable(s)

From figure 2, it can be concluded that *proactiveness* in the organization is strongly dependent on the risk taking orientation, and the flexible resource usage; similarly the *risk taking orientation* factor is strongly affected by proactive attitude while negatively affected by flexible resource usage, which suggests that providing more flexibility in resource

usage may reduce the risk taking orientation of members due to their inclination towards other choices. As expected, the intensity of entrepreneurial activities highly depends on the risk-taking orientation of organizational members.

It can be observed from the above figure that *Flexible resource usage* (VPF2) and *Organizational learning* (VPL2) have the maximum impact on the Entrepreneurship factors. Further, the negative link between flexible resource usage and risk-taking orientation suggest that flexibility in resource usage may increase the dependency on the resource exploitation rather than going for taking new challenge. Further, it can be concluded that all the three factors of entrepreneurship are interrelated in significant manner. Learning from these regression models emphasizes previous research outcomes which discussed about the interrelationships of these four processes. [40],[41],[68],[69]

Conclusion, Limitations and Future Scope

Entrepreneurship can be seen as one of the essential aspects for organization to remain competitive in the uncertain and complex environment. Entrepreneurial process helps in implementing creative ideas for the benefit of customers and exploit the opportunity better than the competitors. Processes like learning, innovation, and flexibility have emerged as vital processes for organizational survival and growth. These vital processes are strongly linked with entrepreneurship. The integrated approach of managing these vital processes will improve future survival and growth prospects. Flexible resource usage has emerged as the major factor with strong effect on all the three entrepreneurship factors. Organizational learning is another factor that effects two entrepreneurship dimensions. Access to facility and resources and strategic flexibility also have significant effect on entrepreneurship dimensions. Correlation analysis for micro level factors suggest that all the four processes are significantly inter-related with each other, and an integrated view of learning, innovation, and flexibility will help in developing an entrepreneurial concern in the organization.

This study is a significant contribution to the literature which discussed about integration of critical organizational processes. The study results strengthen the previous studies that process integration is crucial for organization, considering the organization as a system. The final summary of regression models portrait a framework which can be considered as a guiding framework to develop entrepreneurship in the organization and managing the other critical processes in a better way.

Limitations and Future Direction

The study is limited to select IT and Automobile organizations in India. The respondents were selected from across the country without any specific geographical or organizational focus. This study can be extended to other industries for a better generalized model. The study can be further extended with a focus on specific organization or geographical region. Moreover, detail case studies will help to validate the empirical results. Some other external variables can also be included to see the effect of those variables on the outcomes of this study.

References

1. Sorensen P. D. (2004) Entrepreneurial Orientation, and Sustained Organizational Vitality, http://library.hku.hk/record=b3757987 retrieved on 18.10.2012.
2. Birch D. and Sadati A. (2004) Creating a Healthy Organization, *TD- American Society of Training and Development*, July, 31.
3. Barringer B.R. and Bluedorn A.C. (1999) The Relationship between Corporate Entrepreneurship and Strategic Management, *Strategic Management Journal*, 20 (5), 421–444.
4. Chen J., Zhu Z. and Anquan W. (2005) A System Model for Corporate Entrepreneurship, *International Journal of Manpower*, 26 (6), 529-543.
5. Omerzel D.G. and Antoncic B. (2008) Critical Entrepreneur Knowledge Dimensions for the SME Performance, *Industrial Management & Data Systems*, 108 (9), 1182-1199.
6. Ireland R.D., Hitt M.A., Camp S.M. and Sexton D.L. (2001) Integrating Entrepreneurship and Strategic Management Actions to Create Firm Wealth, *Academy of Management Executive*, 15 (1), 49-63.
7. Carsrud A. and Brannback M. (2011) Entrepreneurial Motivations: What Do We Still Need to Know?, *Journal of Small Business Management*, 49(1), 9-26.
8. McConaughy D.L., Matthews C.H. and Fialko A.S. (2001) Founding Family Controlled Firms: Performance, Risk, and Value, *Journal of Small Business Management*, 39 (1), 31-49.
9. Licuanan V.S., Sengupta K. and Neelankavil J.P. (2015) Entrepreneurship and Innovation Initiatives among Asian Multinationals: A Cross-country Analysis, *International Journal of Commerce and Management*, 25 (1), 67-83.
10. Senge P. (1990) *The Fifth Discipline: The Art and Practice of the Learning Organization*, New York: Doubleday.

11. Epstein E.M. (2003) How to Learn from the Environment about the Environment: A Prerequisite for Organization Well-Being, *Journal of General Management*, 29 (1), 68-80.
12. Weldy T.G. (2009) Learning Organization and Transfer: Strategies for Improving Performance, *The Learning Organization*, 16 (1), 58-68.
13. Secundo G., Schiuma G. and Passiante G. (2017) Entrepreneurial Learning Dynamics in Knowledge-intensive Enterprises, *International Journal of Entrepreneurial Behavior & Research*, 23 (3), 366-380.
14. Vicenzi R. and Adkins G. (2000) A Tool for Assessing Organizational Vitality in an Era of Complexity, *Technological Forecasting and Social Change*, 64 (1), 101-113.
15. Xu J., Houssin R., Ciallaud E. and Gardoni M. (2011) Fostering Continuous Innovation in Design with an Integrated Knowledge Management Approach, *Computer in Industry*, 62 (4), 423-436.
16. Farinha L., Ferreira J.J. and Nunes S. (2018) Linking Innovation and Entrepreneurship to Economic Growth, *Competitiveness Review: An International Business Journal*, 28 (4), 451-475
17. Miller J.R. (1984) Revitalization: The Most Difficult of All Strategies, *Human Resource Management*, 23(3), 293-313.
18. Maisel, L. S. (1992) Performance Measurement: The Balanced Scorecard Approach, *Journal of Cost Management*, 5(2), 47.
19. Becker F. (2001) Organizational Agility and the Knowledge Infrastructure, *Journal of Corporate Real Estate*, 3 (1), 28–37.
20. Tan S. (1994) Living System Theory: A Unifying Conceptual Framework for Management, *Singapore Management Review*, 6 (2), 78-139.
21. Scott W.G. (1961) Organization Theory: An Overview and an Appraisal, *Journal of Academy of Management*, 8-26.
22. McGrath R.G. and MacMillan I. (2000) *The Entrepreneurial Mindset*, Harvard Business School Press: Boston, MA.
23. Federici D., Ferrente F. and Vistocco D. (2008) On the Sources of Entrepreneurial Talent: Tacit vs Codified Knowledge, *The ICFAI University Journal of Knowledge Management*, 6 (6), 7-28.
24. Covin J.G. and Slevin D. (1991) A Conceptual Model of Entrepreneurship as Firm Behavior, *Entrepreneurship: Theory and Practice*, 16 (1), 7-25.
25. Zahra S.A. (1991) Predictors and Financial Outcomes of Corporate Entrepreneurship, *Journal of Business Venturing*, 6, 259-85.
26. Vincenzo P., Duane I.R., Hitt M.A. and Justin W.W. (2007) International Entrepreneurship in Emerging Economies: The Role of Social Capital, Knowledge Development and Entrepreneurial Actions*, International Journal of Technology Management*, 38 (1/2), 11-18.
27. Gilbert B.A., McDougall P.P. and Audretsch D.B. (2006) New Venture Growth: A Review and Extension, *Journal of Management*, 32 (6), 926-950.
28. Michael S.C. and Pearce J.A. (2009) The Need for Innovation as a Rationale for Government Involvement in Entrepreneurship, *Entrepreneurship & Regional Development*, 21 (3), 285-302.
29. Morris M.M., Lewis P.S. and Sexton D.L. (1994) Re-conceptualizing Entrepreneurship: An Input-Output Perspective, *SAM Advanced Management Journal*, winter, 1-31.
30. Isaac R.G., Herremans I.M. and Klinie T.J.B. (2009). Intellectual Capital management: Pathways to Wealth Creation, *Journal of Intellectual Capital*, 10 (1), 81-92.
31. Zhao F. (2005) Exploring the Synergy between Entrepreneurship and Innovation, *International Journal of Entrepreneurial Behaviour and Research*, 11 (1), 25-41.
32. Schwandt, D. and Marquardt, M. (2000) *Organizational Learning: From World-Class Theories to Global Best Practices*, Boca Raton, St. Lucie.
33. Prahalad C.K. and Hamel G. (1990) The Core Competence of the Corporation, *Harvard Business Review*, 68 (3), 79-91.
34. Sushil (2004) Give a New `LIFE' to Your Organization, *Global Journal of Flexible Systems Management*, 4 (1&2), 3.
35. Maurer T.J. and Weiss E.M. (2010) Continuous Learning Skill Demands: Associations with Managerial Job Content, Age, and Experience, *Journal of Business and Psychology*, 25 (1), 1-13.
36. Jitnom S. and Ussahawanitchakit P. (2010) Strategic Learning Capability, Firm Performance and Sustainable Growth: An Empirical Study of Auto Spare Part Manufacturing Businesses in Thailand, *International Journal of Business Strategy*, 10 (4), 107-131.
37. Campbell T.T. and Armstrong S.J. (2013) A Longitudinal Study of Individual and Organizational Learning, *The Learning Organization*, 20 (3), 240-258.
38. Ortenblad A. (2004) The Learning Organization: Towards an Integrated Model, *The Learning Organization*, 11 (2), 129-44.
39. Dovey K. (2009) The Role of Trust in Innovation, *The Learning Organization*, 16 (4), 311-325.
40. Calisir F., Gumussoy C.A. and Guzelsoy E. (2013) Impacts of Learning Orientation on Product Innovation Performance, *The Learning Organization*, 20 (3), 176-194.

41. Chermin M.M. and Nijhof W.J. (2005) Factors Influencing Knowledge Creation and Innovation in an Organization, *Journal of European Industrial Training*, 29 (2), 135-147.
42. Secundo G., Schiuma G. and Passiante G. (2017) Entrepreneurial Learning Dynamics in Knowledge-intensive Enterprises, *International Journal of Entrepreneurial Behavior & Research*, 23 (3), 366-380.
43. Sushil (2013) *Flowing Stream Strategy: Leveraging Strategic Change with Continuity*, Springer, New Delhi.
44. Sonfield M.C. and Lussier R.N. (1997) The Entrepreneurial Strategy Matrix: A Model for New and Ongoing Ventures, *Business Horizons,* 40 (3), 73-77.
45. Nonaka I., Toyama R. and Konn N. (2000) SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation, *Long Range Planning*, 33, 5-34.
46. Dobni C. B. (2008) The DNA of Innovation, *Journal of Business Strategy*, 29 (2), 43-50.
47. Molina C. and Callahan J.L. (2009) Fostering Organizational Performance: The Role of Learning and Intrapreneurship, *Journal of European Industrial Training*, 33 (5), 388-400.
48. Heilbrunn S. (2008) Factors Influencing Entrepreneurial Intensity in Communities, *Journal of Enterprising Communities: People and Places in the Global Economy*, 2 (1), 37-51.
49. Bishwas S.K. and Sushil (2013) Critical Issues for Organizational Growth and Success: A Systems Thinking View using Feedback Loop Analysis, *Proceedings of 31st International Conference of the System Dynamics Society*, Boston, USA.
50. Eppink D.J. (1978) Planning for Strategic Flexibility, *Long Range Planning*, 11, 9-15.
51. Volberda H.W. (1997) Building Flexible Organizations for Fast-moving Markets, *Long Range Planning*, 30 (2), 169-183.
52. Verdu A.J. and GomezGras J.M. (2009) Measuring the Organizational Responsiveness through Managerial Flexibility, *Journal of Organizational Change Management*, 22 (6), 668-690.
53. Grau M.M.A. and Aranda D.A. (2006) Operations Strategy and Flexibility: Modeling with Bayesian Classifiers, *Industrial Management and Data Systems*, 106 (4), 460-484.
54. Weick, K.E. (1982). Management of organizational change among loosely coupled elements. In P. S. Goodman & Associates (Eds.), Change in organizations: New perspectives in theory, research, and practice, 375-408.
55. Sushil (2012) Interpreting the Interpretive Structural Model, *Global Journal of Flexible Systems Management*, 13 (2), 87-106.
56. Bahrami H. and Evans S. (2011) Super-Flexibility for Real-Time Adaptation: Perspectives from Silicon Valley, *California Management Review*, 53 (3), 21-39.
57. Looise J.C., Riemsdijk M.V. and Lange F.D. (1998) Company Labour Flexibility Strategies in the Netherlands: An Institutional Perspective, *Employee Relations*, 20 (5), 461-482.
58. Upton D.M. (1995) What Really Makes Factories Flexible? *Harvard Business Review*, 73 (4), 74–84.
59. Sushil (2014) The Concept of Flexible Enterprise, in Sushil and E.A. Stohr (Eds.), *The Flexible Enterprise*, Flexible Systems Management, Springer, New Delhi, 3-26.
60. Hitt M.A., Keats D.W. and DeMarie S.M. (1998) Navigating in the New Competitive Landscape: Building Strategic Flexibility and Competitive Advantage in the Twenty-first Century, *Academy of Management Executive*, 12 (4), 22-42.
61. Volberda H.W. (1996) Toward the Flexible Form: How to Remain Vital in Hyper-competitive Environments, *Organization Science*, 7 (4), 359-374.
62. Bhardwaj B.R. and Momaya K. (2006) Role of Organizational Flexibility for Corporate Entrepreneurship: Case Study of FedEx Corporation, *Global Journal of Flexible Systems Management*, 7 (1&2), 37-44.
63. Bhardwaj B.R., Sushil and Momaya K. (2007) Corporate Entrepreneurship: Application of Moderator Method, *Singapore Management Review*, 29 (1), 47-58.
64. Guadamillas F. Donate M.J. and Pablo J.D.S. (2008) Knowledge Management for Corporate Entrepreneurship and Growth: A Case Study, *Knowledge and Process Management*, 15 (1), 32-44.
65. Bishwas S.K. (2015a) Achieving Organization Vitality through Innovation and Flexibility: An Empirical Study, *Global Journal of Flexible Systems Management*, 16 (2), 145-156.
66. Bishwas S.K. (2015b) Organizational Flexibility and Entrepreneurship: Knowledge Management Perspective, *Proceedings of Fifteenth Global Conference on Flexible Systems Management,* SIU, Pune, India, 193-213.
67. Bishwas S.K. (2015 c) *Achieving Organization Vitality through Strategic Knowledge Management and Vitalization Processes: A Study of Select Industries* (Unpublished Doctoral Thesis), Indian Institute of Technology Delhi, New Delhi, India.
68. Pascle R.T. (1991) The Two Faces of Learning, *Modern Office Technology*, 36 (3), 14-16.
69. Baker W. and Sinkula J. (1999) Learning Orientation, Market Orientation, and Innovation: Integrating and Extending Models of Organizational Performance, *Journal of Market-Focused Management*, 4 (4): 295-308.

Appendix

Entrepreneurship Factors as Dependent Variables

1) Proactiveness as Dependent (VPE1)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.749[a]	.561	.559	.58390
2	.822[b]	.676	.673	.50334
3	.846[c]	.715	.711	.47263
4	.861[d]	.741	.736	.45177

Predictors: (Constant), VPF1
Predictors: (Constant), VPF1, VPE2
Predictors: (Constant), VPF1, VPE2, VPF2
Predictors: (Constant), VPF1, VPE2, VPF2, VPL2
Dependent Variable: VPE1

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	97.311	1	97.311	285.419	.000[b]
	Residual	76.030	223	.341		
	Total	173.341	224			
2	Regression	117.097	2	58.549	231.100	.000[c]
	Residual	56.243	222	.253		
	Total	173.341	224			
3	Regression	123.973	3	41.324	184.993	.000[d]
	Residual	49.368	221	.223		
	Total	173.341	224			
4	Regression	128.439	4	32.110	157.324	.000[e]
	Residual	44.902	220	.204		
	Total	173.341	224			

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.923	.161		5.734	.000
	VPF1	.757	.045	.749	16.894	.000
2	(Constant)	.302	.155		1.941	.054
	VPF1	.489	.049	.484	9.946	.000
	VPE2	.474	.054	.430	8.837	.000
3	(Constant)	.047	.153		.310	.757
	VPF1	.243	.064	.241	3.803	.000
	VPE2	.461	.050	.418	9.146	.000
	VPF2	.321	.058	.320	5.548	.000
4	(Constant)	-.214	.157		-1.368	.173
	VPF1	.174	.063	.172	2.763	.006
	VPE2	.376	.051	.341	7.315	.000
	VPF2	.351	.056	.350	6.301	.000
	VPL2	.189	.040	.196	4.678	.000

Dependent Variable: VPE1

2) Risk Taking Orientation as Dependent (VPE2)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.729[a]	.531	.529	.54778
2	.799[b]	.639	.636	.48167
3	.819[c]	.670	.666	.46128
4	.832[d]	.693	.687	.44646

a. Predictors: (Constant), VPE1
b. Predictors: (Constant), VPE1, VPE3
c. Predictors: (Constant), VPE1, VPE3, VPI2
d. Predictors: (Constant), VPE1, VPE3, VPI2, VPF2
e. Dependent Variable: VPE2

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	75.745	1	75.745	252.427	.000[b]
	Residual	66.915	223	.300		
	Total	142.660	224			
2	Regression	91.155	2	45.577	196.450	.000[c]
	Residual	51.505	222	.232		
	Total	142.660	224			
3	Regression	95.635	3	31.878	149.817	.000[d]
	Residual	47.025	221	.213		
	Total	142.660	224			
4	Regression	98.808	4	24.702	123.928	.000[e]
	Residual	43.852	220	.199		
	Total	142.660	224			

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.931	.153		6.102	.000
	VPE1	.661	.042	.729	15.888	.000
2	(Constant)	.583	.141		4.141	.000
	VPE1	.405	.048	.447	8.404	.000
	VPE3	.401	.049	.433	8.150	.000
3	(Constant)	.315	.147		2.140	.033
	VPE1	.300	.052	.331	5.825	.000
	VPE3	.343	.049	.370	7.032	.000
	VPI2	.239	.052	.241	4.589	.000
4	(Constant)	.432	.145		2.974	.003
	VPE1	.399	.056	.440	7.165	.000
	VPE3	.369	.048	.399	7.746	.000
	VPI2	.294	.052	.297	5.634	.000
	VPF2	-.207	.052	-.228	-3.990	.000

Dependent Variable: VPE2

3) Entrepreneurial Intensity as Dependent (VPE3)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.724[a]	.524	.522	.59656
2	.764[b]	.584	.580	.55906
3	.770[c]	.592	.587	.55454

a. Predictors: (Constant), VPE2
b. Predictors: (Constant), VPE2, VPF2
c. Predictors: (Constant), VPE2, VPF2, VPL2
d. Dependent Variable: VPE3

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	87.400	1	87.400	245.585	.000[b]
	Residual	79.362	223	.356		
	Total	166.762	224			
2	Regression	97.376	2	48.688	155.778	.000[c]
	Residual	69.386	222	.313		
	Total	166.762	224			
3	Regression	98.801	3	32.934	107.096	.000[d]
	Residual	67.961	221	.308		
	Total	166.762	224			

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.572	.169		3.388	.001
	VPE2	.783	.050	.724	15.671	.000
2	(Constant)	.080	.181		.442	.659
	VPE2	.628	.054	.580	11.566	.000
	VPF2	.279	.049	.284	5.650	.000
3	(Constant)	-.070	.192		-.365	.716
	VPE2	.569	.060	.526	9.422	.000
	VPF2	.272	.049	.276	5.529	.000
	VPL2	.104	.048	.109	2.152	.032

Dependent Variable: VPE3

Role of Flexibility in Marketing Management: A Perspective on Indian Apparel Industry

Naveen Arora

Jagran Institute of Management, Kanpur, U.P., India

naveenarora_80@yahoo.com

Abstract. In business management, flexibility is the ability of a firm to rapidly respond and subsequently adapt to the changes in internal and external environment. In today's competitive marketplace, having flexibility is not an option but a necessity for firms to stay relevant and achieve organizational goals. Firms need to implement flexibility in all the organizational functions including manufacturing, operations, finance, human resource management and marketing. Marketing flexibility helps firms to quickly change or modify marketing variables according to the change in environment and customers' needs and desires. This paper aims to identify the marketing flexibility variables that influence firms' sales, growth and customer satisfaction. Regression analysis has been used to determine the existence and strength of relationship between dependant variable sales and different independent variables. The study establishes association between growth in sales and many independent marketing flexibility variables.

Keywords: Marketing flexibility, Sales, Customer satisfaction, Growth, Customer loyalty, Regression analysis.

1 Introduction

Globalization, accelerated technology development and constantly changing market conditions have increased competition among marketers in Indian marketplace. To stay relevant in this competitive market, marketers have been exploring diverse strategies to gain competitive advantage over competitors. Use of flexible marketing practices is one of the important practices for marketers to attain competitive advantage. Flexibility, in terms of business, can be defined as the firm's ability to respond and successively adapt to environmental changes and needs (Evans, 1991). A more flexible organization can respond to environmental changes in a more efficient and effective way. Flexibility is considered as a resource that enables innovativeness and can create vitality in the firm. While maintaining focus, coordination and control, flexible organizations facilitate innovation, creativity and pace.

Advancements in technology have significantly enhanced the importance of flexibility for marketing performance and customer satisfaction. Marketing being customer-centric concept, focuses on enhancing customer experience. Customer experience can be improved by better responding to varied needs of different customers. Firm that practices flexibility in management of marketing functions is capable of adapting itself according to varied customer needs. Flexibility in marketing functions helps marketers to provide customers with a personalized experience. It is essential for a marketer to practice market flexibility if its marketing strategy focuses on customized products and frequent product changes (Sethi and Sethi, 1990). Need for change or dynamism has increased considerably in recent years and this has helped the concept of flexibility to gain prominence (Sushil, 2001). Flexibility also enables an organization to effectively and efficiently respond to environmental changes by changing marketing mix. There are four basic dimensions of marketing mix: Product, Price, Place and Promotion. Marketers, having flexible marketing practices are capable of having flexibility in products, place, communication and even price as a response to customers' needs or requirements. However, marketers need to understand that implementation of flexibility in marketing functions is possible if the marketers have efficient information system. Efficient two-way sharing of information between marketer and customer should be taken as a prerequisite for flexibility. A strong relationship between marketer and customer can help in increasing cooperation and value creation. Superior customer value has been considered as one of the key drivers of customer satisfaction, loyalty and retention. As the relationships get closer, those are considered as partnerships or alliance rather than traditional spot market exchange. During the process of growth and development, marketers have moved from offering products to offering products/services, from product/services to solutions and from solutions to offering experience.

Apparel industry in India is one of the most prominent industries as it provides employment to a large number of skilled and non-skilled workers. Clothing industry also has significant contribution in Gross Domestic Product (GDP) of India. Apparel industry integrates different types of operations including manufacturing, marketing, human resource management and financial management. In developing countries like India, textile and clothing industry largely influences employment opportunities for different segments of society. It also facilitates the evolution and growth of micro and small enterprises. Indian apparel industry is characterized by presence of many national and international marketers. Some of these marketers practice flexibility in different aspects of marketing functions while some others do not have capability or willingness to practice flexibility. As a result of globalization, prospect customers have more knowledge and broader experience about offerings of different firms. Their expectations are much higher and they expect international quality products and services. It is observed that firms that fail to meet customer expectations, experience decline in sales and other related parameters (Arora and Banerjee, 2018)

This study aims to establish the relationship between growth in sales and different aspects of marketing flexibility for marketers of apparels. The study intents to investigate the role of marketing flexibility in determining firms' growth and customer satisfaction.

2 Literature Review

Flexibility is considered to be a concept that covers multiple aspects (Sushil, 2001). In business management, flexibility is a system that helps firm to achieve short-term goals like sustaining market share and long-term goals like sustaining profitability in case of any change in environment (Singh, 2010). Flexibility is a company-wide attempt to eliminate bottlenecks and to enhance responsiveness across the value chain (Hamel and Prahalad, 1989). Clearly, achieving flexibility requires commitment from all the departments and all the levels of management. Marketing flexibility can be defined as the ability of a marketer to rapidly enter (Lumpkin and Dess, 1996) or leave markets (Prahalad and Hamel, 1990), to launch new products (Kara et al., 2002) or modify (Slack, 1987), withdraw (Sethi and Sethi, 1990) existing products and reposition products (Harrigan, 1985) in response to the change in environment. Other aspects of marketing flexibility include: ability to modify delivery schedule (Corrêa, 1992), ability to quickly launch new promotion campaigns (Shalender and Singh, 2015) or withdraw ongoing campaigns (Shalender and Singh, 2015), ability to modify communication channels (Shalender and Singh, 2015), modify the quantity supplied (Vickery and Calantone, 1999), ability to change marketing strategies (Evans, 1991), modify customer service (Prahalad and Ramaswamy, 2004), changing suppliers and the country of manufacturing (Aaker and Mascarenhas, 1984) and ability to change price (Sahay, 2007).

It is being observed that for firms, the environment is changing at fast pace. Marketers are facing the challenges of shorter Product Life Cycles (PLCs), increase in demand for customization and technological innovation (Ariss and Zhang, 2002). With the change in external business environment for marketers, the need to adapt according to the environment is also growing (Badri et al., 2002). In recent years the uncertainty in the environment has grown as a result of changes in customer expectations, competition, and technology (Zhang et al., 2002). Rapid development of new process and product technologies and increased competition has contributed to shorter Product Life Cycles (PLCs) and more frequent product obsolescence (Franza and Gaimon, 1998). Changes in customers' tastes, psychographics or demographics are also responsible for forcing products to enter the decline stage of the PLC or decline in market (Karakaya, 2000). Many marketers tend to enter into new products markets more rapidly as a response to shortened PLCs (Griffin, 1993). It has been established that the marketers have to enter into new markets or exit from an existing market because of competitors' actions and their abilities to launch new products (Kim et al., 1999). Flexible firms rapidly response to change in the environment and enter into new markets as soon as an opportunity emerges. Product profitability is adversely influenced for the firms that are late in market entry (Franza and Gaimon, 1998). Flexible marketing enhances customers' experience by improving the range of available products, raising the marketer's ability to respond quickly and improving performance over wide range of products (Upton, 1995).

Marketer's flexibility, reputation and level of information sharing also influence customers' perceived value (Hansen et al., 2008). Marketers require strong partnerships and relationships built on understandings and trust of mutual benefits with all stakeholders to enhance the capacity for flexibility (Child and McGrath, 2001). In serving customers,

flexibility and alliances are more important for the products characterized by complex buying behavior where a number of members of the buying group in the customer's company are involved in making purchase (Kotler and Keller, 2013). Researches have found that Indian consumers are accompanied by friends, relatives or peer groups during the process of apparel buying (Arora and Banerjee, 2014). It is very important for marketers to meet customers' expectations as customers switch to other brands or stop using a particular brand or reduce the consumption of a brand if their expectations are not met (Karakaya, 2000).

Role of flexibility is very much implicit in marketing functions (Combe and Greenley, 2004). In business management, the role of flexibility in manufacturing processes (Prabhaker, 2001), human resource management and strategic management has been examined widely. However, there are limited studies focusing on the dimensions of marketing flexibility and the role of marketing flexibility in firm's growth and customer satisfaction.

3 Research Methodology

A comprehensive study has been conducted to determine the role of flexibility in improving sales of different firms of apparel industry. To evaluate the impact of flexibility, sales has been used as an indicator of customer satisfaction and experience; as the primary payoff from customers' thoughts, feelings, perception and satisfaction is the purchase they make (Keller and Lehmann, 2006). Secondary literature has been reviewed to explore the topic and to comprehend different aspects of flexibility in marketing management. Primary data has been collected from fifty two marketers engaged in marketing of apparels. For this, structured interviews have been conducted using questionnaires. Questionnaires include questions related to marketers' ability to rapidly modify different aspects of marketing functions in response to change in environment. Marketers have been asked to rate different statements from 1 to 5, where '1' represents 'Strongly disagree' and '5' represents 'Strongly agree'. Data related to marketers' sales trend has been used to determine the impact of different aspects of marketing flexibility on growth in sales. Data has been analyzed using regression analysis.

Table 1 exhibits construction of scale and different aspects of flexible marketing along with the sources.

Table 1. Flexible marketing aspects and sources

S. No.	Construct	No. of Aspects	Source
1	Ability to rapidly enter into new markets	1	Lumpkin and Dess, 1996
2	Ability to rapidly leave existing markets	1	Prahalad and Hamel, 1990
3	Ability to launch new products	1	Kara et al., 2002
4	Ability to modify existing products	1	Slack, 1987
5	Ability to withdraw existing products	1	Sethi and Sethi, 1990
6	Ability to rapidly reposition products	1	Harrigan, 1985
7	Ability to modify delivery schedule	1	Corrêa, 1992
8	Ability to quickly launch new promotion campaigns, ability to withdraw ongoing promotion campaigns, ability to modify communication channels	3	Shalender and Singh, 2015
9	Ability to modify the quantity supplied	1	Vickery and Calantone, 1999
10	Ability to modify customer service	1	Prahalad and Ramaswamy, 2004

11	Ability to change suppliers and the country of manufacturing	2	Aaker and Mascarenhas, 1984
12	Ability to change price	1	Sahay, 2007

Hypotheses have been developed to establish relationships between dependant variable sales and different aspects of marketing flexibility which are considered as independent variables or predictors.

Hypothesis 1

$H^{0\ \text{Entry into new markets}}$: There is no association between growth in sales and firm's ability to rapidly enter into new markets.

Hypothesis 2

$H^{0\ \text{Leave existing markets}}$: There is no association between growth in sales and firm's ability to rapidly leave existing markets.

Hypothesis 3

$H^{0\ \text{Launch new products}}$: There is no association between growth in sales and firm's ability to launch new products.

Hypothesis 4

$H^{0\ \text{Modify existing products}}$: There is no association between growth in sales and firm's ability to modify existing products.

Hypothesis 5

$H^{0\ \text{Withdraw existing products}}$: There is no association between growth in sales and firm's ability to rapidly withdraw existing products.

Hypothesis 6

$H^{0\ \text{Reposition products}}$: There is no association between growth in sales and firm's ability to rapidly reposition products.

Hypothesis 7

$H^{0\ \text{Modify delivery schedule}}$: There is no association between growth in sales and firm's ability to modify delivery schedule.

Hypothesis 8

$H^{0\ \text{Launch new promotions}}$: There is no association between growth in sales and firm's ability to quickly launch new promotion campaigns.

Hypothesis 9

$H^{0\ \text{Withdraw promotion campaign}}$: There is no association between growth in sales and firm's ability to withdraw ongoing promotion campaigns.

Hypothesis 10

$H^{0\ \text{Modify communication channels}}$: There is no association between growth in sales and firm's ability to modify communication channels.

Hypothesis 11

$H^{0\ \text{Modify quantity supplied}}$: There is no association between growth in sales and firm's ability to modify quantity supplied.

Hypothesis 12

$H^{0\ \text{Modify customer service}}$: There is no association between growth in sales and firm's ability to modify customer service.

Hypothesis 13

$H^{0\ \text{Change suppliers}}$: There is no association between growth in sales and firm's ability to change suppliers.

Hypothesis 14

$H^{0\ \text{Change country of manufacturing}}$: There is no association between growth in sales and firm's ability to change country of manufacturing.

Hypothesis 15

$H^{0\ \text{Change price}}$: There is no association between growth in sales and firm's ability to rapidly change price.

4 Analysis

Regression analysis is a statistical procedure that helps in determining associative relationship between one metric dependant variable and one or more independent variables. This analysis finds out the existence of an association and the strength of relationship. It also determines the mathematical equation relating the independent and dependant variables (Malhotra and Dash, 2009). Cases that involve a single dependant variable and more than one independent variables, are analyzed using multiple regression. Table 2 exhibits the results of ANOVA.

Table 2. ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	49.571	15	3.305	26.514	.000
Residual	4.487	36	.125		
Total	54.058	51			

a. Predictors: (Constant), Ability_to_change_price, Ability_to_change_the_country_of_manufacturing, Ability_to_withdraw_existing_products, Ability_to_rapidly_leave_existing_markets, Ability_to_modify_existing_products, Ability_to_change_suppliers, Ability_to_rapidly_reposition_products, Ability_to_modify_the_quantity_supplied, Ability_to_withdraw_ongoing_promotion_campaigns, Ability_to_launch_new_products, Ability_to_modify_customer_service, Ability_to_quickly_launch_new_promotion_campaigns, Ability_to_modify_delivery_schedule, Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_communication_channels

b. Dependent Variable: Growth_in_Sales

As the F value is statistically significant, it could be derived that the model explains a significant amount of variance in the outcome variable. Since p-value < 0.05, the null hypotheses of no association are rejected. It is derived that there exists enough evidence to conclude that at least one of the predictors is useful for predicting growth in sales; therefore the model is useful.

Table 3 shows the values of R and R square (Coefficient of multiple determination). This table determines what % variability in the dependant variable is accounted for by all of the independent variables together. The footnote on this table shows the variables that have been included in this equation.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.958[a]	.917	.882	.35305

a. Predictors: (Constant), Ability_to_change_price, Ability_to_change_the_country_of_manufacturing, Ability_to_withdraw_existing_products, Ability_to_rapidly_leave_existing_markets, Ability_to_modify_existing_products, Ability_to_change_suppliers, Ability_to_rapidly_reposition_products, Ability_to_modify_the_quantity_supplied, Ability_to_withdraw_ongoing_promotion_campaigns, Ability_to_launch_new_products, Ability_to_modify_customer_service, Ability_to_quickly_launch_new_promotion_campaigns, Ability_to_modify_delivery_schedule, Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_communication_channels

b. Dependent Variable: Growth_in_Sales

Value of R square is 0.917, therefore about 91.7% of the variation in the growth in sales is explained by the 15 independent variables.

Table 4 exhibits the coefficient values for regression analysis.

Table 4. Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.562	.266		-2.112	.042		
Ability_to_rapidly_enter_into_new_markets	.201	.110	.227	1.827	.036	.198	5.049
Ability_to_rapidly_leave_existing_markets	.085	.084	.079	1.012	.318	.381	2.625
Ability_to_launch_new_products	.126	.109	.218	1.152	.027	.221	4.519
Ability_to_modify_existing_products	.105	.089	.102	1.179	.246	.305	3.274
Ability_to_withdraw_existing_products	-.046	.093	-.043	-.500	.620	.313	3.192
Ability_to_rapidly_reposition_products	.053	.105	.042	.500	.620	.323	3.099
Ability_to_modify_delivery_schedule	.270	.101	.282	2.681	.011	.209	4.787
Ability_to_quickly_launch_new_promotion_campaigns	.048	.095	.047	.508	.614	.271	3.697
Ability_to_withdraw_ongoing_promotion_campaigns	.049	.103	.052	.476	.637	.194	5.142
Ability_to_modify_communication_channels	-.009	.121	-.008	-.075	.940	.194	5.159
Ability_to_modify_the_quantity_supplied	.082	.104	.078	.789	.435	.238	4.199
Ability_to_modify_customer_service	.319	.106	.290	3.003	.005	.248	4.034
Ability_to_change_suppliers	.008	.074	.008	.108	.915	.373	2.681
Ability_to_change_the_country_of_manufacturing	.017	.088	.011	.194	.847	.696	1.436
Ability_to_change_price	-.127	.101	-.103	-1.256	.217	.346	2.893

a. Dependent Variable: Growth_in_Sales

In multiple regression model, Variance Inflation Factor (VIF) is a measure of how much the variance of the estimated regression coefficient is inflated by the existence of correlation among the predictor variables in the model. .VIFs exceeding 4 in some predictors justifies further investigation. In addition, values of $p > .05$ and beta coefficients are not statistically significant for many predictors. Therefore, forward selection procedure has been used. This procedure chooses a subset of the predictor variables for the final model. This procedure is also a good choice when multicollinearity is a problem.

Table 5 exhibits the results of forward selection procedure ANOVA.

Table 5. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.119	1	38.119	119.584	.000[a]
	Residual	15.938	50	.319		
	Total	54.058	51			
2	Regression	45.567	2	22.783	131.483	.000[b]
	Residual	8.491	49	.173		
	Total	54.058	51			
3	Regression	48.063	3	16.021	128.278	.000[c]
	Residual	5.995	48	.125		
	Total	54.058	51			
4	Regression	48.949	4	12.237	112.587	.000[d]
	Residual	5.109	47	.109		
	Total	54.058	51			

a. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets

b. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_delivery_schedule

c. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_delivery_schedule, Ability_to_modify_customer_service

d. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_delivery_schedule, Ability_to_modify_customer_service, Ability_to_launch_new_products

e. Dependent Variable: Growth_in_Sales

Since p-values < 0.05, the null hypotheses of no association are rejected. It is derived that there exists enough evidence to conclude that four predictors are useful for predicting growth in sales; therefore the model is useful.

Table 6 shows the values of R and R square (Coefficient of multiple determination).

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.840[a]	.705	.699	.56459
2	.918[b]	.843	.837	.41627
3	.943[c]	.889	.882	.35340
4	.952[d]	.905	.897	.32968

a. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets

b. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_delivery_schedule

c. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_delivery_schedule, Ability_to_modify_customer_service

d. Predictors: (Constant), Ability_to_rapidly_enter_into_new_markets, Ability_to_modify_delivery_schedule, Ability_to_modify_customer_service, Ability_to_launch_new_products

e. Dependent Variable: Growth_in_Sales

Values of R square and adjusted R square increase by adding predictors. Its could be concluded that about 90.5% of the variation in the growth in sales is explained by the 4 independent variables.

Table 7 exhibits the coefficient values for regression analysis. Regression equation can be determined using these values.

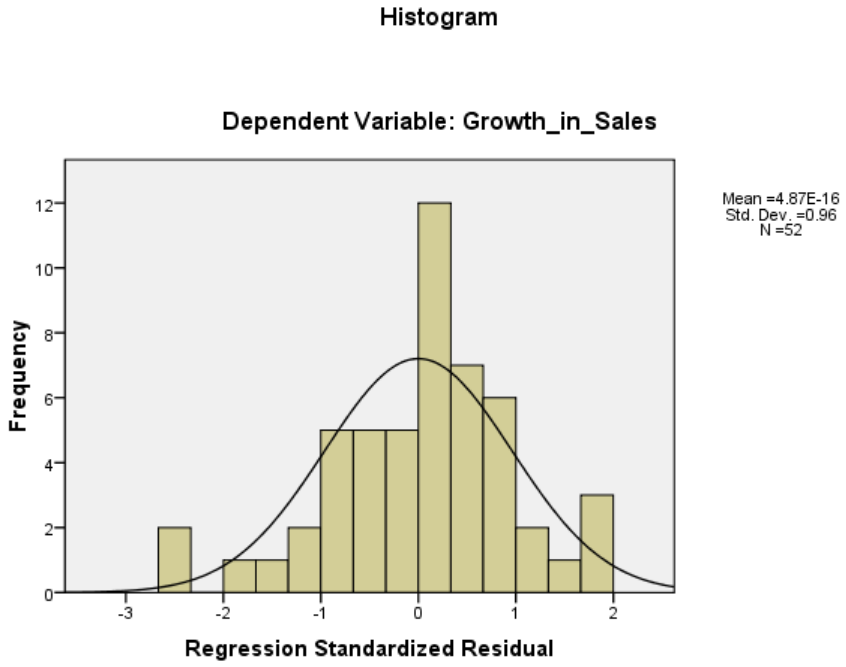
Table 7. Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.499	.097		1.680	.029		
	Ability_to_rapidly_enter_into_new_markets	.858	.078	.840	10.935	.000	1.000	1.000
2	(Constant)	-.099	.137		-.416	.034		
	Ability_to_rapidly_enter_into_new_markets	.563	.073	.551	7.692	.000	.624	1.603
	Ability_to_modify_delivery_schedule	.451	.069	.470	6.556	.000	.624	1.603
3	(Constant)	-.413	.113		-1.935	.041		
	Ability_to_rapidly_enter_into_new_markets	.305	.085	.298	3.586	.001	.334	2.993
	Ability_to_modify_delivery_schedule	.416	.059	.434	7.063	.000	.613	1.632
	Ability_to_modify_customer_service	.386	.086	.351	4.470	.000	.376	2.662
4	(Constant)	-.523	.103		-2.579	.113		
	Ability_to_rapidly_enter_into_new_markets	.216	.085	.211	2.537	.015	.290	3.452
	Ability_to_modify_delivery_schedule	.335	.062	.349	5.409	.000	.483	2.070
	Ability_to_modify_customer_service	.376	.081	.342	4.663	.000	.375	2.667
	Ability_to_launch_new_products	.221	.077	.206	2.856	.006	.388	2.580

a. Dependent Variable: Growth_in_Sales

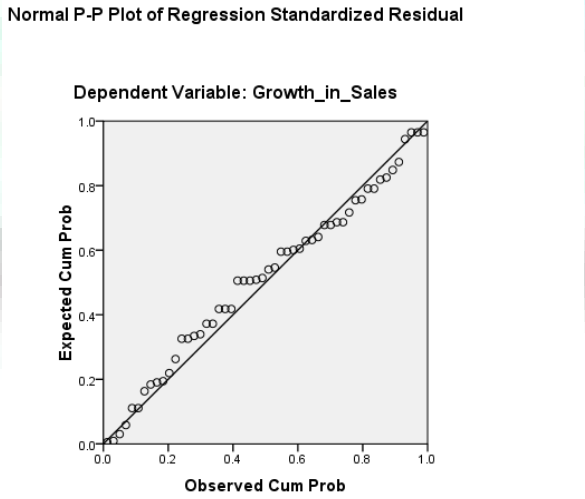
The coefficients table shows that all b coefficients for model are statistically significant.
Predicted Growth in sales = - 0.52 + 0.22* Ability to rapidly enter into new markets+ 0.33 * Ability to modify delivery schedule+ 0.38 * Ability to modify customer service + 0.22 * Ability to launch new products
Residual plots are used to examine normality assumption. Figure 1 exhibits residual plots for regression analysis.

Figure 1. Residual Plots



A scatter plot allows visual assessment of the relationship between the dependent variable and predictors. The scatter plot shows the fit, simultaneous confidence intervals and prediction intervals. Scatter Plot is exhibited in Figure 2.

Figure 2. Scatter Plot



5 Findings

It is found that in apparel industry, firms' sales, which has been used as an indicator of customer satisfaction and experience (Keller and Lehmann, 2006) is influenced by marketing flexibility. Through this study, fifteen aspects or independent variables of marketing flexibility have been identified. The strength of association between dependent variable growth in sales and independent variables has been determined in this study. This study establishes strong relationship between growth in sales and four predictors (Firm's ability to rapidly enter into new markets, Ability to

modify delivery schedule, Ability to modify customer service, Ability to launch new products). The study could not establish significant relationship between dependent variable growth in sales and other predictors.

6 Conclusion

The paper determines various aspects and dimensions of flexibility in marketing as well as the positive impact of flexibility on growth in sales, customer satisfaction and retention. Flexibility plays important role in marketing management and helps in improving customer experience and satisfaction. This enhanced experience and satisfaction leads to improved perception and enhanced customer loyalty, which subsequently leads to growth in sales. Through this study, the strength of association between growth in sales and different independent flexibility variables has also been established. It is evident that the flexibility variables that have strong relationship with growth in sales are the most important variables or aspects for marketers of apparels in India. Marketers are required to strengthen all the important variables or aspects of marketing flexibility to improve sales and sustain growth.

References

1. Aaker, D. A. and Mascarenhas, B. (1984), The need for strategic flexibility. *Journal of Business Strategy*, 5(2), 74-82.

2. Ariss, S. and Zhang, Q. (2002), The impact of flexible capability on the product-process matrix: An empirical examination, *International Journal of Production Economics*, 76, 135-145.

3. Arora, N. and Banerjee, N. (2014), A study of consumer buying behavior in apparels' segment, *Review of Business and Technology Research*, 11(1), 825-831.

4. Arora, N. and Banerjee, N. (2018), Why do small brands decline: A perspective on Indian apparel industry, Flexible Strategies in VUCA Markets, Springer Nature Singapore Pte Ltd.

5. Badri, M.A., Davis, D, and Davis, Do. (2000), Operations strategy, environmental uncertainty and performance: A path analytic model of industries in developing countries, *Omega,* 28, 155-173.

6. Child, J. and McGrath, R. (2001), Organizations unfettered: Organizational form in an information-intensive economy, *Academy of Management Journal*, 44(6), 1135-1148.

7. Combe, I. A., and Greenley, G. E. (2004), Capabilities for strategic flexibility: A cognitive content framework, *European Journal of Marketing*, 38(11/12), 1456–1480.

8. Corrêa, H.L. (1992), The links between uncertainty, variability of outputs and flexibility in manufacturing systems, Ph.D. thesis, School of Industrial and Business Studies, University of Warwick.

9. Evans, S. (1991), Strategic flexibility for high technology manoeuvres: A conceptual framework, *Journal of Management Studies,* 28(1), 69-89.

10. Franza, R. and Gaimon, C. (1998), Flexibility and pricing decisions for high-volume products with short life cycles, *The International Journal of Flexible Manufacturing Systems*, 10, 43-71.

11. Foretell, C. and Wernerfelt, B. (1987), Defensive marketing strategy by customer compliant management: A theoretical analysis, *Journal of Marketing Research*, 24, 237-346.

12. Griffin, A. (1993), Metrics for measuring product development cycle time, *Journal of Product Innovation Management*, 10, 112-125.

13. Hamel, G. and Prahalad, C. K. (1989), Strategic Intent, *Harvard Business Review*, May-June, 63–76.

14. Hansen, H., Samuelsen, B. M., and Silseth, P. R. (2008), Customer perceived value in B-t-B service relationships: Investigating the importance of corporate reputation, *Industrial Marketing Management*, 37, 206–217.

15. Harrigan, K. R. (1985), *Strategic Flexibility: The Economics of Strategic Planning.* Lexington: Lexington Books.

16. Karakaya, F. (2000), Market exit and barriers to exit: theory and practice, *Psychology and Marketing*, 17(8), 651-668.

17. Kara, S., Kayis, B., and O'Kane S. (2002), The role of human factors in flexibility management: A survey, *Human Factors and Ergonomics in Manufacturing,* 12(1), 75-119.

18. Keller, K. L. and Lehmann, D. R. (2006), Brands and branding: Research findings and future priorities, *Marketing Science*, 25(6), 740-749.

19. Kim, N., Bridges, E., and Srivastava, R.K. (1999), A simulation model for innovative product category sales diffusion and competitive dynamic, *International Journal of Research in Marketing*, 16, 95-111.

20. Kotler, P. and Keller, K.L. (2013), *Marketing Management*, Pearson, Prentice Hall.

21. Lumpkin, G. T. and Dess, G. G. (1996), Clarifying the entrepreneurial orientation construct and linking it to performance, *Academy of Management Review*, 21(1), 135-172.

22. Malhotra, N. K. and Dash, S. (2009*), Marketing Research: An Applied Orientation*, Prentice Hall, Pearson Education.

23. Prabhaker, P. (2001), Integrated marketing-manufacturing strategies, *Journal of Business and Industrial Marketing*, 16(2), 113-128.

24. Prahalad, C.K. and Ramaswamy, V. (2004), *The Future of Competition: Co-creating Unique Value with Customers*, Boston Massachusetts: Harvard Business School Press.

25. Sahay, A. (2007). How to reap higher profits with dynamic pricing, *MIT Sloan Management Review*, 48(4), 53–60.

26. Sethi, A.K. and Sethi, S.P. (1990), Flexibility in manufacturing: A survey, *International Journal of Flexible Manufacturing Systems,* 2(4), 289-328.

27. Shalender, K. and Singh, N. (2015), Marketing flexibility: Significance and implications for automobile industry, *Global Journal of Flexible Systems Management*, 16(3), 251-262.

28. Singh, N. (2010), A conceptual framework for flexible marketing system, *Global Journal of Flexible Systems Management*, 11(4), 11-16.

29. Slack, N. (1987), The flexibility of manufacturing flexibility, *International Journal of Operations and Production Management,* 7(4), 35-45.

30. Sushil (2001), Demythifying flexibility, *Management Decision,* 39(10), 860-865.

31. Upton, D. M. (1995), What really makes factories flexible, *Harvard Business Review*, 73(4), 74–84.

32. Vickery, S. and Calantone, R. (1999), Supply chain flexibility: An empirical study, *The Journal of Supply Chain Management*, 35(3), 25-33.

33. Zhang, Q., Vonderembse, M., and Lim, J. (2002), Manufacturing flexibility: Defining and analysing relationships among competence, capability, and customer satisfaction, *Journal of Operations Management*, 327, 1-19.

Influence of Product Placement on Purchase Intention – A study with reference to Tamil Nadu

S.Dinesh Kumar[1], Dr.V. Hemanth Kumar[2]

[1]Research scholar, Bharathiyar University, Coimbatore, Assistant professor,
Sri Sai Ram Institute of Management studies, Chennai,
[2]Professor- Sri Sai Ram Institute of Management studies, Chennai
{dhineselvaraj, vhk.sai} @gmail.com

Abstract. In earlier days the products were purchased based on the needs of the consumer. In this context when a product is promoted or used by a celebrity in movie which is very explicit that gains the attraction of the customers to a larger extent. When the product placed in the movie is associated with certain attributes like clear visibility, attractiveness, credibility and status quotation, then the viewers consider the products to purchase while making a purchase decision. This aspect prompted the researcher to conduct a study to understand the influence of product placement in movies which is resulting in the purchase intention of the consumers amongst 6 selected cities in Tamil Nadu with a sample size of 360 diversified set people. Structured questionnaire was used to collect the data and SPSS was used for statistical analysis. Correlation and Regression analysis were carried out and the results suggest that product placement in movies have more influence than the normal mode of advertisements.

Keywords: Product Placement, Celebrity endorsement, visibility, attractiveness, credibility and status quotation, Purchase Intention

1 Introduction

The world is evolving in a greater phase that makes every individual to become a icon in their own regard. When their legendary skills are unappreciated by the external environment they relate their image in the celebrities of the movies for self-appreciation. When that relation is backed up with the attractiveness of the celebrity and knowledge of the products its becomes a undisputed decision for the people to purchase the product. When the same celebrity responds with other set of product which is clearly visible and attractive that implies the image of the celebrity then the viewers are fascinated by the products promoted and jump into decision of purchasing the product. We are always thinking that if our favorite celebrity is using them. Then we should use that to be like them (Khatri 2006). In today's scenario the best promotional strategy used by marketers to influence customers is by showing celebrities with their products in their respective medium so as to include different appeals lie, exciting, absurdity, sexual etc. Belch, G. and Belch, M. (2008) acknowledged that the main aim of formulating such strategies is to get high brand revelation, longing, concentration and curiosity. To do so, marketers attach famous personalities' with their products in the respective medium. McCracken (1989) stated that these famous personalities' had great influence on the consumer's purchase intention that's why it becomes the most attractive tool of advertising now a day. The major aim to do advertising and adopt this strategy is to influence customers towards their products (Ohanian 1990).

2 Product Placement

In this current situation movies are considered to be one of the most potent medium to reach the target audiences. Promoting a product in movies has two advantages viz. there is huge recognition for the product which blends with the situation of the movie and there is a celebrity who adds value to the existing product. This amplifies the intensity of the recognition of the product in the minds of the viewers which replicates while purchasing of the product. The marketers can categorically choose the region for which the product to be promoted and use the celebrities and movies showcased in that region. When a product is promoted in movies the products get blended with the fictional content of the movie and gels with status quotation of the celebrities. The only problem would be to identify the right movie and the right celebrity. Thus product places is defined as discreet and planned entry for promotion Balasubramanian. et al (2006).

3 Celebrities

Erdogan (1999) concludes that celebrities are those people who have well known by the large number of people. They have special uniqueness and features like magnetism, unusual standard of living or special skills that are nor commonly experiential in common people. That it can be said that in society they are different from the common people. Among the model forms of celebrities, actors (e.g. Saif Ali khan, Shan, Salman Khan, Amitabh Bachan etc), models (e.g. Pareeniti Chopra, Ali Zafar, Bipasha Basu, Kareena Kapoor etc), Sports-men (e.g. Yousuf Pathan, Shahid Afridi, Sachin Tendulker, etc.) are significant.

4 Celebrity endorsement

Khatri (2006) studied that the celebrity endorsement is the Promotion strategy to attract the customers. By analyzing the current market, now it's become the need of the marketers to use the different famous personalities to relate with their brands to create unique identity of the brand and to do famous his company's brand or product, which results high expenditure for the company to use that strategy, however nowadays it is used to be a powerful strategic tool to get maximum profit. It also shows that this can carry risk, because there is no sureness that the celebrity can come up with the sales generation of the firm. But it creates a buzz and gives popularity to the company and the brand. This can increase the expectation of the customers in terms of real star by delivering the company promise. There are certain perspectives occur where the real persons can work better than the celebrities' endorsement, but not always.

5 Visibility, Attractiveness, Credibility, Status Quotation

The image of the celebrities is not static and there is adequate risk of change in image. A successful movie will keep the celebrity in the limelight whereas consecutive failures will have a huge stake in the image of the celebrities. When a successful celebrity endorses a particular product there appeals a greater amount of visibility compared to non successful celebrities. (Erdogan & Kitchen 1998, Irwin, Sutton & McCarthy 2002). The attractiveness and credibility of the product and celebrity depends on the effectiveness of a medium and the necessity of the message and it is also depended on perceived level of expertise and trustworthiness of the medium (Misra,S and S,. Beatty, (1990)). The status quotation of the viewers are implied on the celebrity and celebrity can affect the brand they endorse strongly due to the dual effect of his/her star status on the one hand and physical appeal on the other Kamins, (1990).

This information has extended by Zafar (2009) and suggested that the celebrities' endorsements in movies are being used to get the attention of the customers, by involving the best models in the advertisement and motivate people to get attention towards the product because this will ultimately raise the customer toward that company's product.

6 Purchase Intention

Purchase Intention is a process by which a people search for the product/services they need or want, make decision to buy the required and most suitable one from different alternatives, use and the dispose it. For making marketing decision buying process model is playing a very important role for any one. It makes marketers to think about each step of this process rather than just purchase decision because if marketers just consider the purchase decision, it may be too late for a business to influence the choice of customers. According to this model the customer pass through all stages for purchasing every goods or services. However, in more regular purchases, customer often skips some the stages (Kirmani & Shiv1998). Some other factors influencing the purchase intention are cultural, social, family, psychological parameters of individuals Brewster, Sparrow and Vernom (2007).

7 Review of Literature

Advertisers regularly practice the strategies intended to attract customer's interest to their message and to differentiate their offerings from rival products with the anticipation of influencing buying behavior of the customer. In today's competitive world, a quality is positioned on an approach, which can accomplish these objectives. One challenge at such a plan includes the use of a celebrity representative. According to Atkin and Block (1983), there are numerous bases as to why a famous endorser may be dominant. First, such a representative attracts consideration toward the commercials into the messy flow of communication. In addition, celebrities are conventionally observed

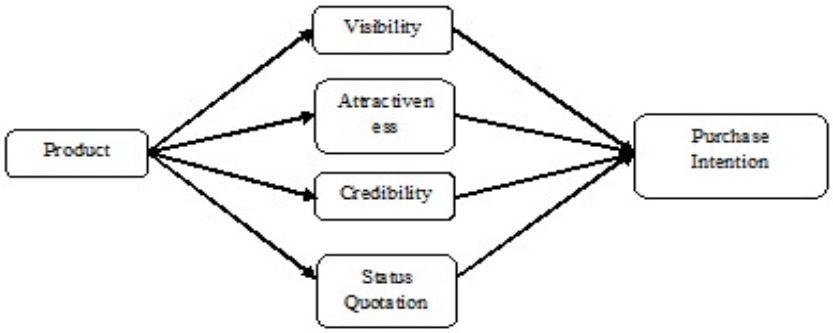
as being greatly active individuals with eye- catching and likeable traits (Kamins et al. 1989). The use of famous persons in promotions is traced back to nineteenth century and these general promotional practices have revealed a large quantity of intellectual as well as realistic considerations. Mainly academic analysis of celebrity support encompasses the sphere of spokesperson credibility and charismatic representatives, and recommends that famous persons exercise their impact on customers through apparent traits (Ahmed 2012; Ohanian 1990, 1991). A number of research studies reveal that use of eye- catching celebrity serve as a foundation to enhance feelings towards the ads. This mind-set to the commercials is identified as psychological circumstances that be exercised by persons to systematize the manner, how to recognize the surroundings as well as organize the manner a person react towards it (Haghirian & Madlberger 2005). Today the mass media are flooded through descriptions of along with information concerning superstars, and because of a consequence, celebrities have high repute, distinctive traits, and fascinating descriptions according to the community's opinion (Giles 2000; McCracken 1989). Celebrities regularly emerge in promotions in connection among customer goods or services. By means of skill to pierce the hectic mess of publicity, portray customer consideration, produce high memory rates, generate as well as distinguish brand descriptions thus, create trade and income, superstar endorsement have demonstrated to be a helpful approach. No doubt dealer spends huge amount of capital in utilizing superstars to sponsor their brands (Agrawal & Wagner 1995; Erdogan 1999; Kaikati 1987; Mathur et al. 1997; Gabor et al. 1987). McCracken (1998) proposes that superstar is considered like memorial, entertainer or representative of the business organization. Investigation has established that spokesperson endorsement influence consumers' mind-set in common and it may change the feelings of customers towards the commercial and products as well. This may perhaps effect in improvement of acquisition plan and as an outcome in increase of trade. Researchers have intended for extensive concentration to consumer's mind-set to the commercial as a sentimental creation and intervening influence on brand attitudes and acquiring intentions (Lutz et al. 1983; MacKenzie et al. 1986; Mitchell & Jerry 1981; Shimp 1981, Ahmed et al. 2014).

8 Research Objectives

- ✓ To examine the influence of product placement on purchase intention.
- ✓ To analyze the perception about the product placement.
- ✓ To analyze influence of celebrity in product placement.
- ✓ To analyze which product placements attributes more influence amongst the respondents.

9 Conceptual framework & Hypotheses

The framework formulated gives an understanding of product placement and its attributes influence on purchase intention of the respondents which also emphasizes the feasible model for understanding product placement and the consumers' perception towards product placement across various consumers (Biswas & Hussain 2009).



Thus the following hypotheses were formulated:

H0: There is no influence of product placement on purchase intention. H1: There is an influence of product placement on purchase intention.

H2: There is no any relationship between product placements on purchase intention. H2a: There is a relationship between product placements on purchase intention.

H3a: There is a relationship among the product placement attributes. H3b: There is no any relationship among the product placement attributes.

10 Research Description

The type of research design is descriptive in nature for which a structured questionnaire was framed which emphasizes the influence of product placement on purchase intention, model developed based on Kumar (2010). The questionnaire was distributed to people among the 6 cities in Tamil Nadu viz. Chennai, Coimbatore, Trichy, Madurai, Salem and Thanjavur. Out of the questionnaire distributed in each city a total of 360 filled in questionnaire was received which reflects the sample size of the study. The statistical analysis was done in SPSS to obtain the results by using Correlation and regression analysis.

11 Results and Discussion

Table 1. Reliability Statistics

Variable No	Variables	Cronbach Alpha (α)
1	Visibility	0.982
2	Attractiveness	0.864
3	Credibility	0.916
4	Status Quotation	0.818

All the constructs in the conceptual mode were put for composite reliability for internal consistency and the outcome of the same was above 0.8 (Cronback Alpha value is greater than 0.5) which clearly indicates good reliability among the constructs.

11.1 Advertisement Medium Analysis

The various advertisement medium were analyzed for the influence it has on the purchase intention among respondents which clearly shows that movies as a medium plays a bigger role followed by TV ads, newspapers, Internet and Magazines.

Table. 2. Medium advertisement Medium Analysis

S.No	Ad Medium	Frequency	Percentage
1	TV Ads	91	25.3
2	Magazines	40	11.1
3	Internet	51	14.2
4	Movies	122	33.9
5	Newspapers	56	15.6
	Total	360	100

11.2 Celebrity versus Non-celebrity Analysis

Since the movies are ruled by celebrities the respondents were questioned about the influence of celebrity endorsed products and non-celebrity endorsed products where the results were prompted that celebrity endorsed advertisements has a greater influence than the non celebrity endorsed products.

Table. 3. Celebrity Vs. Non-celebrity Analysis

S.No	Particulars	Frequency	Percentage
1	Celebrity endorsed advertisements	292	81.1
2	Non-Celebrity endorsed advertisements	68	18.9
	Total	360	100

11.3 Correlation Analysis

The analysis shows that the highest correlations is among the visibility and purchase intention, which is .920, this shows that there is a significant relationship between visibility and the purchase intention. The second highest correlation of purchase intention is with the status quotation, followed by the attractiveness and then credibility.

Table. 4. Correlation Analysis

Correlations						
		Visibility	Attractiveness	Credibility	Status Quotation	Purchase Intention
Visibility	Pearson Correlation	1	.668**	.469**	.691**	.920**
	Sig. (2-tailed)		0	0	0	0
	N	400	400	400	400	396
Attractiveness	Pearson Correlation	.668**	1	.656**	.634**	.733**
	Sig. (2-tailed)	0		0	0	0
	N	400	400	400	400	396
Credibility	Pearson Correlation	.469**	.656**	1	.549**	.507**
	Sig. (2-tailed)	0	0		0	0
	N	400	400	400	400	396
Status Quotation	Pearson Correlation	.691**	.634**	.549**	1	.751**
	Sig. (2-tailed)	0	0	0		0
	N	400	400	400	400	396
Purchase Intention	Pearson Correlation	.920**	.733**	.507**	.751**	1
	Sig. (2-tailed)	0	0	0	0	
	N	396	396	396	396	396
**. Correlation is significant at the 0.01 level (2-tailed).						

Secondly Status Quotation has the highest relationship with the purchase intention, which is .751, which is followed by the attractiveness and then credibility. Thirdly, attractiveness is the highest relationship with the purchase intention with .733, followed by credibility.

Hence all sub-variables have significant relationship on purchase intention, where visibility, which has highest impact with value of 0.920; while low relationship is credibility

.507. So the analysis can be concluded that all the variables have significant relationship amongst each other and they also have high relationship with the purchase intention.

11.4 Regression Analysis

Model Summary

The influence of product placements on purchase intention concludes the adjusted R square to be .883 which is more than 0.6 and justifies that the adopted model to be fit.

Table. 5. Model Summary

Model	R	R Square	Adjusted R Square	Std.Error of the Estimate
1	.941[a]	0.886	0.883	1.686

a. Predictors: (Constant), visibility, attractiveness, credibility, status quotation

11.5 Coefficients Analysis

Since Beta is .694 on the visibility and t value is 18.781 & $p<0.05$, it clearly illustrates that the visibility has a significant influence on purchase intention and also the attractiveness has $t=4.638$ & $p<0.05$, on Status quotation has which has $t=4.750$ & $p<0.05$, implies that both attractiveness & Status quotation have a significant influence on purchase intention as well.

Since the credibility has the negative result (B), it shows that the increase in credibility decreases the influence on the purchase intention. Finally it could be concluded that product placement has the huge influence on purchase intention.

Table. 6. Coefficients Analysis

Coefficients[a]					
	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	T	Sig.
(Constant)	0.663	0.411		1.612	0.109
Visibility	1.216	0.065	0.694	18.781	0
Attractiveness	0.528	0.114	0.18	4.638	0
Credibility	-0.082	0.095	-0.029	-0.862	0.39
Status Quotation	0.33	0.069	0.173	4.75	0
a. Dependent Variable: Purchase Intention					

Therefore, H1 is accepted hence it is proved that there is a notable and worthy influence of product placement over the purchase intention and H0 is rejected.

Moreover, H2a is also accepted that there is a significant relationship between product placement over the purchase intention and H2 is rejected. This research also suggested that H3a is accepted, which states that there is a relationship between all the attributes of product placement over the purchase intention and H3b is rejected.

12 Conclusion

This research suggests that the Celebrity endorsed advertisements are more attractive than the non-celebrity endorsed products. It is also event from respondents that the most influential medium for product promotion is movies than TV, newspapers, internet and then Magazines. It is further concluded that the highest relationship existed between the visibility and the purchase intention. The lowest relationship is, between credibility and the purchase

intention. There is a significant relationship among all attributes of the product placement expect credibility. It is finally concluded that there is a significant relationship between product placements over the purchase intention. The study also suggested that respondents were willing to purchase those products and services, which are endorsed by the celebrities.

Findings conclude that the product placement has a reasonable influence on customers as per their attitude towards purchase intention. Visibility, attractiveness, credibility and status quotation of the products placed & celebrity endorsed with the reference to endorsed product all have a greater influence on customer perception towards buying the advertised product. It has also been highlighted that products promoted in movies are boosting up the sales and purchase of product and people like to buy the products more if endorsed by the celebrity in movies.

References

1. Agrawal, J. and Wagner A.K. (1995), The Economic Worth of Celebrity Endorsers: An Event Study Analysis, Journal of Marketing, 59, 56-62
2. Ahmed, R.R. and Ahmad, S. (2014), Pharmaceutical drug promotion in Pakistan: Issues in ethical & non-ethical practices, Middle-East Journal of Scientific Research, 20 (11), 1630-1640
3. Ahmed, R.R., Parmar, V. and Ahmed, J. (2012), Factors that affect attitude towards Generic Drugs Perception: Comparison of Physicians & General Practitioners of Karachi City, International Journal of Management, IT and Engineering, 2 (11), 151-178
4. Ahmed, R.R., Vishnu, P. and Amin, M.A. (2014), Impact of Product Packaging on Consumer's Buying Behavior", European Journal of Scientific Research, 122 (2), 125-134
5. Ahmed, R.R., Vveinhardt, J., Ahmad, N. and Mujeeb, M. (2014), The Business Outsourcing in Atkin, C. and Block M. (1983), Effectiveness of Celebrity Endorsers, Journal of Advertising Research, 23, 57-61
6. Balasubramanian, S. K., Karrh, J. A., & Patwardhan, H. (2006). Audience response to product placements: An integrative framework and future research agenda. Journal of Advertising, 35(3), 115-141. doi:10.2753/JOA0091-3367350308.
7. Belch, G.E., and Belch, M.A. (2008), Advertising and Promotion: An Integrated Marketing Communication Perspective. (6th ed.) New York
8. Biswas, S. and Hussain, M.D. (2009), Celebrity endorsment in advertisements and consumer perception, Journal of global marketing, 2, 121-137
9. Brewster, C., Sparrow, P. and Vemon (2007), International human resource management. In 3rd edition. london: charted institue of personnel and devlopment.
10. Erdogan B & Kitchen P (1998). Getting the best out of celebrity endorsers. Admap, April,17- 20.
11. Erdogan, B.Z. (1999), Celebrity endorsement: a literature review, Journal of Marketing Management, 15 (4), 291-314
12. Erdogan, B.Z. (1999), Celebrity endorsement: a literature review, Journal of Marketing Management, 15(3), 291–314
13. Gabor, A., Jeannye, T. and Daniel, P.W. (1987), Star Turns That Can Turn Star-Crossed. U.S. News and World Report, 103 (7), 57
14. Giles, D.C. (2000), Illusions of Immortality: A Psychology of Fame and Celebrity, London: MacMillan Haghirian P. and Madlberger M. (2005), Consumer attitude toward advertising via mobile devices - an empirical investigation among Austrian user, in Proceedings of the European Conference on Information Systems, Regensburg, Germany
15. Heider, F. (1946), Attitudes and cognitive organization, Journal of Psychology, 21, 107-112
16. Kaikati G.K. (1987), Celebrity Advertising: A Review and Synthesis, International Journal of Advertising, 6

(2), 93-106

17. Kamins, M. A., Meribeth, J., Brand, S.A. and John C.M. (1989), Two sided versus one sided celebrity Endorsement: the impact on advertising effectiveness and credibility, Journal of advertising, 18(2), 4- 10
18. Kamins, M. A. 1990. An investigation into the "matchup"; hypothesis in celebrity advertising: When beauty may be only skin deep. Journal of Advertising, 19: 4–13.
19. Kelman, H.C. (1961), Processes of Opinion Change, Public Opinion Quarterly, 25 (1), 57–78
20. Khatri, P. (2006), Celebrity Endorsement: A Strategic Promotion Perspective, Indian Media Studies Journal, 1 (1), 25-37
21. Kirmani, A. and Shiv, B. (1998), Effects of source congruity on brand attitudes and beliefs: the moderating role of issue-relevant elaboration, Journal of Consumer Psychology, 7 (1), 25-47
22. Kumar. A. (2010), Celebrity endorsment and its impact on consumer buying behavior. In Advertisment. India: Bournemouth University
23. Lutz, R.J., MacKenzie, S.B. and Belch, G.E. (1983), Attitude toward the ad as a mediator of advertising effectiveness: Determinants and consequences, Advances in consumer research
24. MacKenzie, S.B., Lutz, R.J. and Belch, G.E. (1986), The Role of Attitude toward the Ad as a Mediator of Advertising Effectiveness: A Test of Competing Explanations, Journal of Marketing Research, 23(2), 130-143. http://dx.doi.org/10.2307/3151660
25. Mathur, L.K., Ike M. and Nanda R. (1997), The Wealth Effects associated with a Celebrity Endorser: The Michael Jordan Phenomenon, Journal of Advertising Research, 37 (3), 67-73
26. McCracken, G. (1986), Culture and Consumption: A Theoretical Account of the Structure and Movement of the Cultural Meaning of Consumer Goods, Journal of Consumer Research, 13 (June), 71-84
27. McCracken, G. (1989), Who Is the Celebrity Endorser?: Cultural Foundations of the Endorsement Process, Journal of Consumer Research, 16 (3), 310-321
28. Misra,S and S,. Beatty, "Celebrity spokesperson and Brand Congruence". Journal of Business Research, 21 (1990) pp159-173.
29. Mitchell, A.A. and Jerry, C.O. (1981), Are Product Attribute Beliefs the Only Mediator of Advertising Effects on Brand Attitude? Journal of Marketing Research, 18 (3), 318-332
30. Ohanian, R. (1990), Construction and validation of a scale to measure celebrity endorsers' perceived expertise, Journal of Advertising, 19 (3), 39-52
31. Ohanian, R. (1991), The impact of celebrity spokespersons' perceived image on consumers' intention to purchase, Journal of Advertising Research, 31 (1), 46-54
32. Puto CP, Wells WD (1984) Informational and Transformational Advertising: The Differential Effects of Time. In: Kinnear TC (ed.) Advances in Consumer Research, vol. 11. Provo, UT: Association for Consumer Research: 638-643.
33. Ranjbarian B., Shekarchizade, Z. and Momeni Z. (2010), Celebrity Endorser Influence on Attitude Towards Advertisements and Brand European, Journal of Social Sciences, 13(3), 112-123.
34. Shimp, T.A. (1981), Attitude Toward the Ad as a Mediator of Consumer Brand Choice, Journal of Advertising, 10(2), 9-14
35. Silvera, D.H. and Austad, B. (2004), Factors predicting the effectiveness of celebrity endorsements advertisements, European Journal of Marketing, 38(11/12), 1509-1526
36. Telecommunication Industry: Case of Pakistan, Transformations in Business & Economics, 13, 2B (32B), 760-779
37. Zafar, R.M. (2009), Celebrity endorsment in advertisment. In Impact on the overall brand is of significance and got recognition, Asian Journal of Business and management Sciences, 53-67.

Challenges faced by the distributors under the scheme Pradhan Mantri Ujjwala Yojana in north India

Sourabh Kumar[a], Mukesh Kumar Barua[a]

[a]Department of Management Studies, IIT Roorkee, India

Abstract

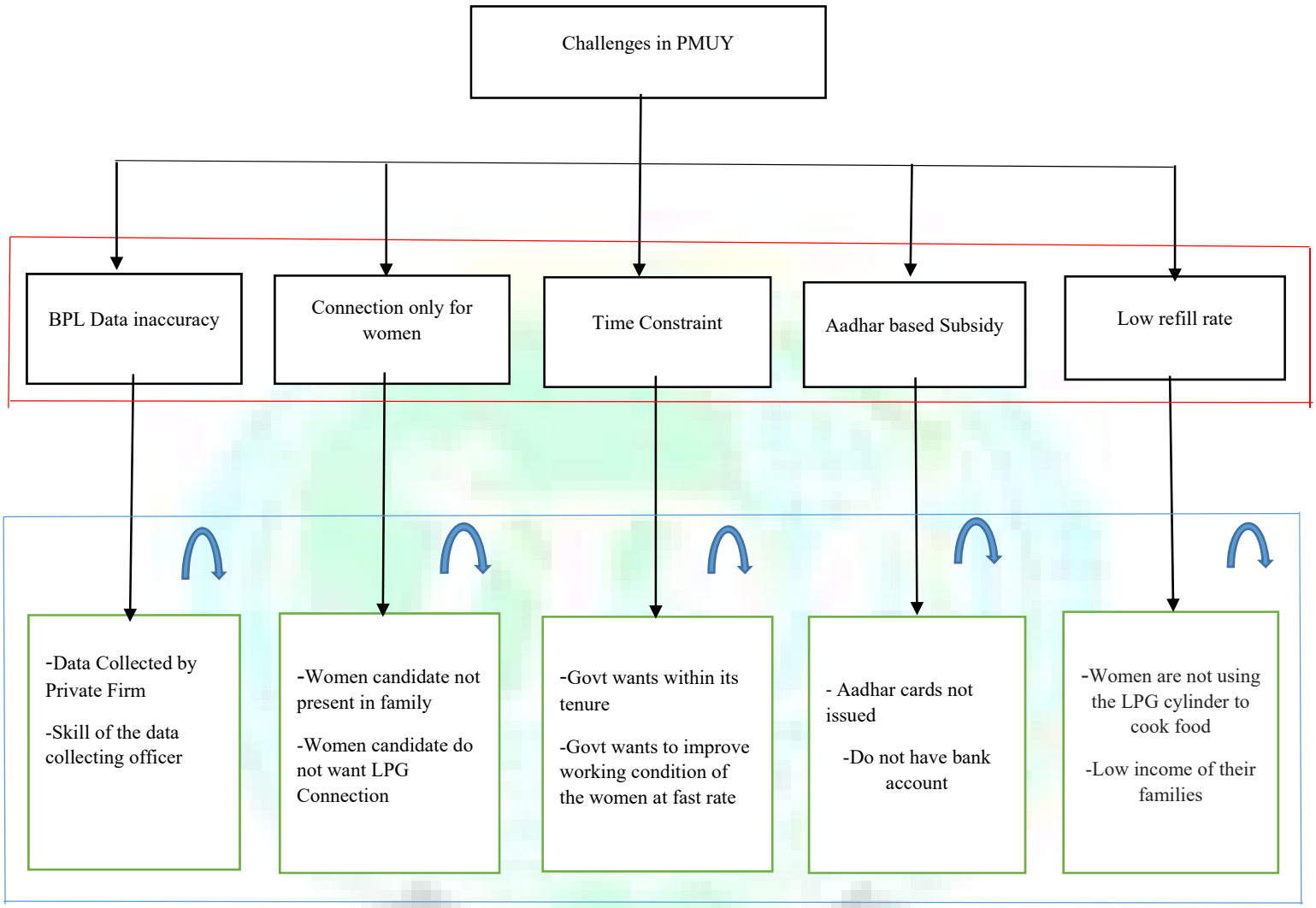
In India around 25 crore household are there still, 10 crore are not using the LPG, instead of it they are using firewood, coal dung as the primary source of the kitchen. Using these source smoke of these greatly after the women health. According to the WHO report, smoke inhaled by the women in one hour is equivalent to the 400 cigarettes in one hour. With the aim of improving the working condition of the women by providing them clean cooking fuel-LPG, Government of India launched scheme Pradhan Mantri Ujjwala Yojana(PMUY) with an aim 5 crore LPG connection will be providing to the BPL families. Distributors of the LPG, facing the crucial challenges by implementing the scheme effectively. Some of these are proper and authenticate data on BPL households identified through Socio-Economic Caste Census data are not available, connection only for women name, only a 3-year plan till 2019 is provided, Adhar based direct benefits transfer system, only for SC/ST categories, no safety awareness program for targeted beneficiaries etc. The objective of this papers is identifying the various risk facing by the distributors of the LPG in north India using the AHP. By implementing the AHP we can prioritize the various challenges faced by the distributors.

Keywords: Health, Ujjwala, Distributors, fuels, LPGs

1. Introduction

In India around 10 crore families still dependent on the fossil fuel to cook food. These fossil fuels include firewood, coal, and biomass like animal dung, cake and waste crop. The smoke of these fossil fuels contain various several toxic harmful air pollutants including benzene, formaldehyde, acrolein and polycyclic aromatic hydrocarbons (PAHs) and carbon monoxide, which affect the respiratory system and eyes of the women, surrounding atmosphere neighbors as well as the surrounding atmosphere. Fossils fuel easily and cheaply available in abundant in nature that's why the majority of the rural area women are using these, but it severely effects the health of the women. For improving the working condition and empowering of the women Indian Prime Minister Narender Modi has launched the Pradhan Mantri Ujjwala Yojana on 1st May 2016 at Uttar Pradesh's Ballia district which will benefit 5 crore families till 2019. Under this scheme around 5 crore connections are to be provided BPL household. The identification of the BPL families will be made in consultation with state and union territories. BPL is an economic benchmark used by the government to identify the individual/ household which required the governmental financial assistant. Under PMUY preference would be given, which comes under the categories namely all SC/STs households under BPL, Antyoday Anna Yojana, Forest dwellers Most Backward Classes, Tea & Ex-Tea Garden Tribes. The Release of the connection under these categories only for the women.

2. Challenges Faced by the Distributors



3. Data Analysis

The questionnaire was designed to collect the opinion of the distributors regarding the Pradhan Mantri Ujjwala Yojana. It is extremely necessary to collect data of large no of the distributors. Total 55 responses were collected to study the distribution centers of the northern part of the Uttar Pradesh. The criteria chosen was assessed for importance on a 9 point scale. After an analysis done by the analytical hierarchy process(AHP) , we found the relative weight and the ranking of the first level of the criteria. In which we saw that BPL data inaccuracy is the most typical task for successfully implementing the Pradhan Mantri Ujjwala Yojana. Then most typical challenges aadhar based subsidy subsequently time constraint, low refills rate and connection only for woman.

Table I. Relative Weight of the five Perspective.

Perspective	Relative weight	Rank
BPL Data inaccuracy	0.513	1
Connection only for women	0.08	5
Time Constraint	0.131	3
Aadhar based Subsidy	0.185	2
Low refill rate	0.084	4

At the second level of the hierarchy, the weight of the sub-criteria are given in Table II. Within the BPL Data inaccuracy perspective, data collected by the private firm was found to be the most important than the skill of the data collecting officer. Data collected in 2011, during data collection various inaccuracy found. Connection only for women perspective, women candidate not in the family was found more important than women does not want LPG connection. It is found that there are a lot of families without the only single women, so that families do not avail PMUY facility. Time constraint perspective, the government want to complete the scheme within its own tenure more important than the government want to improve working condition of women as a fast rate. Aadhar based subsidy perspective, most women do not have the bank account more important than does not have aadhar card. In the rural area, women are still financial exclusion so most of the women do not have the bank account. The Bank account is important because subsidy given by the government directly come to the bank account. In the low refills rate perspective, low income of the families more important than the women does not use the LPG cylinders.

Table II, Relative Weight of the Sub Criteria under each perspective

Perspective	Criteria	Relative Weight
BPL Data inaccuracy	Data Collected by Private Firm	0.857
	Skill of the data collecting officer	0.143
Connection only for women	Women candidate not present in family	0.667
	Women candidate do not want LPG Connection	0.333
Time Constraints	Govt wants within its tenure	0.75
	Govt wants to improve working condition of the women at fast rate	0.25
Aadhar based Subsidy	Aadhar cards not issued	0.25
	Do not have bank account	0.75
Low refill rate	Women are not using the LPG cylinder to cook food	0.125
	Low income of their families	0.875

4. Conclusion

Pradhan Mantri Ujjwala Yojana is very helpful to improve the working condition of the women. Using the LPG will improve the quality of life of the poor families. In this scheme connection is allotted only to the name of women candidate of poor household which is the good step towards women empowerment. Traditional fuel also causes the air pollution, use LPG will help to reduce the air pollution. Hence we can say that the LPG is environment-friendly. If we focus on the removing the challenges faced by the PMUJ, is can be effective implement.

References:

1. Das, T.K., Deb, C., Jash, T., 2000. Environmental consequences of parallel marketing of LPG in India. Energy 25, 81–84.
2. Hasalkar S, Sobhna Huilgol. Knowledge and Awareness of Rural Women on Energy Sources. 2012; 40(10):95-99.
3. Kimemia, D., Annegarn, H., 2016. Domestic LPG interventions in South Africa: challenges and lessons. Energy Policy 93, 150–156.
4. Matthews, W.G., 2014. Opportunities and challenges for petroleum and LPG markets in
5. Sub-Saharan Africa. Energy Policy 64, 78–86
6. Newspaper Hindustan Time, New Delhi, 2016
7. Parikh, J., 2011. Hardships and health impacts on women due to traditional cooking
8. fuels: a case study of Himachal Pradesh, India. Energy Policy 39, 7587–7594.
9. Raman devi, 2017. Pradhan Mantri Ujjwala Yojana: Issues and challenges. International Journal of Academic Research and Development. 2. 705-706.
10. Sharma A. Pradhan Mantri Ujjwala Yojana for Empowerment of Rural People, Indian Economy Article, Pratiyogita Darpan. 2016, 80.
11. www.pmuy.gov.in

Agribusiness Export Performance in Egypt: Constant Market Shares Analysis

Shaymaa Omran[1], Pushpa Trivedi[2]

[1] Doctoral Student, IIT Bombay, India & Assistant lecturer of Economics, Future University, Egypt.

[2] Professor and Head of Humanities and Social Sciences dep, IIT, Bombay,

shaymaa.omran@iitb.ac.in, shaomran@gmail.com, trivedi@hss.iitb.ac.in, pushpa.cmdr@gmail.com

Abstract. The recent situation in Egypt given the backdrop of the revolution that broke out in 2011 and its economic and political turmoil had an important impact on trade flows. Egypt is highly competitive in its exports of agricultural products especially vegetables and textiles. This paper carries out CMS analysis on dis-aggregated trade data throughout the period 2000-2017. The results show that agribusiness groups and selected products display a negative 'commodity effect' after 2011. For individual products, most of them showed negative 'regional effect' after 2011. Three-level decomposition for the products shows that world growth effect was positive. Commodity composition and competitiveness effect were positive during 2006-2010. Market distribution effect was positive after 2011 which indicates correct channeling of Egypt's exports after 2011 for these products. After 2011, commodity effect and competitiveness effect exhibited negative values. This indicates that composition of trade needs to be revised to target relatively fast growing commodities.

Keywords: Competitiveness - Agriculture - Agriculture in International Trade – Agribusiness – Constant Market Shares Analysis

1. Introduction

Competitiveness is not an end in itself or a target but rather a powerful mean to achieve rising standards of living and increasing social welfare (Fougner, T. 2006). The revolution that broke out in Egypt more than seven years back had a huge effect on the domestic economy. The effect of the revolution was very clear on the trade flow. During the period 2012-2015, the export's growth rate was decreasing by 8 percent and imports increased by 5 percent. Total investments as a percentage of GDP decreased from 19%, during 2006-2011, to 14% during 2012-2015 based on the data from the Ministry of Finance. Deploying the Standard International Trade Classification (SITC), the agribusiness related products comprised around 34% of total exports in 2016 (see Appendix 1, 2, 3). On the other hand, upon calculating the Agri-Orientation Index; which is a measure of how far is the government expenditures on the agricultural sector matching the contribution of this sector in the GDP (AOI = Agricultural share of the total outlays/Agricultural share of GDP), for the period 2000-2016 for Egypt (see Appendix 4), it was found that the AOI was deteriorating during this period as it was 0.3 in 2000 and reached 0.11 in 2016. This indicator shows that in 2016 for every unit spent of the government budget, agriculture gets only 11% of what it should obtain if allocated according to the contribution to GDP. This shows that although this sector is contributing highly to exports and contributing to GDP, it is not getting the sufficient allocation of resources from the government budget.

Under these circumstances, an interesting question was whether Egypt's pattern of exports in the agribusiness is still competitive after the revolution, and if it played any major role in determining export performance. This paper is a continuation of a work in progress on the competitiveness of the agribusiness in Egypt. Based on a broad overview of the structure of trade patterns of agricultural and agro-based products during the period before and after the revolution, from 2000-2017 where 14 agricultural products were selected after calculating six competitiveness measures. Raw and processed vegetables and textiles topped the table considering the higher ranking in the indicators, see Table 1.

Table 3: Summary of indicators for the product groups in 2015

Item	2015 Market Share (%)	RCA	RTB	TSI (N)	TSI (S)	Trade Ratio
(06-15) Vegetable Products						
06: Live trees, plants, bulbs, roots, cut flowers	0.29	2.1	**0.9**	0.002	0.006	**33.0**
07: Edible vegetables and certain roots and tubers	**1.78**	**13.1**	0.4	0.044	**0.106**	2.1
08: Edible fruit, nuts, peel of citrus fruit, melons	1.13	8.3	0.2	0.041	**0.096**	1.6
11: Milling products, malt, starches, inulin, wheat glute	0.63	4.6	0.5	0.005	0.011	2.7
13: Lac, gums, resins, vegetable saps and extracts	1.74	12.8	0.7	0.005	0.013	5.3
16-24 Foodstuffs						
20: Vegetable, fruit, nut, etc food preparations	0.63	4.7	0.4	0.014	0.034	2.1
41-43 Raw Hides, Skins, Leather, & Furs						
41: Raw hides and skins (other than furskins) and leather	0.54	4.0	**0.9**	0.007	0.018	**13.0**
50-63 Textiles						
52: Cotton	0.89	6.5	-0.2	0.012	0.020	0.7
57: Carpets and other textile floor coverings	**2.34**	**17.2**	0.6	0.014	0.036	3.8
58: Special woven or tufted fabric, lace, tapestry	1.68	12.4	0.4	0.008	0.020	2.5
61: Articles of apparel, accessories, knit or crochet	0.23	1.7	0.6	0.020	0.050	3.7
62: Articles of apparel, accessories, not knit or crochet	0.43	3.2	-0.1	0.026	0.048	0.8
63: Other made textile articles, sets, worn clothing etc	0.44	3.2	0.4	0.010	0.025	2.2
31: Fertilizers	0.68	5.0	0.4	0.017	0.041	2.4

Source: Calculated by the researcher based on COMTRADE database

This paper is trying to identify the channels or sources of competitiveness for the agribusiness sector and especially highly competitive products. In order to identify these channels, in this paper we apply Constant Market Shares (CMS) analysis. The analysis is considered an accounting technique which is used to decompose the export share development aggregated for a country. The CMS analysis is a descriptive approach and not causal.

Leamer and Stern constructed CMS analysis which decomposes absolute export change into three effects; product or the commodity composition effect, the market or the geographic component of exports, and residual component or competitiveness effect. Fagerberg and Sollie (1985) introduced another approach for CMS analysis which considered the market share changes and not the change in value of exports in absolute terms. They introduced five effects: (1) product effect, (2) market effect, (3) competitiveness effect, (4) product adaptation effect, and (5) the geographic adaptation effect. The competitiveness effect shows the contribution of competitiveness as an explanatory factor for the change in market share throughout a certain period. The product and the geographic adaptation effect explain information in regards to the country's capability to modify its exports composition and focus more on products and regions or markets that shows a growing pattern. Milana (1988) developed another method for the CMS which can provide a satisfactory solution to the problems that were faced in applying the CMS.

This paper applies the original method as developed by Leamer and Stern, as a first step for carrying out CMS. Also, applying the Export share growth decomposition which is the basic decomposition proposed by Fagerberg and Sollie (1985). The CMS analysis was carried out over the period 2000-2017 at the dis-aggregated level using the COMTRADE and Trade Map database.

This paper has the following structure; the first section shows the identities used in calculating the CMS for Egypt exports (agribusiness groups and selected 14 agricultural products) on a commodity level and on a region level. Also, it shows the identity used to calculate the three-level CMS decomposition and share decomposition identity. The second section shows the literature review for the CMS analysis; it highlights major contributions to CMS analysis emphasizing the components and evolution of the CMS, in addition to highlighting important studies which employed CMS analysis. The third section shows the CMS results for the agribusiness product groups (two-level analyses of the commodity effect), selected 14 product's analysis (two-level decomposition on the regional level), the complete decomposition for 14 products and regions for each product (three-level decomposition) and finally the share decomposition which is carried out for 14 products. The fourth section summarizes and concludes the paper results.

2. Methodology

The paper uses CMS analysis using the following two-level and three-level identities:

- Two Level analyses (Commodity composition)

$$V'_{..} - V_{..} = \sum_i r_i V_{i.} + \sum_i (V'_{i.} - V_{i.} - r_i V_{i.})$$

$$= rV_{..} + \sum_i (r_i - r)V_{i.} + \sum_i (V'_{i.} - V_{i.} - r_i V_{i.}) \rightarrow \text{Two Level Analyses}$$

Where,
$V'_{.j}$ = Value of exports (country X exports to country j in Y_2)
V_{ij} = Value of exports (country X exports of commodity i to country j in Y_1)
r = increase in total world exports from Y_1 to Y_2 (Percentage)
r_i= increase in world exports of commodity i from Y_1 to Y_2 (percentage)
r_{ij}= increase in world exports of commodity i to country j from from Y_1 to Y_2 (Percentage)
$rV_{..}$-> General rise in world exports
$\sum_i (r_i - r)V_{i.}$-> Commodity composition of Country X exports in Y_1
$\sum_i (V'_{i.} - V_{i.} - r_i V_{i.})$ -> unexplained residual (representing difference between country X actual increase in exports and the proposed increase if country X had maintained its share of the exports of each commodity group)

- Three-levels decomposition across commodities and regions:

$$V'_{..} - V_{..} = \sum_i \sum_j r_{ij} V_{ij} + \sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij} V_{ij})$$

$$= rV_{..} + \sum_i (r_i - r)V_{i.} + \sum_i \sum_j (r_{ij} - r_i)V_{ij} + \sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij} V_{ij}) \rightarrow \text{Three Level Analyses}$$

Where,
$rV_{..}$--> General rise in world exports
$\sum_i (r_i - r)V_{i.}$--> Commodity Composition
$\sum_i \sum_j (r_{ij} - r_i)V_{ij}$ → Market distribution
$\sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij} V_{ij})$ → Residual (shows the difference between actual growth and growth that would have occurred in case country A preserved its share of exports of each commodity to each market) (Leamer and Stern, 1970)

Export share growth decomposition:

$$\Delta\theta_r = \Delta\theta_{rp}\delta_p^0 + \Delta\delta_p\theta_{rp}^0 + \Delta\theta_{rp}\Delta\delta_p$$

$\theta_r = \frac{X_r}{X_w}$
$\theta_{rp} = \frac{X_r}{X_{wp}}$
$\delta_p = \frac{X_{Wp}}{X_W}$

$\Delta\theta_{rp}\delta_p^0$: Effect on the share of expanding into the partner's market, holding the size of the partner constant
$\Delta\delta_p\theta_{rp}^0$: The effect of growth in the size of the partner, holding relative penetration constant
$\Delta\theta_{rp}\Delta\delta_p$: Interaction of the two effects. (Gilbert, J., & Muchová, E. 2018)

3. Literature Review

Leamer and Stern (1970) introduced the basic model for CMS. They discussed the idea that the country's exports may be unsuccessful to grow due to concentration of their exports in commodities that are not highly demanded or growing slowly or due to exporting their products to countries that are relatively stagnant or the country might not be able to face competition from other countries supplying the same product. The main assumption of CMS analysis is a constant share in the world market, for a certain country, over time. Thus, the

difference between assumed constant export growths and the actual export performance can be due to (1) competitiveness, (2) commodity composition, (3) market distribution.
The theory as discussed by Leamer and Stern can be illustrated as follows:
The export demand in a certain market from two competing sources of supply can be shown as follows:

$$\frac{q_1}{q_2} = f\left(\frac{P_1}{P_2}\right) \text{ --- Basic form}$$

q_i --- Quantity sold of the commodity from the i[th] supply source
P_i --- Commodity price from the i[th] supply source
"X" basic form by $\frac{P_1}{P_2}$

$$\frac{P_1 q_1}{P_1 q_1 + P_2 q_2} = (1 + \frac{P_2 q_2}{P_1 q_1})^{-1}$$

$$= \left\{1 + \left[\frac{P_1 f(\frac{P_1}{P_2})}{P_2}\right]^{-1}\right\}^{-1}$$

$$= g\left(\frac{P_1}{P_2}\right)$$

A constant market share will remain only if $\frac{P_1}{P_2}$ varies. The differences between export growth implied and actual growth can be explained by changes in price or due to competitiveness factor. Therefore, in case of the inability of the country to retain its world market share, the competitiveness factor will display negative value. This negative value can be an indication of higher prices offered by the country which is higher than its competitors.
Let,
$V'_{.j}$ = Value of exports from country X to country j in Y_2
V_{ij} = Value of exports from country X from commodity i to country j in period Y_1
r = increase in total world exports from Y_1 to Y_2 (%)
r_i= increase in world exports of commodity i from Y_1 to Y_2 (%)
r_{ij}= increase in world exports of commodity i to country (j) from Y_1 to Y_2 (%)
For period Y_1: $\sum_j V_{ij} = V_{i.}$, $\sum_i V_{ij} = V_{.j}$
And for Y_2: $\sum_i \sum_j V_{ij} = \sum_i V_{i.} = \sum_j V_{.j} = V_{..}$
If Country X can retain its share in one market, therefore, its exports will increase by $rV_{..}$

$$V'_{..} - V_{..} = rV_{..} + (V'_{..} - V_{..} - rV_{..}) \quad \text{-→ One Level analysis}$$

$rV_{..}$ -> increase in world exports
$(V'_{..} - V_{..} - rV_{..})$ ->Unexplained residual or competitiveness effect
And for the i[th] commodity

$$V'_{i.} - V_i = r_i V_{i.} + (V'_{i.} - V_{i.} - r_i V_{i.})$$

This maybe aggregated to:

$$V'_{..} - V_{..} = \sum_i r_i V_{i.} + \sum_i (V'_{i.} - V_{i.} - r_i V_{i.})$$

$$= rV_{..} + \sum_i (r_i - r) V_{i.} + \sum_i (V'_{i.} - V_{i.} - r_i V_{i.})$$

→ Two Level Analyses

Where,
$rV_{..}$-> General rise in world exports

$\sum_i (r_i - r)V_{i.}$-> Commodity composition of Country X exports in Y_1
$\sum_i (V'_{i.} - V_{i.} - r_i V_{i.})$ -> unexplained residual (the difference between the increase in Country X actual exports and the assumed increase if country X had maintained its share of the exports of each group of commodities)

In case of a positive commodity effect, this implies that country X had concentrated on exporting commodities which are growing relatively fast. $\{\sum_i (r_i - r)V_{i.}\}$ positive if $r_i > r$
Same applies for the constant share of exports of a certain commodity to a specific market or region.

$$V'_{ij} - V_{ij} = r_{ij}V_{ij} + (V'_{ij} - V_{ij} - r_{ij}V_{ij})$$

When aggregated

$$V'_{..} - V_{..} = \sum_i \sum_j r_{ij}V_{ij} + \sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij}V_{ij})$$

$= rV_{..} + \sum_i (r_i - r)V_{i.} + \sum_i \sum_j (r_{ij} - r_i)V_{ij} + \sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij}V_{ij})$ → Three Level analyses

Where,
$rV_{..}$--> General rise in world exports
$\sum_i (r_i - r)V_{i.}$--> Commodity Composition
$\sum_i \sum_j (r_{ij} - r_i)V_{ij}$ → Market distribution
$\sum_i \sum_j (V'_{ij} - V_{ij} - r_{ij}V_{ij})$ → Residual (Difference between actual growth and growth that would have happened if country X retained its share of exports for each commodity exported to each market)
If the market distribution is positive $\{\sum_i \sum_j (r_{ij} - r_i)V_{ij}\}$, then country X had concentrated its exports in relatively growing markets.
Negative residual (competitiveness effect) reflects the failure to maintain market shares. It might reflect prices; export price inflation, quality improvement, the efficiency of marketing and the ability of the prompt fulfilment of export orders.

Richardson (1971) in his paper highlighted some pitfalls in the previous CMS analysis and suggested improvements to the implementation of CMS. In the simplest form of CMS where the world's growth effect, the country's growth in exports keeping its export share constant, and the competitiveness effect explains the total export's growth of a certain country.Two characteristics of commodity effect and the market effect were highlighted; both are treated asymmetrically and both refer to rather static and not dynamic changes in the structure of exports in a given country. Richardson argued CMS as a method for examining a country's exports growth should be more complex to address other factors. These factors can be technology, rivals, government policies and factor availability. The objective of Richardson paper was to show theoretical limitations of exploring export by CMS and suggesting developments to the CMS approach. Studies that used analysis were using export value share due to the unavailability of export's quantity data which is not considered to be accurate. As in the case of a product effect displaying positive value can be explained that the exports of a certain country are more inclined toward products which are relatively growing rapidly worldwide. But this case can also be explained as the country's exports are more inclined towards products whose prices exhibit a rising rates. Therefore, using quantities and values can give contradicting results or explanations. Another concern is related to the homogeneity of products, when products are highly homogenous, thus, geographical market shares are less sensitive to demand factors. Prices in the market do not mirror or reflect these factors. In this case of product homogeneity, these markets are indifferent to the nationality of the supplying country. Another problem is related to the definition of the appropriate world exports (Q) to be used. Several CMS studies used the total world exports which overlooked the consideration of the competitors for the country under study. Adversaries of this opinion claim that the use of the systematic total world is more consistent as it makes the comparison applicable between countries, but this can cause the problem of losing the meaning of results as the identity of competitors varies across exports. Thus, the selection of the appropriate world of competitors for each exported product or market and employing quantity data rather than values were important concerns raised by Richardson.

In 1985 Fagerberg and Sollie's approach focused on the market share changes and not absolute change in exports. Fagerberg and Sollie (1985) introduced five effects:

- Product Effect (PE)
- Market Effect (ME)

} Static Component

- The Competitiveness Effect (CE)
- The Product Adaptation Effect (PAE) } Dynamic Component
- Geographic adaptation Effect (GAE)

The competitiveness effect shows the contribution of competitiveness as an explanatory factor to the variation in market share throughout a specific period. Product and Geographic adaptation effect present information about the ability of a certain country to adjust in its export's composition toward products and markets that are growing.

$$\Delta Q = PE + ME + CE + PAE + GAE$$

Where, $Q = \frac{X_i}{X_w}$

ΔQ = Change in country (i)'s export share between two periods (t) and base period (0).

Milana (1988) introduced another method for the CMS as it aimed at identifying reasonable solutions to the problems faced by the earlier approaches in applying CMS. Milana proposed a re-formulation of the discrete-time version of decomposing the changes in export share. The paper discussed the different weights that can be applied in CMS analysis. It illustrated the different identities which can be used to calculate the different effects, either by using the Laspeyres type system of weight (using year Y_0 weights to compute the competitiveness and structural effects) or using the Paasche type system of weights (using year Y_1 weights for calculation) or use a combination of both techniques (using Laspeyres for one component and Paasche for the other component or using symmetric weights α; if neither the beginning nor the end period has a dominant effect, the weight α can be set to 0.5 to be representative of the period). Since shorter time intervals give a closer discrete approximation to the continuous case, Milana suggested applying decomposition to the shortest intervals applicable to the data as one solution for the index number problem.

Cheptea and others 2012 developed an econometric CMS decomposition of export growth. This decomposition identifies the influence of the composition of exports for each exporter segregated by product, destination and competitiveness. The method shows the competitiveness effect as estimated and not computed as a residual. They applied this econometric method on EU-27 as an integrated economy from 1995-2009. The econometric approach introduced is useful as it makes it feasible to identify a confidence interval for both, the product effect and the market effect.

CMS analysis is a convenient tool to analyze the export performance of countries. Finicelli, A. and others (2010) used the CMS analysis to study export performance in a dis-aggregated study of selected industrial countries. This paper described the influence of geographical and sectoral specialization of these economies during the period 1985-2003. This study showed that although the market shares for these countries was falling, CMS analysis showed a positive structural effect as industrial countries could gain that from either working in fast-growing sectors or growing regions.

Another study conducted by Helmy O. (2012) to assess the competitiveness of Egypt in the EU market specifically for exports of fruits and vegetables using CMS analysis. This paper assessed the competitiveness of Egypt's exports to the EU over the period (2004-2008). The paper suggested policies to enhance exports to the EU from fruits and vegetables. The study showed that Egypt's exports from these products to the EU performed well among the Southern Mediterranean countries (SMC)[2]. The better performance of Egypt is attributed to its higher competitiveness in exporting these products compared to the other SMCs.

In a study by De Munnik, D and others (2012) on the development of Canada's global export market share which used the CMS analysis to segregate changes in Canada's market share into two effects; competitiveness effect and structural effect, during (1990-2010). The geographical effect was dominant in understanding the reason behind the slow performance of Canadian exports. The geographical aspects were related to a large proportion of exports going to the slow-growing US market and a smaller weight to the relatively fast-growing economies.

Pandiella, A. (2015), employed the CMS analysis of Spanish goods exports over 1996-2013. It was found that the concentration of Spanish exports in slow-growing markets was one of the reasons for the loss of global market share in addition to focusing on products that are relatively slow growing.

Skriner (2011), employed Milana (1988) model for CMS analysis. The study presented the changes in market, product and competitiveness structure of Austrian goods exports from 1990 -2006. The Austrian trade sector could maintain its market share and the drawbacks in competitiveness were removed, however, after year 2000, the market and product effects displayed a negative trend.

The next section presents the results of analysis based on two-level and three-level identities, which is applied on the agribusiness product groups and on 14 highly competitive products. In addition, the results of applying the

[2] Algeria, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria and Tunisia

export share decomposition to 14 products are shown in the three periods of analysis (2001/2005, 2006/2011, 2012/2017).

4. Results of CMS by commodity groups and by Region

CMS analysis is considered a useful method to understand a country's exports. It helps in understanding the reasons for failure to have growing exports or for growth in the country's exports. Also, it helps in understanding whether the country's exports are more concentrated on goods that are characterized by high demand or not. In addition to the identification if the country's exports are directed to dynamic or stagnant regions. CMS is considered as a descriptive technique and is not used in prediction. CMS is a good stage in acquiring information about the country's exporting process which can help further in export policies. (Bonanno, G. (2015).)

In this section a two-level decomposition of Egypt's exports on three categories:

1) Agribusiness product groups
2) The regional decomposition for each product of 14 products

Also, this section shows a three level decomposition for 14 products; which are the market growth effect, commodity effect, the region effect and competitiveness effect.

4.1 Two level decomposition for Agribusiness Product Groups

This section shows the CMS analysis outcomes for two-levels of analyses (the commodity composition) for 6 agribusiness related product groups during three periods; 2001/2005, 2006/2010, and 2011/2017. As illustrated in tables 2, 3 and 4, the commodity composition effect showed positive value only in the second period, (2006/2010) however, after 2011, it showed a negative value indicating that on the level of these product groups, they were not the relatively growing products worldwide in the last 7 years. The world trade growth also showed a negative value for these products after 2011 which indicates a decline in the world trade in general in the last 7 years. The competitiveness effect showed a negative value after 2011 indicating problems in the products exported by Egypt related to pricing and other factors. However, due to the application of CMS analysis on the level of agribusiness products, it is difficult to draw conclusions about specific products related to pricing or other factors. This analysis only gives the channel or the reason behind the increase or decrease of export's value during a certain time period.

Table 4: Illustration of the Constant Market Share analysis of changes in Egyptian exports of agribusiness product groups (2001 - 2005)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commodity[3]	**Actual World Imports (Million USD)**		**Actual EGY exports (Million USD)**					
			V.j	V'.j	**ri**	**riV.j**	**rV,j**	
	2001	2005	2001	2005	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
(G1)	123,475	183,162	15	58	0.48	7.4	11	7
(G2)	152,048	238,377	357	757	0.57	202.8	246	203
(G3)	177,240	275,511	67	167	0.55	37.2	46	37
(G4)	51,187	69,557	25	29	0.36	9.1	17	9
(G5)	350,559	504,238	723	651	0.44	316.7	497	317
(G6)	14,915	27,167	68	39	0.82	55.6	47	56
(OTH)	5,258,044	9,042,847	2,886	8,944	0.72	2,077.1	1,984	2,077
Total	**6,127,468**	**10,340,858**	**4,141**	**10,646**	**0.69**	**2,706.0**	**2,847**	**2,706**
			$(\sum_{j=1}^{7} Vj)$	$(\sum_{j=1}^{7} V'j)$	**r**	$(\sum_{j=1}^{7} riV.j$	$(\sum_{j=1}^{7} rV.j$	$(\sum_{j=1}^{7} r.jV.j)$

[3] The agribusiness product groups involved in the three level analyses are

01-05 Animal & Animal Products (G1) 41-43 Raw Hides, Skins, Leather, & Furs (G4) 31 - Fertilizers (G6)

06-15 Vegetable Products (G2) 50-63 Textiles (G5) Other exports (OTH)

16-24 Foodstuffs (G3)

Analysis			In Million USD
	Egyptian Exports in 2005	10,646	
	Egyptian Exports in 2001	4,141	
	Change in Exports	**6,505**	100%
1) Due to increase in world trade	$\sum_{j=1}^{7} rV.j$	2,847	44%
2) Due to Commodity composition	$(\sum_{j=1}^{7} riVi.) - (\sum_{j=1}^{7} rVi.)$	-141	-2%
4) Due to increased competitiveness	$(\sum_{j=1}^{7} V'j) - (\sum_{j=1}^{7} Vj) - (\sum_{j=1}^{7} r.jV.j)$	3,799	58%

Source: Calculated by the researcher based on COMTRADE and Trademap database

Table 5: Illustration of the Constant Market Share analysis of changes in Egyptian exports of agribusiness product groups (2006 - 2010)

Commodity	(1) Actual World Imports Million USD		(2) Actual EGY exports Million USD		(3)	(4)	(5)	(6)	(7)	(8)
			V.j	V'.j	ri	riV.j	rV,j			
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$		
(G1)	196,405	272,109	46	568	0.39	17.7	12	18		
(G2)	266,782	438,503	734	2,985	0.64	472.5	192	472		
(G3)	310,561	438,629	170	1,274	0.41	69.9	44	70		
(G4)	74,983	90,227	31	178	0.20	6.2	8	6		
(G5)	556,318	641,106	544	2,905	0.15	82.8	142	83		
(G6)	28,454	54,404	78	1,152	0.91	71.6	21	72		
(OTH)	10,522,753	13,155,599	12,118	17,271	0.25	3,031.9	3,177	3,032		
Total	11,956,257	15,090,576	13,720	26,332	0.26	3,752.7	3,597	3,753		
			$(\sum_{j=1}^{7} Vj)$	$(\sum_{j=1}^{7} V'j)$	r	$(\sum_{j=1}^{7} riV.j$	$(\sum_{j=1}^{7} rV.j$	$(\sum_{j=1}^{7} r.jV.j)$		

Analysis			In Million USD
	Egyptian Exports in 2010	26,332	
	Egyptian Exports in 2006	13,720	
	Change in Exports	**12,612**	100%
1) Due to increase in world trade	$\sum_{j=1}^{7} rV.j$	3,597	29%
2) Due to Commodity composition	$(\sum_{j=1}^{7} riVi.) - (\sum_{j=1}^{7} rVi.)$	156	1%
4) Due to increased competitiveness	$(\sum_{j=1}^{7} V'j) - (\sum_{j=1}^{7} Vj) - (\sum_{j=1}^{7} r.jV.j)$	8,859	70%

Source: Calculated by the researcher based on COMTRADE and Trademap database

Table 6: Illustration of the Constant Market Share analysis of changes in Egyptian exports of agribusiness product groups (2011 - 2017)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commodity	**Actual World Imports Million USD**		**Actual EGY exports Million USD**					$\sum_i rijVij$
			V.j	V'.j	ri	riV.j	rV,j	
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	
(G1)	323,040	361,197	568	397	0.12	67	-16	67
(G2)	551,627	586,844	3,067	3,028	0.06	196	-84	196
(G3)	515,888	484,325	1,330	1,433	-0.06	-81	-37	-81
(G4)	108,452	113,488	159	113	0.05	7	-4	7
(G5)	751,980	735,007	3,436	2,822	-0.02	-78	-95	-78
(G6)	74,343	51,012	1,443	1,053	-0.31	-453	-40	-453
(OTH)	15,753,275	15,248,832	21,578	17,096	-0.03	-691	-594	-691
Total	**18,078,604**	**17,580,705**	**31,582**	**25,943**	**-0.03**	**-1,032**	**-870**	**-1,032**
			$(\sum_{j=1}^{7} Vj)$	$(\sum_{j=1}^{7} V'j)$	**r**	$(\sum_{j=1}^{7} riV.j$	$(\sum_{j=1}^{7} rV.j$	$(\sum_{j=1}^{7} r.jV.j)$

Analysis			In Million USD
	Egyptian Exports in 2017	25,943	
	Egyptian Exports in 2011	31,582	
	Change in Exports	**-5,639**	100%
1) Due to increase in world trade	$\sum_{j=1}^{7} rV.j$	-870	15%
2) Due to Commodity composition	$(\sum_{j=1}^{7} riVi.) - (\sum_{j=1}^{7} rVi.)$	-163	3%
4) Due to increased competitiveness	$(\sum_{j=1}^{7} V'j) - (\sum_{j=1}^{7} Vj) - (\sum_{j=1}^{7} r.jV.j)$	-4,607	82%

Source: Calculated by the researcher based on COMTRADE and Trademap database

The next section shows the CMS analysis identity as proposed by Leamer & Stern on the highly competitive 14 products in 4 regions during the three periods of study. The three-level analyses show the channels or sources of changes in Egypt's exports due to competitiveness, world trade growth, market or regional effect and commodity effect.

4.2 Three Level Decomposition for Selected 14 Products

In this section, we apply the three-level decomposition for 14 products[4]to understand the interaction between the commodity and regional effects as illustrated in tables 5, 6 and 7. Commodity composition, when considered in the higher level product groups discussed in the previous section and among 14 products, was positive during the second period (2006-2010) which indicates a period of focus on the right combination of products for exports. The market effect which was calculated for 14 products was negative in the first and second period which indicates exporting to regions which are not growing in the international market for these specific products. However, after 2011, the market

[4] The 14 products involved in the three level decomposition are:

06: Live trees, plants, bulbs, roots, cut flowers	20: Vegetable, fruit, nut, etc food preparations	61: Articles of apparel, accessories, knit or crochet
07: Edible vegetables and certain roots and tubers	41: Raw hides and skins (other than furskins) and leather	62: Articles of apparel, accessories, not knit or crochet
08: Edible fruit, nuts, peel of citrus fruit, melons	52: Cotton	63: Other made textile articles, sets, worn clothing etc
11: Milling products, malt, starches, inulin, wheat glute	57: Carpets and other textile floor coverings	31: Fertilizers
13: Lac, gums, resins, vegetable saps and extracts nes	58: Special woven or tufted fabric, lace, tapestry etc	Other exports (OTH)

effect was positive indicating the stable and correct channeling of Egypt's exports to different regions. The competitiveness effect shows the changes in prices, as suggested by Leamer and Stern, which was negative in the first period and turned positive in the second period indicating the provision of competing prices for exports of these products. After 2011, the competitiveness effect was negative. The world trade growth was the leading factor for three periods.

Table 7: Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

In Million USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual World Exports		**Actual EGY exports**		**ri**	**riV.j**	**rV,j**	$\sum_i rijVij$
			V.j	V'.j				
	2001	2005	2001	2005	(2) / (1) - 1	(5)*(3)	r * (3)	
Africa	7,147	11,224	14	45	0.57	8	6	8
America	109,590	150,460	283	160	0.37	106	129	110
Asia	96,215	133,710	242	368	0.39	94	110	108
Europe	174,129	269,374	433	503	0.55	237	196	166
All other	10,457	14,286	0.903	2	0.37	0.330	0.411	0.282
Total	**398,511**	**580,133**	**973**	**1,078**	**0.46**	**445**	**444**	**392**
			$(\sum_{i=1}^{14}\sum_{j=1}^{5} Vij)$	$(\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij)$	**r**	$(\sum_{j=1}^{5} riV.j$	$(\sum_{j=1}^{5} rV.j$	$(\sum_{i=1}^{14}\sum_{j=1}^{5} r.jV.ij)$

In Million USD

Commodity	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual World Exports		**Actual EGY exports**		ri	riV.j	rV,j	
			V.j	V'.j				
	2001	2005	2001	2005	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Live trees, plants, bulbs, roots, cut flowers	8,777	13,770	2	5	0.57	1	0.919	1
Edible vegetables and certain roots and tubers	23,386	35,211	97	210	0.51	49	44	44
Edible fruit, nuts, peel of citrus fruit, melons	32,600	54,901	58	121	0.68	40	27	33
Milling products, malt, starches, inulin, wheat glute	5,777	8,658	5	10	0.50	2	2	2
Lac, gums, resins, vegetable saps and extracts	2,448	3,711	0.698	0.417	0.52	0.359	0.318	0.365
Vegetable, fruit, nut food preparations	19,901	32,094	17	45	0.61	10	8	10
Raw hides and skins (other than furskins) and leather	22,244	25,671	23	27	0.15	4	10	3
Cotton	34,960	43,813	345	294	0.25	87	157	69
Carpets and other textile floor coverings	7,849	11,060	3	4	0.41	1	1	1
Special woven or tufted fabric, lace, tapestry	6,628	10,092	0.565	0.786	0.52	0.295	0.257	0.286
Articles of apparel, accessories, knit or crochet	89,835	126,996	104	80	0.41	43	47	43
Articles of apparel, accessories, not knit or crochet	107,923	148,695	134	103	0.38	51	61	42
Other made textile articles, sets, worn clothing	18,846	32,111	117	139	0.70	82	53	87
Fertilizers	17,337	33,350	68	39	0.92	63	31	56
Total	**398,511**	**580,133**	**973**	**1,078**	**0.46**	**434**	**444**	**392**
			$\sum_{i=1}^{14}\sum_{j=1}^{5} Vij$	$\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{14} riVi.$	$\sum_{j=1}^{14} rVi.$	$\sum_{i=1}^{14}\sum_{j=1}^{5} rijV.ij$

Analysis		In Million USD	
	Egyptian Exports in 2005	1,078	
	Egyptian Exports in 2001	973	
	Change in Exports	**105**	100%
1) Due to increase in world trade	$(\sum_{j=1}^{14} rV.j)$	444	451%
2) Due to Commodity composition	$(\sum_{j=1}^{14} riVi.)$ - $(\sum_{j=1}^{14} rVi.)$	-10	-9.30%
3) Due to market distribution effect	$(\sum_{i=1}^{14}\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{14} r_i Vi.)$	-42	-39.76%
4) Due to increased competitiveness	$(\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij)$ - $(\sum_{i=1}^{14}\sum_{j=1}^{5} Vij)$ - $(\sum_{i=1}^{14}\sum_{j=1}^{5} rijV.ij)$	-287	-273.55%

Source: Calculated by the researcher based on COMTRADE and Trademap database

Table 8: Illustration of the Constant Market Share analysis of changes in Egyptian exports ((2006 - 2010)

In Million USD

Market	(1) **Actual World Exports**		(3) **Actual EGY exports** V.j	(4) V'.j	(5) **ri**	(6) **riV.j**	(7) **rV,j**	(8)
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Africa	12,676	20,408	39	469	0.61	24	9	32
America	159,818	181,986	164	1,221	0.14	23	38	20
Asia	141,697	184,363	281	1,683	0.30	85	65	137
Europe	294,213	353,835	518	2,968	0.20	105	120	103
All other	19,692	27,625	3	15	0.40	1	0.661	1
Total	**629,102**	**774,573**	**1,005**	**6,356**	**0.23**	**237,252**	**232**	**294**
			$(\sum_{i=1}^{14}\sum_{j=1}^{5} Vij)$	$(\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij)$	**r**	$(\sum_{j=1}^{5} riV.j$	$(\sum_{j=1}^{5} rV.j$	$(\sum_{i=1}^{14}\sum_{j=1}^{5} r.jV.ij)$

In Million USD

Commodity	(1) **Actual World Exports**		(3) **Actual EGY exports** V.j	(4) V'.j	(5) **ri**	(6) **riV.j**	(7) **rV,j**	(8)
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijV$
Live trees, plants, bulbs, roots, cut flowers	14,636	17,883	5	44	0.22	1	1	1
Edible vegetables and certain roots and tubers	39,808	57,489	197	834	0.44	88	46	88
Edible fruit, nuts, peel of citrus fruit, melons	60,136	83,647	123	955	0.39	48	28	56
Milling products, malt, starches, inulin, wheat glute	9,313	15,022	7	66	0.61	4	2	6
Lac, gums, resins, vegetable saps and extracts	3,834	5,252	0.229	220	0.37	0.084	0.053	0.041
Vegetable, fruit, nut food preparations	36,003	46,850	51	236	0.30	15	12	24
Raw hides and skins (other than furskins) and leather	27,846	26,309	28	171	-0.06	-2	6	-2
Cotton	45,957	53,750	243	608	0.17	41	56	33
Carpets and other textile floor coverings	11,993	12,576	2	359	0.05	0.102	0.486	0.225
Special woven or tufted fabric, lace, tapestry	10,254	9,432	1	174	-0.08	-0.976	0.281	-0.02

Articles of apparel, accessories, knit or crochet	139,568	169,403	68	456	0.21	14	16	13
Articles of apparel, accessories, not knit or crochet	159,717	172,722	77	821	0.08	6	18	-0.10
Other made textile articles, sets, worn clothing	36,099	45,410	126	259	0.26	32	29	31
Fertilizers	33,938	58,828	78	1,152	0.73	58	18	45
Total	**629,102**	**774,573**	**1,005**	**6,356**	**0.23**	**306**	**232**	**294**
			$\sum_{i=1}^{14}\sum_{j=1}^{5} V_i$	$\sum_{i=1}^{14}\sum_{j=1}^{5} V'$	r	$\sum_{j=1}^{14} riVi.$	$\sum_{j=1}^{14} rVi.$	$\sum_{i=1}^{14}\sum_{j=1}^{5} r$

Analysis In Million USD

Egyptian Exports in 2010		6,356	
Egyptian Exports in 2006		1,005	
	Change in Exports	**5,351**	100%
1) Due to increase in world trade	$(\sum_{j=1}^{14} rV.j)$	232	5%
2) Due to Commodity composition	$(\sum_{j=1}^{14} riVi.) - (\sum_{j=1}^{14} rVi.)$	74	1.68%
3) Due to market distribution effect	$(\sum_{i=1}^{14}\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{14} r_iVi.)$	-12	-1.09%
4) Due to increased competitiveness	$(\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij) - (\sum_{i=1}^{14}\sum_{j=1}^{5} Vij) - (\sum_{i=1}^{14}\sum_{j=1}^{5} rijV.ij)$	5,057	94.84%

Source: Calculated by the researcher based on COMTRADE and Trademap database

Table 9: Illustration of the Constant Market Share analysis of changes in Egyptian exports ((2011 - 2017)

In Million USD

Market	(1) Actual World Exports		(2) Actual EGY exports		(3) ri	(4) riV.j	(5) rV,j	(6)
			V.j	V'.j				
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Africa	28,589	24,180	517	410	-0.15	-80	10	-123
America	211,450	223,409	1,590	1,088	0.06	90	30	-23
Asia	228,250	251,678	1,775	2,335	0.10	182	33	591
Europe	407,766	410,247	3,441	2,630	0.01	21	64	-181
Other	31,776	16,248	12	46	-0.49	-6	0.222	-6
Total	**915,165**	**932,271**	**7,334**	**6,509**	**0.02**	**208**	**137**	**258**
			$(\sum_{i=1}^{14}\sum_{j=1}^{5} Vij)$	$(\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij)$	r	$(\sum_{j=1}^{5} riV.j$	$(\sum_{j=1}^{5} rV.j$	$(\sum_{i=1}^{14}\sum_{j=1}^{5} r.jV.ij)$

In Million USD

Commodity	(1) Actual World Exports		(2) Actual EGY exports		(3) ri	(4) riV.j	(5) rV,j	(6)
			V.j	V'.j				
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Live trees, plants, bulbs, roots, cut flowers	20,289	19,290	46	60	-0.05	-2	0.866	-3
Edible vegetables and certain roots and tubers	62,462	73,879	986	1,066	0.18	180	18	258
Edible fruit, nuts, peel of citrus fruit, melons	95,123	125,297	1,021	1,270	0.32	324	19	453

Milling products, malt, starches, inulin, wheat glute	19,317	18,695	74	112	-0.03	-2	1	-23
Lac, gums, resins, vegetable saps and extracts	7,140	7,142	208	21	0.00	0.818	4	-44
Vegetable, fruit, nut food preparations	55,521	59,834	271	400	0.08	21	5	22
Raw hides and skins (other than furskins) and leather	31,577	26,508	152	112	-0.16	-24	3	-23
Cotton	68,453	49,530	645	471	-0.28	-178	12	-184
Carpets and other textile floor coverings	13,651	14,279	412	314	0.05	19	8	46
Special woven or tufted fabric, lace, tapestry	10,569	10,812	208	24	0.02	5	4	3
Articles of apparel, accessories, knit or crochet	193,171	205,837	558	466	0.07	37	10	40
Articles of apparel, accessories, not knit or crochet	200,155	203,705	994	911	0.02	18	19	4
Other made textile articles, sets, worn clothing	52,095	57,958	315	231	0.11	35	6	32
Fertilizers	85,640	59,505	1,443	1,053	-0.31	-440	27	-323
Total	**915,165**	**932,271**	**7,334**	**6,509**	**0.02**	**-9**	**137**	**258**
			$\sum_{i=1}^{14}\sum_{j=1}^{5} Vij$	$\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{14} riVi.$	$\sum_{j=1}^{14} rVi.$	$\sum_{i=1}^{14}\sum_{j=1}^{5} rijV.ij$

Analysis			In Million USD
Egyptian Exports in 2017		6,509	
Egyptian Exports in 2011		7,334	
	Change in Exports	**-825**	100%
1) Due to increase in world trade	$(\sum_{j=1}^{14} rV.j)$	137	-47%
2) Due to Commodity composition	$(\sum_{j=1}^{14} riVi.) - (\sum_{j=1}^{14} rVi.)$	-146	38.52%
3) Due to market distribution effect	$(\sum_{i=1}^{14}\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{14} r_iVi.)$	267	55.37%
4) Due to increased competitiveness	$(\sum_{i=1}^{14}\sum_{j=1}^{5} V'ij) - (\sum_{i=1}^{14}\sum_{j=1}^{5} Vij) - (\sum_{i=1}^{14}\sum_{j=1}^{5} rijV.ij)$	-1,083	52.92%

Source: Calculated by the researcher based on COMTRADE and Trademap database

The next section shows the two-level decomposition of the products for 14 groups under study in three durations of analysis.

4.3- Two-Level CMS decomposition for Selected 14 Products

Based on the CMS two-level analysis for each for 14 products on a regional level, the following conclusions can be highlighted for each product as summarized in Table 8 (*see Appendix 21 – 62*).

Live trees, plants and bulbs, roots, cut flowers. Upon selecting the top four importing countries from Egypt for this product, the United Kingdom, Germany, Libya and Netherlands comprise around 80% of Egypt's exports in 2017. However, the top importing countries from this product worldwide are the USA, Canada and the Russian Federation. This is an indication that Egypt is not targeting the top importing countries for this product as these four countries comprise only 34% of world imports in 2017. Upon applying the CMS on the regional level, in the first two periods (2001/2005 and 2006/2011) showed a positive regional and world growth effect. However, after the revolution period (2012/2017), the regional effect was negative which implies the export growth was attributed to an export profile that is comprised of regions that are relatively slow growing compared to the world average.

Edible vegetables and certain roots and tubers. Based on the trade map database, the top importing countries worldwide for this product were Canada, the Russian Federation, the USA, China and India. Egypt top importers were Saudi Arabia, the **Russian Federation**, Italy and the United Arab Emirates. These countries comprise around 46% of Egypt's exports of this product. The CMS analysis showed a positive world growth effect and a negative competitiveness effect in the last period (2012/2017). This indicates that the exports of Egypt are growing between the two periods (keeping the same world average) and that Egypt's exports have grown faster than the world average and the economy gained market share. However, the regional effect showed a negative value between 2012 and 2017

indicating the export growth in regions that are growing with a slow pace compared to the world average. In the last period, the competitiveness effect also displayed a negative value which can be explained by changes in prices. This indicates an increase in the prices of exports in these markets reducing the competitiveness of this product.

Edible fruit, nuts, and peel of citrus fruit, melons. Top importing countries for this product are Canada, the Russian Federation, the USA, China and India. Egypt exports around 43% of its exports of edible fruits to Saudi Arabia, the **Russian Federation**, the Netherlands and the United Kingdom in 2017. CMS analysis on the regional level showed a negative regional effect and competitiveness effect as the previous product. This also indicates that Egypt is exporting to countries that are growing relatively slow compared to the world average. However, world growth showed positive values in three periods.

Milling products, malt, starches, inulin, and wheat glute. The top importing countries for this product worldwide are the USA, China, Brazil, Mexico and Canada. Egypt's exports of this product don't have special markets to export which comprises relatively high exports share. Saudi Arabia, Syria and Libya were on the top of the exports share in 2017. In the period after the revolution, the world growth effect and the regional effect were negative which implies that the selection of the markets for this product is not matching the relatively fast growing importing regions.

Lac, gums, resins, vegetable saps and extracts. The top importing countries worldwide for this product in 2017 were the USA, China, Canada, the Russian Federation and India. Egypt exports around 13% of its exports in 2017 to Saudi Arabia and Kuwait. The CMS analysis showed a positive regional effect during the period 2011-2017 and negative world growth and the competitiveness effect. This indicates that the total demand for this product worldwide was decreasing between "2011-2017", however, the markets that are importing from Egypt were increasing their demand for that product in the same period. An important point is that the markets that Egypt exports its product to are not from the top markets demanding this product.

Vegetable, fruit, nut, food preparations. The top importing countries worldwide are the USA, Canada, Russian Federation and China. Egypt exports 16% of its exports to Saudi Arabia, Libya, the **USA** and the United Arab Emirates. Due to the low concentration on the fast-growing markets, the regional effect showed a negative value in the period after the revolution (2012/2017).

Raw hides and skins (other than fur skins) and leather. China, India, the USA and Mexico were the top importing countries worldwide. Portugal, Spain, Italy and India were top importers from Egypt for this product. These countries comprised around 74% of total exports from this product in 2007. Due to the concentration of Egypt exports in the relatively growing markets, the regional effect was positive in the period after the revolution. This indicates the sustained growth of the right regions which are growing fast compared to the world average. However, world trade growth showed a negative value for the same period.

Cotton. China, Turkey, the USA, India and Mexico were the top importing markets for cotton in 2017. Egypt's top importing markets were Turkey, Italy, **India** and Pakistan. These countries comprised around 75% of the total exports of this product in 2017. Although cotton was not considered from the highly competitive products based on the indicators calculated previously, however, it was included due to the importance of this product; the selection of the markets shows a positive effect especially after 2011. Thus, Egypt is managing to invest in the right markets which are showing fast growth relative to the world average.

Carpets and other textile floor coverings. The United States, Canada and Australia are the top importing regions worldwide in 2017. Egypt exports 60% of its exports from this product to the **USA**, **Canada**, Germany and the United Kingdom in 2017. World growth effect and the regional effect were positive for this product after 2011. This also indicates the selection of the right markets to sell these products compared to the world average. However, the competitiveness effect was negative after 2011, which indicates problems related to the pricing of the product compared to other suppliers.

Special woven or tufted fabric, lace, tapestry. China, the USA, India and Turkey are the top importing countries in the world in 2017. Egypt's importing markets for this product are **Turkey**, Saudi Arabia, Kuwait and Spain. These markets comprise 64% of the total exports of this product in 2017. Although the selection of the markets involved one of the top markets worldwide, however, the share of this market was not growing in fast pace, thus the regional effect showed a negative value. Also, the world trade effect was negative in the last two periods for this product and the competitiveness effect was negative after 2011.

Articles of apparel, accessories, knit or crochet. The USA, Canada, the Russian Federation, China and Australia are the top importing countries. Egypt's top importing countries in 2017 were the **USA**, the United Kingdom, Spain and Italy with a share of 76%. The regional effect showed negative value before and after the revolution, however, the world growth effect showed positive values for the three periods.

Articles of apparel, accessories, not knit or crochet. The USA, Spain, Canada and China were the top importing markets worldwide. The **USA**, Spain, Turkey and the United Kingdom were the top importers from Egypt

in 2017 with a share of 74%. The regional effect showed also negative values in the three periods; however the world trade effect was positive for the last three periods. The competitiveness effect was negative after 2011.

Other made textile articles, sets, worn clothing. The United States, Canada and Australia are the top importing countries worldwide. Egypt top importing countries are Italy, the **USA**, Germany and France. These countries comprised 44% of exports of this product in 2017. World growth effect showed positive value in the three periods however the regional effect or the regional composition of trade were of negative values in the last two periods.

Fertilizers. The USA, Brazil, India and China are the top importers of this product. Egypt's top importers in 2017 were Turkey, France, Italy and Spain comprising 61% of total exports from this product. The regional composition of trade for this product showed a positive value after 2011, although the world trade effect was negative in the last period. The competitiveness effect showed a positive value after 2011.

The CMS analysis on the regional basis for 14 products showed that after the revolution, the competitiveness effect for most of the products was negative except live trees (06), milling products (11), vegetables and food preparations (20) and fertilizers (31). The regional effect displayed a negative value indicating the concentration of regions that are not growing fast except for lac, gums, vegetable saps and extracts (13), leather (41), cotton (52), carpets (57) and fertilizers (31). The world growth effect was positive for most of the products during three periods.

Table 10: Two-level decomposition (regional effect)

Items	1) Due to increase in world trade			2) Due to market distribution effect			3) Due to increased competitiveness		
	01/05	06/11	12/17	01/05	06/11	12/17	01/05	06/11	12/17
Live trees, plants, bulbs, roots, cut flowers	+	+	+	+	+	-	+	+	+
Edible vegetables and certain roots and tubers	+	+	+	-	+	-	+	+	-
Edible fruit, nuts, peel of citrus fruit, melons	+	+	+	+	-	-	+	+	-
Milling products, malt, starches, inulin, wheat glute	+	+	-	+	-	-	+	+	+
Lac, gums, resins, vegetable saps and extracts	+	+	-	+	-	+	-	+	-
Vegetable, fruit, nut, food preparations	+	+	+	+	+	-	+	+	+
Raw hides and skins (other than furskins) and leather	+	+	-	-	-	+	+	+	-
Cotton	+	+	-	-	-	+	-	+	-
Carpets and other textile floor coverings	+	+	+	-	-	+	-	+	-
Special woven or tufted fabric, lace, tapestry	+	-	-	-	-	-	-	+	-
Articles of apparel, accessories, knit or crochet	+	+	+	-	-	-	-	+	-
Articles of apparel, accessories, not knit or crochet	+	+	+	-	-	-	-	+	-
Other made textile articles, sets, worn clothing	+	+	+	+	-	-	-	+	-
Fertilizers	+	+	-	-	-	+	-	+	+

Source: Calculated by the researcher based on COMTRADE and Trademap database

The next section shows the results of the export share growth decomposition for the products under study in 2000, 2010 and 2017.

4.4 Export share growth decomposition

In this section, we apply the export share growth decomposition on 14 products for three years (2000, 2010 and 2017). This export share decomposition is based on identifying the weight of each component which is linked to the change in export share. In 2017, the products under the vegetable's products group showed a higher share of export growth due to expanding into the partner market. Also, Lac, gums, resins, vegetable saps and extracts (13) showed 35% of growth due to the increase in the size of the partner. This product also showed a positive regional effect in the two-level decomposition after the revolution. Foodstuffs and leather also showed more weight to expanding into the partner's market and no effect from the growth in the size of the partner. This indicates that the markets that Egypt's exports are channeled to are not saturated and has more room to increase Egypt's exports to them given their current size. Most of the textile products also showed the bigger share for the expansion in the partner's market as a reason for export share growth, however, carpets and special woven showed more weight for growth in the size of the partner. Fertilizers export share growth showed 74-92% attributed to expanding into the partner market and 11-32% due to growth in the size of the partner.

Table 11: Export share growth decomposition for selected 14 products in 2000, 2010 and 2017:

Product	Export share growth decomposition								
	Effect on the share of expanding into the partner market			Effect of growth in the size of the partner			Interaction effect		
	Δθrp*δp(0)			Δδp*θrp			Δθrp*Δδp		
	00	10	17	00	10	17	00	10	17
(06-15) Vegetable Products									
06: Live trees, plants, bulbs, roots, cut flowers	52%	94%	93%	44%	4%	9%	4%	2%	-2%
07: Edible vegetables and certain roots and tubers	-55%	106%	92%	149%	-7%	8%	7%	1%	1%
08: Edible fruit, nuts, peel of citrus fruit, melons	13%	86%	193%	87%	16%	-89%	-1%	-2%	-4%
11: Milling products, malt, starches, inulin, wheat glute	93%	420%	349%	2%	-123%	-155%	5%	-196%	-94%
13: Lac, gums, resins, vegetable saps and extracts	107%	-107%	88%	-17%	199%	35%	10%	8%	-23%
(16-24) Foodstuffs									
20: Vegetable, fruit, nut, etc food preparations	109%	106%	834%	-7%	-5%	-616%	-1%	-1%	-118%
(41-43) Raw Hides, Skins, Leather, & Furs									
41: Raw hides and skins (other than furskins) and leather	71%	703%	163%	25%	-579%	-69%	4%	-24%	6%
(50-63) Textiles									
52: Cotton	75%	107%	294%	21%	-4%	-221%	4%	-3%	27%
57: Carpets and other textile floor coverings	431%	-861%	17%	-392%	912%	83%	61%	49%	0%
58: Special woven or tufted fabric, lace, tapestry	87%	12%	96%	2%	89%	12%	11%	-1%	-7%
61: Articles of apparel, accessories, knit or crochet	111%	93%	135%	-15%	9%	-29%	4%	-2%	-6%
62: Articles of apparel, accessories, not knit or crochet	97%	113%	176%	3%	-14%	-61%	0%	1%	-15%
63: Other made textile articles, sets, worn clothing	121%	118%	114%	-29%	-20%	-15%	8%	2%	0%
31: Fertilizers	92%	74%	79%	11%	32%	18%	-4%	-6%	3%

Source: Calculated by the researcher based on COMTRADE and Trademap database

Used values of 2002 due to missing data in 2000

5. Conclusion

In this paper, we presented the Constant market share analysis which is a method for decomposing the development of a country's export share. The change in the country's exports decomposes to world growth effect, commodity effect, regional effect and competitiveness effect. Richardson revisited this method and Fagerberg and others introduced a new form of this method, which adds a static and dynamic definition to its components. In 1988, Milana introduced amendments in the CMS based on the Index number theory and in 2012 Cheptea, A. and others introduced an econometric technique to measure the components of the CMS.

This paper is confined to applying the basic Leamer and Stern two-level and three-level identities as it serves the objective of the paper in understanding the channels of exports growth. Also, this paper applies the basic export share growth decomposition introduced by Fagerberg, J. and Sollie. This paper is a work in progress and a continuation of the previous work which tackles the competitiveness of agribusiness in Egypt. Based on the previous work, highly competitive products from the agribusiness chain are used in the CMS analysis. First, the application of the CMS analysis involved calculating the identity of two-level analyses for agribusiness product groups and three level analyses for 14 highly competitive products on the commodity level and regional level. Second, applying the two-level analysis for each product of 14 highly competitive products and third, applying the export share growth decomposition on 14 products. The duration of the analysis covered the period 2000-2017.

Based on the outcomes of the identity application, it was found that the trade channels when using the CMS decomposition for agribusiness commodity groups and upon using it specifically on the highly competitive 14 products showed a positive commodity effect during 2006-2010. This means that the growth in exports of agribusiness product groups in general and in 14 product groups specifically can be attributed to an export profile that is comprised of goods that are relatively fast growing compared to the world average during that period. However, upon using the

CMS for the selected 14 products, the market distribution effect was negative in the first two periods, and then it showed positive value after 2011. The dominant positive effect in all periods is the world growth effect. The world trade growth was negative after 2011 for the agribusiness product groups compared to positive value after 2011 for the specific 14 products. That shows that the level of aggregation can offer a different interpretation of the sources or channels of competitiveness.

Applying the three-level decomposition for 14 products to understand the interaction between the commodity and regional effects showed that in the first two periods (before the revolution) the world growth effect was positive. In the second period, both, the commodity composition and competitiveness effect, were positive. The market distribution effect was positive after 2011 only. This indicates the stable and correct channeling of Egypt's exports to different regions after 2011 for these products. However, after 2011, the commodity effect and competitiveness effect, exhibited negative values. This indicates that the composition of trade needs to be revised to target the commodities that are growing fast relative to world growth rates.

On the basis of individual product analysis on the region level, there were different outcomes for each product. Live trees, edible fruits, edible vegetables and vegetables, fruit, nut and food preparation showed positive world growth effect and competitiveness effect, however, after the revolution, it showed a negative regional effect. This shows that after 2011, the selection of the markets for these products is not matching with the relatively fast growing importing regions. *Milling products* showed a positive competitiveness effect in the three periods of analysis; however, after 2011, the world growth effect and region effect were negative. *Lac, gums, resins, vegetables saps and extracts* only showed a positive regional effect after 2011 which indicated that the selection of the markets for this product is matching the relatively fast growing importing regions. *Leather products* showed a positive regional effect in the period after the revolution, as it was negative in the period before the revolution (2006/2011). This indicates the re-direction or focus on the right regions which are growing in a fast pace if compared to the world average. *Cotton* showed that the regional effect after the revolution was positive, however, the competitiveness and world growth effect were negative after 2011. *Carpets and other textile floor coverings* showed a positive world growth effect and the regional effect after 2011, which indicates the selection of the right markets to sell these products compared to the world average. *Special woven or tufted fabric, lace, tapestry* showed a negative regional effect, world growth and the competitiveness effect after 2011. *Articles of apparel, accessories, knit or crochet's* regional effect showed negative value before and after the revolution, however, the world growth effect showed positive values for three periods. *Articles of apparel, accessories, not knit or crochet*, the regional effect showed negative values in three periods; however, the competitiveness effect was positive for the second period only. *Other made textile articles, sets, worn clothing's* world's growth effect showed a positive value in three periods, however; the regional effect and the regional composition of trade were of negative values. *Fertilizer's* regional effect and the competitiveness effect for this product showed a positive value after 2011.

In the last section, we apply the export share growth decomposition on 14 products for three years (2000, 2010 and 2017). In 2017, the products under the vegetables' product group showed a higher share of export growth due to expanding into the partner market. Also, Lac, gums, resins, vegetable saps and extracts (13) showed 35% of growth due to the increase in the size of the partner. Foodstuffs and leather also showed more weight to expanding into the partner's market and no effect from the growth in the size of the partner. This indicates that the markets that Egypt's exports are channeled to are not saturated and has more room to increase Egypt's exports to them given their current size. Most of the textile products also showed the bigger share of the expanding in the partner's market as a reason for export share growth, however, carpets and special woven showed more weight for growth in the size of the partner. Fertilizers export share growth was more attributed to expanding into the partner market.

The CMS analysis in this stage only gave a preliminary indicator or map of how the agribusiness products as groups and selected products (on a disaggregated manner of two digits HS codes) were performing before and after 2011. It was clear that not all products were in the same direction in regards to the commodity effect or the regional effect or the competitiveness effect. However, this basic Leamer and Stern identity can direct the study for a detailed analysis for products (six digits HS codes).

References

1. Baldwin, R. The Commodity Composition of Trade: Selected Industrial Countries, 1900-1954. The Review of Economics and Statistics, (1985) 40(1), p.50.
2. Bonanno, G.. A Note: Constant Market Share Analysis. International Journal of Economics & Management Sciences, (2015), 4(10). doi:10.4172/2162-6359.1000302
3. Cheptea, A., Fontagne, L. and Zignago, S.. European Export Performance. SSRN Electronic Journal (2012)

4. Cheptea, A., Gaulier, G. and Zignago, S. World Trade Competitiveness: A Disaggregated View by Shift-Share Analysis. SSRN Electronic Journal (2005)
5. De Munnik, D., Jacob, J., & Sze, W. The Evolution of Canada's Global Export Market Share (Working paper No. 2012-31). Canadian Economic Analysis Department, Bank of Canada (2012)
6. DIEWERT, E. IRVING FISHER AND INDEX NUMBER THEORY. Journal of the History of Economic Thought, (2013) 35(02), pp.199-232.
7. Diewert, W. Exact and superlative index numbers. Journal of Econometrics, (1976) 4(2), pp.115-145.
8. Dubov, I. Discussion: Analyzing the Structure of Agribusiness Relations. Journal of Farm Economics, (1966) 48(5), p.1400.
9. Fagerberg, J. and Sollie, G. The method of constant market shares analysis reconsidered. Applied Economics, (1987) 19(12), pp.1571-1583.
10. Finicelli, A., Sbracia, M., & Zaghini, A. A disaggregated analysis of the export performance of some industrial and emerging countries. International Economics and Economic Policy, (2010) 8(1), 93-113. doi:10.1007/s10368-010-0174-8
11. Fougner, T. The state, international competitiveness and neoliberal globalisation: Is there a future beyond 'the competition state' Review of International Studies, (2006) 32(01), 165. doi:10.1017/s0260210506006978
12. Gaulier, G. and Zignago, S. BACI: International Trade Database at the Product-Level (the 1994-2007 Version). SSRN Electronic Journal (2010)
13. Gilbert, J. Constant Market Shares Analysis Part I Decomposition of Values. Lecture presented at Capacity Building Workshop Enhancing Capacity on Trade Policies and Negotiations in Laos" May 8-10, 2017 Vientienne, Lao PDR, Vientienne, Lao PDR (2017)
14. Gilbert, J. Constant Market Shares Analysis Part II Decomposition of Shares. Lecture presented at Capacity Building Workshop Enhancing Capacity on Trade Policies and Negotiations in Laos" May 8-10, 2017 Vientienne, Lao PDR, Vientienne, Lao PDR (2017)
15. Gilbert, J., & Muchová, E. Export competitiveness of Central and Eastern Europe since the enlargement of the EU. International Review of Economics & Finance, (2018) 55, 78-85. doi:10.1016/j.iref.2018.01.008
16. Helmy, Omneia, Competitiveness of Egypt in the EU market for fruits and vegetables. International Agricultural Trade and Development: New Research (2012) 215-255.
17. Leamer, E. and Stern, R. Quantitative international economics (1970)
18. Merkies, A. H., & Meer, T. V. A theoretical foundation for Constant Market Share analysis. Empirical Economics, (1988) 13(2), 65-80. doi:10.1007/bf01973315
19. Milana, C. Constant-market-shares analysis and index number theory. European Journal of Political Economy, (1988) 4(4), pp.453-478.
20. Pandiella, A. G. A Constant Market Share Analysis of Spanish Goods Exports. OECD Economics Department Working Papers. (2015) doi:10.1787/5js69lb4b5mt-en
21. Richardson, J. Constant-market-shares analysis of export growth. Journal of International Economics, 1(2), (1971) pp.227-239.
22. Richardson, J. Some Sensitivity Tests for a "Constant-Market-Shares" Analysis of Export Growth. The Review of Economics and Statistics, (1971) 53(3), p.300.
23. Scofield, W. Analyzing the Structure of Agribusiness Relations. Journal of Farm Economics, (1966) 48(5), p.1379.
24. Skriner, E. Competitiveness and Specialisation of the Austrian Export Sector - A Constant-Market-Shares Analysis (2011) Retrieved from https://econpapers.repec.org/paper/wsrwpaper/y_3a2009_3ai_3a032.htm

Appendix

Table A1: SITC value of exports and imports in 2000, 2010 and 2016

In Million USD

	Exports			Imports		
	2000	2010	2016	2000	2010	2016
Total Exports/Imports Value in USD	**4,693**	**26,332**	**22,507**	**13,964**	**53,003**	**58,053**
0: Food and live animals	339	4,008	3,995	2,873	7,903	9,544
1: Beverages and tobacco	7	108	128	241	430	279
2: Crude materials, inedible, except fuels	294	1,310	843	1,019	3,900	2,745
3: Mineral fuels, lubricants and related materials	1,967	7,551	3,219	1,059	7,129	8,197
4: Animal and vegetable oils, fats and waxes	24	146	167	299	1,023	737
5: Chemicals and related products.	310	3,530	3,415	1,621	6,306	7,790
6: Manufactured goods classified chiefly by material	813	5,427	4,046	2,093	10,876	10,894
7: Machinery and transport equipment	49	1,132	1,803	3,532	12,946	15,231
8: Miscellaneous manufactured articles	761	2,017	1,989	598	2,439	2,283
9: Commodities and transactions not classified elsewhere in the SITC	131	1,103	2,904	629	53	353

Table A2: SITC share of exports and imports in 2000, 2010 and 2016

Item	SITC	Exports share of total exports			Imports share of total imports		
		2000	2010	2016	2000	2010	2016
Total - Million USD		**4,693**	**26,332**	**22,507**	**13,964**	**53,003**	**58,053**
Food and live animals	0	7%	15%	18%	21%	15%	16%
Beverages and tobacco	1	0.2%	0.4%	0.6%	1.7%	0.8%	0.5%
Crude materials, inedible, except fuels	2	6%	5%	4%	7%	7%	5%
Mineral fuels, lubricants and related materials	3	42%	29%	14%	8%	13%	14%
Animal and vegetable oils, fats and waxes	4	1%	1%	1%	2%	2%	1%
Chemicals and related products, n.e.s.	5	7%	13%	15%	12%	12%	13%
Manufactured goods classified chiefly by material	6	17%	21%	18%	15%	21%	19%
Machinery and transport equipment	7	1%	4%	8%	25%	24%	26%
Miscellaneous manufactured articles	8	16%	8%	9%	4%	5%	4%
Commodities and transactions not classified elsewhere in the SITC	9	3%	4%	13%	5%	0%	1%

Table A3: SITC detailed share of exports and in 2000, 2010 and 2016

	Exports			Imports		
	2000	2010	2016	2000	2010	2016
0: Food and live animals						
00 - Live animals other than animals of division 03	1.2%	0.4%	0.4%	5.9%	2.4%	1.5%
01 - Meat and meat preparations	0.5%	0.2%	0.2%	9.9%	12.9%	14.9%
02 - Dairy products and birds' eggs	1.7%	12.8%	7.9%	5.8%	5.9%	6.2%
03 - Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof	0.4%	0.4%	1.0%	4.8%	6.2%	6.3%
04 - Cereals and cereal preparations	32.2%	12.9%	6.4%	44.0%	44.8%	33.1%
05 - Vegetables and fruit	50.6%	50.9%	63.4%	9.2%	8.8%	12.5%
06 - Sugars, sugar preparations and honey	6.9%	12.3%	9.3%	1.5%	6.3%	5.9%
07 - Coffee, tea, cocoa, spices, and manufactures thereof	3.8%	3.5%	4.3%	4.9%	5.3%	6.3%
08 - Feeding stuff for animals (not including unmilled cereals)	0.7%	2.6%	2.3%	11.9%	5.1%	10.0%
09 - Miscellaneous edible products and preparations	2.0%	4.1%	4.7%	2.2%	2.1%	3.2%
1: Beverages and tobacco						
11 - Beverages	54.4%	10.1%	8.7%	0.4%	15.4%	8.4%
12 - Tobacco and tobacco manufactures	45.6%	89.9%	91.3%	99.6%	84.6%	91.6%
2: Crude materials, inedible, except fuels						
21 - Hides, skins and furskins, raw	0.1%	0.4%	0.0%	0.1%	0.6%	0.2%
22 - Oil-seeds and oleaginous fruits	1.9%	7.1%	5.9%	10.5%	20.2%	14.0%
23 - Crude rubber (including synthetic and reclaimed)	0.2%	0.2%	0.1%	1.6%	3.3%	3.0%
24 - Cork and wood	0.6%	1.5%	2.4%	49.9%	24.0%	34.8%
25 - Pulp and waste paper	0.0%	0.0%	0.0%	1.7%	4.5%	6.6%
26 - Textile fibres (other than wool tops and other combed wool) and their wastes (not manufactured into yarn or fabric)	69.0%	25.7%	20.1%	8.7%	8.3%	10.6%
27 - Crude fertilizers, other than those of division 56, and crude minerals (excluding coal, petroleum and precious stones)	14.5%	32.4%	30.2%	2.8%	3.2%	8.3%
28 - Metalliferous ores and metal scrap	3.5%	2.0%	2.1%	20.5%	32.9%	17.5%
29 - Crude animal and vegetable materials, n.e.s.	10.0%	30.6%	39.1%	4.1%	3.0%	4.9%
4: Animal and vegetable oils, fats and waxes						
41 - Animal oils and fats	0.1%	8.7%	0.2%	2.7%	0.1%	0.1%
42 - Fixed vegetable fats and oils, crude, refined or fractionated	15.5%	71.9%	92.8%	91.6%	96.5%	89.0%
43 - Animal or vegetable fats and oils, processed; waxes of animal or vegetable origin; inedible mixtures or preparations of animal or vegetable fats or oils, n.e.s.	84.4%	19.3%	7.0%	5.6%	3.5%	10.8%
5: Chemicals and related products, n.e.s.						
51 - Organic chemicals	1.2%	3.2%	3.8%	13.6%	15.2%	14.2%
52 - Inorganic chemicals	26.3%	16.0%	6.0%	7.9%	4.5%	4.0%
53 - Dyeing, tanning and colouring materials	2.3%	2.3%	3.7%	8.2%	7.1%	5.9%
54 - Medicinal and pharmaceutical products	16.0%	7.1%	8.4%	20.8%	19.8%	27.1%
55 - Essential oils and resinoids and perfume materials; toilet, polishing and cleansing preparations	16.9%	7.3%	19.0%	3.2%	9.5%	5.5%
56 - Fertilizers (other than those of group 272)	24.9%	32.6%	24.8%	2.7%	1.8%	1.3%
Other (57 - Plastics in primary forms, 58 - Plastics in non-primary forms, 59 - Chemical materials and products, n.e.s.)	12.3%	31.5%	34.2%	43.6%	42.2%	42.0%
6: Manufactured goods classified chiefly by material						
61 - Leather, leather manufactures, n.e.s., and dressed furskins	2.2%	2.9%	3.0%	0.0%	0.0%	0.0%
63 - Cork and wood manufactures (excluding furniture)	0.3%	0.3%	0.5%	5.0%	2.5%	3.3%
64 - Paper, paperboard and articles of paper pulp, of paper or of paperboard	2.1%	7.3%	10.6%	14.2%	9.2%	10.1%
65 - Textile yarn, fabrics, made-up articles, n.e.s., and related products	50.5%	23.8%	29.8%	9.8%	18.7%	19.0%
Other (62 - Rubber manufactures, n.e.s., 66 - Non-metallic mineral manufactures, n.e.s., 67 - Iron and steel, 68 - Non-ferrous metals, 69 - Manufactures of metals, n.e.s.)	44.8%	65.6%	56.1%	71.0%	69.6%	67.6%

Table A4: Agri-Orientation Index for the period 2000-2016:

Years	Agriculture, forestry, fishing (General Government) (Share of Total Outlays)	Agriculture, forestry, and fishing, value added (% of GDP)	AOI
2000	5.1	17.0	0.30
2004	3.6	14.3	0.25
2005	2.5	14.0	0.18
2006	2.2	13.2	0.16
2007	2.4	13.4	0.18
2008	1.8	12.6	0.14
2009	2.1	13.0	0.16
2010	1.9	13.3	0.14
2011	1.7	13.9	0.12
2012	2.1	11.3	0.19
2013	1.9	11.3	0.17
2014	1.6	11.3	0.14
2015	1.5	11.4	0.13
2016	1.4	11.8	0.11

Table A5: Egypt Exports Trade Value in Million USD for selected Agribusiness Products from 2000-2017

Year	06	07	08	11	13	20	41	52	57	58	61	62	63	31	Tot.Exp. 14 Prod.	Other exp.	Total Exp.
2000	2	96	59	1	1	14	17	394	23	1	116	196	145	78	1,143	3,550	4,693
2001	2	97	58	5	1	17	23	345	3	1	104	134	117	68	973	3,168	4,141
2002	4	127	38	2	1	18	25	464	3	4	86	121	99	44	1,037	3,626	4,662
2003	5	134	53	6	1	26	27	514	3	1	99	134	117	70	1,189	4,971	6,159
2004	5	194	106	2	0	31	27	610	3	1	105	128	130	15	1,358	6,322	7,680
2005	5	210	121	10	0	45	27	294	4	1	80	103	139	39	1,078	9,567	10,646
2006	5	197	123	7	0	51	28	243	2	1	68	77	126	78	1,005	12,715	13,720
2007	5	311	220	14	0	62	37	275	3	1	78	101	146	77	1,331	14,836	16,167
2008	17	664	708	21	63	131	63	364	171	57	519	254	278	678	3,988	21,979	25,967
2009	26	806	1,006	46	190	185	117	267	302	181	509	811	250	1,143	5,839	18,344	24,182
2010	44	834	955	66	220	236	171	608	359	174	456	821	259	1,152	6,356	19,976	26,332
2011	46	986	1,021	74	208	271	152	645	412	208	558	994	315	1,443	7,334	24,248	31,582
2012	60	804	990	66	172	314	119	527	390	180	486	770	284	1,284	6,447	22,970	29,417
2013	65	1,040	1,010	65	80	340	173	535	405	177	500	867	317	1,186	6,761	22,019	28,779
2014	79	1,239	1,053	74	67	421	195	474	402	182	512	781	333	742	6,555	20,257	26,812
2015	54	1,134	1,123	114	120	363	158	479	340	211	483	870	262	423	6,134	15,834	21,967
2016	73	967	1,196	97	80	377	120	462	303	66	388	757	227	848	5,961	16,547	22,507
2017	60	1,066	1,270	112	21	400	112	471	314	24	466	911	231	1,053	6,509	19,434	25,943

Source: COMTRADE database

06: Live trees, plants, bulbs, roots, cut flowers

07: Edible vegetables and certain roots and tubers

08: Edible fruit, nuts, peel of citrus fruit, melons

11: Milling products, malt, starches, inulin, wheat glute

13: Lac, gums, resins, vegetable saps and extracts nes

20: Vegetable, fruit, nut, etc food preparations

41: Raw hides and skins (other than furskins) and leather

52: Cotton

57: Carpets and other textile floor coverings

58: Special woven or tufted fabric, lace, tapestry etc

61: Articles of apparel, accessories, knit or crochet

62: Articles of apparel, accessories, not knit or crochet

63: Other made textile articles, sets, worn clothing etc

31: Fertilizers

Table A6: World Exports Trade Value in Million USD for selected Agribusiness Products from 2000-2017

Year	06	07	08	11	13	20	41	52	57	58	61	62	63	31	Other exp.	Total Exp.
2000	8,454	19,778	28,030	5,340	1,958	19,580	21,154	32,640	8,352	8,289	80,385	103,533	17,295	15,162	5,910,162	6,280,1
2001	8,510	21,724	28,749	5,514	2,098	19,848	22,691	32,380	7,685	7,786	79,752	100,835	17,522	14,915	5,757,461	6,127,4
2002	9,577	22,919	30,784	6,045	2,296	21,765	22,318	33,855	8,020	8,857	84,834	106,543	19,152	15,175	6,032,251	6,424,3
2003	11,663	27,292	37,154	6,995	2,645	25,794	24,101	41,407	9,367	9,663	100,046	120,834	25,220	18,566	7,025,457	7,486,2
2004	12,691	30,417	42,092	7,989	3,004	28,958	26,351	46,536	10,457	10,608	113,707	133,826	29,131	22,959	8,581,272	9,099,9
2005	13,538	32,533	48,653	8,440	3,434	31,408	26,350	45,299	11,409	11,557	122,169	144,140	33,661	27,167	9,781,103	10,340,8
2006	15,459	37,681	52,328	9,090	3,728	35,979	28,971	48,686	12,329	12,426	144,043	157,632	36,813	28,454	11,332,637	11,956,2
2007	17,210	43,692	59,422	12,563	3,915	44,533	31,232	49,668	13,283	13,671	170,847	169,293	40,591	40,312	13,122,111	13,832,3
2008	18,732	48,135	68,669	16,318	4,887	49,901	28,792	50,819	13,841	14,189	177,235	180,609	44,874	74,585	15,186,701	15,978,2
2009	17,622	47,663	66,179	13,807	4,684	44,912	20,633	41,162	11,693	10,671	158,763	155,990	42,578	40,494	11,671,807	12,348,6
2010	17,969	56,102	75,380	14,254	5,634	47,588	30,021	55,932	13,994	11,700	178,317	168,178	48,447	54,404	14,312,655	15,090,5
2011	20,974	60,662	86,025	18,045	7,878	56,459	32,246	68,391	15,399	12,899	207,780	196,674	55,964	74,343	17,164,865	18,078,6
2012	20,113	56,546	87,366	18,353	12,563	56,417	31,092	65,044	14,430	12,543	199,503	179,446	55,025	72,625	17,502,580	18,383,6
2013	22,021	64,420	95,850	19,119	9,003	60,467	34,841	68,872	15,505	13,254	219,286	194,556	61,122	65,274	18,031,757	18,975,3
2014	21,826	64,518	101,588	19,536	8,400	60,800	35,472	61,627	16,014	13,586	221,983	214,766	64,876	63,457	18,005,491	18,973,9
2015	18,760	63,594	99,393	17,967	6,917	57,286	29,171	53,873	14,497	12,520	205,461	202,128	59,910	62,189	15,594,881	16,498,5
2016	19,969	70,249	111,934	17,936	7,022	59,506	26,229	52,756	15,152	12,065	217,345	216,370	60,510	50,057	15,074,082	16,011,1
2017	21,013	72,065	115,805	17,662	7,146	61,671	25,925	56,117	15,348	12,310	225,814	228,412	63,080	51,012	16,607,323	17,580,7

Source: COMTRADE database

06: Live trees, plants, bulbs, roots, cut flowers

07: Edible vegetables and certain roots and tubers

08: Edible fruit, nuts, peel of citrus fruit, melons

11: Milling products, malt, starches, inulin, wheat glute

13: Lac, gums, resins, vegetable saps and extracts nes

20: Vegetable, fruit, nut, etc food preparations

41: Raw hides and skins (other than furskins) and leather

52: Cotton

57: Carpets and other textile floor coverings

58: Special woven or tufted fabric, lace, tapestry etc

61: Articles of apparel, accessories, knit or crochet

62: Articles of apparel, accessories, not knit or crochet

63: Other made textile articles, sets, worn clothing etc

31: Fertilizers

Table A7: Actual World Imports by region and Egypt actual exports of 06: Live trees, plants, bulbs, roots, cut flowers to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

06: Live trees, plants, bulbs, roots, cut flowers	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Actual World Imports		Actual EGY exports		Actual World Imports		Actual EGY exports		Actual World Imports		Actual EGY exports	
Market	2001	2005	2001	2005	2006	2010	2006	2010	2011	2017	2011	2017
Africa	30,731	78,729	194	365	136,412	120,449	276	6,626	955,855	167,796	3,150	7,239
America	1,513,390	2,098,573	50	145	2,237,941	2,296,955	288	2,358	2,432,156	3,069,125	2,271	531
Asia	609,982	868,749	487	1,632	895,348	1,271,030	1,208	5,013	1,433,845	1,862,973	5,605	5,349
Europe	6,572,490	10,643,601	1,284	2,390	11,274,850	14,071,287	3,090	29,445	15,329,634	14,088,982	35,227	47,051
All other	50,470	79,854	2	8	91,220	122,832	45	101	137,232	100,725	72	21
Total	**8,777,063**	**13,769,506**	**2,017**	**4,540**	**14,635,771**	**17,882,553**	**4,907**	**43,543**	**20,288,722**	**19,289,601**	**46,325**	**60,191**

Table A8: Actual World Imports by region and Egypt actual exports of 07: Edible vegetables and certain roots and tubers to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

07: Edible vegetables and certain roots and tubers	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	Actual World Imports		Actual EGY exports		Actual World Imports		Actual World Imports		Actual World Imports		Actual World Imports	
	2001	2005	2001	2005	2006	2010	2006	2010	2011	2017	2011	2017
Africa	517,379	910,750	979	4,744	937,923	1,804,401	6,371	50,142	2,226,773	2,428,268	68,396	66,732
America	5,016,442	7,468,611	1,073	3,021	8,190,895	11,468,436	4,629	17,235	12,572,782	15,784,401	37,904	32,990
Asia	4,707,672	5,923,706	43,603	69,914	6,929,437	12,166,782	54,063	366,295	13,622,969	22,182,056	358,660	476,290
Europe	12,483,070	20,276,927	50,850	131,892	22,591,839	29,926,701	131,804	398,677	32,108,881	32,919,693	519,981	486,823

All other	661,283	631,261	98	398	1,157,571	2,122,315	359	1,949	1,931,060	564,668	1,090	2,766
Total	**23,385,846**	**35,211,255**	**96,603**	**209,969**	**39,807,665**	**57,488,635**	**197,226**	**834,298**	**62,462,465**	**73,879,086**	**986,031**	**1,065,601**

Table A9: Actual World Imports by region and Egypt actual exports of 08: Edible fruit, nuts, peel of citrus fruit, melons to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

08: Edible fruit, nuts, peel of citrus fruit, melons	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	222,262	436,267	411	2,503	463,817	1,048,110	4,343	45,827	1,341,651	1,349,420	50,726	35,221
America	6,656,096	10,455,853	115	602	11,538,463	15,950,149	898	2,417	17,884,798	26,204,545	1,281	6,025
Asia	5,657,155	8,562,368	47,557	24,918	8,814,712	16,198,280	38,937	423,126	20,235,771	35,362,787	488,628	660,063
Europe	19,270,998	34,525,913	10,174	92,991	37,603,907	47,163,015	78,249	481,560	52,163,224	61,108,000	479,188	559,419
All other	793,001	920,339	5	99	1,714,904	3,287,815	294	2,141	3,497,877	1,271,758	786	9,143
Total	**32,599,512**	**54,900,740**	**58,262**	**121,113**	**60,135,803**	**83,647,369**	**122,721**	**955,071**	**95,123,321**	**125,296,510**	**1,020,609**	**1,269,871**

Table A10: Actual World Imports by region and Egypt actual exports of 11: Milling products, malt, starches, inulin, wheat glute to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

11: Milling products, malt, starches, inulin, wheat glute	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	551,162	784,387	1,401	6,745	865,280	1,654,525	3,799	52,643	2,414,197	1,565,621	65,098	77,072
America	1,295,299	1,936,039	1	15	2,211,382	3,380,245	4	200	3,961,883	4,288,486	253	281
Asia	1,415,004	2,173,012	1,996	3,216	2,307,672	4,619,201	2,787	11,847	5,635,982	6,542,950	7,448	34,055
Europe	1,980,103	2,922,246	1,208	131	3,172,510	4,564,898	0	741	6,148,517	5,934,874	862	113
All other	535,390	842,227	0	9	756,526	803,586	1	167	1,156,387	363,271	1	234
Total	**5,776,958**	**8,657,911**	**4,605**	**10,116**	**9,313,370**	**15,022,455**	**6,591**	**65,598**	**19,316,966**	**18,695,202**	**73,662**	**111,755**

Table A11: Actual World Imports by region and Egypt actual exports of 13: Lac, gums, resins, vegetable saps and extracts to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

13: Lac, gums, resins, vegetable saps and extracts	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	49,250	69,509	380	83	75,004	207,255	58	127,947	564,512	163,297	124,812	11,825
America	778,824	998,603	0	12	1,106,493	1,443,817	0	66	2,395,434	2,159,811	0	0
Asia	529,298	871,519	316	262	869,165	1,115,907	142	87,156	1,329,910	1,834,899	80,756	9,002
Europe	1,025,695	1,696,435	3	60	1,688,584	2,336,251	28	4,752	2,663,332	2,862,208	2,711	69
All other	65,060	75,261	0	0	94,285	149,253	1	0	186,386	122,162	1	1
Total	**2,448,127**	**3,711,327**	**698**	**417**	**3,833,531**	**5,252,483**	**229**	**219,920**	**7,139,574**	**7,142,377**	**208,280**	**20,897**

Table A12: Actual World Imports by region and Egypt actual exports of 20: Vegetable, fruit, nut, etc food preparations to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

20: Vegetable, fruit, nut, etc food preparations	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	219,288	470,496	2,242	15,214	689,251	1,420,834	11,837	70,482	1,759,639	1,516,106	95,867	93,217
America	4,481,522	6,779,709	1,512	5,254	7,546,178	9,985,623	3,749	30,922	11,710,856	14,098,512	23,665	49,410
Asia	3,643,509	5,277,466	10,843	16,734	5,497,687	7,572,240	21,129	101,545	9,311,349	12,014,288	108,640	177,516

Europe	10,950,571	18,564,340	2,106	7,886	21,037,710	25,980,356	13,759	32,792	30,545,007	30,841,698	42,832	77,695
All other	606,093	1,001,898	30	205	1,232,534	1,890,452	144	607	2,193,706	1,363,522	399	1,755
Total	**19,900,983**	**32,093,909**	**16,733**	**45,293**	**36,003,360**	**46,849,505**	**50,618**	**236,348**	**55,520,557**	**59,834,126**	**271,403**	**399,593**

Table A13: Actual World Imports by region and Egypt actual exports of 41: Raw hides and skins (other than furskins) and leather to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

41: Raw hides and skins (other than furskins) and leather	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	323,540	358,529	92	453	415,781	665,469	42	2,218	943,359	461,856	1,341	363
America	2,505,225	2,501,234	32	1,509	2,346,582	1,671,732	1,251	2,418	1,957,749	2,188,863	0	134
Asia	9,820,508	12,695,680	6,509	5,994	13,917,483	13,834,808	6,755	51,545	15,948,710	12,880,775	39,781	34,734
Europe	9,355,558	9,962,207	16,310	19,124	10,998,117	10,009,588	19,908	115,040	12,569,215	10,910,770	111,149	76,799
All other	239,219	153,393	1	0	167,669	127,583	4	59	158,433	65,504	3	0
Total	**22,244,050**	**25,671,043**	**22,944**	**27,078**	**27,845,632**	**26,309,180**	**27,960**	**171,280**	**31,577,466**	**26,507,768**	**152,274**	**112,030**

Table A14: Actual World Imports by region and Egypt actual exports of 52: Cotton to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

52: Cotton	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	2,137,748	2,439,134	4,378	1,560	2,402,250	3,153,729	2,988	10,027	3,744,213	3,210,321	9,793	39,040
America	4,829,919	5,730,830	58,936	23,568	5,377,362	5,645,465	15,018	16,915	7,460,986	4,491,957	33,667	15,716
Asia	15,936,584	23,485,215	112,716	171,514	25,314,370	34,431,325	130,783	376,029	44,186,826	33,633,483	344,265	265,707
Europe	11,132,980	11,318,195	168,612	97,020	11,410,970	9,707,427	94,005	205,060	12,003,290	7,949,290	257,116	150,652
All other	922,684	839,446	202	248	1,451,913	812,389	197	176	1,057,351	244,866	100	47
Total	**34,959,915**	**43,812,820**	**344,844**	**293,910**	**45,956,865**	**53,750,335**	**242,991**	**608,207**	**68,452,666**	**49,529,917**	**644,941**	**471,162**

Table A15: Actual World Imports by region and Egypt actual exports of 57: Carpets and other textile floor coverings to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

57: Carpets and other textile floor coverings	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	53,458	99,009	44	1,660	118,255	322,912	223	22,448	306,015	346,005	25,002	21,782
America	2,202,519	3,105,692	2,111	1,091	3,399,075	3,062,356	1,183	147,322	3,348,952	4,219,866	154,175	152,088
Asia	986,894	1,430,516	151	265	1,464,778	1,951,842	218	38,937	2,217,048	2,918,525	40,105	31,656
Europe	4,276,061	5,789,881	949	557	6,281,010	6,201,473	479	145,865	6,691,534	6,237,162	187,308	102,446
All other	330,116	634,637	1	0	730,148	1,037,272	0	4,522	1,087,730	557,082	5,484	5,926
Total	**7,849,048**	**11,059,735**	**3,256**	**3,572**	**11,993,266**	**12,575,855**	**2,103**	**359,094**	**13,651,279**	**14,278,640**	**412,074**	**313,898**

Table A16: Actual World Imports by region and Egypt actual exports of 58: Special woven or tufted fabric, lace, tapestry to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

58: Special woven or tufted fabric, lace, tapestry	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	288,813	412,589	45	23	413,145	483,659	151	16,532	704,225	606,214	17,262	2,723
America	1,383,067	2,036,803	107	229	1,986,418	1,526,162	90	95,839	1,745,076	1,706,592	103,158	1,615
Asia	2,238,006	3,598,467	89	284	3,527,050	3,738,207	651	18,386	4,070,090	5,307,296	18,873	15,186
Europe	2,394,898	3,598,118	322	252	3,664,013	3,133,012	323	43,411	3,429,023	3,121,121	68,694	3,987
All other	322,743	446,320	2	0	663,631	550,705	2	6	621,028	70,995	2	59

Total	**6,627,527**	**10,092,297**	**565**	**786**	**10,254,257**	**9,431,745**	**1,217**	**174,174**	**10,569,442**	**10,812,218**	**207,989**	**23,570**

Table A17: Actual World Imports by region and Egypt actual exports of 61: Articles of apparel, accessories, knit or crochet to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

61: Articles of apparel, accessories, knit or crochet	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	518,266	948,978	431	82	1,090,502	1,659,060	190	3,354	2,059,118	2,838,506	3,729	2,839
America	31,472,048	40,341,698	59,044	36,162	43,847,120	48,467,443	35,971	238,932	53,669,308	57,500,511	281,157	277,490
Asia	19,650,826	24,825,788	3,109	9,214	26,019,231	29,131,445	2,721	27,004	33,779,917	42,578,391	42,625	42,426
Europe	36,316,799	58,084,677	41,000	34,476	64,407,496	83,666,399	28,648	185,869	95,869,314	98,974,192	230,316	141,921
All other	1,877,238	2,795,151	2	15	4,203,839	6,478,851	59	650	7,793,804	3,945,118	619	1,265
Total	**89,835,177**	**126,996,292**	**103,586**	**79,949**	**139,568,188**	**169,403,198**	**67,589**	**455,809**	**193,171,461**	**205,836,718**	**558,446**	**465,941**

Table A18: Actual World Imports by region and Egypt actual exports of 62: Articles of apparel, accessories, not knit or crochet to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

62: Articles of apparel, accessories, not knit or crochet	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	791,333	1,484,919	216	1,341	1,684,550	2,952,384	857	6,567	3,135,507	3,550,377	8,807	4,294
America	36,405,272	45,503,221	102,322	49,239	47,198,247	44,869,632	54,623	470,616	49,658,231	48,875,158	551,153	423,988
Asia	22,799,753	28,145,969	3,483	36,707	30,014,398	32,324,839	7,337	42,738	40,206,845	47,246,746	66,866	151,832
Europe	45,654,728	70,352,553	28,251	15,998	76,382,154	86,825,964	13,822	300,444	100,477,527	100,023,697	366,787	327,920
All other	2,271,909	3,208,578	24	23	4,437,307	5,748,932	119	677	6,677,044	4,009,448	659	2,698
Total	**107,922,995**	**148,695,240**	**134,296**	**103,308**	**159,716,656**	**172,721,751**	**76,758**	**821,042**	**200,155,154**	**203,705,426**	**994,272**	**910,732**

Table A19: Actual World Imports by region and Egypt actual exports of 63: Other made textile articles, sets, worn clothing etc to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

63: Other made textile articles, sets, worn clothing	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	591,165	1,010,590	1,031	3,896	1,376,972	2,278,641	3,607	16,292	2,743,341	2,845,171	16,608	16,144
America	6,223,482	11,662,029	32,460	36,293	12,981,477	15,051,574	32,925	41,274	16,211,581	19,569,641	48,421	31,156
Asia	3,222,216	4,585,950	6,075	10,148	4,777,900	6,546,639	5,372	41,303	8,121,754	11,155,277	49,034	25,200
Europe	7,998,145	13,630,577	76,979	88,067	15,130,276	19,045,191	82,091	156,890	22,216,530	22,570,106	198,857	143,928
All other	811,279	1,222,141	535	1,032	1,832,234	2,488,180	1,632	3,623	2,802,285	1,818,010	1,933	14,671
Total	**18,846,287**	**32,111,287**	**117,080**	**139,436**	**36,098,859**	**45,410,225**	**125,627**	**259,382**	**52,095,491**	**57,958,205**	**314,853**	**231,099**

Table A20: Actual World Imports by region and Egypt actual exports of 31: Fertilizers to the top importing countries for the periods (2001/2005, 2006/2010, 2011-2017) in Thousand USD

31: Fertilizers	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
	Actual World Imports		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**		**Actual World Imports**		**Actual EGY exports**	
	2001	**2005**	**2001**	**2005**	**2006**	**2010**	**2006**	**2010**	**2011**	**2017**	**2011**	**2017**
Africa	866,355	1,765,475	1,773	6,285	2,045,520	3,105,970	4,014	37,856	6,206,942	3,541,463	26,178	31,635
America	5,110,456	10,001,186	25,686	2,821	10,014,215	18,387,312	13,072	154,860	28,030,197	20,339,547	352,747	96,909
Asia	5,238,987	11,633,614	4,854	16,923	11,629,151	21,143,787	9,177	91,967	29,923,518	18,492,117	123,599	405,921
Europe	5,150,377	8,511,874	35,408	12,643	9,088,347	14,171,522	52,219	867,595	18,992,191	15,335,298	939,933	511,506
All other	971,058	1,437,498	0	4	1,161,132	2,019,508	0	-0	2,487,371	1,796,620	724	7,007

Total	**17,337,233**	**33,349,647**	**67,720**	**38,676**	**33,938,365**	**58,828,099**	**78,482**	**1,152,278**	**85,640,219**	**59,505,045**	**1,443,181**	**1,052,978**

Table A21: Two-Level Decomposition for 06: Live trees, plants, bulbs, roots, cut flowers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egypt's exports (2001 - 2005)

06: Live trees, plants, bulbs, roots, cut flowers — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2001	(2) Actual Market Imports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
United Kingdom	968,038,785	1,620,519,149	147	8,002	0.67	99.1	87	99
Germany	1,670,325,680	2,494,651,629	8,320	118,371	0.49	4,106.0	4,915	4,106
Libya	299,257	606,636	3,419	178,938	1.03	3,511.8	2,020	3,512
Netherlands	800,807,879	1,175,172,511	327,876	863,794	0.47	153,276.7	193,674	153,277
Other	5,068,121,307	8,242,022,521	1,677,595	3,370,584	0.63	1,050,590.6	990,944	1,050,591
Total	**8,507,592,908**	**13,532,972,446**	**2,017,357**	**4,539,689**	**0.59**	**1,211,584**	**1,191,640**	**1,211,584**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005		4,539,689	
Egyptian Exports in 2001		2,017,357	
	Change in Exports	**2,522,332**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	1,191,640	47%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	19,945	1%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	1,310,748	52%

Table A22: Two-Level Decomposition for 06: Live trees, plants, bulbs, roots, cut flowers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egypt's exports (2006 - 2010)

06: Live trees, plants, bulbs, roots, cut flowers — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2006	(2) Actual Market Imports (Excl EGY) 2010	(3) Actual EGY exports V.j 2006	(4) Actual EGY exports V'.j 2010	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
United Kingdom	1,690,941,641	1,702,574,010	45,083	15,383,358	0.01	310.1	7,210	310
Germany	2,471,999,888	3,651,436,571	451,112	4,003,396	0.48	215,233.8	72,143	215,234
Libya	757,958	6,008,045	114,148	5,946,867	6.93	790,659.8	18,255	790,660
Netherlands	1,307,870,577	1,429,830,722	696,066	4,652,575	0.09	64,908.8	111,317	64,909
Other	9,982,422,938	11,135,588,943	3,600,481	13,556,369	0.12	415,926.3	575,799	415,926
Total	**15,453,993,002**	**17,925,438,291**	**4,906,890**	**43,542,565**	**0.16**	**1,487,039**	**784,723**	**1,487,039**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2010		43,542,565	
Egyptian Exports in 2006		4,906,890	
	Change in Exports	**38,635,675**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	784,723	2%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	702,315	2%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	37,148,636	96%

Table A23: Two Level Decomposition for 06: Live trees, plants, bulbs, roots, cut flowers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egypt's exports (2011 - 20017)

06: Live trees, plants, bulbs, roots, cut flowers In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2011	**2017**	**2011**	**2017**	**(2) / (1) - 1**	**(5)*(3)**	**r * (3)**	$\sum_i rijVij$
United Kingdom	1,781,257,313	1,525,542,131	18,881,098	24,980,333	-0.14	-2,710,548	23,123	-2,710,548
Germany	3,911,788,789	3,203,498,184	3,492,144	9,429,118	-0.18	-632,307	4,277	-632,307
Libya	1,976,269	995,358	2,680,673	7,133,396	-0.50	-1,330,538	3,283	-1,330,538
Netherlands	1,773,992,820	2,350,760,261	4,482,685	6,061,552	0.33	1,457,428	5,490	1,457,428
Other	13,458,457,031	13,872,305,066	16,788,423	12,586,601	0.03	516,245	20,560	516,245
Total	**20,927,472,222**	**20,953,101,000**	**46,325,023**	**60,191,000**	**0.00**	**-2,699,721**	**56,732**	**-2,699,721**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis		In Thousand USD	
	Egyptian Exports in 2017	60,191,000	
	Egyptian Exports in 2011	46,325,023	
	Change in Exports	**13,865,977**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	56,732	0.4%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-2,756,453	-20%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	16,565,698	119%

Table A24: Two-Level Decomposition for 07: Edible vegetables and certain roots and tubers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

07: Edible vegetables and certain roots and tubers In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual World Exports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2001	**2005**	**2001**	**2005**	**(2) / (1) - 1**	**(5)*(3)**	**r * (3)**	$(\sum_i rijVij)$
Saudi Arabia	116,423,410	124,819,811	13,807,686	23,359,482	0.07	995,803.8	6,828,135	995,804
Russian Federation	202,895,791	712,330,483	49,265	10,683,166	2.51	123,695.5	24,362	123,696

Italy	752,892,551	1,292,537,136	16,101,757	30,486,030	0.72	11,541,123.6	7,962,592	11,541,124
United Arab Emirates	268,851,634	312,561,490	1,969,865	6,346,649	0.16	320,260.3	974,132	320,260
Other	20,286,780,054	29,880,929,914	64,674,301	139,093,306	0.47	30,586,171.6	31,982,539	30,586,172
Total	**21,627,843,440**	**32,323,178,834**	**96,602,874**	**209,968,633**	**0.49**	**43,567,055**	**47,771,760**	**43,567,055**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis In Thousand USD

Egyptian Exports in 2005		209,968,633	
Egyptian Exports in 2001		96,602,874	
	Change in Exports	**113,365,759**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	47,771,760	42%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-4,204,705	-4%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	69,798,704	62%

Table A25: Two-Level Decomposition for 07: Edible vegetables and certain roots and tubers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

07: Edible vegetables and certain roots and tubers In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV.j	
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Saudi Arabia	162,232,099	297,571,530	18,171,844	139,260,483	0.83	15,159,558.7	8,621,497	15,159,559
Russian Federation	922,179,680	2,167,355,664	12,236,903	56,642,400	1.35	16,522,916.4	5,805,708	16,522,916
Italy	1,335,500,600	1,705,898,429	33,773,456	95,721,337	0.28	9,366,985.5	16,023,566	9,366,986
United Arab Emirates	448,826,914	849,008,992	6,048,356	32,620,184	0.89	5,392,822.0	2,869,598	5,392,822
Other	34,615,079,684	50,247,904,325	126,995,790	510,053,756	0.45	57,353,700.6	60,252,211	57,353,701
Total	**37,483,818,977**	**55,267,738,940**	**197,226,349**	**834,298,160**	**0.47**	**103,795,983**	**93,572,579**	**103,795,983**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis In Thousand USD

Egyptian Exports in 2010		834,298,160	
Egyptian Exports in 2006		197,226,349	
	Change in Exports	**637,071,811**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	93,572,579	15%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	10,223,404	2%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	533,275,828	84%

Table A26: Two-Level Decomposition for 07: Edible vegetables and certain roots and tubers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

07: Edible vegetables and certain roots and tubers — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY)		(3) Actual EGY exports		(5)	(6)	(7)	(8)
			V.j	V'.j	ri	riV.j	rV,j	
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Saudi Arabia	312,304,962	386,674,497	134,792,664	163,299,627	0.24	32,098,330	25,578,153	32,098,330
Russian Federation	2,880,422,796	1,632,239,543	159,525,506	162,560,535	-0.43	-69,127,722	30,271,438	-69,127,722
Italy	1,795,856,295	1,743,573,409	103,965,963	89,129,273	-0.03	-3,026,768	19,728,502	-3,026,768
United Arab Emirates	943,763,225	1,000,313,347	35,251,837	70,422,982	0.06	2,112,284	6,689,362	2,112,284
Other	53,743,386,914	66,236,955,204	552,494,746	580,188,583	0.23	128,436,841	104,840,982	128,436,841
Total	**59,675,734,192**	**70,999,756,000**	**986,030,716**	**1,065,601,000**	**0.19**	**90,492,965**	**187,108,437**	**90,492,965**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017		1,065,601,000	
Egyptian Exports in 2011		986,030,716	
	Change in Exports	**79,570,284**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	187,108,437	235%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-96,615,472	-121%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-10,922,681	-14%

Table A27: Two-Level Decomposition for 08: Edible fruit, nuts, peel of citrus fruit, melons (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

08: Edible fruit, nuts, peel of citrus fruit, melons — In Thousand USD

Market	(1) Actual World Exports (Excl EGY)		(3) Actual EGY exports		(5)	(6)	(7)	(8)
			V.j	V'.j	ri	riV.j	rV,j	
	2001	2005	2001	2005	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Saudi Arabia	260,686,460	495,515,825	34,822,709	9,867,243	0.90	31,368,697.3	24,081,720	31,368,697
Russian Federation	681,474,062	2,107,792,172	2,931,478	26,881,348	2.09	6,135,552.9	2,027,270	6,135,553
Netherlands	1,458,229,277	2,943,896,642	278,218	17,091,808	1.02	283,453.0	192,402	283,453
United Kingdom	2,603,018,092	4,341,192,140	3,435,571	18,502,201	0.67	2,294,114.0	2,375,877	2,294,114
Other	23,687,294,126	38,643,422,702	16,793,845	48,770,739	0.63	10,603,613.2	11,613,820	10,603,613
Total	**28,690,702,017**	**48,531,819,481**	**58,261,821**	**121,113,339**	**0.69**	**50,685,430**	**40,291,089**	**50,685,430**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
	Egyptian Exports in 2005	121,113,339	
	Egyptian Exports in 2001	58,261,821	
	Change in Exports	**62,851,518**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	40,291,089	64%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	10,394,341	17%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	12,166,088	19%

Table A28: Two-Level Decomposition for 08: Edible fruit, nuts, peel of citrus fruit, melons (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

08: Edible fruit, nuts, peel of citrus fruit, melons

In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
	2006	2010	V.j 2006	V'.j 2010	ri (2) / (1) - 1	riV.j (5)*(3)	rV,j r * (3)	$(\sum_i rijVij)$
Saudi Arabia	503,101,625	725,906,762	15,134,744	168,627,690	0.44	6,702,619.4	6,441,859	6,702,619
Russian Federation	2,956,472,425	5,343,393,062	16,562,321	127,775,750	0.81	13,371,660.6	7,049,484	13,371,661
Netherlands	3,454,968,761	4,405,776,767	14,353,153	77,957,811	0.28	3,949,990.2	6,109,187	3,949,990
United Kingdom	4,703,373,554	4,800,003,578	19,061,821	118,415,271	0.02	391,621.9	8,113,355	391,622
Other	40,587,147,745	59,150,223,819	57,609,330	462,294,343	0.46	26,348,399.3	24,520,478	26,348,399
Total	**52,205,064,110**	**74,425,303,988**	**122,721,369**	**955,070,865**	**0.43**	**50,764,291**	**52,234,363**	**50,764,291**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
	Egyptian Exports in 2010	955,070,865	
	Egyptian Exports in 2006	122,721,369	
	Change in Exports	**832,349,496**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	52,234,363	6%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-1,470,071	-0.2%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	781,585,205	94%

Table A29: Two-Level Decomposition for 08: Edible fruit, nuts, peel of citrus fruit, melons (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

08: Edible fruit, nuts, peel of citrus fruit, melons — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2011	(2) Actual Market Imports (Excl EGY) 2017	(3) Actual EGY exports V.j 2011	(4) Actual EGY exports V'.j 2017	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $\sum_i rijVij$
Saudi Arabia	853,265,520	1,334,688,000	164,304,285	172,705,000	0.56	92,702,417	57,078,562	92,702,417
Russian Federation	6,057,797,911	4,509,114,244	146,819,053	168,632,082	-0.26	-37,534,476	51,004,272	-37,534,476
Netherlands	5,347,103,670	6,476,287,236	54,016,959	118,247,506	0.21	11,407,122	18,765,246	11,407,122
United Kingdom	5,377,382,430	6,266,536,776	105,226,366	85,197,313	0.17	17,399,261	36,555,161	17,399,261
Other	67,369,049,862	95,948,184,744	550,242,088	725,089,099	0.42	233,422,364	191,151,601	233,422,364
Total	**85,004,599,393**	**114,534,811,000**	**1,020,608,751**	**1,269,871,000**	**0.35**	**317,396,688**	**354,554,843**	**317,396,688**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017		1,269,871,000	
Egyptian Exports in 2011		1,020,608,751	
	Change in Exports	**249,262,249**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	354,554,843	142%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-37,158,155	-15%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-68,134,439	-27%

Table A30: Two-Level Decomposition for 11: Milling products, malt, starches, inulin, wheat glute (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

11: Milling products, malt, starches, inulin, wheat glute — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $\sum_i rijVij$
Saudi Arabia	25,103,690	38,198,205	2,837	513,265	0.52	1,479.8	1,504	1,480
Syria	4,350,647	7,326,353	8,733	1,586,065	0.68	5,973.1	4,629	5,973
Libya	209,098,556	192,606,223	7,569	4,678,690	-0.08	-597.0	4,012	-597
Other	5,270,883,915	8,191,809,242	4,586,248	3,337,661	0.55	2,541,525.9	2,431,129	2,541,526
Total	**5,509,436,808**	**8,429,940,023**	**4,605,387**	**10,115,681**	**0.53**	**2,548,382**	**2,441,274**	**2,548,382**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2005		10,115,681	
Egyptian Exports in 2001		4,605,387	
	Change in Exports	**5,510,294**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	2,441,274	44%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	107,107	2%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	2,961,912	54%

Table A31: Two-Level Decomposition for 11: Milling products, malt, starches, inulin, wheat glute (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

11: Milling products, malt, starches, inulin, wheat glute — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		Actual EGY exports					
	2006	2010	V.j 2006	V'.j 2010	ri (2) / (1) - 1	riV.j (5)*(3)	rV.j r * (3)	$(\sum_i rijVij)$
Saudi Arabia	49,907,679	62,007,083	82,380	3,004,474	0.24	19,971.9	46,296	19,972
Syria	8,449,153	15,696,550	104,743	204,064	0.86	89,845.0	58,864	89,845
Libya	161,281,546	1,767,441	3,032,841	10,664,780	-0.99	-2,999,604.9	1,704,406	-2,999,605
Other	8,864,168,279	14,109,284,505	3,370,597	51,724,272	0.59	1,994,453.7	1,894,220	1,994,454
Total	**9,083,806,657**	**14,188,755,579**	**6,590,561**	**65,597,590**	**0.56**	**-895,334**	**3,703,786**	**-895,334**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2010		65,597,590	
Egyptian Exports in 2006		6,590,561	
	Change in Exports	**59,007,029**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	3,703,786	6%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-4,599,121	-8%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	59,902,363	102%

Table A32: Two-Level Decomposition for 11: Milling products, malt, starches, inulin, wheat glute (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

11: Milling products, malt, starches, inulin, wheat glute — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2011	(2) Actual Market Imports (Excl EGY) 2017	(3) Actual EGY exports V.j 2011	(4) Actual EGY exports V'.j 2017	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Saudi Arabia	111,706,537	131,134,474	3,986,821	2,065,032	0.17	693,386	-93,416	693,386
Syria	11,543,511	89,346,899	284,271	3,714,104	6.74	1,915,990	-6,661	1,915,990
Libya	155,895,916	10,031,675	7,806,957	667,860	-0.94	-7,304,591	-182,926	-7,304,591
Other	17,691,955,078	17,319,503,952	61,583,707	105,308,004	-0.02	-1,296,461	-1,442,979	-1,296,461
Total	**17,971,101,042**	**17,550,017,000**	**73,661,756**	**111,755,000**	**-0.02**	**-5,991,676**	**-1,725,982**	**-5,991,676**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017		111,755,000	
Egyptian Exports in 2011		73,661,756	
	Change in Exports	**38,093,244**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	-1,725,982	-5%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-4,265,694	-11%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	44,084,920	116%

Table A33: Two-Level Decomposition for 13: Lac, gums, resins, vegetable saps and extracts (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

13: Lac, gums, resins, vegetable saps and extracts — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Saudi Arabia	6,682,265	14,027,298	16,677	16,999	1.10	18,331.1	10,623	18,331
Kuwait	746,000		0		-1.00	0.0	0	0
Other	2,090,025,657	3,419,497,942	679,855	399,641	0.64	432,458.0	433,065	432,458
Total	**2,097,453,922**	**3,433,525,240**	**696,532**	**416,640**	**0.64**	**450,789**	**443,689**	**450,789**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005		416,640	
Egyptian Exports in 2001		696,532	
	Change in Exports	**-279,892**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	443,689	-159%

2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	7,100	-3%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-730,681	261%

Table A34: Two-Level Decomposition for 13: Lac, gums, resins, vegetable saps and extracts (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

13: Lac, gums, resins, vegetable saps and extracts — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		Actual EGY exports					
			V.j	V'.j	ri	riV.j	rV,j	
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$\sum_i rijVij$
Saudi Arabia	16,326,708	16,879,073	38,331	15,806,035	0.03	1,296.8	17,337	1,297
Kuwait	2,658,000	2,566,000	53,000	88,000	-0.03	-1,834.5	23,972	-1,834
Other	3,709,109,876	5,394,883,947	137,876	204,025,757	0.45	62,664.0	62,362	62,664
Total	**3,728,094,584**	**5,414,329,020**	**229,207**	**219,919,792**	**0.45**	**62,126**	**103,671**	**62,126**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis		In Thousand USD
	Egyptian Exports in 2010	219,919,792
	Egyptian Exports in 2006	229,207
	Change in Exports	**219,690,585**
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	103,671 — 0.0%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-41,545 — 0.0%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	219,628,459 — 100.0%

Table A35: Two-Level Decomposition for 13: Lac, gums, resins, vegetable saps and extracts (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

13: Lac, gums, resins, vegetable saps and extracts — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		Actual EGY exports					
			V.j	V'.j	ri	riV.j	rV,j	
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Saudi Arabia	15,342,571	40,225,863	17,594,804	996,137	1.62	28,536,068	-1,248,003	28,536,068
Kuwait	3,872,000	8,607,000	161,000	633,000	1.22	196,884	-11,420	196,884
Other	7,650,332,989	7,076,712,137	190,524,414	19,267,863	-0.07	-14,285,493	-13,513,935	-14,285,493
Total	**7,669,547,560**	**7,125,545,000**	**208,280,218**	**20,897,000**	**-0.07**	**14,447,459**	**-14,773,358**	**14,447,459**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
	Egyptian Exports in 2017	20,897,000	
	Egyptian Exports in 2011	208,280,218	
	Change in Exports	**-187,383,218**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	-14,773,358	8%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	29,220,817	-16%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-201,830,677	108%

Table A36: Two-Level Decomposition for 20: Vegetable, fruit, nut, etc food preparations (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

20: Vegetable, fruit, nut, etc food preparations — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Saudi Arabia	182,733,372	326,798,713	4,311,395	4,872,111	0.79	3,399,064.9	2,506,998	3,399,065
Libya	58,426,141	45,554,080	1,647,723	10,169,332	-0.22	-363,015.4	958,121	-363,015
USA	2,633,792,415	4,298,843,712	1,293,662	4,632,478	0.63	817,837.3	752,241	817,837
United Arab Emirates	97,083,573	328,565,528	2,508,636	1,851,961	2.38	5,981,485.3	1,458,726	5,981,485
Other	16,858,932,707	26,362,553,242	6,971,817	23,766,793	0.56	3,930,112.6	4,053,985	3,930,113
Total	**19,830,968,208**	**31,362,315,275**	**16,733,233**	**45,292,675**	**0.58**	**13,765,485**	**9,730,070**	**13,765,485**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
	Egyptian Exports in 2005	45,292,675	
	Egyptian Exports in 2001	16,733,233	
	Change in Exports	**28,559,442**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	9,730,070	34%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	4,035,414	14%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	14,793,957	52%

Table A37: Two-Level Decomposition for 20: Vegetable, fruit, nut, etc food preparations (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

20: Vegetable, fruit, nut, etc food preparations — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY)	(2)	(3) Actual EGY exports V.j	(4) V'.j	(5) ri	(6) riV.j	(7) rV,j	(8)

	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Saudi Arabia	353,201,976	577,736,617	5,675,067	18,807,595	0.64	3,607,706.7	1,804,409	3,607,707
Libya	68,859,577	132,622,742	6,079,884	26,777,899	0.93	5,629,901.7	1,933,122	5,629,902
USA	4,698,252,095	5,908,728,109	2,659,426	27,123,379	0.26	685,184.9	845,575	685,185
United Arab Emirates	221,072,850	338,026,944	2,866,704	14,691,101	0.53	1,516,571.4	911,480	1,516,571
Other	30,586,820,045	40,394,603,356	33,336,999	148,947,542	0.32	10,689,638.9	10,599,627	10,689,639
Total	**35,928,206,543**	**47,351,717,768**	**50,618,080**	**236,347,516**	**0.32**	**22,129,004**	**16,094,213**	**22,129,004**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis				In Thousand USD
	Egyptian Exports in 2010		236,347,516	
	Egyptian Exports in 2006		50,618,080	
	Change in Exports		**185,729,436**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$		16,094,213	8.7%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$		6,034,791	3.2%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$		163,600,432	88.1%

Table A38: Two-Level Decomposition for 20: Vegetable, fruit, nut, etc food preparations (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

20: Vegetable, fruit, nut, etc food preparations — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Saudi Arabia	745,008,036	900,493,535	21,804,656	39,479,465	0.21	4,550,700	1,972,774	4,550,700
Libya	166,209,416	102,958,846	28,190,458	38,249,840	-0.38	-10,727,807	2,550,529	-10,727,807
USA	6,920,108,592	8,517,811,567	18,766,189	30,691,424	0.23	4,332,706	1,697,869	4,332,706
United Arab Emirates	408,564,998	506,222,781	18,123,841	27,415,219	0.24	4,332,075	1,639,753	4,332,075
Other	47,947,904,031	51,243,894,271	184,518,015	263,757,052	0.07	12,683,966	16,694,252	12,683,966
Total	**56,187,795,073**	**61,271,381,000**	**271,403,159**	**399,593,000**	**0.09**	**15,171,639**	**24,555,177**	**15,171,639**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2017		399,593,000	
Egyptian Exports in 2011		271,403,159	
	Change in Exports	**128,189,841**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	24,555,177	19%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-9,383,538	-7%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	113,018,202	88%

Table A39: Two-Level Decomposition for 41: Raw hides and skins (other than furskins) and leather (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

41: Raw hides and skins (other than furskins) and leather In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual World Exports (Excl EGY)		**Actual EGY exports**					
	2001	2005	V.j 2001	V'.j 2005	ri (2) / (1) - 1	riV.j (5)*(3)	rV,j r * (3)	$(\sum_i rijVij)$
Portugal	865,039,010	799,514,639	306,685	2,880,717	-0.08	-23,230.6	49,449	-23,231
Spain	1,633,746,312	1,242,671,600	6,830,416	2,231,510	-0.24	-1,635,017.0	1,101,307	-1,635,017
Italy	7,137,065,094	6,518,111,903	7,557,513	12,774,135	-0.09	-655,416.0	1,218,541	-655,416
India	417,716,426	606,353,271	3,520,689	1,013,368	0.45	1,589,910.3	567,661	1,589,910
Other	12,614,157,881	17,155,919,868	4,728,487	8,177,424	0.36	1,702,504.7	762,401	1,702,505
Total	**22,667,724,723**	**26,322,571,281**	**22,943,790**	**27,077,154**	**0.16**	**978,751**	**3,699,358**	**978,751**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2005		27,077,154	
Egyptian Exports in 2001		22,943,790	
	Change in Exports	**4,133,364**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	3,699,358	89%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-2,720,607	-66%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	3,154,613	76%

Table A40: Two-Level Decomposition for 41: Raw hides and skins (other than furskins) and leather (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

41: Raw hides and skins (other than furskins) and leather — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2006	(2) Actual Market Imports (Excl EGY) 2010	(3) Actual EGY exports V.j 2006	(4) Actual EGY exports V'.j 2010	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Portugal	846,066,334	956,406,181	4,219,865	28,487,428	0.13	550,334.2	132,183	550,334
Spain	1,320,821,801	1,125,074,924	3,165,662	48,821,083	-0.15	-469,153.7	99,161	-469,154
Italy	7,698,016,913	6,654,490,926	8,995,887	36,328,642	-0.14	-1,219,462.4	281,787	-1,219,462
India	686,791,916	940,117,577	2,240,816	22,127,603	0.37	826,533.0	70,191	826,533
Other	18,391,659,942	20,173,889,223	9,338,002	35,515,007	0.10	904,891.7	292,504	904,892
Total	**28,943,356,906**	**29,849,978,831**	**27,960,232**	**171,279,763**	**0.03**	**593,143**	**875,827**	**593,143**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis		In Thousand USD
Egyptian Exports in 2010	171,279,763	
Egyptian Exports in 2006	27,960,232	
Change in Exports	**143,319,531**	
1) Due to increase in world trade $(\sum_{j=1}^{5} rV.j)$	875,827	1%
2) Due to market distribution effect $(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-282,684	-0.2%
3) Due to increased competitiveness $(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	142,726,388	100%

Table A41: Two-Level Decomposition for 41: Raw hides and skins (other than furskins) and leather (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

41: Raw hides and skins (other than furskins) and leather — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2011	(2) Actual Market Imports (Excl EGY) 2017	(3) Actual EGY exports V.j 2011	(4) Actual EGY exports V'.j 2017	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Portugal	1,091,945,146	966,285,052	34,539,209	33,652,826	-0.12	-3,974,742	-6,759,997	-3,974,742
Spain	1,600,080,696	1,237,943,562	36,048,347	21,302,247	-0.23	-8,158,617	-7,055,365	-8,158,617
Italy	8,606,970,071	7,040,708,431	39,386,215	18,579,684	-0.18	-7,167,344	-7,708,651	-7,167,344
India	1,039,488,814	1,225,823,720	16,326,920	9,905,280	0.18	2,926,703	-3,195,497	2,926,703
Other	19,755,738,970	15,341,997,235	25,973,699	28,589,963	-0.22	-5,802,931	-5,083,560	-5,802,931
Total	**32,094,223,697**	**25,812,758,000**	**152,274,390**	**112,030,000**	**-0.20**	**-22,176,931**	**-29,803,069**	**-22,176,931**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis		In Thousand USD
Egyptian Exports in 2017	112,030,000	

Egyptian Exports in 2011		152,274,390	
	Change in Exports	**-40,244,390**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	-29,803,069	74%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	7,626,137	-19%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-18,067,459	45%

Table A42: Two-Level Decomposition for 52: Cotton (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

52: Cotton — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual World Exports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2001	2005	2001	2005	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Turkey	931,165,000	2,061,022,000	18,905,000	18,269,000	1.21	22,938,949.1	7,654,035	22,938,949
Italy	1,767,958,000	1,814,068,000	78,480,000	54,648,000	0.03	2,046,831.9	31,774,065	2,046,832
India	396,631,000	385,391,000	32,950,000	50,502,000	-0.03	-933,759.6	13,340,411	-933,760
Pakistan	309,671,000	880,438,000	8,846,000	37,403,000	1.84	16,304,416.2	3,581,465	16,304,416
Other	28,629,686,578	39,864,194,121	205,663,300	133,087,724	0.39	80,703,848.7	83,266,553	80,703,849
Total	**32,035,111,578**	**45,005,113,121**	**344,844,300**	**293,909,724**	**0.40**	**121,060,286**	**139,616,530**	**121,060,286**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005		293,909,724	
Egyptian Exports in 2001		344,844,300	
	Change in Exports	**-50,934,576**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	139,616,530	-274%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-18,556,243	36%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-171,994,862	338%

Table A43: Two-Level Decomposition for 52: Cotton (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

52: Cotton — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Turkey	2,075,425,000	3,274,767,000	14,764,000	110,986,000	0.58	8,531,787.6	2,096,828	8,531,788
Italy	1,957,131,000	1,697,656,000	58,676,000	115,562,000	-0.13	-7,779,221.3	8,333,344	-7,779,221
India	419,384,000	351,123,000	43,634,000	107,758,000	-0.16	-7,102,084.2	6,197,034	-7,102,084
Pakistan	1,176,775,000	645,710,000	31,802,000	38,273,000	-0.45	-14,351,876.2	4,516,617	-14,351,876

Other	42,814,764,570	49,354,314,162	94,115,136	235,628,366	0.15	14,375,195.2	13,366,518	14,375,195
Total	**48,443,479,570**	**55,323,570,162**	**242,991,136**	**608,207,366**	**0.14**	**-6,326,199**	**34,510,342**	**-6,326,199**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
	Egyptian Exports in 2010	608,207,366	
	Egyptian Exports in 2006	242,991,136	
	Change in Exports	**365,216,230**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	34,510,342	9%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-40,836,540	-11%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	371,542,429	102%

Table A44: Two-Level Decomposition for 52: Cotton (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

52: Cotton — In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV.j	
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Turkey	3,487,514,000	2,846,870,000	121,346,000	148,216,000	-0.18	-22,290,831	-21,674,168	-22,290,831
Italy	2,124,401,000	1,183,060,000	137,486,000	82,864,000	-0.44	-60,921,271	-24,557,008	-60,921,271
India	398,824,000	1,110,409,000	70,977,000	50,995,000	1.78	126,637,736	-12,677,529	126,637,736
Pakistan	1,009,177,000	1,137,765,000	37,532,000	23,639,000	0.13	4,782,278	-6,703,764	4,782,278
Other	60,726,348,547	49,367,688,000	277,599,701	165,448,000	-0.19	-51,924,096	-49,583,362	-51,924,096
Total	**67,746,264,547**	**55,645,792,000**	**644,940,701**	**471,162,000**	**-0.18**	**-3,716,184**	**-115,195,831**	**-3,716,184**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
	Egyptian Exports in 2017	471,162,000	
	Egyptian Exports in 2011	644,940,701	
	Change in Exports	**-173,778,701**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	-115,195,831	66%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	111,479,647	-64%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-170,062,517	98%

Table A45: Two-Level Decomposition for 57: Carpets and other textile floor coverings (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

57: Carpets and other textile floor coverings — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
United States of America	1,412,287,000	2,115,556,000	2,095,000	1,082,000	0.50	1,043,235.9	1,015,453	1,043,236
Canada	491,939,000	2,116,630,000	5,000	8,000	3.30	16,513.1	2,424	16,513
Germany	1,154,247,000	680,080,000	318,000	8,000	-0.41	-130,635.0	154,136	-130,635
United Kingdom	967,758,000	1,427,604,000	361,000	175,000	0.48	171,535.0	174,978	171,535
Other	3,655,418,651	5,065,097,357	476,879	2,298,875	0.39	183,904.0	231,145	183,904
Total	**7,681,649,651**	**11,404,967,357**	**3,255,879**	**3,571,875**	**0.48**	**1,284,553**	**1,578,134**	**1,284,553**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005		3,571,875	
Egyptian Exports in 2001		3,255,879	
	Change in Exports	**315,996**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	1,578,134	499%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-293,581	-93%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-968,557	-307%

Table A46: Two-Level Decomposition for 57: Carpets and other textile floor coverings (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

57: Carpets and other textile floor coverings — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2006	(2) Actual Market Imports (Excl EGY) 2010	(3) Actual EGY exports V.j 2006	(4) Actual EGY exports V'.j 2010	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
United States of America	2,259,202,000	1,732,185,000	1,177,000	115,952,000	-0.23	-274,565.5	124,888	-274,566
Canada	2,260,373,000	1,830,541,000	6,000	17,596,000	-0.19	-1,141.0	637	-1,141
Germany	774,024,000	762,989,000	6,000	17,596,000	-0.01	-85.5	637	-86
United Kingdom	1,529,451,000	1,092,780,000	147,000	28,411,000	-0.29	-41,969.7	15,598	-41,970
Other	5,503,655,912	8,216,162,718	766,738	179,539,173	0.49	377,891.0	81,356	377,891
Total	**12,326,705,912**	**13,634,657,718**	**2,102,738**	**359,094,173**	**0.11**	**60,129**	**223,116**	**60,129**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2010		359,094,173	
Egyptian Exports in 2006		2,102,738	
	Change in Exports	**356,991,435**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	223,116	0.1%

2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-162,986	0.0%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	356,931,306	100.0%

Table A47: Two-Level Decomposition for 57: Carpets and other textile floor coverings (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

57: Carpets and other textile floor coverings — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2011	(2) Actual Market Imports (Excl EGY) 2017	(3) Actual EGY exports V.j 2011	(4) Actual EGY exports V'.j 2017	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
United States of America	1,905,315,000	2,787,190,000	120,486,000	117,708,000	0.46	55,766,942	379,782	55,766,942
Canada	2,009,686,000	2,879,612,000	16,115,000	25,286,000	0.43	6,975,646	50,796	6,975,646
Germany	785,298,000	759,439,000	16,115,000	25,286,000	-0.03	-530,649	50,796	-530,649
United Kingdom	1,108,727,000	1,137,636,000	45,479,000	21,586,000	0.03	1,185,822	143,354	1,185,822
Other	9,178,016,616	7,470,406,000	213,878,676	124,032,000	-0.19	-39,793,074	674,163	-39,793,074
Total	**14,987,042,616**	**15,034,283,000**	**412,073,676**	**313,898,000**	**0.00**	**23,604,686**	**1,298,890**	**23,604,686**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017	313,898,000	
Egyptian Exports in 2011	412,073,676	
Change in Exports	**-98,175,676**	
1) Due to increase in world trade $(\sum_{j=1}^{5} rV.j)$	1,298,890	-1%
2) Due to market distribution effect $(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	22,305,796	-23%
3) Due to increased competitiveness $(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-121,780,362	124%

Table A48: Two-Level Decomposition for 58: Special woven or tufted fabric, lace, tapestry (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

58: Special woven or tufted fabric, lace, tapestry — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Saudi Arabia	73,176,000	86,512,000	74,000	124,000	0.18	13,486.2	35,845	13,486
Kuwait	3,410,000		9,000		-1.00	-9,000.0	4,360	-9,000
Spain	131,105,000	257,848,000	32,000	2,000	0.97	30,935.3	15,501	30,935
Other	7,577,253,768	11,211,572,494	449,511	609,430	0.48	215,601.4	217,741	215,601
Total	**7,784,944,768**	**11,555,932,494**	**564,511**	**735,430**	**0.48**	**251,023**	**273,446**	**251,023**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2005		735,430	
Egyptian Exports in 2001		564,511	
	Change in Exports	**170,919**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	273,446	160%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-22,423	-13%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-80,104	-47%

Table A49: Two-Level Decomposition for 58: Special woven or tufted fabric, lace, tapestry (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

58: Special woven or tufted fabric, lace, tapestry In Thousand USD

Market	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Actual Market Imports (Excl EGY)		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Saudi Arabia	76,319,000	54,096,000	406,000	3,126,000	-0.29	-118,221	-29,357	-118,221
Kuwait	18,245,000	14,752,000	39,000	71,000	-0.19	-7,467	-2,820	-7,467
Spain	262,028,000	140,087,000	10,000	3,741,000	-0.47	-4,654	-723	-4,654
Other	12,067,941,690	11,317,208,497	761,572	167,235,910	-0.06	-47,377	-55,068	-47,377
Total	**12,424,533,690**	**11,526,143,497**	**1,216,572**	**174,173,910**	**-0.07**	**-177,718**	**-87,968**	**-177,718**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2010		174,173,910	
Egyptian Exports in 2006		1,216,572	
	Change in Exports	**172,957,338**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	-87,968	-0.1%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-89,751	-0.1%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	173,135,056	100.1%

Table A50: Two-Level Decomposition for 58: Special woven or tufted fabric, lace, tapestry (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

58: Special woven or tufted fabric, lace, tapestry — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2011	(2) Actual Market Imports (Excl EGY) 2017	(3) Actual EGY exports V.j 2011	(4) Actual EGY exports V'.j 2017	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Saudi Arabia	56,994,000	48,066,000	4,859,000	1,841,000	-0.16	-761,153	-154,827	-761,153
Kuwait	13,090,000	21,894,000	143,000	1,787,000	0.67	96,178	-4,557	96,178
Spain	148,791,000	137,682,000	5,250,000	1,614,000	-0.07	-391,974	-167,286	-391,974
Other	12,471,807,744	12,078,664,000	197,737,428	18,328,000	-0.03	-6,233,197	-6,300,718	-6,233,197
Total	**12,690,682,744**	**12,286,306,000**	**207,989,428**	**23,570,000**	**-0.03**	**-7,290,146**	**-6,627,389**	**-7,290,146**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017		23,570,000	
Egyptian Exports in 2011		207,989,428	
	Change in Exports	**-184,419,428**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	-6,627,389	4%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-662,757	0.4%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-177,129,282	96%

Table A51: Two-Level Decomposition for 61: Articles of apparel, accessories, knit or crochet (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

61: Articles of apparel, accessories, knit or crochet — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $\sum_i rijVij$
USA	26,802,075,000	34,815,806,000	55,607,000	34,792,000	0.30	16,626,307.5	29,630,356	16,626,307
United Kingdom	6,843,734,000	10,832,408,000	5,799,000	11,179,000	0.58	3,379,780.8	3,090,014	3,379,781
Spain	1,796,960,000	4,036,863,000	903,000	614,000	1.25	1,125,585.7	481,166	1,125,586
Italy	2,553,182,000	5,198,668,000	462,000	2,156,000	1.04	478,702.5	246,178	478,702
Other	41,652,212,075	67,205,179,408	40,815,404	31,208,160	0.61	25,039,598.9	21,748,610	25,039,599
Total	**79,648,163,075**	**122,088,924,408**	**103,586,404**	**79,949,160**	**0.53**	**46,649,975**	**55,196,324**	**46,649,975**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005		79,949,160	
Egyptian Exports in 2001		103,586,404	
	Change in Exports	**-23,637,244**	

1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	55,196,324	-234%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-8,546,349	36%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-70,287,219	297%

Table A52: Two-Level Decomposition for 61: Articles of apparel, accessories, knit or crochet (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

61: Articles of apparel, accessories, knit or crochet — In Thousand USD

Market	(1) Actual Market Imports (Excl EGY) 2006	(2) Actual Market Imports (Excl EGY) 2010	(3) Actual EGY exports V.j 2006	(4) Actual EGY exports V'.j 2010	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
USA	37,164,540,000	39,714,083,000	35,265,000	235,170,000	0.07	2,419,231.7	8,299,972	2,419,232
United Kingdom	11,534,530,000	12,592,905,000	9,976,000	61,873,000	0.09	915,369	2,347,952	915,369
Spain	4,787,077,000	6,169,461,000	644,000	24,298,000	0.29	185,971	151,572	185,971
Italy	6,152,339,000	7,751,440,000	1,991,000	8,578,000	0.26	517,496	468,602	517,496
Other	84,336,638,689	111,633,227,074	19,713,230	125,890,064	0.32	6,380,429	4,639,707	6,380,429
Total	**143,975,124,689**	**177,861,116,074**	**67,589,230**	**455,809,064**	**0.24**	**10,418,496**	**15,907,804**	**10,418,496**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2010	455,809,064	
Egyptian Exports in 2006	67,589,230	
Change in Exports	**388,219,834**	
1) Due to increase in world trade — $(\sum_{j=1}^{5} rV.j)$	15,907,804	4.1%
2) Due to market distribution effect — $(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-5,489,308	-1.4%
3) Due to increased competitiveness — $(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	377,801,338	97.3%

Table A53: Two-Level Decomposition for 61: Articles of apparel, accessories, knit or crochet (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

61: Articles of apparel, accessories, knit or crochet — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2011	(2) Actual World Exports (Excl EGY) 2017	(3) Actual EGY exports V.j 2011	(4) Actual EGY exports V'.j 2017	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $\sum_i rijVij$
USA	43,013,449,000	45,515,058,000	272,408,000	269,188,000	0.06	15,842,912	23,829,293	15,842,912
United Kingdom	13,766,724,000	12,456,299,000	77,544,000	31,396,000	-0.10	-7,381,247	6,783,276	-7,381,247
Spain	7,443,255,000	7,841,836,000	29,041,000	28,996,000	0.05	1,555,125	2,540,404	1,555,125
Italy	8,840,246,000	7,960,996,000	14,231,000	26,839,000	-0.10	-1,415,414	1,244,878	-1,415,414

Other	134,157,759,310	151,574,246,000	165,222,305	109,522,000	0.13	21,449,315	14,453,066	21,449,315
Total	**207,221,433,310**	**225,348,435,000**	**558,446,305**	**465,941,000**	**0.09**	**30,050,691**	**48,850,917**	**30,050,691**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis In Thousand USD

Egyptian Exports in 2017		465,941,000	
Egyptian Exports in 2011		558,446,305	
	Change in Exports	**-92,505,305**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	48,850,917	-53%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_iVi.)$	-18,800,226	20%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-122,555,996	132%

Table A54: Two-Level Decomposition for 62: Articles of apparel, accessories, not knit or crochet (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

62: Articles of apparel, accessories, not knit or crochet In Thousand USD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Market	**Actual World Exports (Excl EGY)**		**Actual EGY exports**					
			V.j	**V'.j**	**ri**	**riV.j**	**rV,j**	
	2001	2005	2001	2005	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
United States of America	31,585,859,000	39,259,223,000	101,455,000	48,950,000	0.24	24,647,141.8	43,661,269	24,647,142
Spain	2,107,271,000	4,938,818,000	308,000	65,000	1.34	413,860.6	132,548	413,861
Turkey	113,043,000	433,390,000	13,000	0	2.83	36,840.1	5,595	36,840
United Kingdom	7,863,880,000	12,476,761,000	4,800,000	3,275,000	0.59	2,815,636.7	2,065,685	2,815,637
Other	59,030,175,852	86,928,489,485	27,719,958	51,018,042	0.47	13,100,758.6	11,929,314	13,100,759
Total	**100,700,228,852**	**144,036,681,485**	**134,295,958**	**103,308,042**	**0.43**	**41,014,238**	**57,794,411**	**41,014,238**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis In Thousand USD

Egyptian Exports in 2005		103,308,042	
Egyptian Exports in 2001		134,295,958	
	Change in Exports	**-30,987,916**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	57,794,411	-187%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_iVi.)$	-16,780,173	54%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	-72,002,154	232%

Table A55: Two-Level Decomposition for 62: Articles of apparel, accessories, not knit or crochet (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

62: Articles of apparel, accessories, not knit or crochet — In Thousand USD

Market	(1) Actual World Exports (Excl EGY)	(2)	(3) Actual EGY exports V.j	(4) V'.j	(5) ri	(6) riV.j	(7) rV,j	(8)
	2006	2010	2006	2010	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
United States of America	39,626,308,000	35,234,508,000	54,391,000	462,052,000	-0.11	-6,028,177	3,383,602	-6,028,177
Spain	5,777,899,000	7,064,944,000	274,000	43,887,000	0.22	61,034	17,045	61,034
Turkey	579,693,000	1,530,156,000	8,000	19,867,000	1.64	13,117	498	13,117
United Kingdom	13,183,472,000	12,407,617,000	2,660,000	96,995,000	-0.06	-156,543	165,476	-156,543
Other	98,387,979,531	111,119,465,261	19,424,625	198,241,234	0.13	2,513,563	1,208,384	2,513,563
Total	**157,555,351,531**	**167,356,690,261**	**76,757,625**	**821,042,234**	**0.06**	**-3,597,006**	**4,775,004**	**-3,597,006**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2010		821,042,234	
Egyptian Exports in 2006		76,757,625	
	Change in Exports	**744,284,609**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	4,775,004	0.6%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-8,372,010	-1.1%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	747,881,615	100.5%

Table A56: Two-Level Decomposition for 62: Articles of apparel, accessories, not knit or crochet (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

62: Articles of apparel, accessories, not knit or crochet — In Thousand USD

Market	(1) Actual World Exports (Excl EGY)	(2)	(3) Actual EGY exports V.j	(4) V'.j	(5) ri	(6) riV.j	(7) rV,j	(8)
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
United States of America	37,703,546,000	37,427,477,000	543,345,000	407,052,000	-0.01	-3,978,424	88,360,158	-3,978,424
Spain	8,040,466,000	9,902,444,000	60,581,000	101,832,000	0.23	14,029,098	9,851,838	14,029,098
Turkey	1,842,033,000	1,255,834,000	31,997,000	87,357,000	-0.32	-10,182,559	5,203,434	-10,182,559
United Kingdom	14,036,114,000	11,637,202,000	118,136,000	74,253,000	-0.17	-20,190,622	19,211,579	-20,190,622
Other	134,057,624,648	167,278,775,000	240,213,449	240,238,000	0.25	59,527,887	39,064,127	59,527,887
Total	**195,679,783,648**	**227,501,732,000**	**994,272,449**	**910,732,000**	**0.16**	**39,205,380**	**161,691,136**	**39,205,380**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017		910,732,000	
Egyptian Exports in 2011		994,272,449	
	Change in Exports	**-83,540,449**	

1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	161,691,136	-194%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-122,485,756	147%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-122,745,829	147%

Table A57: Two-Level Decomposition for 63: Other made textile articles, sets, worn clothing etc (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

63: Other made textile articles, sets, worn clothing etc — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $\sum_i rijVij$
Italy	429,387,000	841,903,000	18,957,000	31,316,000	0.96	18,212,162.5	17,553,327	18,212,162
United States of America	4,851,151,000	9,668,034,000	31,412,000	35,150,000	0.99	31,190,109.1	29,086,095	31,190,109
Germany	1,649,902,000	2,552,238,000	7,816,000	9,249,000	0.55	4,274,592.2	7,237,264	4,274,592
France	1,016,514,000	1,748,723,000	6,375,000	5,553,000	0.72	4,592,000.1	5,902,963	4,592,000
Other	9,458,016,585	18,710,290,443	52,519,913	58,168,158	0.98	51,377,433.5	48,631,071	51,377,433
Total	**17,404,970,585**	**33,521,188,443**	**117,079,913**	**139,436,158**	**0.93**	**109,646,297**	**108,410,720**	**109,646,297**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005	139,436,158	
Egyptian Exports in 2001	117,079,913	
Change in Exports	**22,356,245**	
1) Due to increase in world trade $(\sum_{j=1}^{5} rV.j)$	108,410,720	485%
2) Due to market distribution effect $(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	1,235,578	6%
3) Due to increased competitiveness $(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-87,290,052	-390%

Table A58: Two-Level Decomposition for 63: Other made textile articles, sets, worn clothing etc (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

63: Other made textile articles, sets, worn clothing etc — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2006	(2) Actual World Exports (Excl EGY) 2010	(3) Actual EGY exports V.j 2006	(4) Actual EGY exports V'.j 2010	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Italy	943,040,000	1,126,629,000	26,088,000	40,460,000	0.19	5,078,756	8,177,394	5,078,756
United States of America	10,596,952,000	11,818,772,000	31,932,000	37,682,000	0.12	3,681,734	10,009,220	3,681,734
Germany	2,727,783,000	3,867,428,000	5,142,000	19,987,000	0.42	2,148,285	1,611,782	2,148,285
France	1,905,958,000	2,311,318,000	6,114,000	18,029,000	0.21	1,300,328	1,916,459	1,300,328
Other	20,514,011,032	29,063,525,095	56,351,250	143,223,564	0.42	23,485,207	17,663,537	23,485,207

Total	**36,687,744,032**	**48,187,672,095**	**125,627,250**	**259,381,564**	**0.31**	**35,694,310**	**39,378,391**	**35,694,310**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2010		259,381,564	
Egyptian Exports in 2006		125,627,250	
	Change in Exports	**133,754,314**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	39,378,391	29.4%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_iVi.)$	-3,684,081	-2.8%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	98,060,004	73.3%

Table A59: Two-Level Decomposition for 63: Other made textile articles, sets, worn clothing etc (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

63: Other made textile articles, sets, worn clothing etc — In Thousand USD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Market	**Actual World Exports (Excl EGY)**		**Actual EGY exports**					
	2011	2017	V.j 2011	V'.j 2017	ri (2) / (1) - 1	riV.j (5)*(3)	rV.j r * (3)	$(\sum_i rijVij)$
Italy	1,332,199,000	1,248,029,000	40,192,000	27,513,000	-0.06	-2,539,381	5,199,947	-2,539,381
United States of America	12,420,260,000	15,432,317,000	44,296,000	27,316,000	0.24	10,742,293	5,730,913	10,742,293
Germany	4,696,271,000	4,339,569,000	28,779,000	25,793,000	-0.08	-2,185,889	3,723,360	-2,185,889
France	2,626,082,000	2,474,728,000	22,695,000	21,532,000	-0.06	-1,308,024	2,936,226	-1,308,024
Other	34,574,443,349	39,354,383,000	178,890,791	128,945,000	0.14	24,731,770	23,144,473	24,731,770
Total	**55,649,255,349**	**62,849,026,000**	**314,852,791**	**231,099,000**	**0.13**	**29,440,769**	**40,734,919**	**29,440,769**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis			In Thousand USD
Egyptian Exports in 2017		231,099,000	
Egyptian Exports in 2011		314,852,791	
	Change in Exports	**-83,753,791**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	40,734,919	-49%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_iVi.)$	-11,294,149	13%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-113,194,560	135%

Table A60: Two-Level Decomposition for 31: Fertilizers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2001 - 2005)

31: Fertilizers — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2001	(2) Actual World Exports (Excl EGY) 2005	(3) Actual EGY exports V.j 2001	(4) Actual EGY exports V'.j 2005	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Turkey	266,389,000	752,236,000	173,000	3,161,000	1.82	315,521.8	143,109	315,522
France	927,764,000	1,469,478,000	11,953,000	6,336,000	0.58	6,979,261.4	9,887,768	6,979,261
Italy	458,153,000	655,484,000	7,355,000	4,590,000	0.43	3,167,870.8	6,084,208	3,167,871
Spain	391,997,000	590,097,000	2,185,000	0	0.51	1,104,213.8	1,807,477	1,104,214
Other	12,802,509,417	23,661,106,480	46,054,476	24,589,269	0.85	39,061,638.7	38,097,211	39,061,639
Total	**14,846,812,417**	**27,128,401,480**	**67,720,476**	**38,676,269**	**0.83**	**50,628,506**	**56,019,773**	**50,628,506**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2005		38,676,269	
Egyptian Exports in 2001		67,720,476	
	Change in Exports	**-29,044,207**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	56,019,773	-193%
2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij) - (\sum_{j=1}^{5} r_i Vi.)$	-5,391,266	19%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij) - (\sum_{j=1}^{5} Vij) - (\sum_{j=1}^{5} rijV.ij)$	-79,672,713	274%

Table A61: Two-Level Decomposition for 31: Fertilizers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2006 - 2010)

31: Fertilizers — In Thousand USD

Market	(1) Actual World Exports (Excl EGY) 2006	(2) Actual World Exports (Excl EGY) 2010	(3) Actual EGY exports V.j 2006	(4) Actual EGY exports V'.j 2010	(5) ri (2) / (1) - 1	(6) riV.j (5)*(3)	(7) rV,j r * (3)	(8) $(\sum_i rijVij)$
Turkey	781,322,000	949,914,000	3,093,000	66,863,000	0.22	667,401	2,711,564	667,401
France	1,509,221,000	1,997,677,000	11,832,000	418,885,000	0.32	3,829,400	10,372,850	3,829,400
Italy	707,237,000	793,770,000	21,481,000	126,108,000	0.12	2,628,278	18,831,913	2,628,278
Spain	633,737,000	726,363,000	6,654,000	93,274,000	0.15	972,538	5,833,413	972,538
Other	24,743,973,236	48,783,924,343	35,422,415	447,147,707	0.97	34,414,567	31,054,040	34,414,567
Total	**28,375,490,236**	**53,251,648,343**	**78,482,415**	**1,152,277,707**	**0.88**	**42,512,184**	**68,803,779**	**42,512,184**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	r	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2010		1,152,277,707	
Egyptian Exports in 2006		78,482,415	
	Change in Exports	**1,073,795,292**	
1) Due to increase in world trade	$(\sum_{j=1}^{5} rV.j)$	68,803,779	6.4%

2) Due to market distribution effect	$(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	-26,291,595	-2.4%
3) Due to increased competitiveness	$(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	1,031,283,108	96.0%

Table A62: Two-Level Decomposition for 31: Fertilizers (Country level decomposition) - In Thousand Units

Illustration of the Constant Market Share analysis of changes in Egyptian exports (2011 - 2017)

31: Fertilizers — In Thousand USD

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Market	**Actual World Exports (Excl EGY)**		**Actual EGY exports**					
			V.j	V'.j	ri	riV.j	rV,j	
	2011	2017	2011	2017	(2) / (1) - 1	(5)*(3)	r * (3)	$(\sum_i rijVij)$
Turkey	1,302,700,000	1,004,491,000	71,734,000	360,204,000	-0.23	-16,421,067	-22,573,670	-16,421,067
France	2,658,376,000	1,798,431,000	506,183,000	140,988,000	-0.32	-163,742,653	-159,288,592	-163,742,653
Italy	977,916,000	713,923,000	107,651,000	83,895,000	-0.27	-29,060,891	-33,876,239	-29,060,891
Spain	984,252,000	954,387,000	70,260,000	61,098,000	-0.03	-2,131,888	-22,109,823	-2,131,888
Other	66,976,112,912	45,487,734,000	687,353,141	406,793,000	-0.32	-220,527,948	-216,300,259	-220,527,948
Total	**72,899,356,912**	**49,958,966,000**	**1,443,181,141**	**1,052,978,000**	**-0.31**	**-431,884,448**	**-454,148,581**	**-431,884,448**
			$\sum_{j=1}^{5} Vij$	$\sum_{j=1}^{5} V'ij$	**r**	$\sum_{j=1}^{5} riVi.$	$\sum_{j=1}^{5} rVi.$	$\sum_{j=1}^{5} rijV.ij$

Analysis — In Thousand USD

Egyptian Exports in 2017	1,052,978,000	
Egyptian Exports in 2011	1,443,181,141	
Change in Exports	**-390,203,141**	
1) Due to increase in world trade — $(\sum_{j=1}^{5} rV.j)$	-454,148,581	116%
2) Due to market distribution effect — $(\sum_{j=1}^{5} r.jV.ij)$ - $(\sum_{j=1}^{5} r_i Vi.)$	22,264,134	-6%
3) Due to increased competitiveness — $(\sum_{j=1}^{5} V'ij)$ - $(\sum_{j=1}^{5} Vij)$ - $(\sum_{j=1}^{5} rijV.ij)$	41,681,307	-11%

Does investor personality really matter! A study of investors' flexible investment decision in Indian context

Gunjan Sharma[1], Tarika Sikarwar[2], Kushagra Kulshreshtha[3] and Naval Bajpai[4]

[1, 3]GLA University, 17km Stone, NH-2, Mathura-Delhi Road P.O. Chaumuhan, Mathura-281 406 (U.P.) India.

[2]Prestige Institute of Management, Airport Rd, D.D. Nagar, Deen Dayal Nagar, Gwalior, Madhya Pradesh 474020.

[4]ABV-IIITM, Morena Link Rd, IIITM Campus, Gwalior, Madhya Pradesh 474015.

gunjan.sharma@gla.ac.in, singh.tarika@gmail.com, kushagra.kulshrestha@gla.ac.in, nbajpai@iiitm.ac.in

Abstract

Right investment decisions become imperative for the better financial returns. In this regard, the personality of the individual plays a significant role. It is the combination of the feelings, thoughts, perceptions, skills, abilities and behavior, which can be identified with the help of the Big Five factor Model, a model consisting of five personality traits. Therefore, the intention of this study is to examine the relationship between personality traits and investment decision. Moreover, to explore how demographic factors play a significant role in investment decisions. For exploring the relationship between the personality and financial decisions, the survey in non-metro cities for 208 respondents is conducted. Finally, the data are analyzed using Regression and ANOVA. This study provides a valuable insight to the policy makers and financial advisors to understand the flexibility in investors' behavior, especially in the non-metro cities that yet has lots of scope for assessment of their personalities and then accordingly spreading the investor awareness.

Keywords: Personality; Demographic variables; Big five factor model; India.

1. Introduction

With the passage of time, the human mind has accumulated a diverse set of complexities that made decision making a difficult task. Kahneman & Tversky (1979, 1974) explained how individual behaves in a risky environment, but they did not explain how this behavior occurs [71], [48], [80], [25]. This develops the need for studying the human mind which becomes the foundation of all decision making. Therefore, the study of human mind helps to comprehend the dynamic and flexible behavior of financial market participants and how the internal process of thoughts like visual dispensation, memory, accepted wisdom, learning, feeling [6], problem-solving and decision making would impact their financial decision making. Moreover, investment decision of an individual is based on a multifarious blend of demographics that comprises of gender, age, income, level of education [9] [63], [53], [37], [7] and personal attributes like values, emotions, personality trait, risk tolerance [86], [56], [15]. Factors such as probable risk, market conditions, rate of return, environment and transaction cost also had noteworthy relevance [58], [28], [14]. Studies conducted over the past decade analyzed the behavior of investors and elucidated the pattern of investors' investment. Some theories like Markowitz (1952) supported that investors behave rationally and believe in the widely available information. However, some studies reflected disbelief on the investor rationality in the behavior and stated that decisions are determined by psychological and behavioral factors [84], [47], [14], [68].

The investors take decisions restricted by cognitive abilities such as peripheral environmental factors, lifestyle, principles, impulse and knowledge [76], [77]. In addition to the aforesaid, the psychological and external environment factors act as a catalyst in influencing the behavior of an individual. However, it is not always necessary in the real world to have a rational behavior [45], [76]. Among the various psychological variables, personality is one of the essential drivers of individual conduct. Every individual is unique in his/her personality; hence, individual investment behavior can be better analyzed by exploring their personality attributes. Personality is a combination of attitude, cognition, decision making way and

these factors significantly influence an individual decision making [21]. Individual personality carries and individual risk tolerance level [64]. The individual risk tolerance level influence investment decisions of investors while investment [85]. The certain demographic factors such as age, gender, marital status affect risk tolerance level of the investors. The risk tolerance level of individual investors decreases with the age [83], [65], [57], [55], though some researchers also have a contrary view in this regard [31], [35], [32], [81]. The research performed in the past revealed that personality influences the individual decision making significantly [3]. Therefore, in the current research, investor behavior has been assessed through personality traits by using the Big five-factor model (BFF model) [23]. This model consists of five traits: extraversion, agreeableness, openness, neuroticism, and conscientiousness [84], [23].

Several studies have been conducted to explore more about the retail investors. However, studies specifically from non-metro cities are yet to be undertaken. Therefore, in this research an attempt has been made to assess the impact of personality traits on the investment decision. Moreover, to examine the impact of demographic factors on investment decisions with reference to investors from non-metro cities of northern India.

2. Literature Review

The three diverse features of literature are explored in this section. First, the introduction of personality, second how Big-five personality traits relate to investment decisions along with the impact of demographic variables on investment decisions is explored.
For the aforesaid purpose, personality and investors' demographic dimensions are discussed as follows:

2.1 Personality

Personality is defined as an approach, where human acts together, responds to others and often displayed through measurable character [21], [40]. Personality is the compilation of persona that makes an individual a person of unique character and traits. An understanding of the individual personality is important to understand interactions with the world. According to Sadi, (2011) personality acts as a key role in defining the actions of the investors. An investor's personality trait, psychology, past experience, financial literacy and demographic factors constitute the factors of risk-taking attitude, ability and investment decision of the investors [31], [18], [86], [42]. Personality traits of the individual come under the psychological factor and many of the research showed that personality traits lead to individual decision-making behavior [3]. Individual personality determines and exert the behavior of investors while investment. These major influencing factors affect the investor's attitude, behavior, and vary from individual to individual. The previous studies demonstrated the impact of personality on risk tolerance level and their investment decisions. It is observed that the personality traits influence investment decisions about various investment avenues such as bonds, stocks, and securities in Post-soviet countries [64]. Moreover, personality influences the risk-taking attitude in diverse phases of life, which include gambling, being social and the investment behavior [78]. Wasiuzzaman & Edalat (2016) studied the relationship between personality, risk tolerance, and social network use.

2.2 Big five Personality factors

The Big-five model of personality is one of the most popular models used in the various studies [23]. In the past, attempts have been made to assess the consumers' behavior using this model. In this context, a research conducted by [62] investigated how personality traits influence saving and borrowing behavior of individuals. In this research, the Big Five personality structure was applied as it is one of the capable frameworks that explores all the dimensions of behaviors in terms of openness, extraversion,

conscientiousness, agreeableness, and neuroticism [6]. Secondly, this framework has been found applicable in various employment contexts [2]. The personality traits can be examined in the light of investment decisions such as to explore are extrovert people friendly, warm, social, companionable, determinants, possess willpower to complete the task, elevated, positive, possess the inclination towards optimism, energetic and not bounded by rationality and alike. They take advice from a financial advisor before making the investment decision and have a positive attitude towards the life so that they could make the estimation of the market and the possible risks associated. However, an investor having a negative attitude makes overestimation of risks leads to the loss of the expected profit. The people with the conscientious trait are competent, expert, flexible, self-disciplined, persistent, reliable, punctual, high risk-taking attitude, etc. An individual with the aforesaid trait tends to be more hardworking and dependable. They prefer to plan rather than behaving spontaneously. It was observed that the people adaptive to experience are curious, creative and receptive to one's own feelings and emotions, they are willing to explore by having social, political and religious values as well as the intensity to take higher risks [53]. Moreover, the people with agreeableness trait are straightforward, trustworthy, compassionate, highly sympathetic, tender-minded, benevolent and extremely generous. However, individuals who are low in agreeableness are usually having doubts, suspicious, cynical [15]. The neuroticism people are impulsive, dependent, anxious, vulnerable, depressed, fearful, and weak in analytical skills, poor conceptual understanding and low in logical and rational thinking [86]. From these big five traits, it can be understood that extraversion and openness to experience exert a significant impact on the choice of making the risky investment as opposed to the neuroticism, agreeableness, and conscientiousness [64]; [41] [38] [54]. An investor with high extraversion may overestimate the profit and underestimate the loss. However, an investor with high agreeableness takes the financial analyst's opinion and found it difficult to take an investment decision on his own [64]. Conscientious investors are analytical, methodological and have a clear investment goal. Neurotic investors can underestimate the gain when the market is favorable and overestimate the risk. Investors who have a high openness to experience easily accept the new market information and may make the changes in the portfolio according to the market changes. Pan & Statman (2012) predicted that investors having high risk-taking attitude, possess a high level of the extraversion and openness as the personality traits in comparison to those who have a high level of conscientiousness with a low level of risk-taking attitude. People who have high confidence associated with the high level of the extraversion on the other hand low confidence associated with the high level of agreeableness. Moreover, Duckworth & Weir (2011) stated that investors who are high in conscientiousness build up the wealth and associate themselves with lifetime earnings.
Neuroticism and agreeableness investors take the support of the financial advisor and there is a positive relationship between them. Acceptance to financial advisors shall be associated with overconfidence bias. Some research associate low degree of overconfidence with high agreeableness to financial advisors and portfolio managers. Jamshidinavid et. al, (2012) anticipated that neuroticism and agreeableness trait has a positive attitude with herd behavior. Those who are high in neuroticism and agreeableness have a positive propensity to accept the advice of advisors as they lack confidence. It is found that extraversion and conscientiousness have a negative relationship with agreeableness with advisors as they are overconfident. This can be related to the findings of Schaefer (2004) who claimed that extraversion has a positive and significant relationship with overconfidence.

2.3 Demographic variables

Some other factors are also associated with the investment decision, such as risk tolerance, tax saving, securing for the future, past market trends, financial literacy and expert advice, etc. In some researches, personality traits have been used as an independent variable. The risk is an important factor that should be considered while making the investment decision. Uncertainty and risk are always present in an investment if it has more than one possible outcome. Risk should be measured and analyzed during the investment decision to scrutinize the opportunities to invest. When investors possess all information about the

investment outcome, there is less uncertainty for an investment decision. However, when they do not know about all outcomes, then the decision becomes difficult [10].

Nagy & Obenberger (1994) while exploring the relationship between wealth maximization and investment decision found the positive relationship among them. Wealth maximization was found playing a significant role among the investors. Cohn et al. (1975) said as wealth increase the attitude towards risk aversion decreases. However, risk aversion also affected by the increase in the age, income, education. Mahmood et al. (2011) in their study assessed that the investment decision of an investor is being affected by various socioeconomic and demographic factors. The demographic factors like age, gender, marital status, education, income, investment experience, etc. also have the significant relationship with the investment decision making by the investors. Many studies have revealed a positive relationship between age and risk tolerance. With the increase in age, the level of risk tolerance also increases [47] [21], [81]. Other researchers state that the younger respondents are adaptable to higher risk than the older generation [74]. Gender is one of the important demographic variables determine investor decision and risk acceptance level like men are more risk tolerant than women [1], [31], [74]. In addition, women give more importance to the loss than men do. In the terms of trading activity, women's participation is less in the trading activity than the men, which can be interpreted as low risk aversion of women, compared to men. Fellner and Maciejovsky (2007, p. 375) stated that "higher level of risk aversion is negatively associated with trading frequency". Investors take less interest in the financial products if they are less aware of it [1]. Moreover, investment experience has a positive relationship with dependency on performance in mutual funds trading business [81]. However, for some variable such as education was opposed by some researchers stated that there is no significant influence of education on financial risk tolerance [37], [74], [31], [35]. The female often prefers the safe avenue to invest rather than riskier avenue even when they are given the advice that they can get a higher risk or they think to get a higher return from the financial products and due to this reason females are less interested in a trade [8]. They are not desirous of making the investment decisions which have high risk involved [4].

Jain & Mandot (2012) found that demographic factors such as age, educational qualification, income, marital status influence the Indian stock market but gender have no effect on the investor's decision. Older investors want no pressure or tension so they focus on the safe investment. Moreover, apart from age, there is a relationship between the investment decision and investment experience. Female investors are conservative in nature, they spend their funds on long-term investments, and dependent on brokers and less risk tolerant. The risk tolerance level is also affected by the education level as the increase in education level increase the risk tolerance level [49], [73], [11]. It is also studied that investors have more family members, therefore, tend to be risk aversion [49]. The younger investors with a high level of income, education and fewer family members, will choose the riskier investment product that offers a higher return. They follow the phenomena of 'high risk, high return'. Aggarwal & Mehta (2011) stated that there is a relationship of demographic profiles and investment choice with their personality type. There is a significant difference between genders for provident funds, real estate, and fixed deposit. As the investors get older, they started relying more on post office investment compare to young age investors. Most of the investors like to take advice from their family members for making the investment.

3. Methodology

Based on the above discussion the following research questions are framed:
RQ1. Does personality traits impacts the investment decision making of the retail investors?
RQ2**.** Does investment decision of investors vary, based on demographic factors such as age, investment experience, and educational status?

The first research questions help to explore how personality traits influence an individual decision making. The second research question facilitates to assess the level of significance of the difference in investment decision making based on demographic factors. The data were collected through a structured questionnaire

containing the questions that help to assess the personality traits of investors by using Big Five Factor Model [23]. The second part of the questionnaire assesses the significance of the difference in investment decision clustered by demographic factors. The questionnaires were filled through online as well as offline mode. The sample size taken was 300 out of which 208 responses were received with a 69.33% response rate. The nonrandom convenience sampling technique was used. For all the questions, 5 points Likert scale was used, where 1 was for the lowest score and 5 for the highest. The internal consistency of the questionnaire is tested through Cronbach's alpha (0.858), stand meritorious to go ahead [61].

3.1 Hypotheses formulation

One of the aims of this research is to witness the impact of personality traits on investment decision. In this study, we used Big Five personality traits i.e. Openness to experience (OTE), Conscientiousness (CON), Extraversion (EXT), Agreeableness (AGRE) and Neuroticism (NEU). For our first research question, regression analysis was applied. Regression analysis is a statistical tool which is used for estimating the relationship between variables. Wasiuzzaman & Edalat (2015) used regression analysis to investigate the relationship between an individual online social networking behavior and his financial risk tolerance level where personality was taken as mediating variable. Similarly, Zubair et, al. (2016) also applied regression analysis to see the relationship between information sources and a trading variable where personality acted as a moderating variable. Therefore, following hypothesis was formulated.

H_1 There is a linear relationship between the personality traits and investment decision.

Moreover, for addressing the second research question, which is to assess the significance of difference in investment decision clustered by demographic variables like education, marital status, and investment experience, ANOVA statistics was applied and following hypotheses were developed

Ha1: There is a significant impact of age on investment decision [64].

Ha2: There is a significant impact of education on investment decision [64].

Ha3: There is a significant impact of investment experience on investment decision [64].

4. Data Analysis

Profile of the respondents

The developed questionnaire having a first part contained demographic and socio-economic information were being asked to fill. Out of 208 respondents, 40.9% respondents are female and 59.1 are male. In respect of age, 2.9% respondents are under 20 age, 71.2% are of 21-30 years, 17.8% are of 31-40 years, 5.8% are between 41-50 years, 1.4% is of 51-60 years, 1% are of 61 and above age groups. In respect of marital status, 34.1 % are single and 65.9% are married. Moreover, in terms of education, 2.4% are intermediate, 34.1% graduate, 55.8% post-graduation and 7.7% having a doctorate degree. Their investment experience was also accessed with 77.4% having 0-5 years of experience, 13.5% having 6-10 years of experience, 7.7% having 11-15 years of experience, 0.5% having 16-20 years of experience and 1% having 21 and above years of experience.

5. Results

The aim of this study was to assess the impact of personality traits on the investment decision making of the retail investors It has been observed that every personality trait is positively correlated with an investment decision. Openness to experience has positive correlation with investment decision ($r=0.399$, $p<0.01$). Conscientiousness have positive correlation with investment decision ($r=0.322$, $p<0.01$) and with

openness to experience (r=0.492, p<0.01). Extraversion is also positively correlated with investment decision (r=0.307, p<0.01) and with openness to experience and conscientiousness (r=0.397, r=0.421, p<0.01). Agreeableness has positive correlation with openness to experience, conscientiousness, extraversion (r=0.291, r=0.463, r=0.497, p<0.01). Neuroticism positively correlated with openness to experience (r=0.141, p<0.05), with extraversion (r=0.286, p<0.01), agreeableness (r=0.105, p<0.1).

Table 1: Expected correlation between personality trait and investment decision

Personality trait	Expected impact on investment decision
Extraversion (EXTRA)	Positive
Agreeableness (AGREE)	Positive
Conscientiousness (CONS)	Positive
Neuroticism (NEURO)	Positive
Openness to the experience (OPEN)	Positive

Source: Authors' estimates using SPSS vs. 20

The model for testing H1 was found overall significant with F-statistics equal to 11.387 (significant at 1% level) and adjusted R^2 equal to 20.3 percent. Table 1 presents the results. The result discloses that openness to experience had a significant and positive impact on investment decisions (significant at 5% level). It means that people are fond of undertaking new things and making an investment in new financial avenues and make choice in risky investment. However, conscientiousness, extraversion, and neuroticism have no significant impact on investment decision (at 5% significant level). Agreeableness had a significant impact on investment decision (at 5% significant level) which means that investors with this trait rely on others opinion and for them the role of the financial advisor is vital. The agreeable investors are less inquisitive and obtain information from their peer group; hence, often considered as inexperienced [20].

Table 2: Correlation Matrix

	FAIDavge	OTEavge	CONavge	EXTavge	AGREavge	NEUavge
FAIDavge	1					
OTEavge	0.399*	1				
CONavge	0.332*	0.492*	1			
EXTavge	0.307*	0.397*	0.421*	1		
AGREavge	0.324*	0.291*	0.463*	0.497*	1	
NEUavge	0.155*	0.141**	0.034	0.286*	0.105***	1

Source: Author's estimates using SPSS vs. 20

Notes: Correlation is significant at the 0.01 level (two-tailed);**correlation is significant at the 0.05 level (two-tailed), ***correlation significant at 0.1 level.

Table 3: Coefficients Matrix

Independent variable	Beta	SE	t-statistics	p-value
OTEavge	0.308	0.085	3.642*	0
CONavge	0.106	0.086	1.232	0.219
EXTavge	0.058	0.085	0.683	0.496
AGREavge	0.185	0.086	2.161*	0.032

Source: Author's estimates using SPSS vs. 20

Notes: *Significant at 5% level.

The second objective was to assess the significance of difference in investment decision clustered by demographic variables like education, marital status, and investment experience. After applying ANOVA, it was observed that there was a statistically significant impact of age on investment decision ($p=0.008$, $p<0.05$). In addition, few of the studies show that the investors, who belong to the 27 to 50 years age group, are willing to take more risk than the investors who belong to the age of over 50. Therefore, it is clear that younger investors are more risk taker than the older [67]. Moreover, with the increasing age the investors are inclined towards safer investment avenues. Education an important demographic variable had no significant impact on investment decision making ($p=0.907$, $p<0.05$). It means that educational status does not affect the investment decision. However, there was a significant impact on the investment experience on the investment decision ($p=0.049$, $p<0.05$). Similar findings were supported by [77], the investors who have investment experience of more than 5 years are more willing to take risks than those who have the experience of less than 5 years. Moreover, male investors do the analysis of the market, securities, spend time and money on the analysis and are less dependent on the broker.

6. Discussion

This study focuses on the examination of investors' behavior in Indian context. In this study, individual personality traits and Big Five factor model were considered to assess the impact of personality traits on investment decision. The categorization of personality trait facilitates the investors to achieve their financial goals by understanding their personality traits, becoming alert about them. By exploring the personality traits, the investors can predict and can amend their personal investments by avoiding impending biases. The study indicates that personality traits such as openness to experience and agreeableness have the significant impact on the investment decision, but the personality trait extraversion, neuroticism and conscientiousness have no significant impact on the investment decision. Every personality traits have the correlation with each other and with the investment decision. The individual with openness to experience trait considered advice from financial specialist more trustworthy due to their expertise in financial investment and market and fine-tune the portfolios when they get guidance from financial professionals. The younger investors who have a high income level and less family members choose the riskier investment avenue. They can invest their money in security rather than bonds and savings account. Thus, they are flexible in their investment decision in terms of deciding what is more appropriate at the time of investment

by keeping the market volatility into consideration. We also found the negative relationship between the educational status and investment decision. It means that educational status does not affect the investment decision. There is no effect of the education investment decision can be affected by the frequency of making investments, age, financial literacy, investment decision and many more. Therefore, we can conclude that the investment decision [17] is not affected by only personality traits and some demographic factors, but it can be affected by other factors like value, belief, intention, perceived behavior, planning and some other demographic factors.

7. Conclusion & Future Scope of Research

This study is having the implications for the financial industry, fund managers, government and policy makers. The financial advisor can improve their service quality in financial markets and can advocate them linking traditional finance with behavioral finance. Moreover, the profiling of the investors based on personality traits can help the individual investors to develop their own understanding about their financial needs. Financial consultants can address their clients' need by looking into their personality traits and can guide them regarding various financial products. By conducting this research we also conclude investor's personality matters as personality is one of the significant variables which can influence investment decisions. With the growing financial markets and increasing awareness program's the investors started putting their money in various investment options. This kind of study would assist the growing capital markets and the government to monitor the irrational behavior of the investors which can affect the Indian stock market.

The limitation of this study is its focus on the personality traits not on other factors that may also affect the investment decisions such as family background, belief, attitude, planned behavior, financial conditions and some other demographic factors like income, city, occupation, the percentage of savings etc. Moreover, the investment decision is affected by the other psychological factors like mood, emotion. Therefore, further research can be conducted in these contexts. Secondly, the probability sampling technique can be applied for better generalization of the result. Moreover, a comparative study of investors from religious and non-religious cities can be further conducted.

References

1. Anbar, A., Eker, M.: An empirical investigation for determining of the relation between personal financial risk tolerance and demographic characteristic: EGE Academic Review. 10(2), 503-523 (2010)
2. Arthur, W., Woehr, D. J., Graziano, W. G.: Personality testing in employment settings: Problems and issues in the application of typical selection practices. Personnel Review. 30(6), 657-676 (2001)
3. Back, K., Seaker, R.: Project performance: implications of personality preferences and double loop learning. Journal of American Academy of Business. 4(1), 292-297 (2004)
4. Bajtelsmit, V. L., Bernasek, A., Jianakopolos, N.A.: Gender effects in pension investment allocation decisions. Working Paper: Center for Pension and Retirement Research.145-156 (1996)
5. Baker, H.K., Haslem, J. A.: The impact of investor socioeconomic characteristics on risk and return preference. Journal of Business Research. 2,469-76 (1974)
6. Boda, J. R., Sunitha, G.: Investor's psychology in investment decision making: a behavioral finance approach, 119 (7), 1253-1261 (2018)
7. Bali, T., Demirtas, O., Levy, H., Wolf, A.: Bond versus stocks: investors' age and risk taking. Journal of Monetary Economics. 56 (6), 817-830 (2009)
8. Barber, B. M., Odean, T.: Trading is hazardous to your wealth: The common stock investment performance of individual investors. Journal of Finance. 55, 773-806 (2000)

9. Barry, D., Edwards, J. R.: Real Profit Consciousness and the Investment Decision. Managerial Finance. 3 (2), 97-105 (1977)
10. Belli, P., Anderson, J., Barnum, H., Dixon, J., Tan, J. P.: Handbook on economic analysis of investment operations. The World Bank, Washington, DC (1998)
11. Bhandari, G., Deaves, R.: The demographics of overconfidence. Journal of Behavioral Finance. 7, 5–11 (2006).
12. Blume, M.: The Changing Role of the Individual Investor, Wiley, New York, NY (1978)
13. Pan, C. Statman, M.: Questionnaires of risk tolerance, Regret, overconfidence, and other investor propensities.SCU Leavey School of Business Research, Paper No. 1005 (2012)
14. Chang, C.: The impact of behavioral pitfalls on investors' decisions: the disposition effect in the Taiwanese warrant market.Social Behavior and Personality. 36 (5), 617-634 (2008)
15. Chitra, K., Sreedevi, V.: Does personality traits influence the choice of investment? The IUP Journal of Behavioral Finance, 8(2), 47-57 (2011)
16. Cohn, Richard A., Lewellen, Wilbur G., Lease, Ronald C., Schlarbaum, Gary G.: Individual Investor Risk Aversion and Investment Portfolio. The Journal of Finance, 30(2), 605-620 (1974)
17. Collan, M., Liu, S.: Fuzzy logic and intelligent agents: towards the next step of capital budgeting decision support. Industrial Management & Data Systems. 103 (6), 410-422 (2003)
18. Corter, J. E.: Investor Attitudes towards Risk and Uncertainty and Reactions to Market Turmoil. In behavioural finance working group conference: Fairness, trust and emotions in finance (2010)
19. Corter, J., E., & Chen, Y. J.: Do investment risk tolerance attitudes predict portfolio risk?' Journal of Business and Psychology. 20 (3), 369-81 (2006)
20. Costa, P. T. Jr., McCrae, R. R.: Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual. Odessa, FL: Psychological Assessment Resources (1992)
21. Crysel, L., Crosier, B., Webster, G.: The dark triad and risk behavior. Personality and Individual Differences. 54(1), 35-40 (2012)
22. Crysel, L., Crosier, B. Webster, G.: The dark triad and risk behavior. Personality and Individual Differences. 54 (1), 35-40 (2012)
23. Digman, J. M.: Personality structure: Emergence of the five-factor model. Annual Review of Psychology.41, 417-440 (1990)
24. Duckworth, A., Weir, D.: Personality and Response to the Financial Crisis. Michigan Retirement Research Center Research Paper No. WP 2011-260 (2011)
25. Edwards, D.: What is neurofinance?. August 9, available at http://brainwaves.corante (2004)
26. Paetzold, F. Busch, T, Chesney, M.: More than money: exploring the role of investment advisors for sustainable investing. Annals in Social Responsibility. 1(1), 195 -223 (2015)
27. Fellner, G. and Maciejovsky, B. (2007). Risk attitude and market behavior: evidence from experimental asset market. Journal of Economic Psychology. 28(3), 338-350.
28. Ferguson, E., Heckman, J., Corr, P.: Personality and economics: overview and proposed framework. Personality and Individual Differences. 51 (3), 201-209 (2011)
29. Filbeck, G, Hatfield, P., Horvath, P.: Risk Aversion and Personality Type. The Journal of Behavioral Finance. 6 (4), 170-180 (2005)
30. Friedman, B.: Risk aversion and the consumer choice of health insurance option. Review of Economics and Statistics. 56(2), 209-14 (1974)
31. Grable, J. E.: Financial risk tolerance and additional factors that affect risk taking in everyday money matters. Journal of Business and Psychology. 14 (4), 625-30 (2000)

32. Grable, J.E., Joo, S.: Determinants of risk preference: implication for the family and consumer science professionals. Family Economics and Resource Management Biennial. 2, 19-24 (1997)
33. Grable, J.E., Joo, S. (1999). Factors related to risk tolerance: a further examination. Consumer Interests Annual. 45, 53-8.
34. Grable, J.E., Joo, S. H.: A cross-disciplinary examination of financial risk tolerance.Consumer Interests Annual. 46, 151-157 (2000)
35. Grable, J.E., Lytton, R. H.: Investor risk tolerance: testing the efficacy of demographics as differentiating and classifying factors. Financial Counseling and Planning. 9(1), 61-73 (1998)
36. Haliassos, M., Bertaut, C.C.: Why do so few hold stocks? Economic Journal. 105(432), 1110-29 (1995)
37. Hallahan, T., Faff, R., McKenzie, M.: An exploratory investigation of the relation between risk tolerance scores and demographic characteristics. Journal of Multinational Financial Management. 13(4/5), 483-502 (2003)
38. Harlow, W.V., Brown, K.C.: Understanding and assessing financial risk tolerance: a biological perspective.Financial Analysts Journal. 46(6), 50-62 (1990)
39. Heshmat, N. A.: Non-professional investors' behavior: an empirical study of female Saudi investors. International Journal of Commerce and Management. 22(1), 75 – 90 (2012).
40. Hogan, R., Hogan, J., Roberts, B. W.: Personality measurement and employment decisions: Questions and answers. American psychologist, 51(5), 469 (1996)
41. Hopfensitz, A., Wrank, T.: How to adapt to changing markets: experience and personality in repeated investment game. TSE Working Paper 09-122 (2009)
42. Hunter, K., Kemp, S.: The personality of e-commerce investors. Journal of Economic Psychology, 25(4), 529-537 (2004)
43. Jamshidinavid, B., Chavoshani, M., Amiri, S.: The Impact of Demographic and Psychological Characteristics on the Investment Prejudices in Tehran Stock. European Journal of Business and Social Sciences. 1(5), 41-53 (2012)
44. Kahneman, D., Tversky, A.: Judgment under uncertainty: Heuristics and biases. Science 185 (4157), 1124-1131 (1974)
45. Kalantari, B.: Herbert A. Simon on making decisions: enduring insights and bounded rationality. Journal of Management History. 16 (4), 509-520 (2010)
46. Kirchler, E., Maciejovsky, B.: Simultaneous over- and under confidence: Evidence from experimental asset markets. Journal of Risk and Uncertainty, 25, 65–85 (2002)
47. Kourtidis, D., Sevic, Z., Chatzoglou, P.: Investors' trading activity: a behavioral perspective and empirical results. The Journal of Socio-Economics. 40 (5), 548-557 (2011)
48. Kuhnen, C.M.: On money, risk and the brain", March 5, available at: www.kelloggnorthwestern.edu/faculty/kuhnen/htm/neuroeconreadinggroup/moneyRiskBrain.pdf (2007)
49. Lewellen, W. G., Lease, R. C., Schlarbaum, G. G.: Patterns of investment strategy and behavior among individual investors. The Journal of Business, 50(3), 296-333 (1977).
50. Mahmood, I., Ahmad, H., Khan, A. Z., Anjum, M.: Behavioral implications of investors for investments in the stock market. European Journal of Social Sciences, 20 (2), 240-247 (2011)
51. Mahmood, O. P.: Impact of personality on risk tolerance and investment decisions: A study on potential investors of Kazakhstan. International Journal of Commerce and Management. 25 (4), 370 -16 (2015)
52. Markowitz, H.: Portfolio selection. Journal of Finance. 7 (1), 77-91 (1952)
53. Mayfield, S., Shapiro, M.: Gender and risk: women, risk taking and risk aversion. Gender in Management: An International Journal. 25(7), 586-604 (2010)

54. McCrae, R., Costa, P.: Toward a new generation of personality theories: theoretical contexts for the five-factor models in Wiggins. J. (Ed.).The Five-Factor Model of Personality: Theoretical Perspectives, Guilford, New York, NY, 51-87 (1996)

55. McInish, T.H.: Individual investors and risk-taking. Journal of Economic Psychology. 2(2), 125-36 (1982)

56. Mishra, S., Lalumiere, M., Williams, R.: Gambling as a form of risk-taking: individual differences in personality, risk-accepting attitudes, and behavioral preferences for risk.Personality and Individual Differences. 49 (6), 616-621 (2010)

57. Morin, R.A., Suarez, A.F.: Risk aversion revisited. Journal of Finance. 38(4), 1201-1216 (1983)

58. Morse, W.: Risk taking in personal investments. Journal of Business and Psychology, 13 (2), 281-288 (1998)

59. Nagy, Robert A., Obenberger, Robert W.: Factors influencing Individual investor Behavior. Financial Analyst Journal.50 (4), 63-68 (1994)

60. Neff, M., Toothman, N., Bowmani, R., Tree, J.E.F., Walker, M.A.: Don't scratch! Self-adaptors reflect emotional stability.International Workshop on Intelligent Virtual Agents, Springer Berlin Heidelberg. 398-411 (2011).

61. Nunnally, J. C.: Psychometric theory (2nd ed.). New York: McGraw-Hill (1978)

62. Nyhus, E. K., Webley, P.: The role of personality in household saving and borrowing behaviour. European journal of personality 15(S1), (2001)

63. Ozmen, O., Sumer, Z.: Predictors of risk-taking behaviors among Turkish adolescents. Personality and Individual Differences. 50(1), 4-9 (2011)

64. Pak, O., Mahmood, M.: Impact of personality on risk tolerance and investment decisions. International Journal of Commerce and Management, 25 (4) 370-384 (2015)

65. Palsson, A. M.: Does the degrees of relative risk aversion vary with household characteristics? Journal of Economic Psychology. 17 (6), 771-87 (1996)

66. Aruna, P., Rajashekar, H.: Factors Influencing Investment Decisions of Retail Investors- A Descriptive Study. International Journal of Business and Management Invention. 5 (12). 6-9 (2016)

67. Riley, W.B., Chow, K.V.: Asset allocation and individual risk aversion. Financial Analysts Journal. 48, 32-7 (1992)

68. Rober, S.: From efficient markets theory to behavioral finance. The Journal of Economic Perspectives.17 (1), 83-104 (2003)

69. Roszkowski, M. J., Snelbecker, G. E., Leimberg, S. R.: Risk tolerance and risk aversion. The tools and techniques of financial planning. 4, 213-225 (1993).

70. Sadi, R., Asl, H., Rostami, M., Gholipour, A.: Gholipour, F.: Behavioral finance: the explanation of investors' personality and perceptual biases effects on financial decisions. International Journal of Economics and Finance. 3 (5), 234-241 (2011)

71. Sapra, S.G., Zak, P. J. (2008).: Neurofinance: bridging psychology, neurology, and investor behavior", available at http://ssrn.com/abstract¼1323051.

72. Schaefer, P. S., Williams, C. C., Goodie, A. S., Campbell, W.: Overconfidence and the Big Five. Journal of Research In Personality, 38 (5), 473–480 (2004)

73. Schooley, D.K., Wordon, D.D.: Risk aversion measures: comparing attitudes and asset allocation. Financial Services Review. 5, 87-99 (1996)

74. Selcuk, E., Altinoklar, A., Aydin, G.: Financial risk tolerance: Scale development and analysis of determinants. Journal of American Academy of Business, 15(2), 89-97 (2010).

75. Simon, H.: A behavioral model of rational choice. Quarterly Review of Economics. 69 (1), 99-118 (1955)

76. Simon, H.: Rational decision making in business organizations. American Economic Review, 69 (4), 493-513 (1976)

77. Simon, H.: Making management decisions: the role of intuition and emotion. Academy of Management Journal. 1(1), 57-64 (1987)

78. Soane, E., Dewberry, C., Narendran, S.: The role of perceived costs and perceived benefits in the relationship between personality and risk-related choices. Journal of Risk Research. 13(3), 303-318 (2010)

79. Sung, J., Hanna, S.: Factors related to risk tolerance. Financial Counsel and Planning. 7, 11-12. 1201-1216 (1996)

80. Tseng, K. C.: Behavioral finance, bounded rationality, neuro-finance, and traditional finance. Investment Management and Financial Innovations, 3 (4), 7-18 (2006)

81. Wang, H., Hanna, S.: Does risk tolerance decrease with age? Financial Counseling and Planning. 8(2), 27-32 (1997)

82. Wasiuzzaman, S., Edalat, S.: Personality, risk tolerance and social network use: an exploratory study. Managerial Finance, 42 (6), 536-552 (2016)

83. Watson, J., McNaughton, M.: Gender differences in risk aversion and expected retirement benefits. Financial Analysts Journal .63(4), 52-62 (2007)

84. Weller, J., Thulin, E.: Do honest people take fewer risks? Personality correlates of risk-taking to achieve gains and avoid losses in HEXACO space. Personality and Individual Differences. 53(7), 923-926 (2012).

85. Yip, U.Y.: Financial Risk Tolerance: A State or a Trait? The University of New South Wales, Sydney (2000)

86. Young, S., Gudjonsson, G., Carter, P., Terry, R., Morris, R.: Simulation and risk-taking and it relationship with personality. Personality and Individual Differences.53 (3), 294-299 (2012)

Cryptocurrency: An Investment Perspective in India

Akshay Vyavahare and Kalyani Sahoo

Indian Institute of Management Indore, India

Abstract :

Cryptocurrency has made a transition from being an academic concept to (virtual) reality with the creation of Bitcoin in 2009. While Bitcoin attracted an increase in followers in subsequent years, it captured significant investors and media attention with a sudden surge in its price. The continuous and unpredictable highs-and-lows makes it even more difficult to take a decision for investment. This paper tries to understand the concept of cryptocurrency, study the current status of cryptocurrency in different parts of the world (USA, India/Mexico and China) and concludes with an investment perspective in the context of Indian society.

Keywords : Cryptocurrency, Bitcoin, Investment

1 Introduction

The invention of Bitcoin by Satoshi Nakamoto (Nakamoto [2008]) in 2008 incited the creation of many new cryptocurrencies. Many of these cryptocurrencies were developed for different purposes or to address the pain points of the Bitcoin network. These innovations and the observed investment potential have led to rapid growth in the number of altcoins and the market size of cryptocurrency. According to CoinMarketCap, nearly 869 cryptocurrencies are currently trading around the world with a combined market capitalization of US$148.3 billion by circulating supply and US$321.5 billion by total supply as of October 6, 2017. The price of bitcoin surged to US$4,780.15 on September 2, 2017. Cryptocurrency is a subset of the class of digital currency (Lee [2015]), but it has become an important type of digital currency. Unlike other digital currencies that can be centrally issued, circulated within a community or geographical location, or tied to fiat currency or the organizations issuing them, cryptocurrency has very different characteristics. The blockchain technology used by cryptocurrency, such as Bitcoin, is an open distributed ledger that records transactions. This resolves the double-spending problem and does not require a trusted third party. Decentralization allows the blockchain technology to have increased capacity, better security, and faster settlement. Some of these features are at the top of the list of inadequacies of traditional financial systems. As a result, blockchains and cryptocurrencies have become two of the most demanding topics in the financial industry. In this paper, we focus on the current status of Cryptocurrency in USA, China and also attempt to understand the Indian perspective in this context.

As demand for cryptocurrency keeps growing, global regulators are divided on how to keep up. Most digital currencies are not backed by any central government, meaning each country has different standards.

Every seemingly small regulation announcement has driven the price of bitcoin and other cryptocurrencies in 2018.

1.1 Status of Cryptocurrency in United States

The policy on exchanges of Cryptocurrency in USA accepts it as legal, depending on the state. It handles the second largest volume of bitcoin, roughly 26 percent, according to Cryptocompare.

U.S. regulators differ in their definitions of bitcoin and other cryptocurrencies.

The Securities and Exchange Commission has specified it views digital currency as a security. The agency extended its scrutiny and said it is considering to apply securities laws to everything from cryptocurrency exchanges to digital asset storage companies known as ‘wallets’. The agency has focused on initial coin offerings, or digital coins released through fundraisers known as token sales, and has stepped up efforts to police them through recent orders.

The Commodity Futures Trading Commission states that bitcoin is a commodity.

The IRS says cryptocurrency is not actually a currency. It defined it in 2014 as property and issued guidance on how it should be taxed.

USA Crypto Regulations–Slow, but Gaining Speed

The United States government has treated cryptocurrencies with a rather slow and steady method when compared with some of the world's other major powers. This has resulted in an environment where cryptocurrencies and blockchain-based startups can establish themselves with some promise that business will not be interrupted by the swift, heavy-handed actions of a government acting hastily.

At the same time, the United States' lack of a uniform regulatory framework has not prepared the country as well-suited as, say, Switzerland, which has become a global hub for blockchain technology, as well as the home of the Crypto Valley Association. Without a solid set of rules in place, some blockchain startups may be hesitant to put roots down—a lack of regulation could mean a big change in taxation in the future.

Trump's Administration on Blockchain Technology

By its very nature, cryptocurrency and the various kinds of distributed ledger technology that power it was intentional to place more economic power in the hands of the individual. Blockchain allows for regular people to be in full control of their funds without depending on a third-party institution (i.e. banks and credit card companies).

Therefore, it can well be stated that, the Trump administration's interest in blockchain technology is somewhat unexpected, given that most of the administration's policies have been directed toward putting more power into the hands of large corporations. However, it seems that the Trump administration's interest in blockchain, cryptocurrency, and DLT is dedicated towards improving existing government and financial systems.

Crypto, Anonymity, and Cyber Crime in the US

Indeed, the decentralized and anonymous nature of cryptocurrencies has long been regarded as a good thing by crypto users who hope to remain as anonymous and tax-free as possible. However, a few large-scale incidents have made plan the US government's seemingly limited ability to protect crypto users from theft and fraud, a situation that is only exacerbated by a lack of solid, uniform legal framework.

Identifying and penalising cyber criminals has proven to be an very difficult and often unproductive endeavor for most governments around the world within and without the cryptosphere.

Crypto Regulations State-by-State

Since the United States Federal Government has not yet put in place any comprehensive set of laws that would regulate the classification and usage of cryptocurrency in the country, states have been left to make their own decisions regarding the regulation of crypto. This has caused in an absolute makeshift of uncertainty, welcoming, argumentative, and indifferent.

Huge majority of the states in the Union have not agreed any specific laws regarding the practice of cryptocurrency; some have taken steps to embrace blockchain technology, and others have made moves to deter residents from engaging with cryptocurrency.

Status of Cryptocurrency in few states of USA:

State	Attitude	Special Legislation
Alabama	Unfriendly	In August of 2017, the Alabama Monetary Transmission Act was signed into law. According to Al.com, the law "regulates money transmitters and covers non-banking entities that engage in checks and money transfers [i.e. cryptocurrencies], as well as debt management services."
Arizona	Friendly	In March of 2017, the Governor of Arizona signed HB 2417 into law. According to New Media Law, the bill "stipulates that records or signatures in electronic form cannot be

		denied legal effect and enforceability based on the fact they are in electronic form". In other words, smart contracts are legally recognized in the state.
California	Friendly	California is arguably the most crypto-friendly state in the Union. Former CA Governor Jerry Brown officially declared Bitcoin legal tender in the state with the signing of Assembly Bill 129. Hundreds of California-based businesses accept Bitcoin as payment– there are at least 177 BTC-accepting businesses in San Francisco alone. California is home to the most blockchain-based startups of any state in the US.
Florida	Unclear	Florida's House Bill 1379 passed in May 2017, defining that virtual currency constitutes a "monetary instrument". According to BraveNewCoin, the bill also prohibited the use of cryptocurrency in money-laundering criminal proceedings.
Georgia	Unfriendly	Georgia requires sellers and holders of Bitcoin to have a license. Georgia also added virtual currency to several pre-existing laws regarding money transmission and AML (Georgia House Bill No.811, Code Section 7-1-680 and Code Section 7-1-690)
Illinois	Friendly	In June 2017, the Illinois Department of Financial and Professional Regulation made clear that cryptocurrency is not included under the Illinois Transmitters of Money Act (TOMA). At the same time, the IDFPR clarified that third-party crypto exchanges would need to obtain a TOMA license. According to CoinDesk, the IDFPR additionally stated that cryptocurrencies were allowed as investments for blockchain-based startups.
Massachusetts	Unclear	In December 2017, Secretary of the Commonwealth William Galvin announced that his office would be conducting a "sweep of entities" who are conducting ICOs within the state. The sweep is part of a plan for "aggressive policing" of crypto and ICOs in the future.
Montana	Friendly	Because there are no laws regarding money transmission in the state of Montana, crypto traders, holders, and exchanges are not required to hold licensure. In June 2017, the Montana state government awarded $416,000 to what the governor referred to as a "data center that provides blockchain security services for the bitcoin network." (BraveNewCoin)
New York	Unfriendly	While crypto holders, traders, and exchanges are not required to obtain a money transmitter's license, the state requires businesses that have dealings in virtual currency to obtain a license from the Department of Financial Services. The license is known as a 'BitLicense'.
North Carolina	Unfriendly	Crypto sellers and peer-to-peer traders are required to register with the federal Financial Crimes Enforcement network. In 2016, the Governor of North Carolina signed a bill expanding NC's Money Transmitters Act to cover cryptocurrency-related practices.
Tennessee	Friendly	Cryptocurrency sellers and traders are explicitly not required to hold money transmitter licenses in Tennessee.
Texas	Friendly	Cryptocurrency sellers and traders are explicitly not required to hold money transmitter licenses in Texas.
Virginia	Unclear	In May of 2017, Virginia passed a law defining cryptocurrency as a monetary instrument. The bill also made the use of cryptocurrency in crime-related activities illegal.
Vermont	Indifferent	In 2016, Vermont came close to passing a bill that would have supported blockchain records as legal evidence for use in court cases.

Washington	Unclear	As of July 2017, cryptocurrency exchanges based in the state of Washington must comply with the state's money transmitter laws. This means that Washington-based exchanges must be licensed with the Washington State Department of Financial Institutions. Additionally, Washington-based exchanges must now undergo regular audits of their data systems. This measure has had a rather polarizing effect on various popular cryptocurrency exchanges. Both Poloniex and Bitfinex decided to discontinue access to their platforms to residents of Washington; on the other hand, Gemini became the first exchange to gain a license for operation in Washington state.
West Virginia	Unclear	In May 2017, West Virginia passed a law that legally defined cryptocurrency as a monetary instrument and made its use in association with criminal activities illegal.

Source: Finance Magnates

1.2 Current status of Cryptocurrency in China

Cryptocurrency is not a legal tender. Moreover, there are no policies on the exchange. Trading bitcoin in China is technically illegal.

In 2017, the government banned ICOs — a way for start-ups to raise funds by selling off new digital currencies — and shut down domestic crypto currency exchanges.

But activity in crypto has carried on through alternate channels like mining. Chinese authorities are looking to finish the practice, according to Reuters.

China Is Tightening Its Grip On Cryptocurrency To Promote Rather Than Purge It

China's financial technology entrepreneurs keeps experimenting new things with cryptocurrency, meaning borderless digital assets not supported by any country's monetary authority. For example, one businessman in Shanghai created an open software system to build an exchange for cryptocurrency trades. But the Chinese government keeps taking action against crypto-operations, also.

Expect these highs and lows to go on for a while. The country with a managed $12 trillion-plus economy throttled potentially destabilizing capital outflows just over a year ago. It's eager to keep the control it has today. But China also realizes advantages in allowing crypto to develop in a manageable way, analysts who follow China say.

Signs of tougher crypto rules

Last year, Chinese authorities banned Initial Coin Offerings (ICOs) as fundraising tools as well as some types of cryptocurrency exchange. In January 2018, they took an axe to peer-to-peer and over-the-counter trading networks. After a month, it banned offshore exchanges of cryptocurrency.

Also, China wants to discontinue any regeneration of the mass capital outflows. Moving assets offshore shelters them from legal detection or any volatility in China's capital markets. Policymakers in Beijing worry that capital flight would undervalue the yuan currency and undermine economic stability that rests on a strong foreign exchange reserve. Extensive investment in cryptocurrency could pose risks to the yuan, a finance institute under the People's Bank of China .

Hints of an eventual welcome for cryptocurrency

According to the monetary authority the idea is to ultimately develop research and development of cryptocurrency in China. The authority's finance institute calls cryptocurrency a top priority for 2018. When China announces priorities, it almost always acts on them. The Chinese government wants to develop blockchain technology after cryptocurrency and may be keen to use digital currency in its monetary policy.

While reports of closures have flowed from China since late 2017, a lot more crypto-linked businesses are probably booming. Earlier, the local government-backed Xiong'An Global Blockchain Innovation Fund, for instance, began offering $1.6 billion to Chinese blockchain startups.

Another possibility is that China wants its own stake in cryptocurrency.

China Creating Government-Backed Cryptocurrency

The PBoC have stated that only the digital currency issued by them will be recognised nationally, excluding other coins such as bitcoin or ether. As foreign cryptos are already banned in China, the government would essentially force mining operations to switch to the national crypto. This could impact global mining communities, and reduce the value of bitcoin as it becomes less popular. A government validation could lead the crypto gain popularity worldwide, as it becomes appreciated as credible in the eyes of the public.

1.3 Current status of Cryptocurrency in India

The Indian government has labelled Cryptocurrency as not a legal tender, and is reportedly taking steps to outlaw it. The Indian government has issued warnings but does not currently control exchanges.
India is taking steps to make cryptocurrencies illegal to use within its payments system and is looking to appoint a regulator to supervise exchanges.

The government will "take all measures to eliminate the use of these crypto-assets in financing illegitimate activities or as part of the payment system," said India's finance minister.

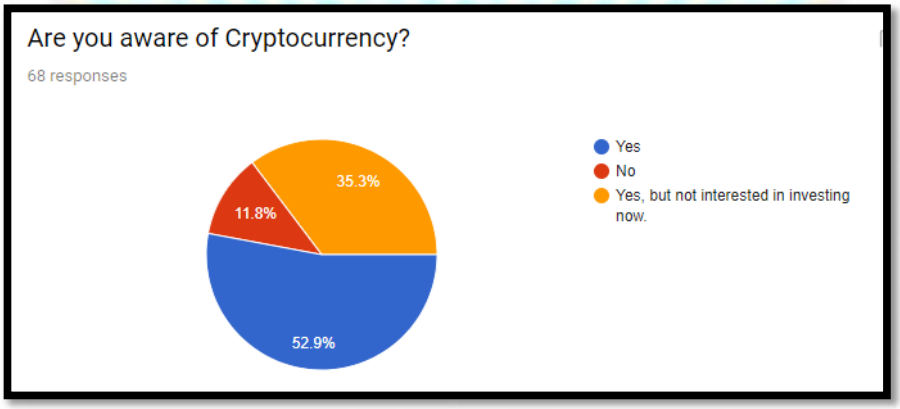
Indian tax department sent notices regarding cryptocurrency investing to thousands of citizens after a national survey revealed more than $3.5 billion worth of transactions have been conducted over a 17-month period.

The Supreme Court (SC) refused to grant a stay on the restriction imposed by the Reserve Bank of India (RBI) in April 2018 on banks extending services to cryptocurrency-related entities. In a notification in April, the RBI had banned the buying of cryptocurrencies via banks or e-wallets in India, stating they "raise concerns of consumer protection, market integrity, and money laundering, among others."

RBI also said regulated entities providing such services would need to "exit the relationship within a specified time."

India has an argumentative status for Cryptocurrency. Thus this paper tries to understand the investment mindset of traders in Indian market.

2 Analysis and Findings:



Pie Chart 1

Pie Chart 1 being a part of our analysis reveals that majority of the people have an idea about Cryptocurrency and its current trend in the market. Some of these respondents are reluctant to invest in Cryptocurrency at the moment. The major findings for these classes of people, as follows:

A primary research using questionnaire/survey method was conducted to understand the perspective of Cryptocurrency in Indian Society. SPSS (version 20.0) was used to compute the data collected from this survey of 68 distinct respondents across different professions. Cross-Tabulation has been used to find the association between the different variables, demonstrated as follows:

Table 1: Reason to invest in Cryptocurrency and Since when have you been investing in Cryptocurrency?

Crosstab

			Since when have you been investing in Cryptocurrency?				Total
			0-6 months	6 months - 1 year	1-3 years	more than 3 years	
Reason to invest in Cryptocurrency	High Returns	Count	16	6	2	1	25
		% within Reason to invest in Cryptocurrency	64.0%	24.0%	8.0%	4.0%	100.0%
	Trending	Count	3	2	0	0	5
		% within Reason to invest in Cryptocurrency	60.0%	40.0%	0.0%	0.0%	100.0%
	Ease of Transaction	Count	4	0	0	2	6
		% within Reason to invest in Cryptocurrency	66.7%	0.0%	0.0%	33.3%	100.0%
Total		Count	23	8	2	3	36
		% within Reason to invest in Cryptocurrency	63.9%	22.2%	5.6%	8.3%	100.0%

Table 1 clearly shows that “High Returns” is the most influential driving factor for the people to invest in cryptocurrency. The other characteristics such as trending and ease of transaction have less signifance as compared to high returns. The table also shows that investment in cryptocurrency has elevated in the past six months.

Table 2: Reason to invest in Cryptocurrency and how much risky Cryptocurrency compared to stock market?

Crosstab

			How much risky is Cryptocurrency compared to stock market?			Total
			Highly risky	Equal	Less risky	
Reason to invest in Cryptocurrency	High Returns	Count	16	8	1	25
		% within Reason to invest in Cryptocurrency	64.0%	32.0%	4.0%	100.0 %
	Trending	Count	4	1	0	5
		% within Reason to invest in Cryptocurrency	80.0%	20.0%	0.0%	100.0 %
	Ease of Transaction	Count	2	2	2	6
		% within Reason to invest in Cryptocurrency	33.3%	33.3%	33.3%	100.0 %
Total		Count	22	11	3	36
		% within Reason to invest in Cryptocurrency	61.1%	30.6%	8.3%	100.0 %

Table 2 gives us an interesting outcome that even though people think cryptocurrency as highly risky when compared to stock market, potential high returns of cryptocurrency still attracts them. This indicates a positive correlation amongst these two variables. Moreover, some people consider both the markets to be equally risky.

Table 3: Reason to invest in Cryptocurrency and How frequently do you transact in Cryptocurrency?

Crosstab

			How frequently do you transact in Cryptocurrency?					Total
			Daily	Monthly	Quarterly	Half-Yearly	Yearly	

		Count	2	3	2	5	13	25
	High Returns	% within Reason to invest in Cryptocurrency	8.0%	12.0 %	8.0%	20.0%	52.0 %	100.0 %
		Count	0	1	0	0	4	5
Reason to invest in Cryptocurrency	Trending	% within Reason to invest in Cryptocurrency	0.0%	20.0 %	0.0%	0.0%	80.0 %	100.0 %
		Count	1	1	0	0	4	6
	Ease of Transaction	% within Reason to invest in Cryptocurrency	16.7%	16.7 %	0.0%	0.0%	66.7 %	100.0 %
		Count	3	5	2	5	21	36
Total		% within Reason to invest in Cryptocurrency	8.3%	13.9 %	5.6%	13.9%	58.3 %	100.0 %

Table 3 shows us that, even though high returns is a motivating factor for the people to invest in crytpocurrency, the people don't invest in it frequently. It seems leveraging the investment along with loosing more than the amount invested might have affected the frequency of transaction in Cryptocurrency and the figures for "daily" transaction are indicating the same.

Table 4: Reason to invest in Cryptocurrency and Do you anticipate Cryptocurrency "Crash"?

Crosstab

			Do you anticipate cryptocurrency "Crash"?				Total
			Yes, within a year	Yes, after a year	No	Can't say	
		Count	10	2	2	11	25
	High Returns	% within Reason to invest in Cryptocurrency	40.0%	8.0%	8.0%	44.0 %	100.0%
		Count	1	1	1	2	5

Reason to invest in Cryptocurrency	Trending	% within Reason to invest in Cryptocurrency	20.0%	20.0%	20.0 %	40.0 %	100. 0%
		Count	1	1	2	2	6
	Ease of Transaction	% within Reason to invest in Cryptocurrency	16.7%	16.7%	33.3 %	33.3 %	100. 0%
		Count	12	4	5	15	36
Total		% within Reason to invest in Cryptocurrency	33.3%	11.1%	13.9 %	41.7 %	100. 0%

Table 4 depicts that, people invest in cryptocurrency expecting for high returns even after anticipating for a crash within a year's time. A major chunk of investors still invest in cryptocurrency even after not being sure about its trend and the value.

Table 5:
Reason/s for not purchasing Cryptocurrency and What do you think Cryptocurrency is ?

Crosstabulation

			What do you think Cryptocurrency is ?				Tota l
			Digital money	Token	Bank Note	I don't know	
Value is not stable		Count	5	0	0	0	5
		% within Reason/s for not purchasing cryptocurrency:	100.0 %	0.0%	0.0%	0.0%	100. 0%
I don't know how to spend in cryptocurrency		Count	10	0	0	1	11
		% within Reason/s for not purchasing cryptocurrency:	90.9%	0.0%	0.0%	9.1%	100. 0%

Reason/s for not purchasing cryptocurrency	It is not real money	Count	2	0	0	0	2
		% within Reason/s for not purchasing cryptocurrency:	100.0%	0.0%	0.0%	0.0%	100.0%
	It is illegal	Count	4	0	0	0	4
		% within Reason/s for not purchasing cryptocurrency:	100.0%	0.0%	0.0%	0.0%	100.0%
	It is not valuable as cash	Count	1	0	0	0	1
		% within Reason/s for not purchasing cryptocurrency:	100.0%	0.0%	0.0%	0.0%	100.0%
	It is not secure	Count	6	1	1	1	9
		% within Reason/s for not purchasing cryptocurrency:	66.7%	11.1%	11.1%	11.1%	100.0%
Total		Count	28	1	1	2	32
		% within Reason/s for not purchasing cryptocurrency:	87.5%	3.1%	3.1%	6.2%	100.0%

Table 5 is about the people who are either not aware of cryptocurrency or reluctant to invest in it. The analysis says that, the main reason for not investing in cryptocurrency is the lack of knowledge about it. Insecurity about online transactions and unstable value of the cryptocurrency also demotivates the investment.

3 Conclusion and Future Implications

Despite tremendous progress in economic globalisation, the global financial system is still very fragmented, with only a few players having an invitation to sit at the table with the big boys. Blockchain technology has tremendous potential to consolidate and, perhaps, even standardise financial markets all over the world. With suitable ecosystem and government regulatory policies in USA, cryptocurrency stands tall for its investment and other applications. Even though China resists to accept the common cryptocurrency like Bitcoin, it is not running away from using the system, trying to develop their own cryptocurrency in near future. Where India lacks in suitable ecosystem, technological infrastructure and suitable platform to impart appropriate knowledge among investors and financial institutions, people

still believe in the potential growth of the cryptocurrency. Industries like banking and healthcare are gearing-up to use blockchain technology, but the tag of illegal tender hampers cryptocurrency to be out of race.

Year 2018 has seen the rise of investment in Cryptocurrency as people expect potential high returns, even if they perceive it as equally or more risky than investing in the regulated Indian stock market.
Two influential factors, among others, which resists people from investing in Cryptocurrency are – (i) they don't how to spend in Cryptocurrency and (ii) they feel that it is not secure. So, there's a direct indication that, people are aware about the trend in Cryptocurrency but lack the knowledge to invest or manage the transactions. Technology plays a crucial role in blockchain and cryptocurrency. Lack of trust in the technology directly impacts the traders to accept it free-heartedly. Legal issues in the country and unstable price of cryptocurrency in the market leads to more doubts in the traders' mind.
Bitcoin may have been in existence and stood the trail for a decade now. However, cryptocurrency are still at the experimental phase. We believe that, although our results maybe interesting, many other issues need to be addressed before cryptocurrencies will gain status of great interest to institutions. The technology itself can be very complex, and investment in this class of investment demands an understanding of the related complexities and risks. Other issues, such as security, reporting standard without custodian and trustee, and the governance structure of a decentralized and autonomous cryptocurrency system as well as the risk and complexity of dealing with unregulated identities, need to be assessed before a clearer picture can materialize. Perhaps a quote from Lee et al. [2017] may be a good way to end this article:

> "While widely dispersed ownership in proportion to individual needs might sound far-fetched, the current state of blockchain and cryptocurrency already enables anyone to hold fractional, decentralized and fluid assets that are digital and highly usable. Slowly but surely, legislation also is changing to accommodate such a new era. In fact, the groundwork of a whole new ecosystem in digital asset management is quietly being installed. Crossover products based on blockchain technology will find their way into the mainstream. The inherently inclusive nature of its architecture can shift a significant part of the (impact) investment movement from being activists for innovations toward actually becoming the driving solutions themselves. Using a needs-oriented mindset, vs. a wealth-focused investment approach, can position future-thinking financiers at the forefront here."

References

1. Chuen, David Lee Kuo, et al. "Cryptocurrency: A New Investment Opportunity?" *The Journal of Alternative Investments*, vol. 20, no. 3, 2017, pp. 16–40.
2. Weaver, Nicholas. "Risks of Cryptocurrencies." *Communications of the ACM*, vol. 61, no. 6, 2018, pp. 20–24.
3. "Live Cryptocurrency Prices, Trades, Volumes, Forums, Wallets, Mining Equipment, and Reviews." *CryptoCompare*
4. "Cryptocurrency Market Capitalizations | CoinMarketCap." *Cryptocurrency Market Capitalizations | CoinMarketCap*
5. "No SC Relief on RBI's Cryptocurrency Circular, Ban to Come into Effect from July 5." *Moneycontrol*, MoneyControl
6. "The Good, the Bad, and the Ugly: Crypto Regulation in the USA | Finance Magnates." *Finance Magnates | Financial and Business News*, Finance Magnates, 9 Jan. 2018
7. Jennings, Ralph. "China Is Tightening Its Grip On Cryptocurrency To Promote Rather Than Purge It." *Forbes*, Forbes Magazine, 27 Apr. 2018
8. "Analysts: China's Cryptocurrency Could Be Bigger Than Bitcoin." *Bitcoin News*, 30 July 2018
9. Rooney, Kate. "Your Complete Guide to Cyprocurrency Regulations around the World and Where They Are Headed." *CNBC*, CNBC, 27 Mar. 2018.
10. "The Growth Of Cryptocurrency: India Versus Global Trends." *Inc42 Media*, 13 July 2017

A study on financial flexibility through Conceptual Model

Rajesh Mamilla, Shubhangi Jain and Pooja Kumari

MBA V Trimester, VIT Business School, VIT (Deemed to be university), Vellore.

Abstract. The purpose of this study is to analyze the financial flexibility by studying the relationship between the financial performance and productivity of select banks in India. After carrying out the analysis on fifteen selected banks in India which were chosen on the basis of their market capitalization during five years of time period, it was found that there exists a relationship between employee cost to value added and Gross profit and value added per rupee of fixed asset.It can be inferred that the rupee incurred on an employee had added value and contributed significantly to the profit of the banks. Likewise, every rupee invested on fixed assets of banks to add value to the organisation had shown impact by increased Gross profits of the banks. This study is helpful to banks, corporates and investors to know about financial flexibility of banking industry.

Keywords: Flexibility, Performance, productivity, Return on capital employed and value added.

1 Introduction

A company to compete in present market conditions must have edge over its competitors in technology. Companies that depend on technology were able to invest in new product or process development, because of their financial flexibility. Financial flexibility helps to improve the firm's performance but the financial performance of the firm depends on their ability to generate profits and maintain productivity. Profitability will be measured through Gross Profit, Net profit, overall profit as well as Value added. Productivity is generally measured through efficiency and effectiveness which is equal to the relationship between value added time and total time (Jackson & Petersson, 1999).

The banking industry in a country like India is quite grown up in the context of bringing in novel products, supply and reach. When it comes to private and foreign banks, the condition is quite uptight because their reach frequency in rural India still remains a challenging task. When Indian banks are studied thoroughly, it is found that they have hygienic, strong and apparent balance sheets in terms of quality of services, as compared to other banks in comparable economies in the same region. In coming days, Indian economy is forecasted to be a strong and emerging player in the service sector. The need for retail banking, personal loans, mortgages and investment services is expected to enhance further. Currently, In India out of 88 scheduled commercial banks, there are 28 public sector banks, 31 foreign banks and remaining private banks. Altogether, the system comprises of 53,000 branches and 17,000ATMs but existence of any bank depends on their performance, particularly the financial performance, while the performance is depending upon the productivity, which is expressed in terms of output. One of the ways in which output can be comprehended is 'value'.

Hence in this direction, in the present study an attempt is made to find out the relationship between productivity and performance of select banks in India.

1.1 Review of Literature

The productivity is measured by using value added. Value added can be found by deducting the cost of raw materials and services outside the firm from the sales. (Muellbauer, 1991). Value added can be calculated using firm's total revenue and the costs of purchased materials, services and utilities. On the other hand it can be calculated as the sum of all depreciation, employee compensation, taxes, as well as retained earnings, etc (Lieberman & Jina Kang). Productivity is the relationship between value added and input of production factors (Aspen, Brathen, Cassel, Ericsson & Marelius, 1991). Productivity is generally measured through efficiency and effectiveness which is equal to the relationship between value added time and total time (Jackson & Petersson, 1999). It is apparent that the productivity measures are linked with value added. Hence the productivity measures using value added are also used in this study. Efficiency and effectiveness are demystified performance through productivity. Effectiveness is usually described through as "doing the right things" while efficiency means "doing things right" (Sink & Tuttle, 1989). Efficiency is strongly associated with the usage of resources which mainly influence the denominator (inputs) of the productivity ratio .This is fundamentally similar to the concept that is referred as utilization rate which implies how much equipment is utilized or a process is used in practice compared to its maximum. On the other hand effectiveness is often connected to the formation of significant worth for the client and mainly influences the numerator (output) of the productivity ratio. It is the capacity to achieve a coveted objective or the degree to which desired result are accomplished. Productivity is actually taking at the broader issue of performance. Generally in performance both the aspects of economics and operations are covered. It can be described as the achievement of an organisation and its activities. So that value added, productivity and performance are closely inter connected.

Productivity provides the technical relationship existing between inputs and outputs (Diewert, 1992). It measures the relationship between the outputs like the services or goods produced by the organisation and the inputs like capital, material, labour and various other resources which are used to create a valuable output (Hill, 1993). A very obvious method of measuring productivity is labour productivity which is measured as output per person employed or per hour worked. There are various factors which could influence the labour productivity. The changes have significant effect on outputs (Barrel, 2000). Usually value added which is a measure of productivity reflects the ability of how much wealth is created by an organisation which is further distributed among the stake holders. So the value added leads to the performance of the organisation. The performance of the organisation depends on the type of firm. So, it becomes important to understand the multidimensional performance constructs to measure the performance of the firm (Lumpkin & Dess). Performance is actually a broader term which includes financial, economic and operational aspects of the firm. It is described as an umbrella term for considering the success of the company (Thomas & Baron, 1994). A triple – P model in which productivity is a physical phenomenon, Profitability is a monetary relationship between the input and output and Performance is a symbol of perfection which incorporates productivity, profitability and various other factors such as flexibility, speedy delivery and quality (Grunberg , 2004). Hence in the present study, an attempt is made to find the relationship between value added, productivity and performance of selected banks in India.

1.2 OBJECTIVES

After thorough reading of the literature, the following objectives are taken for the study:

1. To assess the financial performance of selected banks through Gross Profit, Net Profit, Returned on Capital Employed and Value added per rupee of fixed assets.
2. To determine the productivity of selected banks through Sales per employee, Value added to Employee, Profit Before Tax per employee, Employee cost to sales, Employee cost to value added.
3. To find out the relationship between Productivity as well as financial Performance of selected Indian banks.

1.3 SAMPLING:

The present research study has a sample size of 15 banks. The selected banks are

(1) Axis Bank
(2) State Bank
(3) ICICI Bank
(4) Development Credit Bank(DCB)
(5) Dhana Lakshmi Bank
(6) Federal Bank
(7) HDFC Bank
(8) IngVysya Bank
(9) YES Bank
(10) Bank of Rajasthan
(11) IndusInd Bank
(12) Karnataka Bank
(13) Kotak Mahindra Bank
(14) City Union Bank
(15) KarurVysya Bank.

1.4 PERIOD OF STUDY

Data for the last Five years: 2012-13 to 2016-17 were considered for the study.

1.5 DATA COLLECTION

Required data for the study was collected from the annual report of the respective banks through website.

1.6 HYPOTHESIS:

The following hypothesis is mapped out for the given study:

H_0: There is no significant relationship between Productivity and financial Performance of select banks in India.

H_1: There exists a significant relationship between Productivity and financial Performance of select banks in India.

Conceptual Model

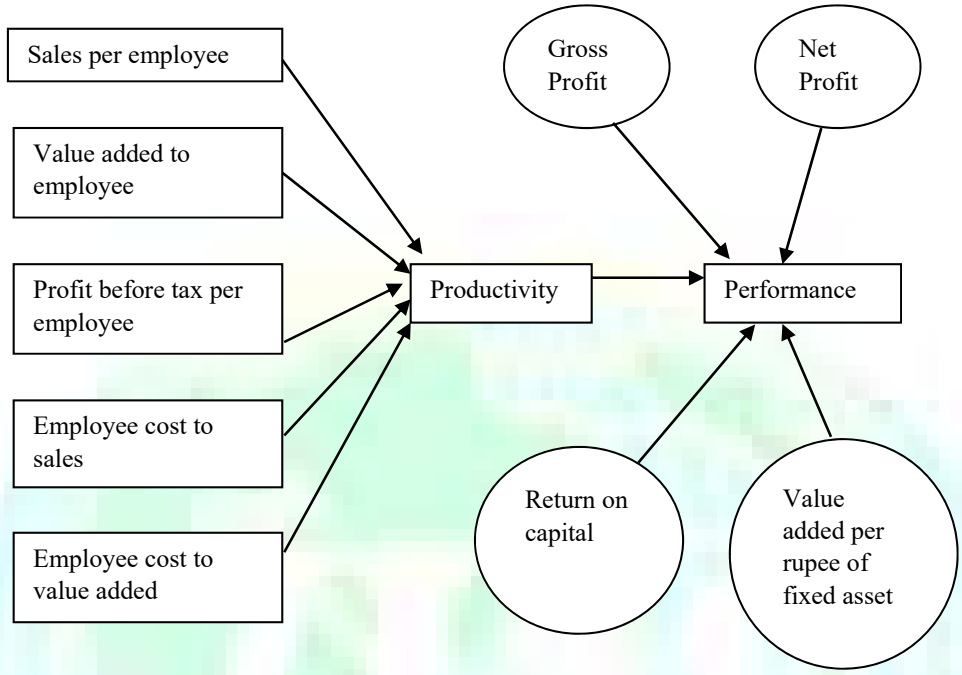


Fig. 1, shows the relationship between the productivity and financial performance.

The model clearly explains the bank's flexibility in terms of meeting its day to day expenses as well as maintaining regular profits at its disposal. Productivity is the independent variable and performance is the dependent variable. Correlation analysis was undertaken to determine the relationship between dependent and independent variables. To test the hypothesis, Regression analysis is tested using SPSS package. The present study considered measures such as Sales, cost, value added, Profit Before Tax per employee, Employee cost to sales, Employee cost to value added, Gross Profit, Net Profit, Returned on capital employed, Value added per rupee of fixed assets, employee cost to sales, and employee cost to value added as independent variables, where as **GP** ratio, **NP** ratio, **ROC** employed, and value added per rupee of fixed asset as dependent variables. With these variables, the following equations were formulated.

$$GP = \hat{a} + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \hat{a}_3 X_3 + \hat{a}_4 X_4 + \hat{a}_5 X_5 + \mu \text{ - - - - - - - - - - } (1)$$

$$NP = \hat{a} + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \hat{a}_3 X_3 + \hat{a}_4 X_4 + \hat{a}_5 X_5 + \mu \text{ - - - - - - - - - - - - } (2)$$

$$ROCE = \hat{a} + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \hat{a}_3 X_3 + \hat{a}_4 X_4 + \hat{a}_5 X_5 + \mu \text{ - - - - - - - - - - } (3)$$

$$VAFA = \hat{a} + \hat{a}_1 X_1 + \hat{a}_2 X_2 + \hat{a}_3 X_3 + \hat{a}_4 X_4 + \hat{a}_5 X_5 + \mu \text{ - - - - - - - - - - } (4)$$

Where,GP- Gross Profit

NP- Net Profit

ROCE- Returned on capital employed

X_1 = Sales per employee

X_2 = Value added per employee

X_3 = Profit before tax per employee

X_4 = Employee cost to sales

X_5 = Employee cost to value added

μ = Error term (â, the constant and â, the co-efficient)

2.0 Analysis

Table 2.1: Performance of variables

Model	Dependent Variable	R	R^2	Adjusted R^2	Std. error
1	GP	.750[a]	.563	.531	14.40088
2	NP	.490[a]	.241	.186	6.47597
3	ROCE	.543[a]	.295	.244	39.78340
4	VAFA	.636[a]	.405	.362	2.91173

Table 2.1: presents the concise measures of the model. The specification of five variables i.e., Sales, cost, value added, Profit Before Tax per employee, Employee cost to sales in the given study disclosed the competency to predict performance. The obtained R^2 values i.e. 0.563,0.241,0.295,0.405 which are in the model reveals that 56.3%,24.1%,29.5%,40.5% of the variation is found in the dependent variables GP,NP, ROCE and VAFA respectively due to the independent variables such as SE,VE,PE,ES,E-VA. Remaining variation of 43.7%, 75.9%, 70.5%, 59.5% in the dependent variables are related to other variables which we have not considered in the study.

Table 2.2: Coefficient for predicators of performance

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
	BETA	Std. Error	BETA		
1-GP Constant	74.759	6.252		11.957	
SE	28.640	9.979	.348	2.870	.005
VE	-89.331	14.233	-.801	-6.276	.000
PE	7.388	20.382	.043	.362	.718
ES	-.491	.303	-.151	-1.619	.110
E-VA	-4.300E-5	.001	-.007	-.085	.932
2-NP Constant	15.494	2.812		5.511	
SE	-5.397	4.487	-.192	-1.203	.233
VE	14.907	6.401	.392	2.329	.023
PE	25.150	9.165	.433	2.744	.008
ES	-.314	.136	-.282	-2.301	.024
E-VA	5.258E-5	.000	.025	.232	.817
3-ROCE Constant	107.329	17.272		6.214	
SE	18.843	27.567	.105	.684	.497
VE	-169.885	39.320	-.700	-4.321	.000
PE	-82.703	56.305	-.223	-1.469	.146
ES	-1.300	.837	-.184	-1.553	.125
E-VA	.000	.001	-.028	-.267	.790
4-VAFA Constant	1.868	1.264		1.478	.144
SE	-4.564	2.018	-.320	-2.262	.027
VE	15.530	2.878	.804	5.396	.000
PE	4.078	4.121	.138	.989	.326
ES	.046	.061	.082	.752	.455
E-VA	-8.785E-5	.000	-.082	-.864	.391

The obtained results from table 2.2, affirm the fact that the t-value is statistically significant for the independent variables SE and VE. Similarly, in Model 2 VE, PE and ES are significant. The variable VE is alone showing significant relationship with ROCE.

The variables SE and VE are having significant relationship with VAFA. The variables which were significantly affecting dependent variables in 4 models can contribute towards the increase of performance of the dependent variable.

Table 2.3: Test of Collinearity

A collinearity test is performed to check for the independence of the variables. If a linear combination is identified between variables

Variable	Tolerance	VIF
Sales per employee	.432	2.315
Value added per employee	.389	2.572
Profit per employee	.442	2.263
Employee cost to sales	.730	1.369
Employee cost to value added	.951	1.051

it can cause problems to fit the model and interpret the results. The outcome of this analysis is depicted in Table 3. The table clearly reflects this fact that the tolerance level is not less than or equal to 0.01; and all of the VIF values are below 10. Therefore, the measures which have been adopted to evaluate independent variables in the given study is not up to the mark indicating no multicollinearity symptoms. The acceptable ambit is between 1.5 and 2.5 for Durbin-Watson range. In this analysis Durbin-Watson values for GP and NP were at the maximum limit and Durbin-Watson values for ROCE and VAFA were 2.36 and 1.96 respectively which are acceptable according to the prescribed range and indicates that there was no auto correlation problem in the data taken for the purpose of research.

3. CONCLUSION

After carrying out the analysis, it has been found that there is a negative correlation between PBT per employee and Value Added per rupee of fixed assets (VAFA). In fact, the ES and GP also have a negative correlation. There is also a correlation between the employee cost to value added (E-VA) and GP and value added per rupee of fixed asset. There is no relationship between the remaining measures of productivity and performance. Indeed fixed assets are the resources of the organizations which have the capacity to generate the profit. So this is the bad signal for the banking organizations. Value added is the wealth created by the organization and hence the cost of materials and services from outside the organization should be minimized in order to improve the value added.

References

1. Aspen.U.,Brathen.A., Cassel.P., Ericsson.P & Marelius.M.(1991). “Professional practice”, “Demystifying productivity & performance”, International journal of productivity & performance management” 54(2), 34-36.
2. Barrell, R. (2000). Productivity, innovation and economic performance, Cambridge University press, Cambridge, 1- 37.
3. Diewert, W.E. (1992). The measurement of Productivity, Bulletin of economic research, 44(3). 163 – 198
4. Grunberg, T. (2004). Performance improvement - towards a method for finding and prioritizing potential performance improvement areas in manufacturing operations; International journal of productivity and performance management, 53(1), 52-71.
5. Hill,T.(1993). Manufacturing strategy: The strategic management of the manufacturing function, 2nd ed, Open University, Macmillan, London.
6. Jackson,M. & Petersson, P (1999,Sep 22-24). “Productivity – an overall measure of competitiveness”, proceedings of the 2nd workshop on intelligent manufacturing system, Leuven, 573-581.
7. Lumpkin, G. T, and Dess, G.G. (1996); Clarifying the entrepreneurial orientation construct and linking it of performance academy of management review. 21.
8. Muellbuaer.J(1991), “Productivity and competitiveness”, Oxford review of economic policy, 7(3), 99-117.
9. Sink, D. S &Tuttle.T.C(1989). “Planning and measurement in your organization of the future”, Industrial engineering and management press, Norcross, GA, 170- 181.

REFEREES

Alok Dixit
Associate Professor
Finance and Accounting
Indian Institute of Management Lucknow

Arunabha Mukhopadhyay
Professor
Information Technology and Systems
Indian Institute of Management Lucknow

L Ganapathy
Professor
Industrial Engineering
National Institute of Industrial Engineering
Vihar Lake, Mumbai

Omkarprasad Vaidya
Associate Professor
Operations Management
Indian Institute of Management Lucknow

Prem Prakash Devani
Associate Professor
Marketing Management
Indian Institute of Management Lucknow

Payal Mehra
Professor
Communication
Indian Institute of Management Lucknow

M. Venkateshwarlu
Director
Institute of Management Technology
Hyderabad

Sanjay Kumar Singh
Professor
Business Environment
Indian Institute of Management Lucknow

K N Singh
Professor
Operations Management
Indian Institute of Management Ranchi

Sushil Kumar
Professor
Operations Management
Indian Institute of Management Lucknow

Ashok K. Pundir
Professor
Industrial Engineering
National Institute of Industrial Engineering
Vihar Lake, Mumbai

Kshitij Awasthi
Assistant Professor
Strategic Management
Indian Institute of Management Lucknow

Mayakant Awathi
Professor
Agribusiness Management
Indian Institute of Management Lucknow

Pradeep Kumar
Associate Professor
Information Technology and Systems
Indian Institute of Management Lucknow

Pawan Kumar Singh
Professor
Organizational Behaviour
Indian Institute of Management Indore

Pushpendra Priyadarshi
Associate Professor
Human Resource Management
Indian Institute of Management Lucknow

Rakesh V
Assistant Professor
Operations Management
Indian Institute of Management Lucknow

Shailendra Singh
Director
Indian Institute of Management Ranchi

Suresh Kumar Jakhar
Assistant Professor
Operations Management
Indian Institute of Management Lucknow

Vivek Gupta
Assistant Professor
Information Technology and Systems
Indian Institute of Management Lucknow

AUTHOR INDEX

Digitalization and Flexibility for Organizational Management and Transformation

This book is a selection of papers presented at the Eighteenth Global Conference of the Global Institute of Flexible Systems Management, GLOGIFT 18, organized by the Indian Institute of Management Lucknow, India. Topics included in the book cover a large spectrum of the area of flexibility for the organizational management and transformation, including:

- Digital Transformation
- Financial Management
- Marketing Management
- Startups and Strategy
- Human Resource and Knowledge Management
- Manufacturing Management
- Supply Chain Management

This book is a useful reference on the state of the art in the area of flexibility in organizational management. It will be a handy reference to the academicians, practitioners, executives, and students of the fascinating world of flexibility in management. The book is a ready-reckoner that helps appreciate the impact of digitalization and flexibility of the organizational management and transformation.

All the editors of this book are with the Indian Institute of Management Lucknow. Professor Vivek Gupta and Professor Pradeep Kumar are in the area of Information Technology and Systems. Professor Omkarprasad S Vaidya and Professor Sushil Kumar are in the area of Operations Management.

Indian Institute of Management Lucknow

ISBN No.: 978-93-83893-08-9