19th Global Conference on Flexible Systems Management (GLOGIFT-19)

Theme: Flexibility, Innovation and Sustainable Business

December 6-8, 2019

Organized by:

Department of Management Studies, IIT Roorkee

Venue:

Department of Management Studies, IIT Roorkee

DoMS
Department of Management Studies
Indian Institute of Technology Roorkee

Co-Sponsored

Haridwar Management Association

Acknowledgement

With immense pleasure, we welcome you all to the Annual International Conference – Glogift 2019 hosted by the Department of Management Studies, Indian Institute of Technology, Roorkee, under the auspices of Global Institute of Flexible Systems Management organized from 6th to 8th December 2019.

This 3-day conference with the theme – "Flexibility, Innovation, and Sustainable Business" is aimed at the dissemination of research knowledge and practical insights on how to chart our journey forward to reach new heights. The conference focuses on recent researches, industrial developments and other contemporary challenges pertaining to five major tracks namely – Flexibility, Innovation, Sustainability, Supply Chain Management, and Analytics. The conference theme is further divided into guiding sub-themes related to the field of finance, marketing, HR, and supply chain management.

The conference provides a unique opportunity for research scholars and practitioners from academia and industry to focus on meeting the changing requirements of global business and to foster collaborative relationships in such areas.

We have an exciting program at this conference that will allow all attendees to reflect upon and celebrate our past accomplishments, renew friendships and extend our networks, and jointly explore current and future research directions. The conference will offer technical workshop sessions on themes – Industry-Academia Leadership and Editorials Perspectives on Scholarly Publications conducted by renowned names in academia. In addition to this, there are several parallel technical sessions chaired by distinguished names in their respective fields, an informative keynote opening, and guest speakers are scheduled to kick-start the discussion with heightened enthusiasm and zeal.

The conference received an overwhelming response from both industry and academia. The submitted abstracts and full papers went through rigorous screening to ascertain high-quality presentations and informative discussions.

Our conference team intends to take complete care ensuring your comfortable stay in Roorkee. We hope that you will have a productive and fun-filled time at this very special conference
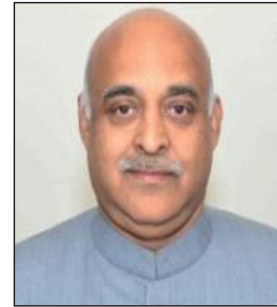
Team, GLOGIFT - 19

Organizing Committee

Prof. Ajit K. Chaturvedi (Director. IIT Roorkee)
PATRON

Prof. D. K. Banwet
(Ex Prof., IIT Delhi)
GLOGIFT Society, President

Prof. M.K. Barua
(Head, DoMS, IIT Roorkee)
CHAIRMAN

Prof. Santosh Rangekar
(DoMS, IIT Roorkee)
GLOGIFT Society, President (Elect)

Prof. Ramesh A
(DoMS, IIT Roorkee)
ORGANIZING SECRETARY

Prof. Rajat Agrawal
(DoMS, IIT Roorkee)
CONVENER

About the Conference

'GLOGIFT 19', an International Conference with the theme "Flexibility, Innovation and Sustainable Business" in an effort to provide a global forum for practitioners, policy makers, academicians, researchers, and students to share their practical experiences, knowledge and insight in the evolution, formulation and implementation of strategies and models for flexible enterprises to meet the changing requirements of global business.

The objective of the conference is to provide a knowledge sharing platform for dissemination of research and experiential findings through empirical study, qualitative modelling, case studies, new concepts and state-of-the-art studies in the areas of flexibility, innovation and sustainable business.

Conference Theme

Flexibility
> Strategic Flexibility
> Organizational Flexibility
> Financial Flexibility and Risk Management
> Marketing Flexibility
> Human Resource Flexibility
> Information System Flexibility
> International Competitiveness
> Technology / Innovation Mgmt.
> Agility/Flexibility in Manufacturing Systems

Innovation
> Digital Transformation and Innovation Management
> Social Innovation
> Open Innovation
> Service Innovation
> Innovation and Export competitiveness
> National Innovation Systems
> Eco-innovation
> Start-up
> Creativity
> Innovation in Education and Teaching

Sustainability
> Sustainable transportation
> Sustainable energy
> Sustainable operations
> Sustainable supply chain
> Sustainable tourism

> Social sustainability
> Sustainable Development Goals (SDGs)

Analytics
> Social Media Analytics
> Petascale (Big) Data Analytics
> Data Science and Machine Learning
> Visual Data Analytics
> Security and Privacy Analytics
> Analytics and Automation
> App market analytics
> Blockchain Technology for Business
> Big data analytics for supply chain

Supply Chain Management
> Humanitarian Supply Chain Management
> Healthcare supply chain
> Industry 4.0
> Circular economy
> Sharing economy
> Sustainable logistics

Message from GLOGIFT Society, President

Prof. D. K. Banwet

I am delighted to know that the Department of Management Studies DOMS of IIT Roorkee is hosting GLOGIFT 2019 an international conference, with the theme; Flexibility, Innovation and Sustainable Business;. An international conference of this calibre signifies scientific cooperation through meetings and dissemination of knowledge to overcome the challenges of the changing business environment.

Governance, sustainability, and enterprise excellence need to be united in an effort to promote continuously relevant & responsible organizations through Sustainable Enterprise Excellence; A holistic flexible dynamic innovative inclusive approach is needed to ethically, efficiently and effectively integrate equity, ecology and economy to cater to the Triple Bottom Line of People, Planet and Profit.

I applaud the team efforts of all stakeholders for consistently putting together an effort in this regard by inviting Industry Associates, Academicians as well as Research Scholars from all parts of the world to contribute in this academic endeavour. The objective of the conference is to provide a knowledge-sharing platform for dissemination of research and experiential findings through empirical study, quantitative & qualitative systems modelling, case studies, new contemporary emerging concepts , techniques and state-of-the-art studies.

On behalf of GIFT as the President & on my own behalf, I warmly welcome you all and extend my best wishes to all invited dignitaries and participants for the grand success of this event.

Message from Chairman

Prof. M.K. Barua

First of all, I would like to extend a warm welcome to all the delegates from Industry and Academia from India and abroad for this International conference, Glogift 2019.

The theme for the conference "Flexibility, Innovation and Sustainable Business" is very apt and imperative for all professionals to keep abreast with the changing requirements of global business and flexible enterprises. The sub-themes of this conference involve Organisational and strategic flexibility, open innovation, creativity, sustainability, humanitarian supply chain management, social media and big data analytics.

It is very important that professionals will assemble on a regular basis and brainstorm for the purpose of holistic knowledge sharing on the contemporary subject related developments.

I am sure that this event will provide a stimulating buzzing platform for the academicians and practitioners in the field of Management and related areas to enhance knowledge, experiences and share new ideas and innovations for business, academics and policy making.

I would like to thank all the Chief-Guests and Keynote speakers for taking out valuable time from their busy schedule to share their views and experience to encourage the young research scholars.

I would like to wish all the delegates an enjoyable and fruitful conference.

Message from GLOGIFT Society, President (Elect)
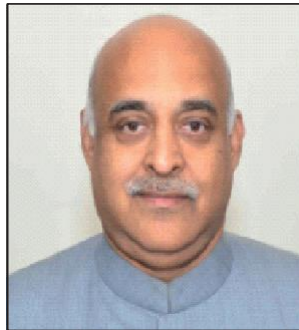
Prof. Santosh Rangekar

On behalf of Global Institute of Flexible Systems Management (GIFT), Department of Management Studies, it gives me distinct pleasure to welcome you to Glogift 2019 at IIT Roorkee. This international conference aims to bring different ideologies under one roof and provide opportunities to exchange ideas face-to-face, to establish research relations, and to find global partners for future collaborations.

The themes and sub-themes for this conference are indicative of relevant research areas to address emerging management issues signifying change, complexity and multiplicity demanding high degree of responsiveness, adaptability and openness in management.

The conference hosts have put a remarkable effort to provide us a wonderful experience at the conference. I hope that this conference will act as a medium for all of us to ponder upon the topic of discussion, challenge us to strive towards finding plausible solutions and inspire us at the same.

Message from Organizing Secretary

Prof. Ramesh A

On behalf of the institute, I extend a cordial welcome to all the distinguished experts and delegates of Glogift 2019. This Annual International Conference is organized to enhance knowledge, experiences and share new ideas and innovations in the area of Flexibility, Innovation, Supply Chain Management, Analytics and Sustainability.

The theme "Flexibility, Innovation and Sustainable Business" is indeed very interesting and thought-provoking. The changing economic and technological scenario is posing newer challenges to manage the emerging situations, and thus, requiring newer paradigm to match with the reality more effectively.

The conference attempts to focus the attention of all concerned attendees to discuss at length the emerging trends and practices in flexibility, digital transformation and innovation management, sustainable operations, supply chain management and circular economy, and analytics.

I take this opportunity to record my heartfelt appreciation and gratitude to all the presenters, delegates, practitioners, and all the others participating in this esteemed event.

Message fromConvener

Prof. Rajat Agrawal

It gives me immense pleasure to be part of this Global Institute of Flexible Systems Management (GIFT) international conference - Glogift 2019 organised by the Department of Management Studies, IIT Roorkee. This Annual conference provides a platform to practitioners, policymakers, teachers, researchers, and students to share their practical experiences, and insights in the formulation and implementation of strategies for flexible enterprises in today's continuously changing economic and technological scenario.

This annual conference also acts as an opportunity for annual meeting for a large number of participants. For many friends from within India and abroad, this is a "homecoming" where we meet fellow academicians and share our progress and effort.

The events of such magnitude provide academic stimulus and a very useful platform for researchers working in different disciplines of management. I am sure deliberations and presentations of this conference will offer immense opportunities for collaborative research in this and allied areas and will open up new and exciting avenues.

I wish the attendees all the best.

Plenary & Workshop Resource Persons
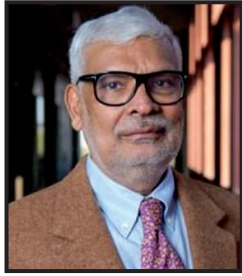
Prof. Ramadhar Singh, an experimental social psychologist trained at Purdue University, served as a faculty member at Patna University (1968-73), Indian Institute of Technology, Kanpur (1973-79), and Indian Institute of Management, Ahmedabad (1979-88). He moved to Singapore in 1988 and retired as a Professor of Psychology from the National University of Singapore in 2010. He spent his sabbaticals at the University of Rochester and the University of Oxford (2003-04) and at Purdue University (2008). During 2010-16, he was the Distinguished Professor of Management at the Indian Institute of Management Bangalore. The Association for Psychological Science, Washington DC lists him among the Faces and Minds of Psychological Science. Singh is currently a Consulting Editor of the Journal of Theoretical Social Psychology and the Review of General Psychology.

Prof. Kirankumar S. Momaya is faculty from Shailesh J. Mehta School of Management, Indian Institute of Technology Bombay, Mumbai, India. His research interests include role of business excellence, management of technology & innovation (MoT), and collaborations for competitiveness. He worked with the Department of Management Studies, IIT Delhi as a core faculty for more than a decade and made several unique contributions. He has done some challenge projects in India, Canada and Japan including one at the Institute of Innovation Research, Hitotsubashi University, Tokyo and has also worked with Shimizu Corporation. He has contributed in editorial roles to journals such as the International Journal of Global Business and Competitiveness, Journal of Advances in Management Research and Global Journal of Flexible Systems Management.

Mr. Jayapraksh Balaraman is an operational excellence and data science practitioner with 18 years of experience in banking, and manufacturing sector across the globe. He received his bachelor's degree in Production Engineering from University of Madras, and Masters in global production engineering from Technical University Berlin Germany. Currently he is serving as Vice President at Standard Chartered Bank, Chennai leading operational excellence initiatives. Prior to his stint in Standard Chartered Bank, Mr, Balaraman has worked with leading organization such as HSBC, Serco, Flextronics Manufacturing Ltd to name a few. He is a seasoned operation professional with expertise in Lean Six Sigma, Robotics Process Automation, Big Data Analytics and Project Management.

GLOGIFT-19

Mr. Vikas Asawat is Patent and Trademark Attorney and Advocate. He obtained LLB-IPR, Law – Specialization IPR from IIT Kharagpur. Mr. Asawat is involved with dealing with Patents (Drafting Filing and other prosecution including consultancy), Trademarks (search report analysis, documents inspection, filing, TM 60 NOC, caution notice, implementation of IPR Enforcement rules at Custom for seizure of counterfeit goods including consultancy), Designs (filing, reply of examination report) and Copyrights (filing and prosecution and consultancy), and consultancy assignments on IPR at industry as well at academic level. He is a seasoned law professional with expertise in patents, intellectual property, trademarks, and copyright Law.

19th Global Conference on Flexible Systems Management
(GLOGIFT-19)
Theme: "*Flexibility, Innovation and Sustainable Business*"
Conference: December 6, 7 & 8 , 2019

Venue: Department of Management Studies,
Indian Institute of Technology Roorkee,
Roorkee- 247 667, India

Co- sponsored by

Programme Schedule for 6th Dec 2019 (Friday) – Day 1

Time	Event
08:30 – 09:30	Registration
09:30 – 11:00	Worksop –I: Industry-Academia Leadership
11:00 – 11:30	High Tea at DoMS
11:30 – 13:00	Conference Inauguration
13:00 – 14:00	Lunch at DoMS
14:00 – 15:30	Technical Session –Parallel
15:30 – 16:00	Tea Break at DoMS
16:00 – 17:30	Technical Session – Parallel
18:00- 19:00	GIFT –DC Meeting at Committee Room at DoMS (First Floor)
19:30 – 20:30	Dinner at DoMS

**19th Global Conference on Flexible Systems Management
(GLOGIFT-19)**

Theme: *"Flexibility, Innovation and Sustainable Business"*

Conference: December 6, 7 & 8 , 2019

**Venue: Department of Management Studies,
Indian Institute of Technology Roorkee,
Roorkee- 247 667, India**

Co- sponsored by

Programme Schedule for 7th Dec 2019 (Saturday) – Day 2

Time	Event
09:30 – 11:00	Technical Session –Parallel
11:00 – 11:30	Tea at DoMS
11:30 – 13:00	Worksop –II: Editors' perspectives on Scholarly Publication
13:00 – 14:00	Lunch at DoMS
14:00 – 15:30	Technical Session –Parallel
15:30 – 16:00	Tea at DoMS
16:00 – 17:30	Technical Session – Parallel
18:00 – 20:00	Cultural Programme by Bharatendu Natya Academy, Dehradun, Uttarakhand
20:00 – 21:00	Conference Dinner at DoMS

19th Global Conference on Flexible Systems Management (GLOGIFT-19)

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Roorkee- 247 667, India

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Worksop – I: Industry-Academia Leadership – 6th Dec 2019 (Friday)
Venue: Multipurpose Hall, DoMS, IITR

Time	Event
09:30 - 09:35	Welcome address by **Prof. Sushil,** IIT Delhi, Founding President GIFT Society
09:35 – 10:00	Address by **Prof. Neelu Rohmetra**, Director IIM Sirmaur
10:00 – 10:30	Address by **Mr Jayapraksh Balaraman,** Vice President, Standard and Charted Bank, Chennai
10:30 – 11:00	Address by **Mr Vikas Asawat,** Patent and Trademark Attorney

19th Global Conference on Flexible Systems Management (GLOGIFT-19)

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Venue: Department of Management Studies,
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Roorkee- 247 667, India

Co- sponsored by

Workshop – II: Editors' perspectives on Scholarly Publication

7th Dec 2019 (Saturday)

Venue: Multipurpose Hall, DoMS, IITR

Time	Event
11:30 - 11:35	Welcome address by Prof. Ramesh Anbanandam, IIT Roorkee
11:35 – 12:00	Address by **Prof. Ramadhar Singh**, Ex Prof – IIT Kanpur, IIM Ahmedabad, National University of Singapore, IIM Bangalore.
12:00 – 12:30	Address by **Prof. Sushil, IIT Delhi**, Editor-in-Chief, Global Journal of Flexible Systems Management, Springer Publications
12:30 – 13:00	Address by **Prof. Kiran Momaya** (on skype), Professor of Competitiveness at SJSOM, IIT Bombay, Editor-in-chief of the International Journal of Global Business and Competitiveness

Technical Session Schedule

Day 1   December 6th, 2019

Technical Session 1 (2:00 PM 3.30 PM)

S.No.	Paper Id	Author	Paper Title

<table>
<tr><td colspan="4" align="center">T1: Innovation

Venue: LR1 (Ground Floor)</td></tr>
<tr><td>S.No.</td><td>Paper Id</td><td>Author</td><td>Paper Title</td></tr>
<tr><td>1</td><td>18</td><td>Praveen Kumar Khanijau* and Saboohi Nasim*</td><td>Critical Success Factors For Adoption Of Open Innovation In Indian It Sector: An Expert Surve</td></tr>
<tr><td>2</td><td>33</td><td>Aseem Tigga And Ramesh Anbanandam</td><td>Potential Of Electric Bus For Reducing Vehicular Exhaust Emission In Delhi</td></tr>
<tr><td>3</td><td>81</td><td>Shivakumar Malagihal* And Kirankumar S. Moma a</td><td>Rise Of The Platform Econom : Exploring The Role Of Innovation Platforms To Improve Competitiveness Of Indian It Service Firms</td></tr>
<tr><td>4</td><td>142</td><td>Kamlesh Meena*, Kirankumar S. Moma a and Pranusha Mantri</td><td>Opportunities of Innovation and Competitiveness of Indian Sports : Findings from a case of Inter-IIT Sports</td></tr>
<tr><td>5</td><td>167</td><td>Nirmal Kundu</td><td>Managing Reverse Innovation in India- Moving Forward b going Reverse</td></tr>
</table>

<table>
<tr><td colspan="4" align="center">T2: Future of Sustainability

Venue: LR2 (Ground Floor)</td></tr>
<tr><td>S.No.</td><td>Paper Id</td><td>Author Name</td><td>Paper Title</td></tr>
<tr><td>1</td><td>119</td><td>Anup Kumar*</td><td>Sustainable Tourism Development And Leadership In Uttarakha nd A Himalayan State</td></tr>
<tr><td>2</td><td>76</td><td>Bhavya Pande* And Gajendra K Adil</td><td>Assessment Of Sustainable Manufacturing Practices: Case Study Of A Textile Manufacturing Firm</td></tr>
<tr><td>3</td><td>89</td><td>Surbhi Gosain*</td><td>Effectiveness Of Crowdfunding For Financing Sustainably Oriented Enterprises In India: A Study</td></tr>
<tr><td>4</td><td>104</td><td>Puneet Mishra And Uttam Kumar Roy</td><td>Deciphering Mixed Land Use: A Way Forward For Indian Cities</td></tr>
<tr><td>5</td><td>52</td><td>Anand Babu, Anjitha Kb and Dr. Santanu Mandal</td><td>Antecedents of Organic Food Buying Intention: An Empirical Study</td></tr>
</table>

GLOGIFT-19

		T3: Financial Management	
		Venue: Conference Room (Ground Floor)	
S.No.	**Paper Id**	**Author Name**	**Paper Title**
1	26	Iram Hasan*, Dr Shveta Singh And Dr Smita Kashiramka	CSR And Its Flexible Dynamics With Financial Performance Of Firms: Empirical Evidence From India
2	131	Neelam Rani*	Flexibility In The Payment Methods For Mergers And Acquisitions
3	114	Shamita Garg* And Prof. Sushil	Impact Of Global Integration On Performance Of Select Auto Firm Of Indian Origin
4	14	Kalikant Mishra	Role Of Forensic Audit In Controlling NPAS In Indian Banks
5	133	Neelam Sharma*	The Mediating Effects Of Economic Growth Between Public Expenditure And Human Development In India

		T4: Digitization and analytics	
		Venue: Committee Room (First Floor)	
S.No.	**Paper Id**	**Author Name**	**Paper Title**
1	46	Ramesh Satuluri* and Radhika Ramanchi	Digital Transformation in Indian Life Insurance Space
2	79	Parthiban M, Suryaprakash M and Praveen Kumar K	Application Of Sap Fiori In Manufacturing Industry
3	102	Yashdeep Singh and Pradeep Kumar Suri	Tracing E-governance research in the context of advancements in Information Technology: A text mining-based approach

		T5: Innovation and creativity- I	
		Venue: Multi-Purpose Hall (Ground Floor)	
S.No.	**Paper Id**	**Author Name**	**Paper Title**
1	112	Ravindra Kumar*, Jainendra Kumar Jain, Vipin Kumar Sharma, Geeta Rana And Ravindra Sharma*	To Study The Effect Of Organizational Factors On Creativity & Innovation In R&D Organizations
2	11	Dr. S. Balasubrahmanyam*	Strategic Nuances of the Razor & Blade Business Model
3	105	Anjali Kushwaha	Skills for startups in an innovation driven economy
4	67	Pranita Burbure, Bhushan Pardeshi*, Padmalochana Bisoyi And Dipti Vashisth Sharma	Leveraging Social Media Analytics In Influencing Organizational Culture

Time: 04.00 PM to 05.30 PM

S.No.	Paper Id	Author Name	Paper Title
T6. Social Sustainability			

T6. Social Sustainability

Venue: Multi-Purpose Hall (Ground Floor)

S.No.	Paper Id	Author Name	Paper Title
1	17	Bhushan Pardeshi, Padmalochana Bisoyi, Pranita Burbure* And Dipti Vashisth Sharma	Inclusion Of NTFPS In Sustainable Livelihood Of Tribal People Of Western Ghats Of Maharashtra
2	82	Dr Ruby Sengar*, Dr Smriti Pande, Narendra Singh Chaudhary And Dr Santosh Rangnekar	Perceptions Of Teachers Towards Higher Educational Institutions Sustainability
3	22	Nachiket Gosavi* And Pragya Bhawsar*	Planning For A Sustainable Passenger Transport In The Backdrop Of Impending Urbanization: The Case Of India
4	34	Ritika* and Himanshu	Climate Finance: A Catalyst For Sustainable Development Goals
5	158	Annapurni Subramanian*, Surya Ananth* and Archana Ms	Adoption of sustainable knowledge management practices in techno-innovative clubs: A case study

T7. Digital Transformation and Innovation Management

Venue: LR2 (Ground Floor)

S.No.	Paper Id	Author Name	Paper Title
1	78	Manikandan VV*, Krishnaraj S* And Parthiban M	Implications Of Industry 4.0 On Erp For Automobile Industry
2	70	Veer Shivajee*, Rajesh Kr. Singh And Sanjay Rastogi	Die Changeover Time Reduction Using No Touch Exchange Of Die (NTED): Case Study
3	35	Anil Kumar And Uttam Kumar Roy	Potential Of E-rickshaws As A Shared Mode For Last Mile Connectivity (Lmc) In India
4	40	Shaurya Mall And Anbanandam Ramesh	Potential Barriers Hindering Electric Vehicle Mass Adoption: A Review
5	115	Andril Alagusabai, Dr.Abdul Zubar Hameed and Karthick K N	A Novel App roach: Refinement on Well-being System of Automobile Users

S.No.	Paper Id	Author Name	Paper Title
		T8. Financial Flexibility and Risk Management	
1	98	Suruchi Satsangi* And Prof.Prem Das Saini	Impact Of Merger And Acquisition On Profitability Perform ance Of Selected Merger (A Case Of Vodafone -idea Merger)
2	66	Subeesh N S*, Dr Sumati Sidharth And Dr Nilesh Ware	Identification Of Critical Success Factors For Project: A Select Case Study In R&D Organization
3	84	Padmalochana Bisoyi*, Bhushan Pardeshi, Dipti Vashisth Sharma And Pranita Burbure	Factors Affecting Financial Flexibility Of Central Public Sector Enterprises
4	86	Dipti Vashisth Sharma*, Padmalochana Bisoyi, Bhushan Pardeshi And Pranita Burbure	Analysing Financial Performance Of Private Banks In India: Application Of Camel Model
5	10	Anshu Agrawal	Developing a modified total interpretive structure model of financial flexibility

S.No.	Paper Id	Author Name	Paper Title
		T9. Supply Chain Management and Perspectives	
		Venue: Conference room (Ground Floor)	
1	156	Ramesh Kumar*, Ravindra Gokhale And L. Ganapathy	Modeling Of Production And Distribution Planning In The Flexible Supply Chain
2	160	Aiman Fathima K*, Nikitha A P*, Archana M S And Ashok K Pundir	Exploring Application Of Lean Methods For Inventory Optimization In A Manufacturing Company: A Case Study
3	140	Kamal Mittal, P K Jain and Dinesh Kumar	Reconfigurable Manufacturing System : Key for Technology Management
4	152	Shashank Kumar*, Ashok Kumar Pundir	Application Of IoT And Blockchain Technology In Supply Chain: A Review
5	63	Srijit Krishnan* And K Mathiyazhagan	Identification And Analysis Of The Enablers Of Additive Manufacturing Implementation
6	130	Vishal Kashav, Chandra Prakash Garg	Cost optimization in liner shipping networks through liner network costing model (LNCM)

Day 2 – December 7th, 2019

Technical Session 3 (09.30 AM - 11.00 AM)

	T10. Circular Economy		
	Venue: Multi-Purpose Hall (Ground Floor)		
S.No.	Paper Id	Author Name	Paper Title
1	145	Vijay Lahri* And Krishnendu Shaw	Sustainable Distribution Network Design Of A Supply Chain
2	147	Madhukar Chhimwal*, Dr Saurabh Agrawal And Dr Girish Kumar	Identification Of Circular Economy Risk From Indian Manufacturing Perspective
3	118	M V Jobin*, T Radha Ramanan And R Sridharan	Factors Affecting Organizational Performance Of A Lean Firm
4	55	K.K. Tripathy And Sneha Kumari*	Modelling The Drivers For Sustainable Agri-value Chain: Multi-Method Research Design
5	128	Chitranshu Khandelwal And Mukesh Kumar Barua	Challenges To Implement Circular Supply Chain Management In Context Of Developing Economy

	T11. Analytics		
	Venue: Committee Room (First Floor)		
S.No.	Paper Id	Author Name	Paper Title
1	90	Sridevi S, Mahalakshmi G, Saranya T*, Parthasarathy S And Chandrakumar T	Forecasting Of Time Series Data Using Fuzzy Based Multi-granular Model
2	103	Shraddha Bhadauria* And Vinay Singh	Open Innovation And Absorptive Capacity: A Bibliometric Review
3	83	Parthiban M, Rishi Revanth R V, Karthick U And Karthick D	Application Of Sap Leonardo In Paint Industry
4	146	Manindra Rajak And Krishnendu Shaw	Using Interpretive Structural Modelling To Determine The Relationships Among Mobile Health Adoption Barriers In India

	T12. Healthcare and Humanitarian Supply Chain Management		
	Venue: Confere nce Room (Ground Floor)		
S.No.	Paper Id	Author Name	Paper Title
1	74	Jalsingh Chaudhary And Faisal Talib	Critical Success Factors Of Total Quality Management In Healthcare Establishments: An Empirical Study
2	126	Umabharati Rawat And Dr Ramesh Anbanandam	Role Of Logistics In The Internal Hospital Supply Chain: A Literature Review
3	15	Md Kamal Hossain And Dr Vikas Thakur	Smart Healthcare Facilities: Value Creation In The Era Of Industry 4.0
4	24	Saboohi Nasim And Ahmad Faraz Khan*	Drivers Of Blockchain Technology Adoption In Indian Pharmaceutical Sector: A Qualitative Study
5	120	Gaurav Kabra	Humanitarian Supply Chain Management: A Review and Future Research Agenda

Technical Session 4 (2.00 PM - 3.30 PM)

S.No.	Paper Id	Author Name	Paper Title
		T13. Block-chain and Transportation	
		Venue: Committee Room (First Floor)	
1	68	Siddharth Chaudhry* And Shveta Kaul*	Blockchain In Transforming The Business Landscape: Scope, Opportunities And Challenges
2	72	Sachin Yadav* And Surya Prakash Singh	Need Of Blockchain For The Sustainable Supply Chain Management: A Fuzzy -ism, Fuzzy-ANP Approach
3	62	Seema Jain* And Pawan Kumar Dhiman	Urban Transport In India: Issues And Challenges
4	148	Manisha Bhardwaj, Rajat Agrawal	Petri Net Modeling For Supply Chain Of Perishable Products
5	157	Alok Kumar*, Dixit Garg And Ramesh Kumar Garg	Risk Factors Involved In Web-Based Supply Chain Or E-supply Chain- A Review

S.No.	Paper Id	Author Name	Paper Title
		T14. Strategic Human Resource Management	
		Venue: LR1 (Ground Floor)	
1	85	Charu Goyal* And Manoj Patwardhan	Strategic Approach To Hrm: A Literature Review On Soft And Hard Hrm Practices
2	150	Shikha Agnihotri*And Dr. Puja Sareen	Perceived Employability: Development And Validation Of An Integrated Scale
3	13	Dr S. Balasubrahmanyam	Dynamic Capabilities And Resource Leverage Practices: A Synthesis Of Concepts
4	59	Aijtabh Ambastha*	Are There Linkages Between Organization's People Capability Maturity Level And Its Business Performance?
5	159	Sanjana Hemaraju, Keerthan Jinaraj Yermal*, Prof. Archana M. S.	Ergonomic Evaluation Through Digital Human Modelling: A Review
6	44	Binita Tiwari and Usha Lenka	Resonant leadership: Scale development and validation of four-factor model in Indian study

T15. Human Resources and Development

Venue: LR2 (Ground Floor)

S.No.	Paper Id	Author Name	Paper Title
1	71	Sanjeet Kumar Sameer* And Dr Pushpendra Priyadarshi	A Framework For Managing Internal Employability By Leveraging Motivating Job Characteristics - Role Of Promotion And Prevention Focused Job Crafting
2	163	Daneshwar Sharma, Prabhat Pankaj, Prasuon Tripathi	Using Teaching Philosophy Statement for Management Education Reforms
3	61	Garima Sharma* and Pravin Kumar	An analysis of factors influencing the performance of service organisations: An approach of interpretive structural modelling
4	110	Aditi Bisht And Santosh Rangnekar	Promoting Training To Increase Learning Adaptability: Role Of Identified Motivation
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Contents

SECTION – 1
SUPPLY CHAIN MANAGEMENT

Urban Transport In India: Issues And Challenges

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Abstract-

The rapidly increasing urban population of India performed a significant role in promoting variety of economic growth activities which are confronting ever-increasing urban travel demand. In upcoming years, urbanization in India become to accelerate as the effect of mixed economy as well as private sector will play a crucial role in nourishing the national economic growth. Since centuries transport had played an important role in national development and nurture the human civilization. Due to globalization, requirement of mobility increased day by day to access of education, employment, health and other basic facilities from them they are deprived. Underprivileged transport systems asphyxiate economic development, and suffered with heavy competitive loss in the globalized world. With mounting rate of personal vehicles and lessening use of public transport as well as non-motorized transport shares, Indian cities are progressing in the erroneous direction and as the result of this they suffer with numerous problems of depleting air quality, increased travel time and cost, and congestion etc. This study is confined to assess the growing trends of automobile sector and accessibility of Indian urban transportation infrastructure and to analyze environmental problems generate due to increasing trends of personal vehicles.

Keywords: Urban Transport, Infrastructure, vehicular Growth, Environmental safety.

1. Introduction

Without transportation network, cities and towns would never have progressed. They support as the back bone socially and economically. Technology with transportation allowed people to provide better goods and services, from also other places, which in turn deliver economic efficiencies.The health of commercially vibrant urban areas and their adeptness to generate wealth for their habitants depends upon the efficiency of its transportation infrastructure. However, to portray the transport drawbacks of American as well as European conurbation, the word 'crisis' has been exercised looks significantly more suitable for urban cities in the emerging world (Gakenheimer, 1990; Pucher, 2005). Developing nations have some factors in common for instance environmental pollution, traffic fatalities, congestion, noise and mobility problems that contribute to the awfulnessin their transport tribulations. Inclusively, increasing urbanization as well as population has led to swift development of outsized cities, which perturbed by the unexpectedly generating travel demand. The availability of transport services, has hang far behind in comparison of demand. Usually, financing from public sectoris woefully inadequate. Along with this majority of travel services are employed beyond their capacity layout and services for cyclists as well as pedestrians are practically not in existence in majority of the urban areas, because of this compel them to share the same lane alongside rapidly going motor vehicles.

In developing countries, the income inequality and inclusively less per-capita income has become major problem. The richest population on average which is only tenth part acquires more than half of whole national income (Vasconcellos,2001) on the other hand rest of the population who cannot have enough money to affordany motorized vehicle and must occupied for a long time for travel. Accordingly, public transport needs priority in funding as the elite do not practice it.

2. Objectives of the study

   2.1 To access the growing trends of automobile and availability of urban transport infrastructure in India.
   2.2 To analysis of environmental problems generated due to increasing trends of personal vehicles.

3. Research Methodology

The present study focuses on the current scenario of urban transport and its effects of growing vehicle composition on economic growth as well as environment. To estimate this effect ten class-I metro cities such as Surat, Banglore, Pune, Ahmedabad, Delhi, Hyderabad, Chennai, Kanpur, Mumbai and Kolkata were selected as sample. For the study secondary data were used. Regarding the details of the study area such as population, vehicular growth etc. was collected from statistical records published by government of India.

4. Urban areas in India

Transport is the lifeline of any region contributing by improving traveling quality, increasing accessibility and maintains the economic activity prolong. Unorganized means of transportation as well as traffic management is a foremost supplier of environmental problems in urban areas. From the last decade, Indian class-I cities grow tremendously in the field of population and convert in the form of crowd. Presently, Indian cities are having million (1 million = 10 lakh) plus population which steadily growing, survive with most pitiable public transport systems lead to a big challenge. To improve condition of transport system the government has formulated several policies but most of time, remedies have been short-sighted and propelled by temporary political and economic concerns. Some studies of Traffic and transport support the accommodation proposal of private and commercial vehicles rather than migration of population. The achievement of a sound transportation system is reflected from number of carried passengers at an affordable price, with reasonable comfort. As per the ramification of urbanization, it's imperative to focus and plan for sustainable urban transport.

Table 1: Population Growth in Metro Urban Cities

Sr. No.	City	Population in 1991 (Lacs)	Population in 2001 (Lacs)	Population in 2011 (Lacs)	Growth Rate In Percentage
1	Surat	15	28	45	5.65
2	Bangalore	41	57	85	3.71
3	Pune	25	37	50	3.53
4	Ahmedabad	32	45	63	3.45
5	Delhi	84	128	163	3.37

6	Hyderabad	43	55	76	2.89
7	Chennai	54	64	86	2.35
8	Kanpur	19	27	29	2.14
9	Mumbai	126	163	183	1.88
10	Kolkata	110	132	140	1.21

Source: Census 2011, Government of India.

As per the study of NTDPC, 2015 cities are gradually prepared to constitute about more than 70 percent of urban population. The data in above table depicts that city population is increasing with rate of 03 percent annually which is unexpected to change considerably during the coming decade. Surat city has the highest position in population growth rate 5.65 percent followed Bangalore with 3.71 growth rate, Pune city 3.53 percent, Ahmedabad has 3.45 percent while Delhi, capital of India has fifth position in class-I metro cities population growth rate of 3.37 percent and the Kolkata has the last position with only 1.21 percent growth rate. According to the report of NTDPC, 2015 urban population in India is estimated to escalate from 377 million in 2011 to 500 million in 2021 which has gone up in 1951from 17percent to 31.8 percent in 2011 and is projected to grow around 35percentup to the year 2021. However, many of metropolitan cities such as Bangalore, Pune, Ahmedabad, Delhi, Hyderabad, Chennai, Mumbai, and Kolkata are having more than 5 million plus population and consistently increasing over this period. The continued urbanization has become a topic of debate between whether it is a sign of growth or distress. As the ramification of urbanization with growing population in the foreseeable future; urban transport is a significant challenge. Hundreds of villages have transformed intown market and majority of small towns of the period of 1960s have converted into large cities ample to qualify as prosperous urban areas in their own right. In 1951, urban population of India was about 17 percent out of 62 million people and presently over 30 per cent, at the scale of 380 million, rising around 2.7 percent every year faster than the rural population.Meanwhile, In1951, there were just 76 cities having a population more than 100,000 and only 5 metropolitan regions with greater than one million households which are increases up to about 53 cities by 2011. Urban transportnecessities have intensified significantly, leading to one side precipitous growth of personal motor vehicle ownership and the other side the development of incompetent public transport.

4.1 Vehicular Augmentation and Accessibility of Transport Infrastructure in Urban Areas

From the past two decades, private vehicle ownership has mounted rapidly. In India as per the study of Ministry of Road Transport and Highways (MoRTH), the total figure of registered automobiles in 1991 was about 21 million only which is soared more than six fold up to 142 million by 2011. In addition, figure of two wheelers as private transport has increased more than 13 times from 14 million to 102 million.

Table 2: Total quantity of registered vehicle in India (% of total) (in millions)

April to March	Two wheelers	Cars, taxis, jeeps	Buses	Freight vehicle	Other vehicle	total
1951	8.8	52.0	11.1	26.8	1.3	0.3
1961	13.2	46.6	8.6	25.3	6.3	0.7

1971	30.9	36.6	5.0	18.4	9.1	1.9
1981	48.6	21.5	3.0	10.3	16.6	5.4
1991	66.4	13.8	1.5	6.3	11.9	21.4
2001	70.1	12.8	1.2	5.4	10.5	55.0
2011	71.8	13.6	1.1	5.0	8.5	141.8
2012	72.4	13.5	1.0	4.8	8.3	159.5
2013	72.7	13.6	1.0	4.7	8.0	176.0
2014	73.1	13.6	1.0	4.6	7.7	190.7
2015	73.5	13.6	1.0	4.4	7.5	210.0
2016	80.5	13.14	0.60	4.5	8.01	230.0

Source: Transport Research Wing, Government of India 2013-16

(a)Also include light motor vehicles, Articulated / multi axled Vehicles, and Lorries
(b) Includes Trailors, Omni buses and Tractors Others.

Table 3: Total quantity of registered motor vehicles in selected urban cities in India: 2001-2015
(As on 31st March (in thousands)

Metro-politan cities / Year	Surat	Bangalore	Pune	Ahmeda-bad	Delhi	Hydera-bad	Chennai	Kanpur	Mumbai	Kolkata
2001	534	1593	620	846	3635	951$	1257	370	1030	664@
2002	575	1680	658	899	3699	1241	1356	385	1069	801
2003	633	1771	697	978	3971	1319	1895	425	1124	842
2004	692	1891	755	1075	4237	1356	2015	425^	1199	875
2005	692*	2232	827	1632	4186	1433	2167	425^	1295	911
2006	692*	2617	874	1780	4487	1522	2338	425^	1394	948
2007	912	2179	930	1451	5492	2181	2518	553	1503	987
2008	982	2640	1141	1586	5899	2444	2701	598	1605	573
2009	1036	3016	1153	1691	6302	2682	2919	642	1674	581
2010	N.A.	3491	1908	N.A.	6747	2728	3149	940	1768	411
2011	N.A.	3791	2094	N.A.	7228	3033	3456	1002	1870	445
2012	1145	4156	2267	1682	7350	3387	3767	1067	2029	496
2013	1241	4591	2347	1796	7785	2040	4072	1143	2187	1278
2014	2244	5050	2185	3196	8293	2203	4354	1227	2333	1339

| 2015 | 2459 | 5560 | 2337 | 3420 | 8851 | 2369 | 4934 | 1462 | 2571 | 1402 |
| CAGR (%) | 11.53 | 9.34 | 9.94 | 10.49 | 6.56 | 6.74 | 10.26 | 10.31 | 6.75 | 5.48 |

Source: Transport Research Wing, Ministry of Road Transport & Highways, Government of India, New Delhi.

Note: (1) CAGR denotes compound annual growth rate. (2) N.A. specifies absence of data. (3) There is a unexpected fall in the quantity of recorded means of transport between 2007-2008 in Kolkata as the effect of order of Calcutta high court in July 2008 to ban on the registration of commercial vehicles before January 1, 1993 in the city and its outer edge.

(*) : Figures related to the 2004 year.   (^) : Figures related to the 2003 year
($) : Figures related to the 1999 year.
(@): Figures related to the 1998 year.

4.2 Impact of vehicular growth on environment

The enormous growth rate of new manufactured motor vehicle enrollment may be necessary for the economic and social development on the other side it producesnumerous critical pollution problems for instance Hydrocarbons (HC), oxide of nitrogen (NOx),carbon dioxide (CO_2), carbon monoxide and particulate matter (PM) has converted in aggravated issue on alarming position. In 2011, number of Indian cities listed in 100 highest polluted cities of world as per the report of World Health Organization (WHO).

Table 4: Estimated on Road vehicular Population in India in 2030

Study	Estimated vehicular Population
ADB (2006)	373 Million
TERI (2009)	315 Million
ICCT (2012)	430 Million
Guttikunda and Jawahar (2012)	426 Million

Source: NTDPC Report, Planning Commission, April, 2014.

By 2010 the study of Global Burden Disease (GBD) revealed that in South Asia 6[th]pinnacle cause of death was pervasive air pollution. A recent study conducted by the Central Pollution Control Board (CPCB) in six cities – Bengluru, Delhi, Mumbai, Kanpur, Chennai and Pune, the transport sector is accountable for the emission of up to 50 percent PM and a large amount of NOx.Urban air pollution has become complicated problem produced by several sources such as traffic exhaust, re-suspended road dust supplies mainly PM and airborne substantial metals concentrations, garbage burning, industrial flumes, agriculture residue from burning process and sea saltfor coastal region. In India, almost 18 percent of whole energy consumed by transport sector followed by industrial sector. Out of which approximately 98 percent energy requirements fulfilled through petroleum products.
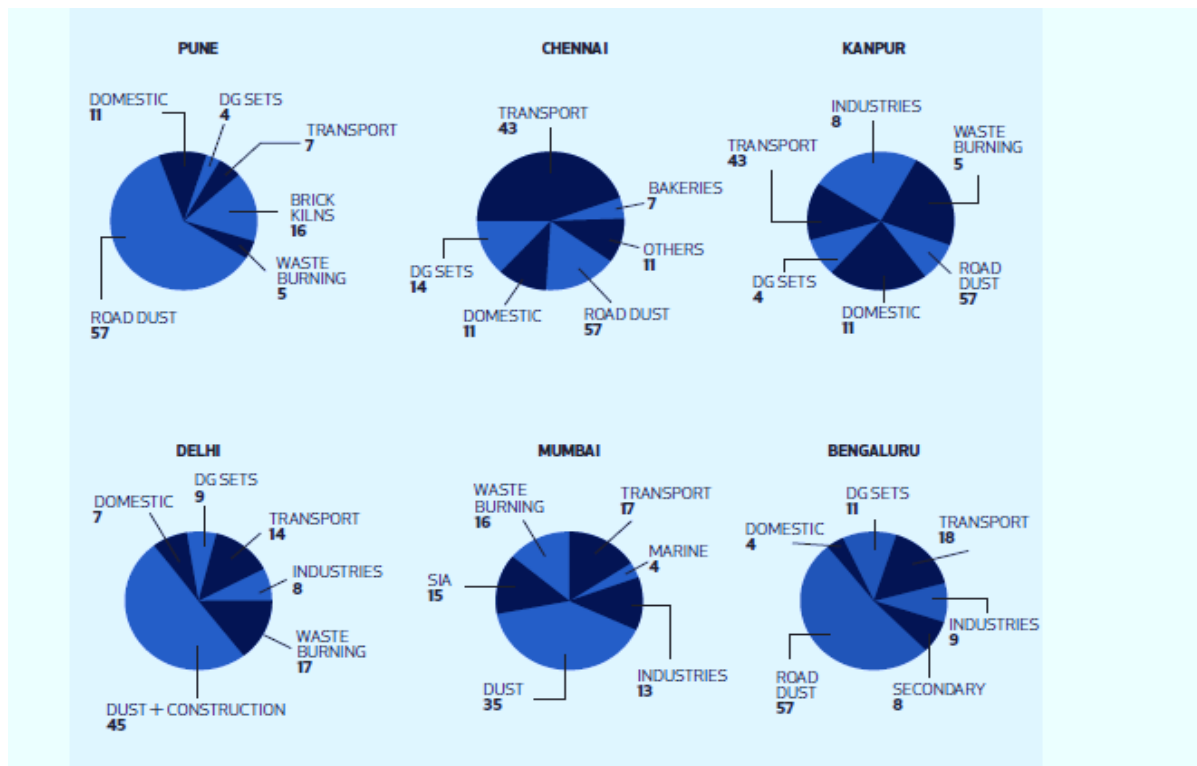
Fig 1: Average per cent contribution of major sources to particulate pollution
Source: NTDPC Report, Planning Commission, April, 2014.

There is an emergency to initiate some appropriate actions for urban planning in the field of transport infrastructure advancement, to reduce consumption of energy specially fuel energy and to curb this extraordinary emission of pollutants as well as Green House Gas (GHG). Although, the present method for urban planning and development to inter change of vehicle in use but as the latest technology existing emission test cycles will required to be strict enforcement. In India, the regulations for vehicle emission has started from 1980s, with the Air Act, 1981, the environment protection act, 1986 and Motor vehicle act, 1988. In the present century, as per the recommendations of the Mashelkar Auto Fuel Policy committee stringent norms were applicable in the year 2010. The intensity of traffic emission is expected to rise throughout the urban regions due to increasing travel demand of passengers as well as freight movement along highway between cities. NOx and CO emission from vehicles are larger compared to PM and SO_2 and this emission create a destruction effects on air quality, global warming as well as public health.

5. Suggestions

Indian government adopted suggestions of Auto Fuel Policy Committee related to reforms and new standards.

- By promoting public transport NMT (non-motorized transport) especially in urban areas, will not only reduced energy consumption and GHG emission but would help to restrict the expansion of private vehicles in majority of Indian cities.

- Upgrade transport management structure and unified modes of transport would be helpful to mitigate these problems.
- Execute strict fuel consumption regulations for all types' vehicles. Further, improve the vehicle fuel efficiency. Still, India lags behind comparatively other countries where LDV (Light – Duty Vehicles) fuel efficiency standard have already implemented and heavy – Duty Vehicles (HDV), two-wheelers, three- wheelers implementation are in process.

6. Conclusion

Economic development is significantly dependent on efficient and adequate amount of transport infrastructure would enhanced the competence of other production sectors. Due to industrialization and services boost the migration from rural areas to urban cities. Augmented urbanization and travel demand already laid the urban transport system under the great stress. Particularly, economic, environmental and social problems generated by excessive use of private vehicles. Though, travel demand far beyond the transport capacity. Any changes of consumption in energy sectors have the immediate effect on Indian economy. India has completed a long journey of last two decades to establish the fuel quality standards, vehicle emission and to generate compliance technique for them. GHG emission and energy consumption in transport sector are increasing intensely would lead to more dependency on imported fuel. As the ramification of it would trouble the energy security and Indian economy. Along with the crisis of global warming is exacerbating can have terrible effects on agriculture and coastal residents.

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Blockchain Technology Applications in Pharmaceutical Sector in India: A Qualitative Study

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Abstract

Blockchain is fast emerging as the next foundational technology after internet, given its increasing applications in business. With the phenomenal popularity and media attention given to Bitcoin- a blockchain based cryptocurrency, businesses and governments worldwide are gearing up to embrace this technology, lest it becomes an opportunity lost. While major central banks worldwide are exploring the possibilities of incorporating blockchain, application of blockchain in other areas such as supply chain, urban management, education records, healthcare and pharmaceutical sector, too, have begun. Further, it's not just the private sector but also the governments around the world, that have started engaging with this technology such as Dubai's 2020 Blockchain Strategy (Government of Dubai, 2016), Georgia's land registration, etc.

The blockchain technology with its defining features of transparency, consensus, data immutability, traceability among others is emerging to be a very useful tool. Many pharmaceutical companies worldwide are partnering together to explore if blockchain technology can be utilized as the future for tracking all individual medications and products manufactured by pharmaceutical companies. It is fast emerging as a promising technology for tracking products and mitigating risk of loss or counterfeiting of pharmaceutical products.

Keywords: *Blockchain, Interpretive Structural Modeling, Decentralization, Data Immutability*

1. Introduction

While the world was wrestling with 2008 financial crisis and the policymakers were in a state of fix about the future, a project called Bitcoin quietly dropped onto the global stage. As a reaction to the centralised money control, this technology proposed an entirely new form of money. Embracing a new paradigm, bitcoin turned away from the humans and choose to rely on software code for building an economy. With this it achieved two things: bring in absolute transparency and predictability in the governance of money and for the first time made it possible for people to transfer money over internet without corporate surrogates. Blockchain, the underlying technology of bitcoin borrows its constituents from researches of cryptography, distributed systems, cyber-security, and game theory, to deliver a new type of shared database. It creates a database which is replicated on multiple computers across many jurisdictions. Additions are made by these same computers, which need share neither an affiliation nor any modicum of trust for the updates to remain secure. The resultant system is being hailed as a breakthrough in computer science. By using blockchains mutually mistrusting parties can

transact with the help of predefined rules. However, there are many unanswered questions before blockchains can claim to be a true alternate.

Today, businesses have many difficulties to face, regardless of their size and scale of activities. These difficulties range from moral, economic, social, and environmental problems. All of them are constantly fighting for the top place and a lot is being compromised in doing so. The occurrence of numerous scams and embezzlements by companies and people in the recent past has confirmed that the foundation rocks of mutual confidence, accountability and ethics that are crucial for any company are shaken. Cutting angles and omitting crucial information is emerging as a trend while exchanging products and services. This presents a severe danger to the integrity of today's organizations.

With the rising globalization, vibrant markets and millions of transactions taking place every second across the globe, it is no wonder that the above-mentioned elements are being ignored and the price is being paid by the end consumer. In addition, it is becoming increasingly hard to maintain pace with pressures to fulfil quality standards, fast and timely delivery, fast turnaround time and service delivery levels. Blockchain promises to solve this issue. Bitcoin's core technology and also of other virtual currencies such as Litecoin, dash, ether, cardano among many, blockchain is a distributed ledger that maintains digital data records or occurrences in a manner that makes them tamper-resistant. Although, all consumers may access, check, or add information, they are unable to alter or delete it. The initial data remains in place, leaving a path or chain of operations that is continuous and has a public trail. It is also possible to program the ledger itself in order to automate transactions.

Our financial, legal and political systems are defined by contracts, transactions and their documents. They are critical to protecting assets and sets organisational boundaries by establishing mechanism for verifying occurrences and transactions related to identities. They lay the interaction structure between countries, organisations, communities, and people. They direct organizational and social action, yet the bureaucracies created around them have failed to keep up with the worldwide digital transition. There have been many instances in which this lag has cost millions of dollars to companies. In a digital globe, we need to alter the way we regulate and retain administrative control.

With blockchain, one can imagine a universe where agreements are integrated in digital software and placed in transparent, shared databases, safe from deletion, manipulation, and

modification. Every agreement, process, task, and payment in this world would have a digital record and signature that could be identified, validated, stored, and shared. Individuals, organisations, and computers would operate freely and communicate with each other with little friction, leaving the function of intermediaries such as attorneys, brokers, and accountants moot. One might think of it this way: if the entire blockchain were the banking transaction history, a single bank statement would be a single "block" in the chain. However, unlike most banking schemes, there is no single agency controlling these operations and can only be modified by the agreement of a majority of scheme respondents. In other words, blockchain is a record-keeping system that makes working together over the internet simpler and safer for companies.

While transparency in finance, billing and control is critical to companies, how well they handle their supply chains is also of significant to them. To guarantee quality service delivery, the level of transparency, efficiency and effectiveness of supply chains has a large say in setting corporate policies. Blockchain technology is emerging as a very helpful instrument with its defining characteristics of transparency, agreement, immutability of information, traceability among others. The implementation of this technology, however, will be gradual and would gain momentum over time, unlike other disruptive technologies that reach prominence exponentially.

Many businesses are working together to study and decide whether blockchain technology will be used in the future to track all medicines and goods by pharmaceutical companies. As an answer to product monitoring and counterfeiting, it presents a useful business case. However, there has been no research exploring the primary driving forces of blockchain in the context of pharma sector. This research paper aims to explore the major drivers of blockchain adoption in pharma sector in detail and uses a qualitative tool ISM for modelling these drivers for pharma sector in India. An in-depth understanding of drivers shall assist in uncovering major application of blockchain technology in pharma sector.

2. Background Literature

In this section, a background literature is presented to delve deeper into blockchain technology and its potential application in the pharmaceutical sector. At the outset, the concept of blockchain technology is explored tracing its genesis, transaction process, benefits etc. Further,

a brief discussion on the domain of the study i.e. the pharmaceutical industry is presented highlighting the possible applications of blockchain technology in this sector.

2.1 Introduction to Blockchain: The Beginning

Blockchain — a peer-to-peer network that works on top of the internet — made its debut in October 2008 in a white paper titled, "Bitcoin: A peer-to-peer electronic cash system" written by an anonymous figure with a pseudo name, Satoshi Nakamoto. It presented a monetary scheme that eliminated the need for a central authority for issuing currency, facilitating asset transfer and confirm operations over digital networks. Soon after the release of the whitepaper, Bitcoin was offered to the open source community in 2009. As the usage of bitcoin increased, the curiosity over the underlying technology of Blockchain also gathered steam.

As a technology, blockchain provided the answer to the long-wrestled issue of digital trust. It provides a transparent, time-stamped and decentralized way of recording any information in a distributed public ledger and doesn't allow anyone to remove it without consensus. In 2014, a new surge in the interest was witnessed after the introduction of Ethereum Virtual Machine (EVM) and the deployment of smart contracts over blockchains What started as an alternative cash system, soon caught the eye of researchers and futurists. Within less than a decade of its existence it began featuring as one of history's ground-breaking technologies with potential to significantly impact every industry from financial to manufacturing to educational institutions. Entrepreneurs who understood the power of blockchain, began proposing newer applications of blockchain in areas as diverse as supply chains, healthcare, insurance, transportation, voting, contract management.

Blockchain Transaction

Blockchain can be called a cryptographically secure and immutable ledger of records which is distributed and does not require a central authority for authentication of transactions. Once envisaged as a storehouse of financial transactions, blockchain has moved beyond bitcoin to demonstrate a number of use cases in diverse arenas such as digital rights management in music industry (Dickson, 2016), supply chain management (Armstrong, 2016), etc.
A typical blockchain transaction is initiated by a request for a transaction which is broadcasting to a peer-to-peer network of computers after adding a cryptographic signature. A group of nodes referred to as miners validates the transaction using known algorithms. The source code of the blockchain details a consensus algorithm and an incentive scheme for the miners. After

validation, the transaction is added to a block. Each block contains a specified number of transactions and is connected to the previous block by a cryptographic hash. This chain of blocks is referred to as a blockchain.

Blockchains can be used for any kind of transactions such as financial transaction, asset record, agreements, or any kind of data. The decentralized nature of blockchains make it resilient and secure. Blockchain can be designed using different cconsensus mechanisms. In a blockchain, consensus mechanism allows a group of separate nodes to distribute the right to update the system according to a specific set of rules. Though bitcoin uses proof-of-work consensus algorithm, there can be other suitable consensus algorithms like proof-of-stake, designated proof-of-stake, proof-of-importance, etc. With respect to the type of access to the users blockchain can be classified into three types namely, *public*; *private* and *hybrid*.

In a public blockchain, anyone can interact with anyone anonymously. In private as well as hybrid, a pre-validated individual/group is allowed special access to the blockchain. Blockchain evangelists do not consider private/hybrid blockchains true blockchains as it brings back the idea of centralization and restores authority of few. However, pragmatist advocates a large number of applications of the private and hybrid blockchains. Whether public or private, blockchain technology creates a trust layer in the system by exhibiting characteristics like Decentralization, Transparency, Flexibility, Auditability, Security and Immutability. This creates an extremely efficient process to administer and monitor transactions and people predict it will dramatically reduce the cost of transactions. Nearly 15% of financial institutions are already using blockchain technology.
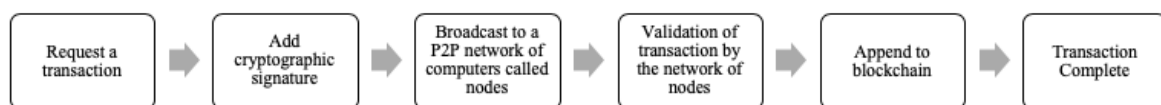
Fig. 1. Steps in a Blockchain Transaction.

2.2 Indian Pharmaceutical Sector and Blockchain

Overall, the Indian pharmaceutical industry is on a strong growth path with the total valuation of $33 Billion in 2017. It is expected to touch $55 billion by 2020. Moreover, the overall

biotechnology industry is expected to reach $100 billion by 2025 (IBEF, 2019). Over the next 5 years, medicine spending in India is projected to grow at 9-12 per cent, making it one of the top 10 countries in terms of medicine spending. The pharma sector, however, is riddled with supply chain constraints.

According to a report by Bioplan Associates, though the number of distributors has increased by four-fold in the last three decades, from 125,000 in 1978, the volume of prescriptions distributed have not increased proportionally. There is also the issue of high fragmentation with around 550,000 retail pharmacies in the country. Organized pharmacy retail chains have a miniscule presence in the country. Moreover, a large rural market which remains untapped. Supply chain remains a key challenge for the pharma sector.

i.   Pharmaceutical Supply Chain

Pharmaceutical supply chains in India comprises of number of players. The upstream side comprise vendors and manufacturers. There exists a variety of manufacturers with their peculiar operations. At one end of the spectrum there are *large multinationals*, having manufacturing at different locations as well as research and development centres. Then there are *large generic manufacturers* and *local manufacturers* primarily catering to domestic demand. There is also a large number of *contract manufacturers*, who sometimes concentrate on key active ingredients and not the whole product. As a support to many of these players, *drug discovery* and *biotechnology companies* are also part of the upstream supply chain. Whereas, on the downstream or distribution side there are *Clearing and Forwarding agents (CFA)*, *stockists*, *retailers* and *customers*. Slight variations can be noted in the exact make-ups of different firms.

On the downstream side, CFAs, stockists and retailers work with different manufacturers. For every state, 1-3 CFAs are designated by manufacturers. The payment to CFAs is linked to the turnover and different payment cycles can be observed in the industry form quarterly, half-yearly to annual. Stockists typically handles the stock for more than 10 companies and may even go up to 50, depending on the capacity. Stockists directly pay the manufacturers and are extended a credit cycle by manufacturers. The credit cycle is accordingly passed on to retailers by stockists. The downstream supply chain accounts for approximately 30-35% of the margins

on maximum retail price of medicines. Stockists serves as hubs, whereas sub-stockists and retailers serve as spokes in this model.

The supply chain in pharmaceutical industry follows either a *replenishment model* or *forecasting model*. In the replenishment model, products are monitored on a daily basis. Stockists prefer this model as it provides free inventory space and freedom to work with multiple companies. The model is demand driven and buffer stocks are used to avoid shortfalls. Though, the concept of just-in-time has been advocated for continuous replenishment, the fragmented nature and technology adoption issues have proved serious hindrances in the Indian context. Forecasting model employs mathematical models for forecasting demand based on past data. The availability of quality information in a timely manner is a critical issue for proper modelling. This is not a popular choice because of the fragmented nature of Indian domestic market.

Some of the areas of concern for pharmaceutical supply chains in India are:

- *Demand Management*: With complex geography and non-reliable historical data, demand forecasting is a major challenge for all the players.
- *Inventory Management*: The fragmentation of the downstream side of supply chain and lack of standardization in warehouse management practices lead to improper utilization and wastage. Further, well documented phenomenon such as Bullwhip effect or Forrester effect are observed especially at the manufacturers' end.
- *Fraud and Pilferage*: With competition rising and lapses in regulation, fraud and pilferage is another serious concern in India.
- *Coordination*: Unlike other parts of the world, organised retail pharmacies constitute a minuscule part of the distribution. Over-reliance on the staggered retailers makes coordination a serious challenge in India. Moreover, the ownership of medicines changes frequently in the downstream. Traceability and visibility remain poor on the part of the manufacturers or marketers.

i. Applications of Blockchain in Pharmaceutical Supply Chain

At the broader level the core challenge of supply chain is to establish 'trust' among the various players throughout the supply chain. Multi-echelon and geographically disjointed entities make modern supply chains innately complex (Lambert and Enz, 2017). A major risk is varied

cultural and human behaviour (Ivanov, Dolgui, and Sokolov, 2018). Tendency to engage in opportunistic behaviour by a business partner (e.g. information distortion and under/over-reporting) (Baird & Thomas, 1991; Bettis & Mahajan, 1985) can result in serious obstruction to efficient supply chain management and customer satisfaction.

There is a need to have a comprehensive view for exploring the interlinkages of pharmaceutical supply chains with the entire healthcare bundle (Narayana, Kumar Pati, Vrat, 2014). Privett and Gonsalvez (2014) considered the employment of sophisticated inventory models as insufficient to improve the existing situation. The call for innovative approaches in order to better integrate pharmaceutical supply chains keeping in view the advances in manufacturing practices and patient-centric delivery model is loud and clear (Srai, Harrington, Alinaghian and Phillips, 2015).

Blockchain promises numerous benefits over traditional supply chains due to its innovative approach of transaction processing and recording (Tapscott and Tapscott, 2017). Its feature of decentralized 'trustless' database makes transactions possible with process disintermediation and decentralization among entities at a global scale (Crosby et al., 2016). Early use case of blockchain deployment by Maersk (Danish Shipping Company) in partnership with IBM indicates potential savings of billions. Though the actual savings are yet to be reported after full-scale deployment. Provenance, a blockchain service provider, presented a use case with pilot in seafood supply chain. In a major development Pfizer Inc., McKesson Corporation, Amerisource Bergen Corporation and Premier Inc. decided to collaborate with Medi Ledger Project Contracting and Chargebacks Working group to experiment with Medi Ledger, a blockchain protocol (Forbes, 2019). The objective of this is to establish a single source of truth for all the players.

A disruptive technology, blockchain offers various benefits over existing technologies. It can be employed to solve many problems. However, pharmaceutical companies are yet to develop proper use cases and establish a link between the business problem and blockchain solution before embarking on any blockchain project. Some potential areas where blockchain can improve pharmaceutical supply chains are as follows:

- *Counterfeit Medicines & Intellectual Property (IP) Protection*: India is one of the biggest markets for counterfeit medicines in the world, with around 25% of all drugs sold (ASSOCHAM, 2014). With blockchain traceability is possible throughout the

supply chain. Authenticity of drugs can be established using immutable blocks of information from every player in supply chain. With growing complexity, traceability is going to become a fundamental requirement for pharmaceutical and medical products (Rotunno et al. 2014). Infringement of IP is commonplace in Indian market and blockchain can be instrumental for governance in this space.

- *Transaction Management*: A key feature of blockchain is the integration of smart contracts, which are self-executable programs. Pharmaceutical supply chains can become more efficient and transparent in terms of transaction data and payments.

- *Security of records:* With the growing use of wearable devices and continuous flow of data, blockchain can be ensure security of records related to customers as well as transactions. As the mass scale usage of artificial intelligence and internet-of-things (iot) devices becomes a reality, pharmaceutical companies shall need to align towards health management from drug distribution.

- *Coordination*: The issue of disintegration of pharmaceutical supply chain can be tackled by adoption of a pharma specific blockchain protocol. Both upstream and downstream entities can become part of a transparent supply chain irrespective of the size of the entity.

Kshetri (2018) uncovers that pioneering organizations are using blockchain to improve various supply chain performance parameters such as cost, speed, dependability, risk reduction, sustainability and flexibility. Despite many organizations leading the way, there is still skepticism around the implementation of blockchain among supply chain players (Sadouskaya 2017). A fundamental requirement of blockchain in supply chain is the identifier tag linking physical products to their virtual identity (Abeyratne and Monfared 2016). This primary challenge seems overwhelming in Indian context.

There are also concerns about the high cost of implementation (Kamble, Gunasekaran and Arha, 2019). As a technology, blockchain is still grappling with behavioural, organisational, technological, and policy-oriented aspects (Crosby et al. 2016; Lemieux and Lemieux 2016; Yli-Huumo et al. 2016). These concerns present a strong case for exploring the drivers of

blockchain adoption in Indian pharmaceutical sector and exploring their linkages. A thorough understanding of the drivers is critical in forming the business case for blockchain adoption.

b. Drivers of Blockchain Adoption in Pharmaceutical sector

Some of the key factors driving the adoption of blockchain technology in the pharmaceutical domain, as identified from the literature, are as follows:

- *Provenance/Immutability*

Provenance refers to the ability to trace origin and ensure the authenticity of the object being traded.Using blockchain's inherent capabilities, the provenance of drugs can be tracked back to ensure authenticity. Every block added to the blockchain network can be computationally linked to the preceding block, thereby providing immutability.

- *Data Governance and Record Management*

Given blockchain's built-in cryptography, possibilities abound in the area of records management and data governance.This is particularly important for value-based healthcare wherethe contracts between payers and pharmaceuticals organizations could be maintained using blockchain to provide legal authenticity.

- *Internal Process Management*

Pharmaceuticals companies typically use many systems to manage factory operations, such as handling inbound raw materials and processing across product lifecycle stages – finished goods, scrap management, packaging and labelling.With a blockchain, the need for artificial internal systems and device processes to reconcile transactions can be reduced, as transactions across systems can be maintained in a single shared ledger.

- *Disintermediation or Decentralization*

An inherent strength of blockchain is that it allows information to be made available to all parties securely, thus obviating the need for an intermediary.In clinical trials, a blockchain

network with participants from pharmaceuticals, investigators, trial sites and regulators could be created in which data could be shared securely without any chance of alteration.

- *Cost Reduction*

Data from multiple sources, such as genomics, wearables and electronic medical records, can be shared with multiple parties using blockchain without the need of external devices or intermediaries to do so, thus, resulting in significant cost reduction.

- *Preservation of IPR*

With extensive amount of research and development being done to come up with safer and more effective drugs in the pharma sector, patenting of drugs becomes an issue of utmost importance to their manufacturers. Through the shared and constantly updated virtual ledger of Blockchain, drug manufacturers could preserve their Exclusive Marketing Rights

- *Security and Trust*

With the advancements in Digital healthcare, the amount of data generated on a consumer's health and lifestyle has dramatically increased. Malicious access to sensitive personal data can cause devastating harm to consumer relationships and grave reputational and financial repercussions to medical device makers. Blockchains can embed rules to control access to sensitive medical data. Patients can specify, for example, that only their family and treating physicians can access their health records.

3.   METHODOLOGY ADOPTED FOR THE PAPER

Even after more than a decade of its inception and variety of ongoing experimental use cases, there are a lot of apprehensions about the adoption of blockchain. While technology enthusiasts evangelise 'blockchain' as 'Internet 2.0' and how it is going to change the face of how we do transactions, but it is seldom highlighted that the transformation is not a cake-walk. Most organizations today sceptical and not yet ready to adopt blockchain, given the challenges that the technology brings forth and hence needs to be addressed to be finally integrated. Although some experts have put forward the blockchain adoption framework (Iansiti and Lakhani, 2017), a lot of clarity is required further in terms of what might be the key drivers or enablers for organisations in expediting its adoption across domains.

This paper is, thus, an attempt to identify the value drivers, explore the existing interrelationships and eventually arrive upon a model around which organizations may build

their blockchain adoption strategy. It, therefore, explores the concept of blockchain technology and its application in the pharma sector in India. The paper, further, identifies the factors driving blockchain and study their inter-relationships using a qualitative depicting the hierarchy of the drivers and their linkages.

3.1 Sample Design and Data Collection

This research paper presents a qualitative study on value drivers of blockchain implementation in Indian Pharmaceutical Industry. At the outset, a preliminary review of the available literature, blogs and news article on blockchain led us to identify a set of factors affecting the implementation/adoption of 'blockchain' in Indian pharmaceutical sector. Further, responses were elicited from the industry experts about the inter-relationships among these factors, in order to understand them better.

Responses were obtained from three experts, who represent the top-level executives of Blockchain Council-India, Blockstein, and Cognitive Clouds. These respondents are 'Blockchain Enthusiast' involved in the implementation of this technology in the industry. Responses were elicited using a template enlisting the drivers identified and their interrelationships to gain insights into their influence on each other. The inputs obtained were further used for modelling the relationships among drivers by deploying a qualitative tool called Interpretive Structural Modelling (ISM), discussed in the next sub-section.

3.2 Introduction to the Analytical Tool: ISM

Interpretive structural modelling (ISM) is an interactive learning technique wherein a set of different directly and indirectly related elements are put together into a structured and comprehensive systematic model (Warfield, 1974). The model so formed portrays the structure of a complex issue or problem in a certain pattern employing graphics as well as words.

Interpretive structural modelling (ISM) is regarded as a well-established methodology for identifying inter-relationships among specific items, which define a problem or an issue. For any complex problem under consideration, a number of factors may be playing. However, the direct and indirect relationships between the factors describe the problem situation far more accurately than the individual factor taken cognisance of, in isolation.

In this approach, a systematic application of some elementary notions of graph theory is employed in such a way that theoretical, conceptual and computational leverage are exploited

to explain the complex pattern of contextual inter-relationship among a set of variables. ISM is intended for use when desired to utilise systematic and logical thinking to approach a complex issue under consideration.

Graphical models or, more specifically, directed graphs (digraphs) are eventually framed to represent the relationships between the elements. In such a representation, the elements or components of a system are represented by the "points" of the graph and the existence of a particular relationship between elements is indicated by the presence of a directed line segment. It is this concept of relatedness in the context of a particular relationship which distinguishes a system from a mere aggregation of components.

This methodology is the aggregate of judgment of a group on whether and how the different elements are related. It is structural, based on mutual relationship, wherein an overall structure is extracted from the complex set of elements. The specific relationships and overall structure are portrayed in a digraph model. It helps to impose order and direction on the complexity of relationships among various elements of a system.

3.2.1 Steps in ISM

The various steps involved in ISM modelling are as follows:

- Identify the elements relevant to the problem either by a survey or group problem solving technique.
- Establish a contextual relationship between the identified elements with respect to which element pairs would be examined.
- Develop a structural self-interaction matrix (SSIM) of elements which is indicative of the pair-wise relationship among elements of the system and check for transitivity.
- Develop a reachability matrix from the SSIM and partition the reachability matrix into different levels.
- Draw digraph based on the relationship given in reachability matrix and remove transitive links.
- Convert the resultant digraph into an ISM based model by replacing element nodes with the statements.
- Review the model to check for conceptual inconsistency and make the necessary modifications.

Structural Self-Interaction Matrix (SSIM)

ISM methodology uses expert opinions based on various management techniques such as brain storming, nominal group technique, etc. in developing the contextual relationship among the variables. The experts from the industry and academia should be well versed with the problem at hand. For analysing the factors, a contextual relationship of 'leads to' or 'influences' type must be chosen wherein one factor influences another factor. A contextual relationship between the identified factors is developed based on the influence. Keeping in mind the contextual relationship for each factor and the existence of a relationship between any two factors (i and j), the associated direction of the relationship is framed. The following symbols are used to denote the direction of relationship between two factors/variables (i and j):

- V for the relation that factor/variable i will influence factor/variable j
- A for the relation that factor/variable j will influence factor/variable i
- X for the relation that both factors/variables i and j will influence each other
- O for no relation between the factors/variables (i.e. variables/factors i and j are unrelated).

The SSIM is developed, based on the contextual relationships elicited from the group of experts at the outset using a template. In order to obtain consensus, an odd number of experts' opinion is taken for having a dominant view on the relationship among the factors/variables. The SSIM, however, may be further discussed by the group of experts, in case of any ambiguity and be finalised before proceeding.

Reachability Matrix

Subsequent to SSIM, an initial reachability matrix is developed, by converting/ substituting the four symbols (i.e., V, A, X or O) by 1s or 0s. The rules for this conversion/substitution are as follows:

- The (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0, if the (i, j) entry in the SSIM is V
- The (i, j) entry in the matrix becomes 0 and the (j, i) entry becomes 1, If the (i, j) entry in the SSIM is A.
- The (i, j) entry in the matrix becomes 1 and the (j, i) entry also becomes 1, If the (i, j) entry in the SSIM is X.

- The (i, j) entry in the matrix becomes 0 and the (j, i) entry also becomes 0, If the (i, j) entry in the SSIM is O.

Following these rules, the initial reachability matrix is prepared. 1* entries are included to incorporate transitivity to fill the gap, if any, during development of structural self-interaction matrix. The final reachability matrix is obtained after incorporating the transitivity concept as described above.

Level Partitioning

For partitioning the variables for determining their levels in the hierarchical model, the reachability set and antecedent sets are derived from the final reachability matrix, for each factor. The reachability set consists of the factor itself and the other factor(s) that it may impact, whereas the antecedent set consists of the factor itself and the other factor(s) that may impact it. The intersection of these sets is identified and the variable/factor for which the reachability and the intersection sets are the same, is partitioned as level 1, occupying the top position in the hierarchy. Once the top-level factor is identified, it is removed from the reachability matrix and the same process is repeated to find out the variables/factors in the next level, until the level of each factor is found. The levels, thus identified, help in building the digraph and the ISM model.

Digraph and ISM Model

After level partitioning of the reachability matrix, a preliminary digraph including transitive links is prepared which is represented by nodes and lines of edges. After removing the indirect links, the final digraph is developed. A digraph, thus, is the visual representation of the elements and their interdependence. While developing the diagraph, the top-level factor is positioned at the top and second level factor is placed at second position and so on, until the bottom level is placed at the lowest position in the digraph. Digraph is then converted into an ISM model by replacing nodes (with numbers) of the factors with names of the variables/factors.

Limitations of ISM approach

While ISM methodology is a valuable technique adopting a systematic approach to understand the underlying relationships among the variables of a problem context, with the help of structured model presented graphically, it has its own set of limitations. The complexity of the ISM modelling increases with the increase in number of variables. Although software has been developed to address the complexity in modelling large number of variables, the subjectivity of the experts-who are limited in numbers- is yet another limitation of this tool. Further, these models are not statistically validated and hence cannot be generalized. However, Structural equation modelling (SEM)-a quantitative technique- can be used for testing the validity of such

3.2.2 MICMAC Analysis:

MICMAC is an acronym for Matriced'Impactscroises-multiplication appliqúe an classment (cross-impact matrix multiplication applied to classification). The objective of MICMAC analysis is to identify and analyse the driving and dependence power of variables/factors. It is based on the multiplicative properties of matrices and is done to identify the key factors/variables that affect the others. Based on the driving and dependence power, the variables are classified into four categories i.e. autonomous, linkage, dependent and independent factors/variables.

'Autonomous variables' have weak driving and weak dependence power and are relatively disconnected from the system or other variables in the system. 'Linkage variables' have strong drive power as well as strong dependence power. These factors are unstable in the fact that any action on these factors will have an effect on others and also a feedback effect on themselves. 'Dependent factors' have weak driving power but strong dependence power. And, 'Independent factors' have strong driving but weak dependence power. The factors with a very strong driving power, falls into the category of independent or linkage factors, and are often the critical/key factors.

4. Data Analysis And Interpretation

This section delineates the process adopted to analyse the data obtained from experts. At the outset, the elements/drivers of blockchain technology affecting Indian pharmaceutical sector as identified from the literature, are summarized in Table 4.1

Further, step by step analysis of the contextual relationships as obtained from the experts, using s template, is presented. In the end, the interpretation of the analysis is presented in order to derive the learnings from the model so obtained.

Step 1: Identification of the Drivers of Blockchain Technology Application

Table 4.1- List of the Drivers of Blockchain Technology in Pharma Sector

D.No.	Drivers of Blockchain Technology
D1	Provenance/Immutability
D2.	Data Governance and Record Management
D3.	Internal Process Management
D4.	Disintermediation or Decentralization
D5.	Cost Reduction
D6.	Preservation of IPR
D7.	Security and Trust

Step 2: Develop a structural self-interaction matrix which is indicative of the pair wise relationship of the drivers

Table: 4.2 - Structural Self Interactive Matrix

DRIVERS	7	6	5	4	3	2
1	V	V	V	O	V	V
2	X	V	V	V	V	
3	V	O	O	A		
4	V	V	O			
5	O	O				
6	O					

Step 3: Develop a Reachability matrix from the SSIM

Table 4.3 - Reachability Matrix

	D1	D2	D3	D4	D5	D6	D7
D1	1	1	1	1	1	1	1
D2	0	1	1	1	1	1	1
D3	0	0	1	0	0	0	1
D4	0	0	1	1	0	1	1
D5	0	0	0	0	1	0	0
D6	0	0	0	0	0	1	0
D7	0	1	0	0	0	0	1

Step 4: Partition the Reachability matrix into different levels

Table-4.4 Partitioning the reach ability matrix into different levels (Iteration-1)

Factors	Reach ability set	Antecedent Set	Intersection Set	Level
1	1,2,34,5,6,7	1	1	
2	2,3,4,5,6,7	1,2,7	2,7	
3	3,7	1,2,3,4	3	
4	3,4,6,7	2,4	4	
5	5	1,2,5	5	**I**
6	6	1,2,4,6	6	**I**
7	2,7	1,2,3,4,7	2,7	**I**

Table-4.5 Partitioning the reach ability matrix into different levels (Iteration-2)

Factors	Reach ability set	Antecedent Set	Intersection Set	Level
1	1,2,3,4	1	1	
2	2,3,4	1,2	2,7	
3	3,	1,2,3,4	3	**II**
4	3,4	2,4	4	

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Table-4.6 Partitioning the reach ability matrix into different levels (Iteration-3)

Factors	Reach ability set	Antecedent Set	Intersection Set	Level
1	1,2,4	1	1	
2	2,4	1,2	2	
4	4	2,4	4	III

Table-4.7 Partitioning the reach ability matrix into different levels (Iteration-4)

Factors	Reach ability set	Antecedent Set	Intersection Set	Level
1	1,2,4	1	1	V
2	2	1,2	2	IV

Table-4.8 Partitioning the reach ability matrix into different levels (Iteration 1-4)

Iteration	Reach ability set	Antecedent Set	Intersection Set	Level
1	5	1,2,5	5	I
1	6	1,2,4,6	6	I
2	2,7	1,2,3,4,7	2,7	I
3	3	1,2,3,4	3	II
3	4	2,4	4	III
4	2	1,2	2	IV
4	1,2,4	1	1	V

Step 5: Convert the reachability matrix into conical form
Table 4.9: Reachability Matrix

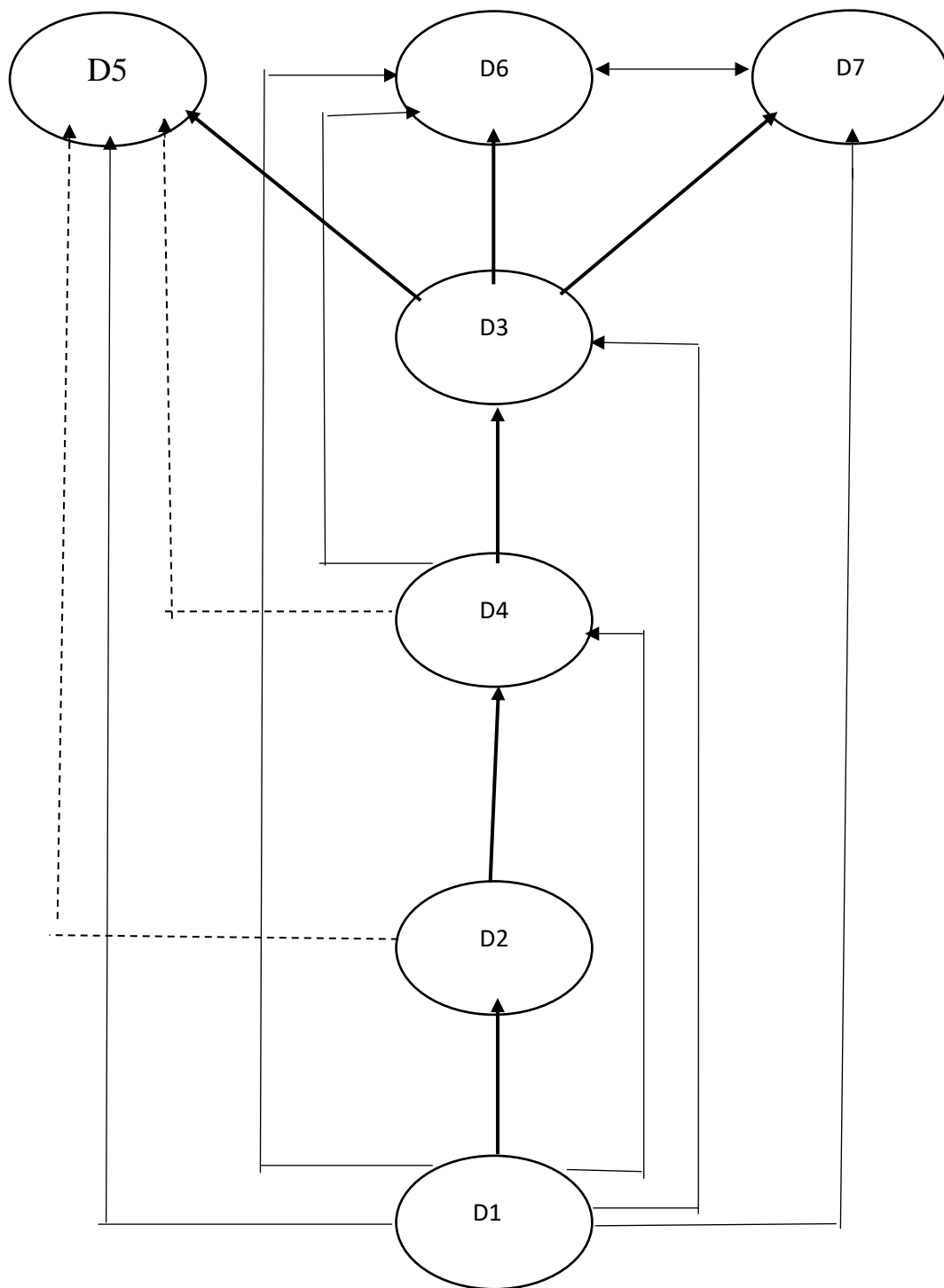|	D1	D2	D3	D4	D5	D6	D7	Driving power
D1	1	1	1	1	1	1	1	7
D2	0	1	1	1	1	1	1	6
D3	0	0	1	0	0	0	1	2
D4	0	0	1	1	0	1	1	4
D5	0	0	0	0	1	0	0	1
D6	0	0	0	0	0	1	0	1
D7	0	1	0	0	0	0	1	2
Dependence	1	3	4	3	3	4	5	

Fig. 4.1: Digraph

Step 7: Interpretive Structural Model
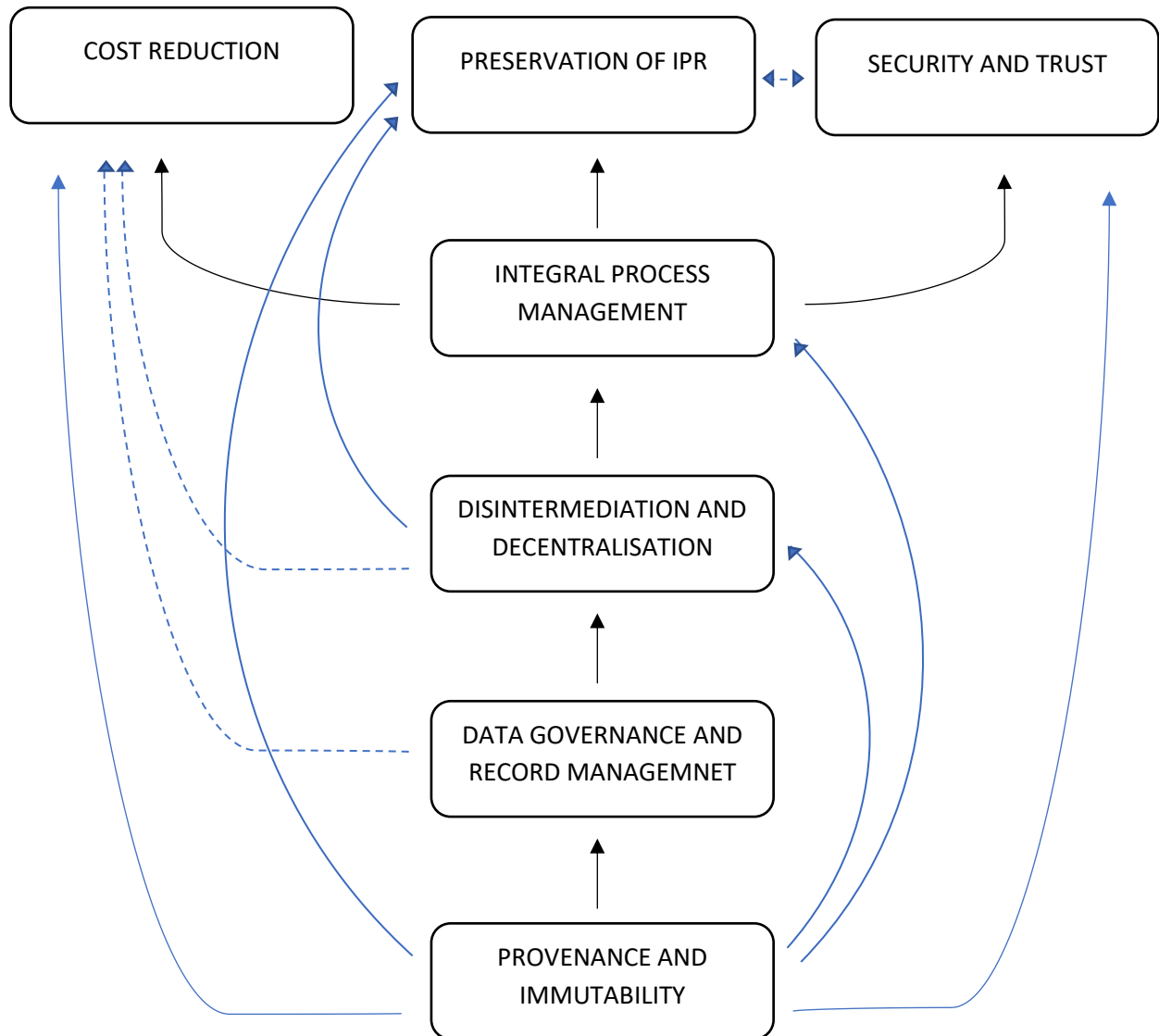
Fig. 4.2: Modelling the drivers of Blockchain technology in Indian Pharmaceutical Sector

Interpretation

- Provenance and Immutability emerged as the most significant driver for blockchain adoptionwith regard to the Indian pharmaceutical industry. Beingthe fundamental driver, it had direct linkages with all the other drivers i.e. it influences each of them which is also shown in the ISM.

- Provenance and Immutability had a direct relationship with the next driver i.e. Data governance and Record Management. Both these drivers complement each other as provenance of data directly leads to its better management. And thus, data becomes accessible to all parties in the need of time. Also, this will lead to elimination of 3rd parties that are paid for data management thus reducing costs (shown with a dotted line).

- Decentralization being a primary feature of blockchain finds itself in the 3rd level of our matrix. Disintermediation of information has direct linkages with immutability, preservation of IPR and thus ensuring trust and security.

- Internal process management comes on the 4th level of our matrix. Again, it has direct linkages with cost reduction and security and trust. Also, it has transitive relations with provenance and immutability which is plausible as transparency of data will ensure better management of information.

- Cost reduction, Preservation of IPR and Security and trust comes at the top level of our matrix these factors have high dependence which is evident as a lot of driving factors like immutability, data intermediation, decentralisation of information when taken into picture will cancel the need of several third parties which are currently required for data management tasks. This will eventually reduce the cost and enhance security and trust in the network.

- Based on the understanding of the text, disintermediation and data governance will eventually lead to the removal of various third-party systems which are employed for it. Thus, it will lead to cost reduction. This relationship is shown by dashed lines in the ISM.

- The above model in essence indicates that the key drivers of blockchain adoption for the Indian Pharmaceutical Industry are data immutability and data governance which will lead to other drivers falling in the higher levels. Cost Reduction, Better preservation of IPR, Security and trust are all outcomes of data immutability and decentralisation.

4.4 Micmac Analysis

Micmac analysis helps in categorisation of variables of the study in terms of driving and dependence power. The drivers are classified into 4 different clusters based on their driving and dependence power, which is derived from the reachability matrix.

Table 4.10: Dependence and Driving powers of the drivers of Blockchain Technology

DRIVING	7	D1						
POWER	6			D2				
	5	INDEPENDENT				LINKAGE		
	4			D4				
	3	AUTONOMOUS				DEPENDENT		
	2				D3	D7		
	1				D5	D6		
		1	2	3	4	5	6	7
		DEPENDENCE						

The first cluster is a group of autonomous drivers that have weak driving and weak dependence power. These are relatively disconnected. The result shows that none of the drivers fall in this quadrant.

- The second cluster is a group of dependent variables that have weak driving and strong dependence power. Internal process management(D3), Cost reduction(D5), Preservation of IPR(D6) and Security and Trust(D7) fall in this quadrant.
- The third cluster is a group of linkage variables that have strong driving force and strong dependence power. These variables are very important variables as they have a significant impact on the variables and therefore a change in these variables could have a ripple effect on all the other variables. In our case there are no such drivers.
- The fourth and last cluster is a group of independent variables that have strong driving and weak dependence power. In our case Provenance and Immutability(D1), Data governance and record management(D2) and Disintermediation and decentralisation

(D4) fall in this cluster. Hence, these are the most important drivers and have a great influence on other drivers.

5. Conclusions and Suggestions

In this study Interpretive Structural Modelling (ISM) based model has been developed for ascertaining the relationship between the drivers of Blockchain Technology in the Pharmaceutical sector in Indian context. An attempt has been made to identify the relevant drivers of Blockchain Technology in the discussed sector. Although many articles are available with depict that how important it is that the Indian Pharmaceutical Sector gets a Blockchain prescription but no study has been done to understand that what drivers of this technology would play an important role in the in the Indian context and their interactions. The contribution of this research work is the development of contextual relationships among variables. MICMAC analysis gives a better understanding of the ISM model and also provides a more valuable insight towards the priority and importance of the drivers of Blockchain Technology. Some key conclusions of the study are listed as follows:

- One of the major finding of this study is that out of the 7 drivers and characteristics of this technology, 3 drivers were found to be the strongest (Provenance and Immutability, Data governance and record management and Disintermediation and Decentralization). Also, according to Micmac analysis, these drivers have strong driving and weak dependence power and lie at the bottom of the ISM hierarchy.

- This can help the Indian Pharmaceutical industry to focus on the priorities while adopting the Blockchain technology and thus leading to better implementation of this technology.

- Cost reduction, Preservation of IPR and Security and trust are the factors with low driving power and high dependence. They are placed at the top of the ISM model.

- According to their positions in the driving power and dependence diagram, the drivers need the required attention and prioritization while adopting this technology in the Indian Pharmaceutical sector.

- Based on the model obtained in the study, Indian Pharmaceutical Sector should give more importance to the drivers which have high driving power so that ot can reduce the effects of key challenges that this technology could provide.

Some of the key suggestions are as follows:

- The pharmaceutical supply chain blockchain could be a 'private' blockchain, overseen by a government regulator. The parties involved in the supply-chain log their data into a common blockchain. The production factory logs the production date and time of each batch and unit. The loading dock logs when a batch was loaded onto the truck. The temperature sensors on the truck report real-time temperatures into the blockchain, and soon.This level of real-time visibility to all stakeholders means problems can be detected and remediated quickly. The data is also immune from tampering. When a consumer buys a medicine, they can also scan the barcode on the packet to instantly verify the authenticity of the medicine from the blockchain and receive any alerts about it.

- Blockchain could bring unprecedented transparency and security in Supply Chain Management (SCM). Blockchain is really useful in building a tamper-proof pharma Supply Chain Management, with original inbuilt security features to stop the circulation of substandard drugs and counterfeiting. Even at the level of individual Stock Keeping Unit (SKU), the blockchain will ensure the tracking of the supply chain for specific sources of any product, by establishing proof of ownership.

- A blockchain network could make sure that only authorized stakeholders willing to join the network are allowed to monitor their actions and medicines and provide information so that only trusted stakeholders are let to do business on the blockchain.

- Also, not all stakeholders of the chain need to have access to the shared ledger. The main objective of the shared ledger is to provide safe medicine and make information, material and cash flows more efficient and secure therefore, starting from the beginning of the (forward) supply chain, the first stakeholders required are R&D labs. Based on their work, new patents are created which will exist on the blockchain as intangible assets, and drug producers can buy rights for production with the help of smart contracts.

- The suppliers of R&D labs are not required to join the blockchain, because their products will not end up in the medicines transported through the supply chain.

- Drug production facilities could also get represented on the blockchain. Their suppliers providing raw materials for drug production are in the network, too. Therefore, by certifying raw material producers and monitoring material flow from them to production facilities, the risk of counterfeit drugs can be lowered.

- All the stakeholders in delivery and dispensing are represented in the network, as they are involved in the supply chain and medicines are distributed through them. These include delivery facilities, wholesalers, hospitals, clinics, pharmacies, government buyers and the end users – patients. Patients are included in the network if they purchase medicines themselves (through pharmacies) and thus determine themselves, which medicine should be used in which situation. For example, in hospitals staff is responsible for giving the right drugs and hospitals make the last purchase of the supply chain before consumption of the product.

- All service intermediaries contribute to at least one of the three flows of the supply chain (cash, information, materials) and thus they should be included on the blockchain. For example, third-party transporters can provide information regarding location of the product and drug disposal service providers can automatically be rewarded for disposing of drugs.

- Information intermediaries play a big role on the blockchain. As stated earlier, a government-run regulatory agency should host the blockchain, but also other organizations can be included in the network in order to gather vital information regarding the pharmaceutical supply chain. These organizations can include NGOs and organizations that unite companies in the industry.

- Blockchain technology enables verifying transactions and participating entities without revealing the information and the entities themselves to the public. This is achieved by encryption and the combination of private and public keys. Considering the pharmaceutical supply chain, this allows regulators, supervisors and other stakeholders to verify secure transactions and still lets business partners maintain their trade secrets. For the first-time competitors may share all their transactions with one another and still protect their privacy.

- Commercializing new products is vital for the company to continue R&D work in the future, too. Still, it takes a lot of time from the patent application to market launch and a product only has a few years before the patents expire (Bayer, 2016). Thus, improvements in protecting and commercializing patents can have an enormous impact on the bottom line.

- On the blockchain, patents could be secured with strong encryption so that virtually no intellectual property may be stolen. Furthermore, smart contracts allow flexible ways to

commercialize patents, as stated earlier. Thus, by applying shared ledgers, smart contracts and powerful encryption technology, pharmaceuticals companies and medical device makers can eliminate costly intermediaries and more effectively ensure security, immutability, transparency, auditability and trust across the value chain.

An immutable blockchain would mitigate selective reporting, data fudging and any risk of consent fraud. The two top hurdles to adoption are perceived to be regulatory issues and data privacy. These are both short-term hurdles. Regulators are globally reviewing how blockchain can help the industry and the blockchain community in adding data privacy to the platforms. A proof-of-value prototype is an excellent place to begin, followed by a pilot with a limited set of partners. This will set one on the correct path to adoption with optimal outcomes and minimal risk.

The ISM model developed is based on expert opinion of few people, therefore, some amount of bias could not be discounted. One major issue faced was collecting responses from the experts of Blockchain technology who work in this particular sector. Therefore, the set of people who could fill this template was quite small. Finally, there was limited time period to carry out the work. However, despite the limitations of the study reported in this research paper, it can be concluded that adoption of blockchain technology is inevitable, especially the pharmaceutical domain, given a strong set of driving forces as highlighted in this paper.

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Appendix
TEMPLATE-1

According to an analysis developed via reading several published papers on the use of Blockchain Technology in several sectors world-wide, the following drivers of using Blockchain Technology in the Indian Pharmaceutical setup have been identified:

Element. No.	Drivers of Blockchain Technology (For further explanation plz. refer to Appendix in the end)
D1.	**Provenance/Immutability**
D2.	**Data Governance and Record Management**
D3.	**Internal Process Management**
D4.	**Disintermediation or Decentralization**
D5.	**Cost Reduction**
D6.	**Preservation of IPR**
D7.	**Security and Trust**

Please indicate your response to the relationship between the pair of 'Drivers of Blockchain Technology' With respect to the Indian Pharmaceutical sector, as given below, by writing 'Y' for 'Yes' and 'N' for 'No' and also cite the reason for the same, in brief.

S. No.	Element No.	Paired Comparison of Drivers of BCT	Y/N	In what Way a driver will influence/enhance other driver? Give reason in brief
		D1-Provenance/ Immutability		
1	D1-D2	*Provenance/Immutability* will influence or enhance*Data Governance and Record Management*		
2	D2-D1	*Data Governance and Record Management* will influence or enhance*Provenance/Immutability*		
3	D1-D3	*Provenance/Immutability* will influence or enhance *Internal Process Management*		
4	D3-D1	*Internal Process Management* will influence or enhance		

		Provenance/Immutability		
5	D1-D4	*Provenance/Immutability* will influence or enhance *Disintermediation or Decentralization*		
6	D4-D1	*Disintermediation or Decentralization* will influence or enhance *Provenance/Immutability*		
7	D1-D5	*Provenance/Immutability* influence or enhance *Cost Reduction*		
8	D5-D1	*Cost Reduction* will influence or enhance *Provenance/Immutability*		
9	D1-D6	*Provenance/Immutability* will influence or enhance *Preservation of IPR*		
10	D6-D1	*Preservation of IPR* will influence or enhance *Provenance/Immutability*		
11	D1-D7	*Provenance/Immutability* will influence or enhance *Security and Trust*		
12	D7-D1	*Security and Trust* will influence or enhance *Provenance/Immutability*		
D2- Data Governance and Record Management				
13	D2-D3	*Data Governance and Record Management* will influence or enhance *Internal Process Management*		
14	D3-D2	*Internal Process Management* will influence or enhance *Data Governance and Record Management*		
15	D2-D4	*Data Governance and Record Management* will influence or enhance *Disintermediation or Decentralization*		

16	D4-D2	*Disintermediation or Decentralization* will influence or enhance *Data Governance and Record Management*		
17	D2-D5	*Data Governance and Record Management* will influence or enhance *Cost Reduction*		
18	D5-D2	*Cost Reduction* will influence or enhance *Data Governance and Record Management*		
19	D2-D6	*Data Governance and Record Management* will influence or enhance *Preservation of IPR*		
20	D6-D2	*Preservation of IPR* will influence or enhance *Data Governance and Record Management*		
21	D2-D7	*Data Governance and Record Management* will influence or enhance*Security and Trust*		
22	D7-D2	*Security and Trust* will influence or enhance *Data Governance and Record Management*		
D3 - Internal Process Management				
23	D3-D4	*Internal Process Management* will influence or enhance *Disintermediation or Decentralization*		
24	D4-D3	*Disintermediation or Decentralization* will influence or enhance *Internal Process Management*		
25	D3-D5	*Internal Process Management* will influence or enhance *Cost Reduction*		
26	D5-D3	*Cost Reduction* will influence or enhance *Internal Process Management*		
27	D3-D6	*Internal Process Management* will		

		influence or enhance *Preservation of IPR*		
28	D6-D3	*Preservation of IPR* will influence or enhance *Internal Process Management*		
29	D3-D7	*Internal Process Management* will influence or enhance *Security and Trust*		
30	D7-D3	*Security and Trust* will influence or enhance *Internal Process Management*		

D4- Disintermediation or Decentralization

31	D4-D5	*Disintermediation or Decentralization* will influence or enhance*CostReduction*		
32	D5-D4	*Cost Reduction* will influence or enhance *Disintermediation or Decentralization*		
33	D4-D6	*Disintermediation or Decentralization* will influence or enhance *Preservation of IPR*		
34	D6-D4	*Preservation of IPR* will influence or enhance *Disintermediation or Decentralization*		
35	D4-D7	*Disintermediation or Decentralization* will influence or enhance *Security and Trust*		
36	D7-D4	*Security and Trust* will influence or enhance *Disintermediation or Decentralization*		

D5- Cost Reduction

37	D5-D6	*Cost Reduction* will influence or enhance *Preservation of IPR*		
38	D6-D5	*Preservation of IPR* will influence or enhance *Cost Reduction*		
39	D5-D7	*Cost Reduction* will influence or enhance *Security and Trust*		
40	D7-D5	*Security and Trust*will influence or enhance *Cost Reduction*		

D6- Preservation of IPR				
41	D6-D7	*Preservation of IPR* will influence or enhance *Security and Trust*		
42	D7-D6	*Security and Trust* will influence or enhance *Preservation of IPR*		

Sustainable distribution network design of a supply chain

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Abstract-

Extreme climate change caused by modern exercises of manufacturing firms has prodded supply chain policymakers to design their supply chain structure in line with the optimal trade-off of Economic, Environmental and Social Sustainability. Moreover, data uncertainty impels great attention among researchers and practitioner. This paper proposed a multi-objective possibilistic mixed-integer linear programming model, which try to curtail the "Economic and Environmental burden" and maximize Social accountability. This paper explicitly includes uncertainty issues in all the three sustainable dimensions at transportation and distribution level of the supply chain. A combined fuzzy solution approach and ε-constraint method have been employed to solve the proposed mathematical model. Epsilon (ε) constraint method provides a range of Pareto-optimal solutions. Obtained results showed a large combination of a trade-off between the objectives from which the decision-makers can set their trade-off as per their preferences, which can be helpful in the tactical and strategic decision making during the network design.

Keywords: Possibilistic programming approach, ε-constraint method, distribution network design, Social accountability, Environmental Sustainability.

1. Introduction

(*Emissions Gap Report 2018*, n.d.) highlights, the efforts to reduce environmental deterioration is not in the track due to uncertainty, and undefined climate controls programs. "Window of opportunity" to curtail the ecological destruction is closing rapidly (*Greenhouse Gas Bulletin*, 2018). Fast-growing urbanization has tremendously increased carbon emission and with the current pace will lead to a severe impact on the humankind (Li, Chen, Gan, & Lau, 2018). To alleviate these challenges, government, environmental agencies and researchers around the world have taken various initiatives. such as, Green Supply Chain (GSC) management (Boonsothonsatit, Kara, Ibbotson, & Kayis, 2015; Shaw, 2017), Sustainable supply chain network design (Arampantzi & Minis, 2017; Ahmed & Sarkar, 2018) Green supplier selection (Shaw, Shankar, Yadav, & Thakur, 2013; Yu, Yang, & Chang, 2018), Sustainable supply chain performance management (Foo, Lee, Tan, & Ooi, 2018) and Green lot sizing (Bushuev, Guiffrida, Jaber, & Khan, 2015; Absi, Dauzère-Pérès, Kedad-Sidhoum, Penz, & Rapine, 2016).

In the early 90s, conventional Supply Chain Network Design (SCND) purpose was to maximize the overall profit or to decrease total Supply Chain (SC) cost by optimized decision making of the activities, such as determining the number of plants, Distribution Centres (DC), warehouses, transportation mode, and quantity to be produced (Beamon, 1998; Farahani, Rezapour, Drezner, & Fallah, 2014). Due to global warming decision-makers now envisage, how to reduce carbon footprints of Supply Chain Network (SCN) and maximize social sustainability (Wu & Pagell, 2011; Arampantzi & Minis, 2017). Moreover, consumer preferences towards greener product and stringent environmental cap by the government lead decision-makers to focus more on to design SCN environment-friendly and sustainable (de Oliveira, Espindola, da Silva, da Silva, & Rocha, 2018). Around 50-70 percent emission is generated due to SC activities (Ahmed & Sarkar, 2018). Therefore, in recent year's carbon emission reduction become the prime challenge for the organization. (Waltho, Elhedhli, &

Gzara, 2018) argued that different types of carbon emission policy have already implemented such as carbon offset, carbon cap, cap-and-trade, and the carbon tax. However, the study found that uncertainty and social accountability are still in the infancy stage. Dynamic and complexity imposed a high degree of unpredictability in decision making (Pishvaee & Torabi, 2010; Pishvaee & Razmi, 2012; Vafaeenezhad, Tavakkoli-Moghaddam, & Cheikhrouhou, 2019). Therefore, to overcome this challenge this study, developed a multi-objective mathematical model based on fuzzy probabilistic programming and ε-constraint method to handle different type of uncertainty in the decision making, pertaining to economic, environmental and social sustainability.

2. Literature review

For several years, SCND turned out to be the leading research area and significant studies have been done (Waltho et al., 2018). A well-optimized SCND could save a substantial amount of resources and deliver a higher profit to the organization (Eskandarpour, Dejax, Miemczyk, & Péton, 2015). Nowadays, every organization designs its SCN with environmental sustainability due to the need of the present situation of global warming (Shaw, Irfan, Shankar, & Yadav, 2016). Moreover, social sustainability is still in an infancy stage with less attention (Das & Jharkharia, 2018).

(Coenen, Van der Heijden, & van Riel, 2018; Das & Jharkharia, 2018) delivered a comprehensive assessment on SCND tools and techniques, as well as these studies pointedly stating the gap towards the development of a sustainable SCND concerning environmental, social and economic dimensions. (Eskandarpour et al., 2015) scrutinized 87 peer-reviewed paper and advocated varied theoretical approaches, modeling techniques, and solution methods, such as Life Cycle Assessment (LCA), partial assessment of environmental factors and performance measurement, Various modeling methods as, deterministic models, stochastic models, and multi-objective models. Similarly, (Govindan, Fattahi, & Keyvanshokooh, 2017) gave a noteworthy picture of an uncertain environment. According to the study uncertainty grouped into three major classes (1) probability distribution is known with random parameters, (2) probability distribution is unknown with random parameters, (3) fuzzy environment (ambiguity and vagueness). Furthermore, (Das & Jharkharia, 2018) exhibited the importance of emission reduction using a content analysis approach. (Garg, Shukla, Kankal, & Mahapatra, 2017) determined the consumption of fossil fuels by the logistic sector accounted on around 91% of carbon emissions. (Paksoy & Özceylan, 2014) developed a mathematical model to reduce carbon emissions, noise pollution and total cost between two-echelon SC. Similarly, (Manupati, Jedidah, Gupta, Bhandari, & Ramkumar, 2019) constructed a mathematical model to optimize the multi-tier production distribution under a carbon tax, strict carbon cap, and cap-and-trade policies. (Peng, Ablanedo-Rosas, & Fu, 2016) developed a multi-period bi-objective one-tier SCN to minimize emission and total cost between plants and distribution points. (Alkhayyal & Gupta, 2018) constructed a single period mixed integer linear programming model to reduce the total cost and carbon emission for reverse SC.

However, conferred studies did not address uncertainty issues in SC. In a real scenario; Uncertainty is always presented in demand, cost, emission, and logistic (Coenen et al., 2018). Hence in the design phase of the Sustainable SCN, uncertainty should be taken into consideration (Waltho et al., 2018). Even though few studies have addressed the uncertainty issues, such as (Shaw et al., 2016) proposed an SCN model based on low carbon chance-constrained. (Jindal & Sangwan, 2014) proposed a multi-objective Fuzzy-MILP model for closed-loop SCN under uncertain parameters. Similarly, (Torabi & Hassini, 2008; Kabak & Ülengin, 2011; Bouzembrak, Allaoui, Goncalves, Bouchriha, & Baklouti, 2012) have

developed forward and reverse SCN under uncertain environmental conditions, and they adopted fuzzy possibilistic programming approach. Surprisingly, to our best knowledge, none of the studies have considered epistemic uncertainty in all three sustainability parameters. To overcome this gap, we have applied the possibilistic programming approach and proposed a mathematical model considering the uncertainty in all three sustainable dimensions, as well as provided optimal trade-offs between economic, environment and social accountability.

3. Model development

In this study a Multi-objective Possibilistic Mixed Integer Linear Programming (MPMILP) model comprises of three layers: with multiple plants, products, DC, modes, and customer is proposed. The main issues addressed in the proposed network under uncertainty of total capacity of plants, products capacity at plants, the variable cost, transportation cost, demand uncertainty, uncertain healthy working environment and job creation concerning three conflicting objective functions. (1) minimizing the total cost (2) minimizing the total carbon emission (3) maximizing social accountability with a reasonable trade-off.

This study does not inculcate supplier, because the prime focus is given at the DC and transportation. To clarify, past studies stated that the activities involved in the consumption of resources by warehouses and logistics have a considerable level of impact on sustainability (Piecyk, Browne, Whiteing, & McKinnon, 2015). The author also argued that less attention has been given to logistics and warehouses while evaluating the carbon imprints within the SCN. According to the report of (*EPA*, 2017) transportation accounts for 28.9 percent greenhouse emissions primarily by burning of fossil's fuels. Similarly, (Fichtinger, Ries, Grosse, & Baker, 2015) argued that activities related to logistics and DC account on a significant amount of CO_2 emission, which is neglected and did not receive much attention from the researchers.

Indices
i	Products
j	Plants
k	Distribution centres
l	Customers
m	Modes

Parameters
f_k	Distribution centre k fixed cost
Z_k	Indicator for opening distribution centre k
$\widetilde{Cost_{ji}^{pu}}$	Manufacturing cost per unit of product i at plant j
$\widetilde{CG_{jkm}}$	Transportation cost per unit from plant j to distribution centre k via mode m
$\widetilde{C_k^{du}}$	Distribution centre k variable cost
$\widetilde{CG_{klm}^{ship}}$	Transportation cost per unit from distribution centre k to customer l via mode m
$\widetilde{PE_{ji}}$	Carbon emission from manufacturing of product i at plant j
$\widetilde{CAR_{jkm}^{pd}}$	Transportation emission per unit from plant j to distribution centre k via mode m
$\widetilde{CAR_{klm}^{dc}}$	Transportation emission per unit from distribution centre k to customer l via mode m
$\widetilde{S_{ji}}$	Capacity of plant j for product i
$\widetilde{T_j^{cap}}$	Total capacity of plant j
$\widetilde{CAP_k}$	Aggregate distribution centre k capacity
$\widetilde{D_{li}}$	Demand for product i from customer l

$\widetilde{Jo}$ Number of job opportunity when distribution centre k opens

$\widetilde{Hw}$ Percentage of healthy working environment with distribution centre k

Decision variables

x_{jikm} Quantity shipped/unit from plant j to distribution centre k

w_{kilm} Quantity shipped/unit from distribution centre k to customer l

3.1. Model construction

we have constructed three objectives pertaining to delineate with social, environmental and economic dimensions.

First objective: Minimizes total cost which includes fixed cost associated with DC, production cost per unit associated with plant, variable cost associated with the DC, and transportation cost from plant to DC and DC to customer.

$$z_1 = \sum_k^K f_k . Z_k + \sum_j^J \sum_i^I \sum_k^K \sum_m^M \widetilde{Cost_{ji}^{pu}} . x_{jikm} + \sum_j^J \sum_i^I \sum_k^K \sum_m^M \widetilde{CG_{jkm}} . x_{jikm} \tag{1}$$

$$+ \sum_j^J \sum_i^I \sum_k^K \sum_m^M \widetilde{C_k^{du}} . x_{jikm} + \sum_k^K \sum_i^I \sum_l^L \sum_m^M \widetilde{CG_{klm}^{ship}} . W_{kilm}$$

Second objective: Minimizes total emission which includes carbon emission associated with plants and transportation from plant to DC and DC to customer.

$$z_2 = \sum_j^J \sum_i^I \sum_k^K \sum_m^M \widetilde{PE_{ji}} . x_{jikm} + \sum_j^J \sum_i^I \sum_k^K \sum_m^M (\widetilde{CAR_{jkm}^{pd}} . x_{jikm} \tag{2}$$

$$+ \sum_k^K \sum_i^I \sum_l^L \sum_m^M \widetilde{CAR_{klm}^{dc}} . W_{kilm}$$

Third objective: Maximizes social accountability which includes job opportunities and percentage of healthy working environment with opening DC.

$$z_3 = \sum_k^K (\widetilde{Jo} + \widetilde{Hw}) . Z_k \tag{3}$$

Constraints

Eq. 4 assures that products coming from the plants should not surpass its production capacity.

$$\sum_k^K \sum_m^M x_{jikm} \leq \widetilde{S_{ji}}, \quad \forall i,j \tag{4}$$

Eq. 5 assures that flow of products from plants should not surpass its total production capacity.

$$\sum_{j}^{J}\sum_{i}^{I}\sum_{k}^{K}\sum_{m}^{M} x_{jikm} \leq \widetilde{T_{J}^{cap}}, \quad \forall j \tag{5}$$

Eq. 6 shows the balanced inbound and outbound flow of products through DCs.

$$\sum_{j}^{J}\sum_{m}^{M} x_{jikm} = \sum_{l}^{L}\sum_{m}^{M} w_{kilm}, \quad \forall i, k \tag{6}$$

Eq. 7 assures that the quantity of products coming from the plants should not surpass the available capacity of the DCs.

$$\sum_{j}^{J}\sum_{i}^{I}\sum_{m}^{M} x_{jikm} \leq \widetilde{CAP_{k}}.Z_{k}, \quad \forall k \tag{7}$$

Eq. 8 depicts the binary property of the variables.

$$Z_{K} \in \{0,1\} \quad \forall, k \tag{8}$$

Eq. 9 assures the demand of customers served by the DCs must be fulfilled.

$$\sum_{k}^{K}\sum_{m}^{M} W_{kilm} \geq \widetilde{D_{li}}, \quad \forall i, l \tag{9}$$

Assumptions:

— Transportation volume is constant.
— No shortage is allowed.
— Single period is considered.

3.2. Equivalent crisp model

There are quite a few techniques available for solving possibilistic mathematical model (Pishvaee & Razmi, 2012). In this study, we have adopted methodology elaborated in (Jiménez, Arenas, Bilbao, & Rodrı, 2007; Pishvaee & Torabi, 2010; Bouzembrak et al., 2012).

4. Methodology

We have employed a two-phase approach. Initially, we developed an MPMILP model. In the first phase developed model has been converted into the equivalent-crisp model by using (Jiménez et al., 2007) method. In the second phase, the equivalent-crisp model solved using the ε-constraint method.
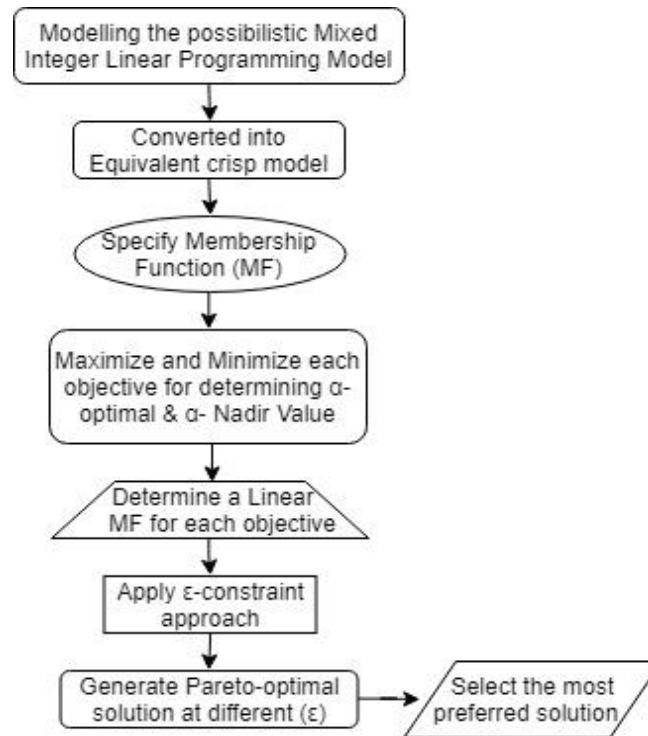
Fig. 1: Flow chart of proposed methodology

5. Implementation and computation

This section delineates the legitimacy and usefulness of the proposed MPMILP model. A hypothetical case study of manufacturing industries is presented and experiments have been carried out and results are reported in the next section. A hypothetical case study with multiple plants, product, DC, and customers has been designed from expert knowledge. The prime objective is to find the number DC considering the sustainable dimension. The problem comprises of three plants, four DC and five customers dealing with two products. To evaluate the performance of the proposed model we have applied distinct minimum acceptable feasibility degrees (i.e. α-value ranging from 0.1 to 0.9) and for distinct α-value, we have generated a range of Pareto-optimal solutions by the help of ε-constraint approach.

6. Results analysis
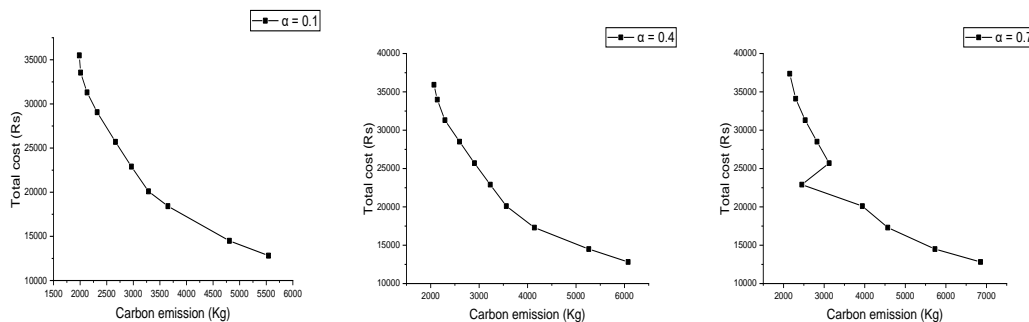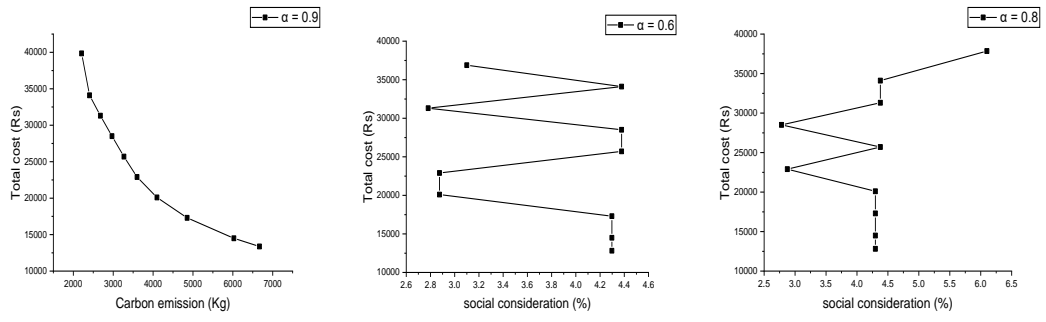
Fig. 2: trade-off between total cost and social accountability
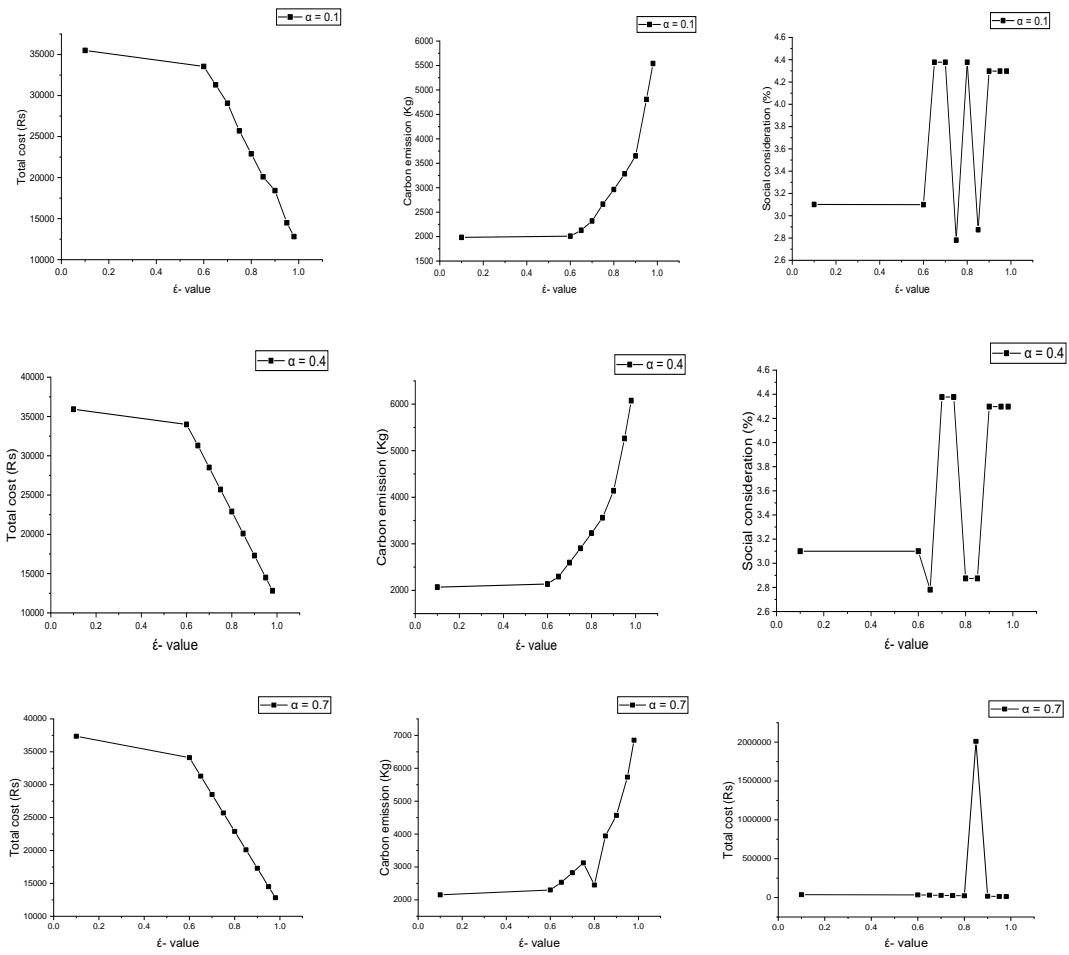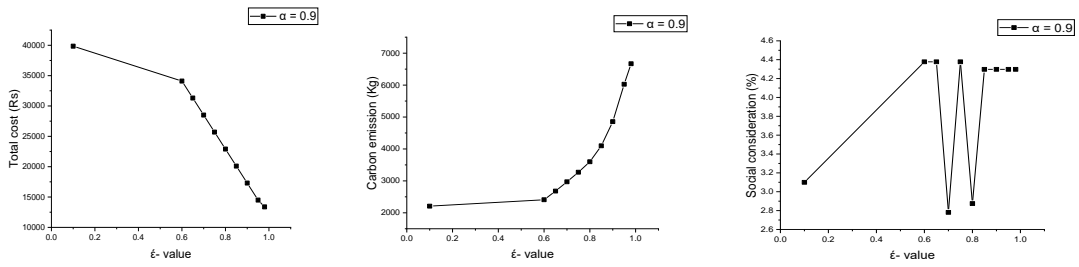
Fig. 3: Pareto curves at distinct α-values
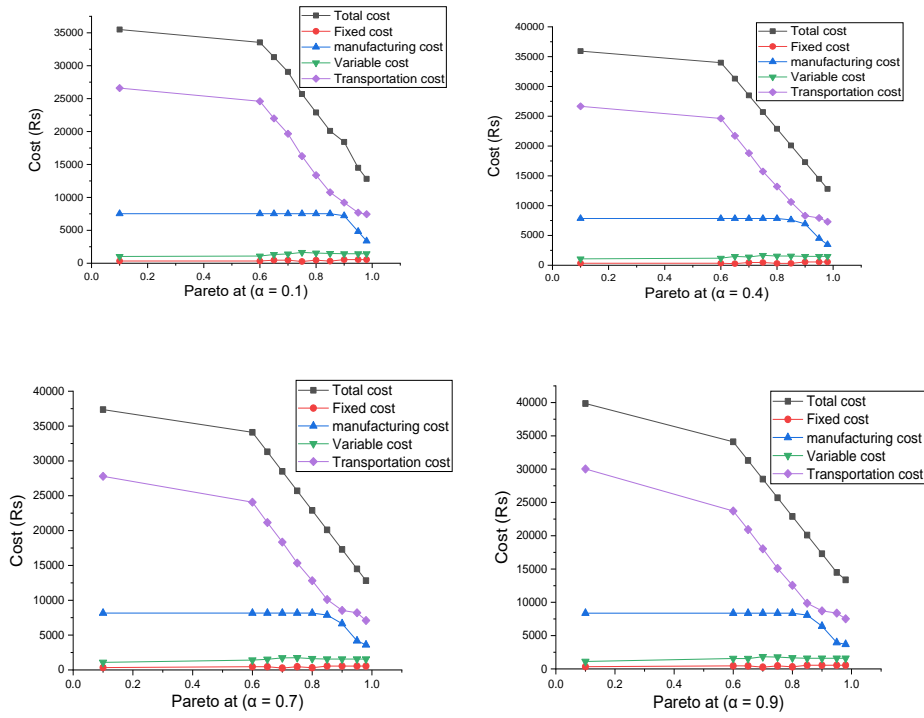
Fig. 4: Different cost associated with SCN
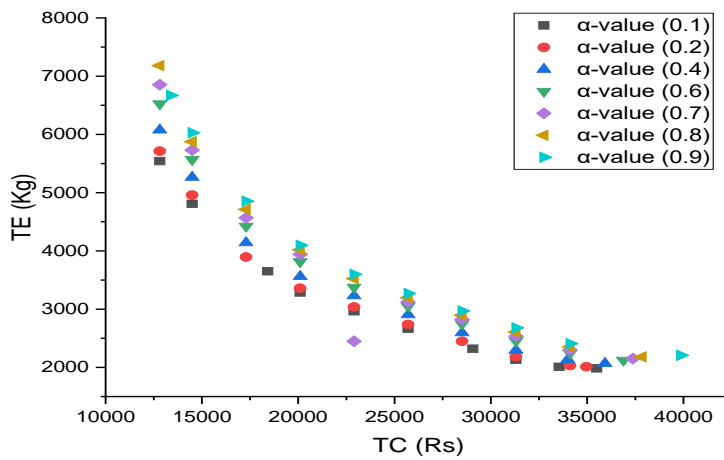
Fig. 5: Sensitivity analysis of distinct α-cut values

Results exhibited; the degree of satisfaction improved with increasing minimum acceptable feasibility (i.e. α value). Figure 2, illustrates the trade-off relationship between the three

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objectives. We noted that with an increased total cost in the SC by acquiring better environmentally friendly technologies and skilled workers, carbon emission considerably reduced as well as social accountability has been achieved with a good percent. Therefore, we can say, the proposed model helps countries like India, which are most suffered from environmental pollution as well as social negligence. According to figure 4, we noted that transportation cost adheres the major portion of the total cost of the SC, and more carbon emitted. While manufacturing cost comes second following with variable and fixed cost. It can be seen that there is no significant change in fixed cost but transportation cost drastically reduced with increasing ε-value. It is surprisingly seen that transportation cost is minimum at $\alpha = 0.8$ and $\varepsilon = 0.98$ with 4.297 percent of social betterment but affecting the environment with a score of 7181.531 Kg of carbon emission. As a result, it seems that by varying α-cut and ε-values, there are different results can be generated. So, decision-makers set values as per their preferences to get the optimal solutions. The scatter diagram from figure 5, shows the sensitivity analysis with distinct α-values. It can be observed that total emission and total cost varied according to the different α cut values.

7. Conclusion, managerial importance and future scope

In this study, an attempt has been made to address issues pertaining to economic, environmental and social sustainability under uncertain business environment. The proposed MOPMILP model minimizes total cost and carbon emission and maximization of social accountability of the SC under epistemic uncertainty. Ill-known parameters have been handled by adopting fuzzy possibilistic programming approach. To get the optimal trade-off between the three objectives ε-constraint method has been applied though which Pareto optimal set is generated by varying the ε-value according to the distinct minimum acceptable feasibility degree. The proposed model has been solved by LINGO 8.0 optimization software. We test the model by a three-node SC example with a hypothetical case study. The Pareto optimal curve by the model gives a collection of configurations for decision-makers to choose an optimal trade-off according to their preferences. Thus, it shows that our model can serve as an effective tool in designing an SSCN. It should be considered by decision-makers that if limited carbon emission and higher social accountability are desirable, it is logical to invest more in the design of SC.

The results from this study conduce meaningful insight for managers of SC firm. The model can easily be adopted by any firm to address sustainability issues in their organization. As the methodology provides a portfolio of configurations through Pareto optimal curve. Managers can set their trade-off according to the need of the organizations.

This study has some of the limitations. For example, in this study carbon emission has been counted as a principal parameter for measuring environmental sustainability as well as job creation and healthy working environmental have been taken for evaluating social sustainability. In perspective on these issues, future research might be led by attending to more important issues with more dimensions, like risk analysis in SC, ethical and political consideration, measurement of gases other than carbon emission. In addition to this, the proposed model can be tested in a real-time scenario.

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Identification of Circular Economy Risk from Indian manufacturing perspective

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Abstract-

In today's manufacturing scenario, firms need to be aware of their supply chain operations and its interaction with the environment. With the fierce global competition and the ever increasing consumer demand companies need to inculcate environment oriented practices throughout their supply chain operations. Solution to this issue is Circular Economy. Circular Economy is one of the important supply chain management strategies that the manufacturing industries look to adopt in their business model. The adoption of Circular Economy as a business strategy not only makes the organization more environmental cautious but also has a major economic advantage with its implementation. However, Circular Economy being a novel strategy in today's business scenario its effective implementation requires identification and mitigation of risk involved with its application in the manufacturing sector. In this regard, effort has been made to identify risks involved with the implementation of Circular Economy from the Indian manufacturing context. This will not only assist the manufacturing organizations located in Indian subcontinent to effectively manage and mitigate the risk but will also increase effectiveness of Circular Economy implementation.

Keywords: Circular Economy, Risk, Manufacturing Industry

1. Introduction

In this era of product development, manufacturing industries and environment need to have a healthy relationship for the improvement of their business performance because the industry environmental impact have seriously imposed a pressure on the way of doing their business (Lieder and Rashid, 2016). Depletion of natural resources and increase in human population are the two circumstances that confront the manufacturing industries to produce in a more sustainable way (Ageron et al. 2012). The increased competitiveness for the access to scarce resources is a major concern among the supply chain of manufacturing organizations. This has led to a series of challenges of resource price volatility and risk in resources supply in addition to the accomplishment of adhering to environmental norms (European Commission, 2014b). Within last few years, the concept of Circular Economy (CE) has gained much interest among the researchers, academicians, and policymakers because of the stress towards a more sustainable development (Vasiljevic et al., 2017). CE is a sustainability approach which optimizes the use of resources while still empowering companies to gain profits from deliverables to market (Ritzén and Sandström, 2017). The major advantage of the application of CE concept is resource conservation, lesser energy consumption and reduced emission of greenhouse gasses thereby weakening the reliance of the economy on natural resources (Vasiljevic et al., 2017). To cope up with the shortcomings of linear models, there is a need of implementation of such business model in the manufacturing industry which can close the material loop and minimize the leakage of material and energy to extract maximum value during its lifecycle. Implementation of CE models may be helpful in overcoming the environmental, societal and economic issues. Bocken

et al. (2016) addressed some of the questions related to product design and business model strategies that could help to the implementation of CE models in manufacturing industry. They introduced the terminology of slowing, closing and narrowing the resource loops. Rizos et al. (2016) focused on enhancing the knowledge and understanding of the barriers and enablers that SME's experience during the implementation of CE business models. Lewandowski et al. (2016) developed a detailed framework that supports all types of companies in developing a circular model. The investigation was carried out under the eight sub components of research of circular models to readdress the components of CE model canvas. They identified two novel components i.e. take-back mechanism, and adoption factors.

In case of developing nations like India, sustainability becomes a major issue since the majority of global population resides in developing countries. CSC can be regarded as a business technique that provides a novel platform to transform conventional system of production and consumption into a circular system (Stahel, 2013). By adopting the 3R principle in the production and consumption process, the CSC will aim at minimizing the use of raw materials and the dependence on primary energy thereby reducing the load on natural resources (Zhu, 2007; Heck, 2006). The transition from a linear model to a circular economic model is of disruptive nature and certainly requires radical changes and new solutions in which current ways of working need to be changed and new ideas and practices should be followed in order to build products more sustainably (Boons and Lüdeke-Freund, 2013).

The implementation of a novel strategy is associated with the influence of risk. Risk may generally be classified into two types: external or internal depending on whether the impact of risk occurs within the organization or outside the organization i.e. within the supply chain of that organization. It is important to analyze various types of risk that organization may face during the implementation of Circular Economy concept at all levels in the manufacturing industry.

In this regard, effort has been made to identify risks involved with the implementation of Circular Economy from the Indian manufacturing context. The next section comprises of the detailed review of the literature pertaining to the identification of various types of risk that may occur during the implementation of CE as a novel business strategy in current manufacturing scenario.

2. Literature Review

To minimize the influence of risks, organization must identify and analyze each and every category of risk which when managed properly can help in achieving circularity in the supply chain. For the proper assessment of risk and what impact it can have on the performance of the circular supply chain, Table 1 provides an organized classification of literature on risk identification by different authors.

Table 1: Risk associated with the implementation of CE

Risk	Types	Internal/External	Sources
Economic risk	• Supply risk, • Problematic ownership structures, • Deregulated markets, • Flawed incentive structures,	External Internal External Internal Internal	Sachs (2015); Jackson (2009); Wang et al. (2008)

	• High investment		
Environmental Risk	• Limited store of resources, • Uneven geographical distribution of resources and appropriation, • The implications of the assimilative capacities of ecosystems over economic growth	External External External	Georgescu-Roegen (1977); Daly and Townsend (1993)
Social Risk	• Excessive working time of the employees, • unfair wages • work-life imbalance • Employment issues related to mass immigration, • ageing population • population growth	Internal Internal Internal External External External	Blackburn (2007); Halldórsson et al., 2009
Technological Risk	• Threat of implementing newer/complex technology, • Fear of problems, • Compatibility issues with existing systems	Internal Internal Internal	Mittal and Sangwan (2014)
Waste management Risk	• Health-associated risk to the society • Improper disposal of waste can impose serious penalty on the organization	External External	Giunipero and Eltantawy (2004) Agrawal et al. (2015)
Fashion Vulnerability	Being unable to respond to fashion changes is another potential issue while introducing a Circular Business Model.	Internal	Monte et al. (2009)
Risk of Cannibalization	The introduction of a Circular Business Model may lead to decreased sales if the new, longer lasting products reduce sales of the previous products	External	Guiltinan (2009); Michaud and Llerena (2011)

Circular Economy is a concept which is based on the three pillars of sustainability i.e. economic, environmental and social. CE is a cradle to cradle approach in which the material is re-circulated in a cycle until its full value is extracted. CE includes forward as well as reverse flow of supply chain so it involves a broader classification of risks as compared to those identified in case of sustainable supply chain.

2.1 *Economic Risk*

Economic stability of any organization comes with the aversion of monetary risks which occur due to deregulated markets, flawed incentive structures and high investment by the organization (Jackson, 2009). Supply risk is also considered as one of the major economic risk which may lead to production breakdown that may cause the organization financially instable (Sachs, 2015).Supply risks is a risk pertaining to the supplier side which includes defaults or failure in delivering the right quality, quantity, cost and reliability. Risk related to Outsourcing also fall in the category of economic risk as manufacturers search for reliable third party service provider in order to insure that investment is done in the right direction (Sodhi et al., 2012).

2.2 *Environmental Risk*

Organization need to establish a balance between their supply chain operation and its effect on environment. Any imbalance may lead to a major effect on the environment which is sometimes regarded as risk for the environment. Circular practices in the supply chain may lead to the mitigation of environmental risk. But a prior knowledge is necessary for the proper planning and development strategy for the mitigation of environmental risk. Limited store of natural resources (Georgescu-Roegen, 1977) and its uneven geographical distribution also becomes a major environmental issue for the manufacturing organization as they have to plan the location of plant establishment for the optimized use of natural resources. Daly and Townsend (1993) argued that the assimilative capacities of ecosystems over economic growth are day by day diminishing which is the reason for the promotion of CE activities during production and consumption of usable products so that the leakage of waste materials and emission into the natural environment is minimized.

2.3 Social Risk

Social responsibility towards the employees and all other people which are linked directly or indirectly to the organization is an important issue for the company to avoid any kind of risk coming from the society. Social risk may be of various kinds. Excessive working time of the employees, unfair wages and work-life imbalance is a major social issue that promotes switching of the employee from one company to other (Blackburn, 2007). Working environment and ensuring employee's health and safety standards is also considered as one of the major social responsibility for the organization (Halldórsson et al., 2009). Employment issues related to mass immigration, ageing population and population growth is also a major demographic challenge for the organization to retain its employees. Disorderliness and disruption due to strikes, work stoppages, street protests and demonstrations can hinder the day to day operations of the company thereby making it socially instable.

2.4 Technological Risk

CE being a novel business strategy for the manufacturing industry demands the introduction of new technologies that could provide better efficiency of production and minimize waste at all levels. So while implementing a new or complex technology there is always risk associated with its implementation whether the introduction of new technology in the manufacturing system will fulfill the desired functions (Mittal and Sangwan, 2014). The introduction of new technology in the existing system is governed by the compatibility of its technological features with the current process of manufacturing. So a prior analysis is required of the new technological functions for the proper adoption and to minimize the risk with its implementation.

2.5 Waste Management Risk

In a supply chain having linear flow of material the customer discards the product after its consumption and it is considered as waste which is having zero value (Stahel, 1982). While in a circular supply chain the product after its complete utilization is again brought back into the supply chain of same organization or different through the methods of reuse, repair, recycle, refurbish or remanufacture. This is done to extract the maximum value from the resources used during the development of product and also to minimize waste that goes to the landfill. Proper

treatment of waste is necessary to prevent any kind of health hazard that may occur during the disposal of waste in the local area. This is a serious issue for the organization and should be given due consideration because the location of a manufacturing or treatment plant depends upon the local habitat. Improper disposal of waste can impose serious penalties on the organization and the government may sometimes cancel the license of the organization if the company is not following the environment and waste management norms or disturbing the local habitat (Giunipero and Eltantawy, 2004).

2.6 Risk of Cannibalization

The introduction of a Circular Business Model may lead to decreased sales if the new, longer lasting products reduce sales of the previous products (Guiltinan, 2009). The products developed by the company adopting circular practices in their manufacturing system will have a greater life as compared to those produced and consumed conventionally. So these circular products will inhibit the introduction of new products in the market thereby decreasing the overall sale of the company (Michaud and Llerena, 2011). This may directly have an effect on turnover of the company. Company should optimize the production of conventional as well as the new products so that the company remains financially stable and very few inventory is piled up.
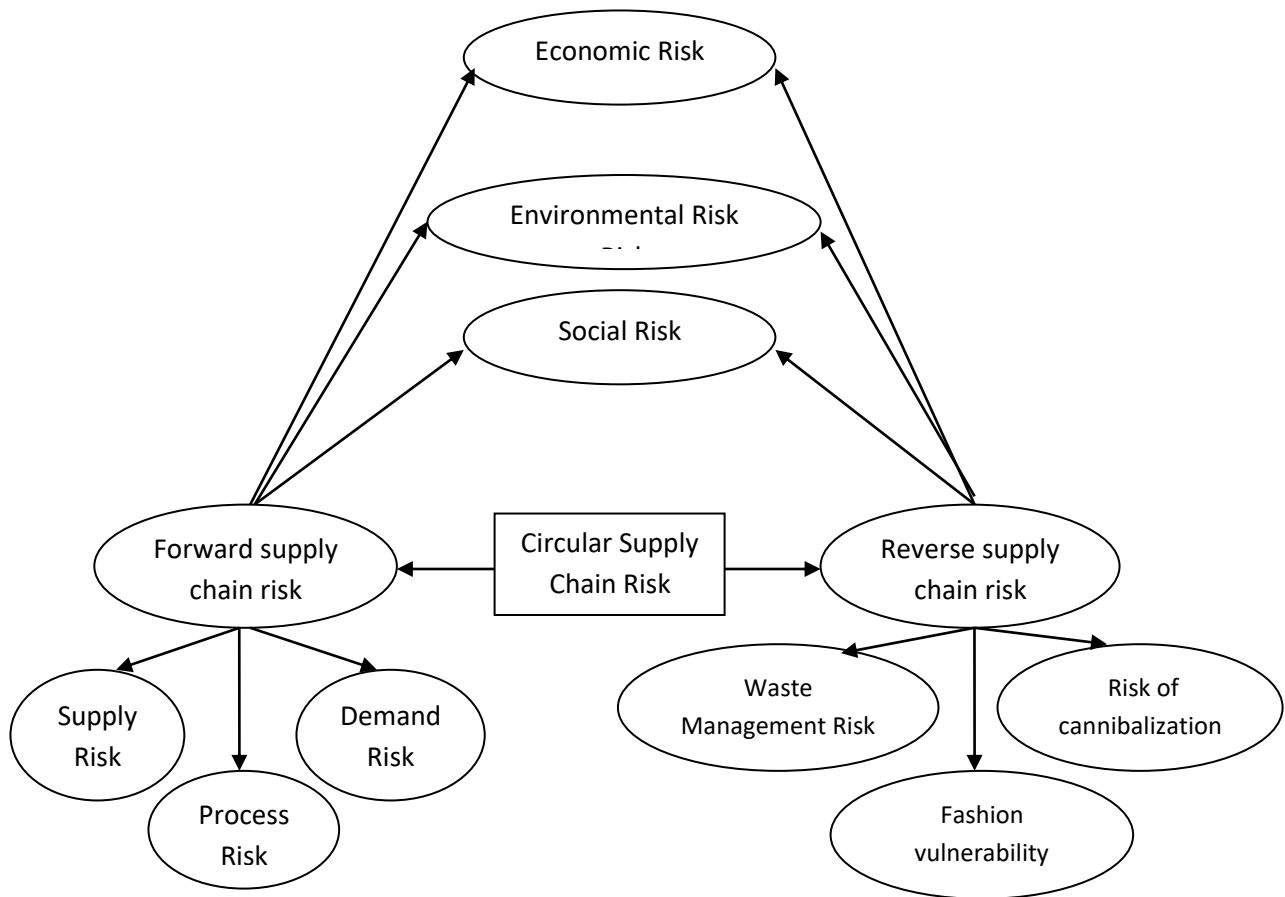
Fig. 1: Risk classification in Circular Supply Chain

3. Discussion and Conclusion

Risk identification is the first step in a risk management process. Circular Economy being a novel strategy so the identification of risk occurrence while implementing this concept is at the nascent stage and not as much of work has been done in this area. The coining of the term CE was done in the year 1994 but still its implementation is lagging in the developing countries. CE concept is evolving with time and most of the developed countries have adopted principles based on CE concept in their manufacturing unit. But in developing countries like India, research is still in progress on how to implement this strategy at all levels : micro, macro and meso level. For this purpose prior identification of risk related to the implementation of CE concept is necessary so as to have an idea of the severity of risk that could affect the performance of circular supply chain.

In the past various researchers have identified risk related to the sustainability and green supply chain management concept but the area of Circular economy is still unexplored. An effort has been made to comprehensively explore various kind of CE related risk pertaining to the manufacturing sector in Indian sub-continent. The concept of sustainability and green supply chain management are strategies that enhance the efficiency of production and consumption. Both these concepts are applied in the forward logistics or forward supply chain. So risk pertaining to these concepts can only occur when there is a forward flow of material. But when the product flows in the reverse direction from the customer to the manufacturer in that case the category or nature of risk is totally different from those prevailing in the forward chain. So this study comprehensively explores risks that occur in forward as well as reverse supply chain. This will not only assist the manufacturing organizations located in Indian subcontinent to effectively manage and mitigate the risk but will also increase effectiveness of Circular Economy implementation.

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Modeling the Drivers for Sustainable Agri-Value Chain: Multi Method Research Design

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Abstract-

Farmers grow fruits and vegetables which have a high potential for value addition. Apart from production, marketing, processing and distribution of agri-commodities are suffering from various management issues in the overall agri-supply chain. With increasing agri-wastes, risks and challenges in the production and management processes of agriculture production, there has always been a felt dire need to shift action-oriented policy focus from agri-supply chain to agri value chain. Agri -Value chain has the potential to become an effective tool for poverty reduction by increasing rural occupational choices and farm and non-farm employment avenues. In the recent year Agri Value chains have gained an increasing attention from academia, policy makers and practitioners. The aim of the study is to build Agri-Value Chain theory using Total Interpretive Structure Modeling (TISM) and then to further empirically validate the framework. To achieve the study objective, in addition to an extensive literature review, primary data has been collected from 100 farmers of the Indian federal State of Maharashtra to derive the drivers of agri-value chain. The study is an action research based on multi method research design. The study concludes that development and successful field implementation of such a model for sustainable Agri-Value chain can be proved as a powerful tool for poverty reduction and food and nutrition security in the coming years.

Keywords: Sustainable, Agri Value Chain, Total Interpretive Structure Modeling, Drivers, Causal Effect

1. Introduction

Economic Policies of developing and underdeveloped countries have always focused on systemic value-addition of farm products with a view to ensure creation of jobs along with increase in the net income of the farmer households. Diversification of crops coupled by value addition throughout their supply chain has the required potential to make the agriculture remunerative and a popular profitable business proposition (Kumari et al., 2017a).

Farmers grow fruits and vegetables which have a high potential for value addition. Apart from production, marketing, processing and distribution of agri-commodities are suffering from various management issues in the overall agri-supply chain. With increasing agri-wastes, risks and challenges in the production and management processes of agriculture production, there has always been a felt need to shift action-oriented policy focus from agri-supply chain to agri value chain (Kumari et al., 2017b). Agri -Value chain has the potential to become an effective tool for poverty reduction by increasing rural occupational choices and farm and non-farm employment and business avenues. In the recent year Agri Value chains have gained an increasing attention from academia, policy makers and practitioners. Agri Value Chain has been found to be one of the sustainable models for increasing the farmers' income and reduction of agri-waste (Kumari et al., 2016). It not only adds value to the agriculture product but also adds to the economic, social and environment dimensions of overall development. Today, when Indian government strives towards achieving its goal of doubling the farmers' income by 2022, establishment of sustainable agri-value chains becomes the core element of the agri-policy of the present government.

Agri Value Chain is a multidisciplinary approach which helps in understanding the emerging trends of agriculture system. At present the agri value chain results in quality and flexibility of the supply chain performance. In the era of competitive advantage where new and acceptable product development are the emerging challenges for the sustainability of agri-business, producer companies of agri-products are striving towards adding value to the agri-commodities specially, fruits and vegetables as these are the most perishable commodities. The country witnesses a huge amount of wastes in the management of fruit and vegetable segments of agri-commodities adding to environment pollution. The present need of today's era is to urgently understand the importance of the agri value chain. The stakeholders involved in agriculture marketing are well aware of the fact that the farmers sell their produce at a very cheap rate and in many occasions most of these perishable commodities do not find a market due to over supply.

This results into registering colossal wastage of the agri-produce due to the absence of a systemic agri value chain in and around the rural areas of the country. The importance of the agri value chain in the sustainable management of agri-resources in India cannot be over-emphasised. Thus, it has become a necessity now to study the driver (s) of the emergence of an appropriate agri value chain. The present study, after resorting to an extensive literature review, finds gaps in the available research. This prompted the authors to study the driver (s) of agri value chain and to relate it to the underpinning theories. The study makes an attempt to answer a research question - what are the drivers of Agri Value Chain? Accordingly, the study aims to (a) build an Agri-Value Chain Management theory using Total Interpretive Structure Modelling (TISM) and (b) empirically validate the framework.

To achieve the study objective, in addition to an extensive literature review, primary data has been collected from 100 farmers of the Indian State of Maharashtra to derive the drivers of sustainable agri-value chain. The fruits and vegetables sector has been studied for the same. The study is an action based research. Multi Method Research Design has been used to derive and empirically validate the drivers. After the identification of drivers, Total Interpretive Structural Modeling (TISM) approach is used to depict different levels and distribution of such drivers. Furthermore, the theoretical model has been empirically validated using the survey data.

ii. The next section discusses the concepts of agri value chain, sustainability, and the drivers of agri value chain. Eleven drivers have been derived from literature review and expert opinion.

iii. The third section outlines the research methods used in the study. It follows the process of development of conceptual framework and analysis using TISM and empirical validation.

iv. The fourth section presents the discussion based on results and further outlines the study contributions to the theory and practice.

v. The study ends with conclusion and further research directions.

2. Literature Review

This section discusses the researches in agri value chain and their linkage with the underpinning theories. The study results in deriving drivers of agri value chain from seminal works. Recent research papers and seminal articles have been extensively reviewed to study the agri value chain.

2.1 UnderPinning Theory

Agri Value Chain is supported by theories proposed in the seminal articles. Altenberg, 2006 has identified the role of relationship based theory in agri value chain. It is essential to link multi theory to develop a theoretical framework for agri value chain. Agency Theory and Resource based Theory are key to Agri Value Chain. Fischer et al., 2008 reported in their study that Agri Value Chain needs high trust from customer and buyer side, high commitment towards buyer/ supplier, high satisfaction and positive collaboration. The relationship based theory has an important role in Agri Value Chain. Agents too need to build up a strong relationship in a chain (Lockie and Kitto, 2000).

2.1.1 Relationship Based Theory

Relationship Based Theory comprises of trust and commitment of the stakeholders towards their work (Morgan and Hunt, 1999). In Agri Value Chain, it is very essential to build up the trust among the farmers for suppliers so that the farmers can sell the agriculture commodity to supplier. The supplier then may process it to undergo the process of value addition. During this process it is essential for the supplier to give commitment for quality work. At the end, for distribution of the final value added product it is essential to build up the trust of the customers to sustain the marketing.

2.1.2 Agency Theory

Agency Theory comprises of agents and principle. This includes situations where there is a conflict between the interest of principle and agent and sufficient outcome uncertainty (Eisenhardt, 1989). In Agri value chain, there is a conflict in the interest of agents and principle. There should be a common interest between the farmers and stakeholders from industry so that agri value chain can sustain providing support to all.

2.1.3 Resource Based Theory

It is essential for agri value chain to have tangible and intangible resources. Tangible resources comprises of Physical capital, human capital and Organizational Capital. Intangible Resources comprises of technical skills, managerial skills and organizational learning (Grant, 1991). The Resource Based Theory (RBV) is a managerial framework which sees resources as key to superior firm performance. It helps the firms to look inside the company to find the strategic resources for competitive advantage (Barney and Clark, 2007). For any organization to exploit external opportunities is much more feasible to do so by using existing resources (Barney, 1996).

As per the name, it is clear that RBV gives major role to resources for achieving the organizational performance growth. The RBV is an interdisciplinary approach developed within the disciplines of ethics, law, management, economics, marketing, general business etc. A key insight arising from the resource based view is that all resources are not of equal importance and do not possess the potential to become a source of sustainable competitive advantage. In the resource based view, management strategists select the strategy that best exploits the internal resources relative to external opportunity.

2.2 Agri Value Chain

Agri Value Chain is different from other supply chains because agriculture products are perishable and bulky in nature, the nature ofthe agriculture product is composed of risk and uncertainty and agri value chain has societal and customer attitude issues like food safety (Aryaman et al., 2006). Agri Value Chain faces different risks viz. low to very low self-lives of agriculture products, seasonality and availability of products, insufficient storage and processing capacities, inadequate transportation facility etc. Further, value addition to agriculture products are influenced by several factors like taste, colour, appearance, size, image, ready to eat and quality of the produce etc.

2.3 Drivers of Agri Value Chain

After an extensive literature review and expert opinion, eleven drivers have been identified for Agri Value Chain. These are summarized in table 2 and have been explained under different sub sections.

2.3.1 Technology Adoption

As mentioned earlier, Agri Value chain is a process which involves several practices like processing, packaging, storage, transportation and transformation. Every step in an agri value chain is dependent upon new techniques and practices. In other words, it can be said that the Agri Value Chain is dependent upon technologies for a high quality and value of the food products (Modern Technology Of Food Processing & Agro Based Industries, 2016). Technologies play a key role in the transformation of agricultural raw materials and this has led to several innovations in technology (Opara, 2004). In recent years, adoption of technologies has been known as a source for increasing income and supporting agri value chain (Pick et al. 2014). The emphasis on technology has encouraged public private partnership (Palmer et al., 2011). In the recent past, technologies and their implication have made a significant improvement in agro

based sector. These changes in the technologies have resulted the development of agro based sector into an efficient one (Schultz, 1964). Installation of several machineries and equipments makes important aspects of technology adoption (Kumari, 2017). New technologies lead to an efficient and new pattern of flow of resources and energy in an industry and thereby making it sustainable (Giurco et al, 2011). There are three alternative means for the technology adoption in agriculture namely transfers of technology, participatory action research and lastly industry led technologies (Lev & Acker, 1994). Technology transfer is an active process of technology adoption by developing nations for creating sustainable agribusiness (Sankat et al., 2007). The transfer of technology comprises of the technologies used by the farmers and researchers. These technologies are developed by the researchers and adopted by the farmers. Such adoption of technology leads to a sustainable and high productive agriculture. Local average treatment effect is a technology used to estimate the impact of improved rice varieties on agriculture productivity. This is highly beneficial for the farmers (Nguezet et al, 2012). There are several high quality pure seeds like breeder seeds produced by the plant breeders which help in making good quality certified seeds (Chambers, 1992). These varieities of seeds generated through improved technology are much beneficial for the farmers in increasing the yield (Sneha and Patil, 2016). Improved seeds and fertilisers are distributed to the famers at subsidized rate in order to encourage technology adoption, food security and poverty reduction (Laajraj, 2012). Industry led technology development is a form of technology adoption comprises of technical knowledge and services and driven by people with resources.

Anderson and Tushman (1990) have proposed a model for the cyclical flow of technology and explored that technologies are divided into four phases as shown in Table 1.

Table 1: Phases of Technology

Phases	Characteristics
Technology Discontinuity	It is represented as repackaging set of existing technology
Era of fermentation	During this stage the companies compete for the quality of the product in terms of technology use and decide the optimal technology to be used.
Domain design	The design of a product is signified by the technology used. The value of the product accepted is identified by the amount of products consumed. A dominant design depends either on the existing technology or on the innovative technology.
Period of incremental change	This refers to the changes in technology applied in

	the industry. The final design becomes the standard for an industry. The optimum technology is obtained from both the economies of scale and experience from production stage to the marketing stage.

Source: Anderson and Tushman (1990)

Technologies are classified as primary technology and secondary technology. The primary technology implies to the equipments, tools and techniques and secondary technology implies to the information related to the technology, database management system and design. Appropriate agri-technologies, thus, will play a crucial role in the transformation of agricultural raw materials into final product.

2.3.2 Diversified Business

Diversification in agriculture business leads to promotion of agri value chain (Roebeling et al., 2006). Farmers can implement business diversification strategies through the adoption of varied farm practices and establishment of agri-business units – poultry and other bird rearing, animal husbandry, agro tourism, waste utilization plants etc. Business diversification not only results in the value addition of the agriculture commodities but also results in economic, environment and social sustainability. Diversification of processing plants ensures provision of potential benefits to the stakeholders.

2.3.3 Capacity Building

Capacity building is the process of obtaining, improving, and retaining the skills, knowledge, tools, equipments and other resources by individuals as well as organizations (Eade, 1997; Potter and Brough, 2004). Capacity Building is vital for Agri Value Chain as it is essential to upgrade the required skill set for adoption of value addition interventions in rural areas. Special emphasis is to be given to inventory and transportation management to actualize the real benefits of value addition.

2.3.4 Training

Training is an important driver for agri value chain (Arshad et al., 2006). Proper training should be given to the farmers and stakeholders to reduce the post harvest losses of fruits and vegetables. The losses can also be reutilized to add value to the waste and generate income. There are several ways to reduce losses of agriculture commodities and training is an important driver which can result in sustainable agri value chain.

2.3.5 Top Management Commitment

Top Management has a significant positive impact on information sharing (Li and Leen, 2006). Top Management helps in providing vision, guidance and support to the stakeholders to sustain the growth of an organization. In Agri Value Chain, information sharing is a core element for product development, processing and supply. Top management Commitment drives the sustainability of Agri Value Chain. Top Management initiatives, roles and responsibility help in sustaining agri value chain (Giunipero et al., 2012). Best practices fuelled by top management commitment in supply chain leads to sustainable supply chain (Pagell and Wu, 2009).

2.3.6 Infrastructure, Connectivity and Network

Smart Agri Food logistic aims at enabling new types of network with flexible approach (Verdow et al., 2013). Networks and Connectivity play an important role in agri value chain (Klerkx and Leeuwis, 2008). Social network in vertical and horizontal processes results in effective supply chain management. Resources and infrastructure are the constraints for agri value chain and should be further worked upon (Trienekens, 2011).

2.3.7 Awareness and Knowledge

Awareness about the different use and value addition of agriculture product results in agri value chain (Kumari and Patil, 2019; Kumari et al., 2018).

2.3.8 Waste Management Process

Waste generation has become a necessity for production (Dietzenbacher, 2009). Therefore it is essential to reuse and recycle these wastes in the form of byproduct to gain material efficiency (Nathani, 2009). These waste if not reused can act as the most important player in unsustainability of the developing nation. A large number of policy in European Union addresses the challenges in production of huge amount of wastes and emissions from the production process acting as obstacle of sustainable development (Giljum et al., 2009). Therefore there is an acute need for the developing nations to focus on the increasing wastes produced from Industries and their detrimental impact towards environment and society. Considering the relevance of the element, waste management is one of the key factors influencing agri value chain.

2.3.9 Customer Focus

Agri Value Chain should be customer driven. Marketing and sales of Agri value products depends upon the customer demand. In order to avoid wastage it is essential for the agri value chain to be customer focused. Agri Value Chain results in the improvement of customer focus

and, therefore, it is a crucial element for the success of Agri Value Chain (Zokei and Simons, 2006). Capabilities of all supply chain participants result in the enhancement of customer value (Zokei and Hines, 2007). Considering the inherent complexity, any Value Chain Analysis always demands a greater understanding of customers (Howieson et al., 2016).

2.3.10 Supplier Relation Management

In Agri Value Chain it is very essential to build up the trust among the farmers for suppliers so that the farmers can sell the agriculture commodity to the supplier with ease. The supplier then may process it to undergo the process of value addition. During this process it is essential for the supplier to give commitment for quality work thereby building up the interpersonal trust.

2.3.11 Competitive Advantage

Competitive Advantage is driven by new product development, market and sales. Competitive Advantage drives Agri Value Chain. Management has the power to drive sustainability in supply chain (Henriques and Sadorsky, 1999). It is identified as one of the mimetic pressure allowing the best sustainable practice in agri value chain (Liang et al. 2007; Dubey, Gunasekaran, and Singh, 2015). Competitive Advantage is an important driver for Agri Value Chain (Ferguson and Toktay 2009).

Table 2: Drivers of Agri Value Chain

S.N	Driver	Reference
1	Awareness and Knowledge	Kumari and Patil, 2019; Kumari et al., 2018
2	Connectivity/ Network	Verdow et al., 2013; Klerkx and Leeuwis, 2008; Trienekens, 2011
3	Technology	Opara, 2004; Pick et al. 2014; Palmer et al., 2011; Schultz, 1964; Giurco et al, 2011; Lev & Acker, 1994; Sankat et al., 2007; Nguezet et al, 2012; Chambers, 1992; Sneha and Patil, 2016; Laajraj, 2012
4	Waste Management Process	Dietzenbacher, 2009; Giljum et al., 2009; Nathani, 2009
5	Customer Focus	Zokei and Simons, 2006; Zokei and Hines, 2007; Howieson et al., 2016
6	Supplier Relation Management	Zhai et al. 2016; Yan, 2008
7	Business Diversification	Roebeling et al., 2006
8	Competitive Advantage	Henriques and Sadorsky 1999; Liang et al. 2007; Dubey, Gunasekaran, and Singh 2015 ; Ferguson and Toktay 2009
9	Top Management Commitment	Li and Leen, 2006; Giunipero et al., 2012;

		Pagell and Wu, 2009
10	Training	Arshad et al., 2006
11	Capacity Building	Eade, 1997; Potter and Brough, 2004

3. Research Methods

A total of eleven Drivers have been identified from the literature review and agriculture experts (Table 2). Focussed group discussions with farmers have been undertaken to derive the drivers of agri-value chain. Agriculture experts from different government organizations have been consulted to examine the drivers. After a systematic review of available literature, experts opinion and focussed group discussions, the drivers of agri value chain have been identified. The relationships between the variables were predicted from group experts. Structural self-interaction matrix (SSIM) was used to collect expert opinion. Expert opinion constituted of 10 senior members from agriculture organizations. After conducting a qualitative study, the total interpretive structure model was empirically validated. Primary data has been collected from 100 respondents including managers and farmers of agriculture firms in Maharashtra to empirically validate the model. The study is an action based research based on multi method research design

3.1 Data Collection

The study targeted experts from agriculture. The ISM structure given by Warfield (1974) and Malone (1975) was adopted and followed. The steps followed were based on the studies available on TISM.

The variables have been collected through extensive literature review. The experts were then approached to confirm the drivers and barriers. Then data collection was started using VAXO approach.

3.2 Data Analysis and Findings

The two parameters among which the relationship is checked is represented by i and j. VAXO model has been used (Table 3) to analyze the Drivers as explained below.

 V: if i leads to j but j doesn't lead to i

 A: if i doesn't lead to j and j leads to i

X: if i and j lead to each other

O: if i and j are not related to each other

Table 3 Structural Self Interaction Matrix of Drivers

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
E1	-	X	V	V	X	X	V	V	X	V	O
E2		-	O	O	X	X	X	V	A	X	X
E3			-	X	V	O	X	V	A	A	V
E4				-	O	A	A	V	A	A	A
E5					-	A	A	O	X	A	A
E6						-	O	V	X	X	X
E7							-	V	A	A	X
E8								-	X	A	A
E9									-	X	V
E10										-	V
E11											-

E1: Awareness and Knowledge, E2: Connectivity/ Network, E3: Technology Adoption, E4: Waste Management Process, E5: Customer Focus, E6: Supplier Relation Management, E7: Business Diversification, E8: Competitive Advantage, E9: Top Management Commitment, E10: Training, E11: Capacity Building

Structural Self Interaction Matrix is converted into Reachability Matrix as show in table 4. After obtaining the Reachability matrix, the level matrix is obtained as shown in table 5. The level matrix shows the level of each drivers.

Table 4 : Final Reachability Matrix for Drivers

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	Driving Power
E1	-	1	1	1	1	1	1	1	1	1	0	9
E2	1	-	0	0	1	1	1	1	0	1	1	7
E3	0	0	-	1	1	0	1	1	0	0	1	5
E4	0	0	1	-	0	0	0	1	0	0	0	2
E5	1	1	0	0	-	0	0	0	0	0	0	2
E6	1	1	0	1	1	-	0	1	1	1	1	8
E7	0	1	1	1	1	0	-	1	0	0	1	6
E8	0	0	0	0	0	0	0	-	1	0	0	1
E9	1	1	1	1	1	1	1	1	-	1	1	10
E10	1	1	1	1	1	1	1	1	1	-	1	10
E11	0	1	0	1	1	1	1	1	0	0	-	6
Dependence Power	5	7	5	7	8	5	6	9	4	4	6	

E1: Awareness and Knowledge, E2: Connectivity/ Network, E3: Technology Adoption, E4: Waste Management Process, E5: Customer Focus, E6: Supplier Relation Management, E7: Business Diversification, E8: Competitive Advantage, E9: Top Management Commitment, E10: Training, E11: Capacity Building

Table 5: Level Matrix for Drivers

Variable	Level
E8	1
E4, E5	2
E3	3
E7, E11	4
E2	5
E6	6
E1	7

E9, E10	8

E1: Awareness and Knowledge, E2: Connectivity/ Network, E3: Technology Adoption, E4: Waste Management Process, E5: Customer Focus, E6: Supplier Relation Management, E7: Business Diversification, E8: Competitive Advantage, E9: Top Management Commitment, E10: Training, E11: Capacity Building
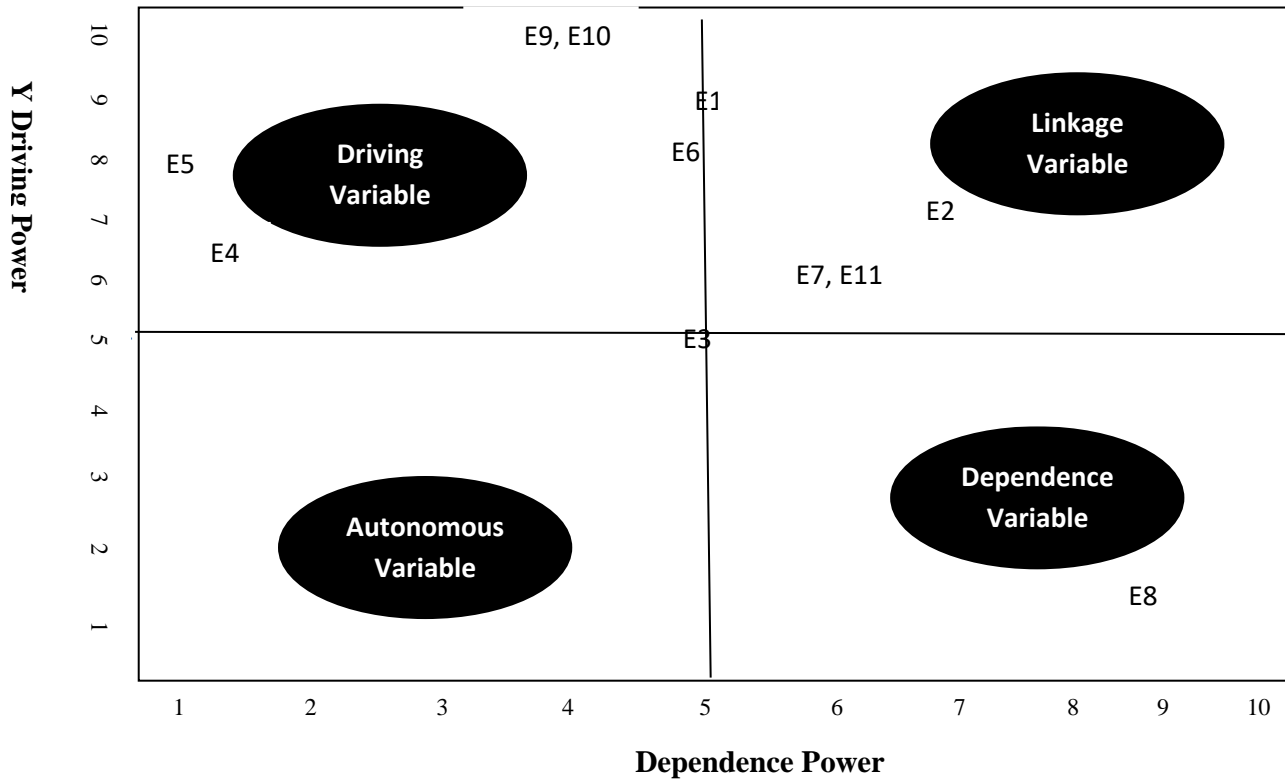
Figure 1: MICMAC Analysis of Drivers

Figure 1 depicts that none of the driver is an autonomous variable. Transitive link shows that if a leads to b and b leads to c then there is a connection between a and c (Table 6). This helps to reduce the gap in the model (Farris and Sage 1975; Vivek, Banwet, and Shankar 2008; Sushil 2015a, 2015b; Kwak et al., 2018).

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Table 6: Transitive Links of Drivers from Experts

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11
E1		Awareness and Knowledge about the agri									

	value chain leads to infrastructure development, better , connectivity and network building.							
E2				Connectivity and Network building leads to focus on customer needs.				
E3					Technology Adoption results in gaining competitive advantage to a firm.			
E4								
E5								
E6								Supplier Relationship Management helps in improving the skills and knowledge of the stakeholders.
E7					Business Diversification in agriculture results in gaining competitive advantage.			
E8								
E9				Top Manag ement Commi tment				

E1 0		Training helps in better connectivity or network building			leads to better supplie r relatio nship manag ement					
E1 0		Training helps in better connectivity or network building								
E1 1				Capacity Building results in better waste managem ent.						

E1: Awareness and Knowledge, E2: Connectivity/ Network, E3: Technology Adoption, E4: Waste Management Process, E5: Customer Focus, E6: Supplier Relation Management, E7: Business Diversification, E8: Competitive Advantage, E9: Top Management Commitment, E10: Training, E11: Capacity Building
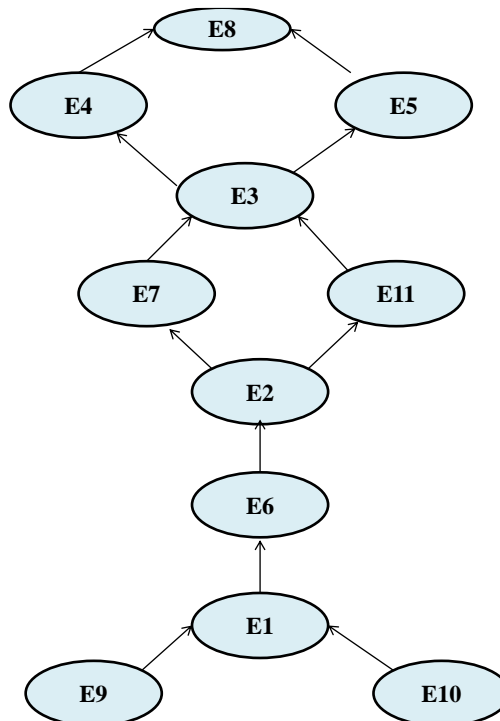
E1: Awareness and Knowledge, E2: Connectivity/ Network, E3: Technology Adoption, E4: Waste Management Process, E5: Customer Focus, E6: Supplier Relation Management, E7: Business Diversification, E8: Competitive Advantage, E9: Top Management Commitment, E10: Training, E11: Capacity Building

Figure 2: TISM Model of Drivers
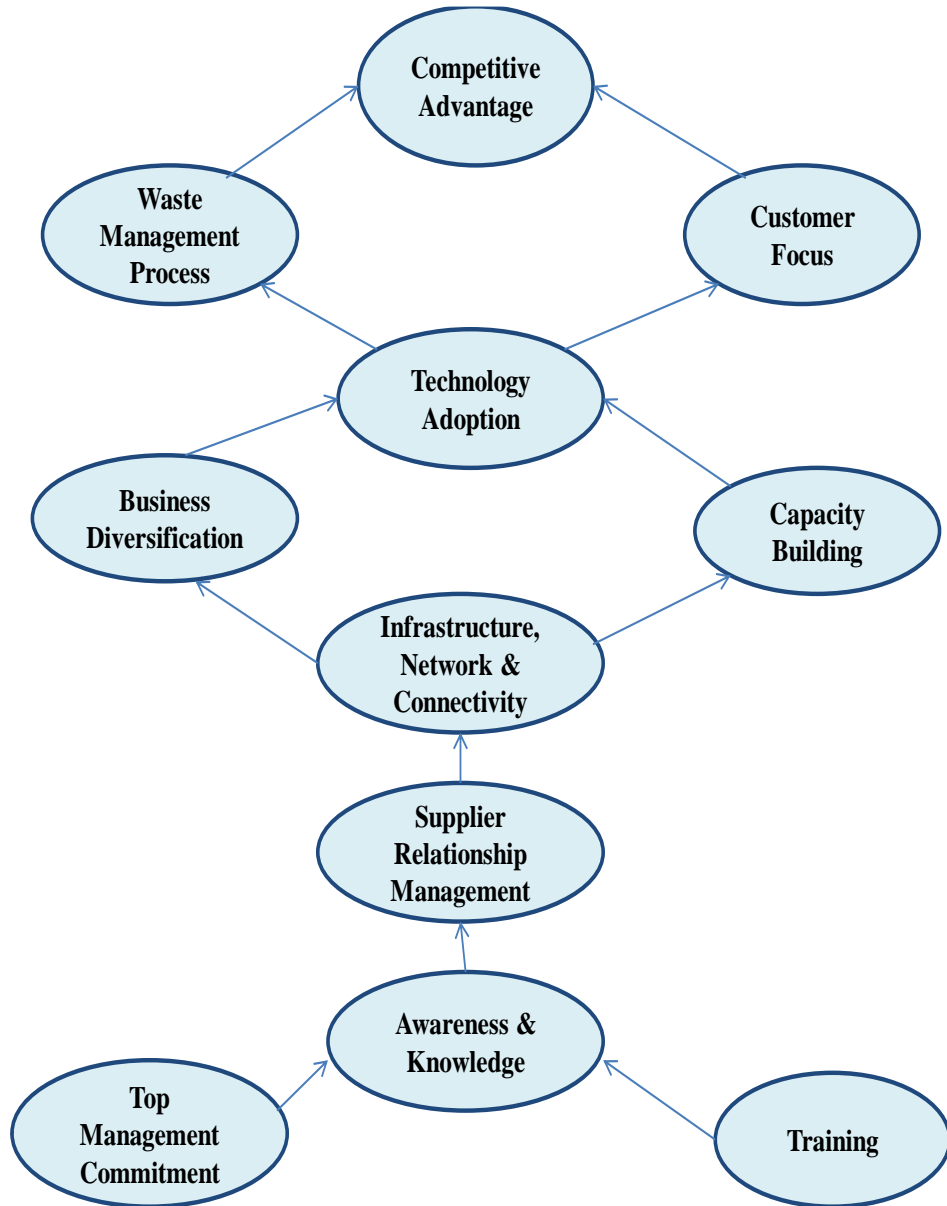
Figure 3: Agri Value Chain Model using TISM

4. Quantitative Survey Result

After developing a model through Total Interpretive Structural Modeling , a survey method was used to test the model. The measures of the construct have been identified from literature survey. All constructs were operationalized as reflective shown in the table 7. Extensive literature has been surveyed to build up the indicators. A structured questionnaire was developed for data collection. The questionnaire has been pre-tested by experts from academics and agri value chain professionals. The suggestions were implemented before its pilot study.

Table 7: Operationalization of the Construct

S.N	Construct	Definition	Indicators	Reference
1	Awareness and Knowledge	Awareness and Knowledge are the state of being acquainted with the factors related to agri value chain	Interest Source	Kumari and Patil, 2019; Kumari et al., 2018
2	Connectivity/ Network	Connectivity is the state of linking all partners for a common cause	Link Explore	Verdow et al., 2013; Klerkx and Leeuwis, 2008
3	Technology Adoption	Technology Adoption refer to identification, preparation, training, implementation and evaluation. Technology Adoption is dependent upon factors like behavioral beliefs and normative beliefs.	Ease of Use Visibility Attitude towards Adoption Perceived Usefulness	Chertow et al., (2004) Graedel, (1994) Karahanna et al., (1999) Kumari and Patil, (2018) Ramasamy, (2004) Shrivastava, (1995)
4	Waste Management Process	Waste management is an important element in Agri value chain	Reduce Reuse Recycle	Kumari and Jeble, (2019) Dietzenbacher, 2009; Giljum et al., 2009; Nathani, 2009
5	Customer Focus	Customer Focus is meeting the customer demand	Customer driven Time Action	Zokei and Simons, 2006; Zokei and Hines, 2007; Howieson et al., 2016
6	Supplier Relation Management	Supply Chain Relationship Management is the ability to measure and facilitate supply chain partners' performance	Trust Commitment	Wu et al., 2012; Hsu et al., 2009
7	Business Diversification	Diversification facilitates the deployment of resources	financial health attractiveness of the	Amit and Livnat, 1988;

		and enhance efficiency	industry availability of workforce resources and government regulatory policies	Kranenburg et al., 2004
8	Competitive Advantage	Competitive Advantage is the extent of creating a position	Product Quality Marketing Sales	Mc Ginnis et al. 1999; Jie and Cox, 2007; Porter 1985
9	Top Management Commitment	Top Management Commitment includes Top Management Participation and Top Management Beliefs.	efficient use of natural resources reduction of the emission of harmful elements creation of more jobs sharing of mission and vision statement sharing potential benefits	Liang et al. 2007, UNEP, 2010; Zutshi and Sohal ; 2004
10	Training	Training is the development and learning of skills and knowledge	organizational support attitude	Goldstein, 1991
11	Capacity Building	Capacity Building is the process of improving and building knowledge, skills and capabilities	Product Performance Permanence	Morgan, 1997

4.1 Data Collection

Survey was administered to managers and farmers from company engaged in Agri Value Chain in Maharashtra. Responses of questionnaire were collected through mail, personal visit and telephone. 100 responses were received.

4.2 Common Method Bias Test

Harman's one factor test was conducted to examine that the results are not biased because of single respondent (Podsakoff and Organ 1986). The variance of a single factor is 25%   which means that common method bias is not a problem as shown in table 8.

Table 8: Common Method Bias Test

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %

1	7.126	24.573	24.573	7.126	24.573	24.573
2	3.895	13.431	38.004			
3	2.674	9.221	47.225			
4	2.449	8.443	55.668			
5	1.768	6.097	61.765			
6	1.346	4.642	66.407			
7	1.291	4.451	70.858			
8	1.176	4.055	74.913			
9	.973	3.357	78.270			
10	.913	3.148	81.418			
11	.823	2.839	84.257			
12	.809	2.791	87.048			
13	.692	2.387	89.435			
14	.638	2.202	91.637			
15	.513	1.771	93.407			
16	.433	1.493	94.901			
17	.410	1.414	96.315			
18	.295	1.018	97.333			
19	.199	.686	98.019			
20	.180	.621	98.640			
21	.127	.439	99.079			
22	.094	.323	99.402			
23	.067	.232	99.635			
24	.048	.164	99.799			
25	.033	.115	99.914			
26	.011	.037	99.951			
27	.010	.034	99.986			
28	.004	.014	100.000			
29	1.031E-015	3.555E-015	100.000			

4.3 Model Estimation and Theory

Warp-PLS has been used to estimate the hypothesis model. The model estimates predicted estimates of the variable. To assess the measurement model, construct validity has been measured through convergent and discriminant validity. Table 9 shows the factor loading, socio-composite ratio (SCR) and average variance extracted (AVE) of the construct.

Table 9: Construct Validity of the Drivers

S.N	Scale	Items	Reliability	Factor Loadings	SCR	AVE
1	Awareness and Knowledge (AKN)	Our Firm is aware of value addition (A1)	0.887	0.78	0.76	0.62
		Agri Value Chain needs knowledge upgradation (A2)		0.80		
2	Connectivity/ Network (CON)	Adequate information systems linkages exist with customers (C1)	0.9	0.9	0.89	0.81
		Adequate information systems linkages exist with farmers (C2)		0.9		
3	Technology Adoption (TA)	Our firm is focusing on reducing wastes from agriculture products (TA1)	0.80	0.79		
		Our firm focuses on using alternate source of energy and technology for value addition (TA2)		0.55		
		Our firm has optimized process to reduce wastage (TA3)		0.80		
		Our firm is using eco-friendly materials for packaging (TA4)		0.94		
4	Waste Management Process (W)	Our Firm is focusing on reduction of waste (W1)	0.63	0.47	0.86	.61
		Our Firm is focusing on reuse of waste (W2)		0.63		
		Our Firm is focusing on recycle of waste (W3)		0.65		

5	Customer Focus (CF)	Our firm has products which are Customer driven (CF1)	0.71	0.78		
		Our firm takes timely action on addition of value (CF2)		0.7		
6	Supplier Relation Management (SRM)	Trust leads to efficient Agri Value Chain (SRM1)	0.77	0.83	0.81	0.69
		Commitment leads to efficient Agri Value Chain (SRM2)		0.83		
7	Business Diversification (BD)	Financial health of a firm leads to Agri Value Chain (BD1)	0.88	0.89	0.88	0.79
		Availability of workforce resources and government regulatory policies results in business diversification of Agri value chain (BD2)		0.89		
8	Competitive Advantage (CA)	Product Quality results in efficient Agri Value Chain (CA1)	0.5	0.53	.60	0.26
		Marketing results in efficient Agri Value Chain (CA2)		0.5		
		Sales results in efficient Agri Value Chain (CA3)		0.60		
9	Top Management Commitment (TMC)	Our firm has an efficient use of natural resources (TM1)	0.5	0.412	.61	.35
		Our firm focuses on reduction of the emission of harmful elements		0.05		

No	Construct	Item	Col1	Col2	Col3	Col4
		(TM2)				
		Mission and Vision statement are shared with all the employees (TM3)		0.62		
		Our firm shares the potential benefits (TM4)		0.70		
10	Training (TR)	Organization supports for training regarding Agri Value Chain (T1)	0.20	0.54	.5	.3
		Our firm has friendly attitude towards training (T2)		0.54		
11	Capacity Building (CB)	Our firm has sufficient infrastructure for Product (CB1)	0.6	0.123	0.7	.5
		Our firm looks after the Performance of the agri value chain (CB2)		.818		
		Our firm looks after the Permanence of the agri value chain (CB3)		.858		
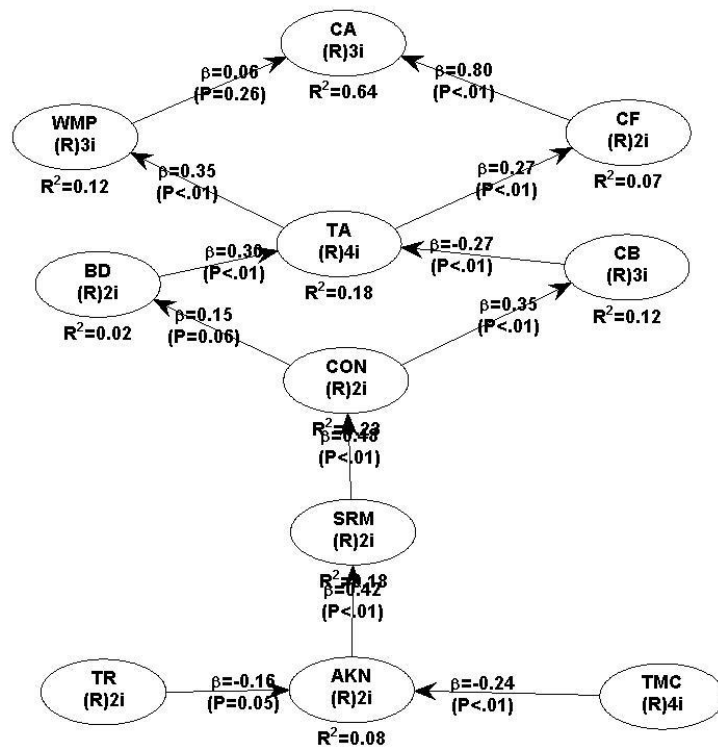
Capacity Building (CB), Training (TR), Top Management Commitment (TMC), Competitive Advantage (CA), Business Diversification (BD), Supplier Relation Management (SRM), Customer Focus (CF), Waste Management Process (WMP), Technology Adoption (TA), Connectivity/ Network (CON), Awareness and Knowledge (AKN)

Figure 4: Agri Value Chain Model

The result depicts that customer is the most powerful driver which leads to capacity building. It is required that the farmers and agri companies should consider the demand for the product. Fruits and vegetables are known as short self life crops or perishable crops. Due to this nature most of the farmers have to throw the crops like banana and tomato into waste. This is the reason that farmers are not able to increase their income. The result demonstrates that perishable crops are demand driven and can increase the income by being customer focus and doing value addition. Capacity Building is occupied at the top of the framework because of it's higher dependency. The capacity building of any agri value chain is dependent upon several factors which should be considered by the agri company. The result also demonstrates that for any agri

value chain the prime element is awareness and knowledge about the process. It has been depicted that many farmers are not able to increase their income because most of the perishable crops are wasted and they are unable to add value. This is because proper training and top management commitment are the primary element which should be moulded at the ground level to promote agri value chain. All the drivers establish a connection and are statistically significant.

This study is an attempt to develop a framework that establishes a connection between the drivers and then validate it. Such an attempt will be beneficial for policy makers and industries to work upon the sustainability of agri value chain.

Model fit and quality indices

Table 10 shows the model fitness and quality indices which are in the acceptable range.

Table 10: Model Fitness and Quality Indices

Model Fit and Quality Indices	Value	Acceptability	Reference
Average path coefficient (APC)	0.321, P<0.001	P<0.05	Rosenthal and Rosnow, 1991
Average R-squared (ARS)	0.20, P=0.014	P<0.05	
Average block VIF (AVIF)	1.20	acceptable if <= 5, ideally <= 3.3	
Average full collinearity VIF (AFVIF)	4	acceptable if <= 5, ideally <= 3.3	Kock, 2015
Tenenhaus GoF (GoF)	0.35	small >= 0.1, medium >= 0.25, large >= 0.36	Medium
Sympson's paradox ratio (SPR)	1.00	acceptable if >= 0.7, ideally = 1	
Statistical suppression ratio (SSR)	1.00	acceptable if >= 0.7	
Nonlinear bivariate causality direction ratio (NLBCDR)	0.792	acceptable if >= 0.7	

4.4 Theoretical Contribution

The study will be beneficial for academicians and researchers as it has studied and validated the relationship among the drivers. The fundamental principle of the model is to create a research environment linking the drivers of Agri Value Chain. This is for the first time, that the simultaneous relationship has been derived among the drivers of agri value chain using multi method research design. The research gaps found in agriculture sector derive the measures to increase farmers' income by undergoing Agri Value Chain.

4.5 Managerial Implication

The empirical research predicts the causality effect of each driver. There is a need to study the driver which have high effect in the model and improvise the agri value chain. The study can be beneficial to all the stakeholders like farmers, agro firms, NGOs, agri companies and others in building Agri Value Chain. The study will also result in reduction of wastage of fruits and vegetables.

4.6 Limitation and Further Research Direction

The study is limited to Agri value chain of fruits and vegetable of Pune district of Maharashtra. It can be further extended taking a wider sample. The effect of other theory in agri value chain like Agency theory and relationship theory can be further studied. The comparative study of firms adopting agri value chain and firms having agri supply chain can also be further explored.

5. Conclusion

Agriculture is a very sensitive sector where the farmers are affected directly or indirectly. Fuel price increase has a twofold impact on agriculture. Firstly it leads to increase the transportation cost and input cost. Secondly if agri produce are used as a means for fuel generation then it leads to less availability of consumption. The amount of waste generation has also been increasing with each agri fresh production cycle. This is a serious concern towards post harvest losses of fruits and vegetables. To meet out the challenges of agriculture and farmers' income, academicians and researchers are trying to explore Agri Value Chain and its drivers. Inventory Management and Transportation factors are primary elements for Agri Value Chain.

Agri Value Chain deals with consistent demand and allows the retailers to source fresh vegetables and fruits at competitive prices directly from the farmers. The Agri Value Chain runs

the platform at lower cost, better speed, and larger scale through integrated supply chain getting supports from technology, data science, logistics network, and infrastructure. Agri Value Chain is driven by top management commitment, training, Awareness and Knowledge, Connectivity/ Network, Technology Adoption, Waste Management Process, Customer Focus, Supplier Relation Management, Business Diversification, Competitive Advantage and Capacity Building. There has been fluctuation in the demand of agri fresh food as they are perishable in nature. Researchers have grouped these agri products into different names like fresh produce, short shelf life produce, perishable produce, deteriorating produce etc (Shukla and Jharkharia, 2013). Factors like awareness, globalization, environmental concerns, technological innovations and trade agreements have attracted the attention of academicians and practitioners towards agri value chain. The study after an extensive literature review and experts' view has come out with eleven drivers of Agri Value Chain. The study develops a model through TISM approach and further empirically validates the model.

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7. Appendix

S.N	Scale	Items
1	Awareness and Knowledge	Our Firm is aware of value addition (A1) Agri Value Chain needs knowledge upgradation (A2)
2	Connectivity/ Network	Adequate information systems linkages exist with customers (C1) Adequate information systems linkages exist with farmers (C2)
3	Technology Adoption	Our firm is focusing on reducing wastes from agriculture products (TA1) Our firm focuses on using alternate source of energy and technology for value addition (TA2) Our firm has optimized process to reduce wastage (TA3) Our firm is using eco-friendly materials for packaging (TA4)
4	Waste Management Process	Our Firm is focusing on reduction of waste (W1) Our Firm is focusing on reuse of waste (W2) Our Firm is focusing on recycle of waste (W3)
5	Customer Focus	Our firm has products which are Customer driven (CF1) Our firm takes timely action on addition of value (CF2)
6	Supplier Relation Management	Trust leads to efficient Agri Value Chain (SRM1) Commitment leads to efficient Agri Value Chain (SRM2)
7	Business Diversification	Financial health of a firm leads to Agri Value Chain (BD1) Availability of workforce resources and government regulatory policies results in business diversification of Agri value chain (BD2)
8	Competitive Advantage	Product Quality results in efficient Agri Value Chain (CA1) Marketing results in efficient Agri Value Chain (CA2) Sales results in efficient Agri Value Chain (CA3)
9	Top Management Commitment	Our firm has an efficient use of natural resources (TM1) Our firm focuses on reduction of the emission of harmful elements (TM2) Mission and Vision statement are shared with all the employees (TM3) Our firm shares the potential benefits (TM4)
10	Training	Organization supports for training regarding Agri Value Chain (T1) Our firm has friendly attitude towards training (T2)
11	Capacity Building	Our firm has sufficient infrastructure for Product (CB1) Our firm looks after the Performance of the agri value chain (CB2) Our firm looks after the Permanence of the agri value chain (CB3)

ExploringApplicationOfLeanMethodsFor Inventory Optimisation In A Manufacturing Company: A CaseStudy

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Abstract-

Present-day, companies all over the world are making huge profits owing to their systematic inventory management. For example, IKEA one of the major players in today's market with its lean management techniques with 403 stores across 49 countries has sustained a profit of over $38 billion. Whereas many companies face huge economic drain in their business capital because of their inefficient Inventory management. This implies that any excess inventory on warehouse shelves is equivalent to wasted capital. Inventory management is a systematic approach for obtaining, storing and profiting from non- capital assets to tackle challenging problems in the area of supply chain management. Efficient inventory management can fulfill the customer's demand and ensure profitability. Whereas, inefficiency in managing inventory results in frozen assets that incur losses to the company. The following study outlines the mismanagement of inventory in the Camshaft department of a manufacturing company. The study unearthed several issues such as unorganized inventory, improper flow of parts between departments, lack of accurate part records, etc. These issues were solved by optimizing the inventory using lean methods which resulted in the reduction of inventory area, thereby resulting in 15% savings and the department's productivity was improved by developing a production leveling plan. This paper provides a detailed methodology of systematic maintenance of inventory and production using lean methodology that was implemented in the company.

Keywords:Inventory management, supermarket, Production leveling,5S Lean method.

1. Introduction

Inventory is the supply of raw materials, semi finished goods called work-in-progress and finished goods that an organization maintains to meet its operational demands. It represents a colossal investment and a potential source of waste that needs to be meticulously controlled. Inventory is characterized as a stock of goods that is maintained by a business in meeting some future demand. Inventory management is an acutely important parameter for business capital enhancement. The inventory management agenda is to develop strategies that will achieve the best investment in inventory. Through efficient inventory management, a company can optimize its sales and mitigate its fluidity and market risk. Successful inventory management reduces superfluous inventory, minimizes costs assigned to it and boosts profitability.

This paper aims for empirical investigation of the relationship between inventory level and profitability, and by modeling the relationships between the stock area and the net pay off reaped from its methodical management. To meet the requirements a routine survey was conducted for camshaft part inventory which is termed as a supermarket by the company. This data was analysed which indicated several issues such Excess inventory space, anonymous parts with no appropriate part numbers, dislocated parts in the supermarket, hindrance in accessing the parts, etc. To work towards the rectification of these issues that were observed, the 5S methodology of lean manufacturing was applied. This approach focuses on simplifying the working environment, effective management of the workplace, an d waste reduction while improving safety and quality.By following the 5S methodology the entire inventory

stock was segregated into different categories based on the frequency of consumption which leads to the reduction of supermarkets, therefore, downsizing the excess area expended by inventory.

Inventory problems of too large or too small quantities on hold can cause a downfall on the business economy. The camshaft department experienced either stock-out or piling up of critical inventory parts in the supermarket that ended up in production halts that emerged in No proper information flow for loading and unloading of camshafts between logistics and camshaft department. A quick fix for this was by coming up with a camshaft production leveling plan which gave an itinerary on production based on stock levels in the supermarket. The key to meet the rising challenges in most Corporate entities today is to use inventory management and this is in response to the fact that inventory is an asset of noticeable features for cost reduction.

2. Literature Review

A number of authors have dealt with the theme of exploring inventory optimisation in various domains. A few relevant works on inventory management have been citied here.

2.1 Inventory management, service level and safety stock [4]:

Alexandru Ioan Cuza University, Iași, Romania,in this paper addressed the actual purpose of the value and stock mix which maintains a high level of customer service and maximizes the financial performance of the businesses. The level of service is determined by the amount of stocks in a company.Therefore, the level of security inventory must be sufficiently high to meet the delivery times of the manufacturer, sufficient to cover the demand of consumers, but not so high that your business is losing money due to the high cost of carrying.

They indicated that all attempts within an organization to increase the level of service consist of an array of sub-objectives that are tracked and must be part of a continuous improvement system. This focuses on the following individual goals for an organization to meet the requirements of the service level this needs to provide :readiness to deliver, delivery time, delivery flexibility, reliability and quality. The ability to meet a specification on time is readiness to produce. Depending on the objective of the business, readiness to produce can be calculated in various ways.

If the company wants tocalculate readiness to supply by the number of units sold, the equation is:

$$\text{SERVICE LEVEL} = \frac{The\ total\ number\ of\ quantity\ delivered\ in\ time}{The\ total\ quantity\ in\ demad}$$

Safety stock is defined as inventory that is carriedto prevent stock out and back order situations. Safety stock protects against various deviations, such as delivery date variances ,requirement variances, delivery quantity variances and inventory variances.

2.2 Management of inventory in a company [3]:

The purpose of the empirical part of the study is to analyzethe inventory balances of surveyed companies and to explore the dependence between companies' level of inventory and profitability expressed in terms of return on assets.

This paper describes how efficient inventory management of businesses is a fundamental problem, and its solution would have a direct influence on business performance and a company's position in a market. The fundamental goal of solving this problem is, on one hand, a constant and total fulfillment of demand and on the other hand, reduced opportunity costs of carrying stock and keeping costs.They used the simple statistical principle of measuring the increased profits with the opportunity costs of carrying incremental stock and retaining costs to develop a new method for estimating net savings from adjustments in inventory policy.

Net inventory-level savings can be described as

net savings = increased profitability - opportunity cost - holding costs

Improved efficiency can be illustrated as follows that is equal to: (sales(1)-sales(0)) x fixed costs

The formula represents the opportunity cost of holding incremental inventory:

opportunity costs = sales(1) / turnover(1)-sales(0) / turnover(0) x rate of return

In this paper, we analyzed stock levels expressed in terms of financial ratios along with dependence between stock levels and profitability and also examined adjustments in stock policy as an important practice in inventory management. Based on the results of this operation, an optimization model was developed.

2.3 *5S [1]* :

Vipulkumar C. Patel and Hemant Thakkar in their paper have metioned the objectives in the paper to reduce the process wastes, smooth the process flow and maintain proper quality control, improve storage facilities, safety, security and process cost savings in a company through case study. 5S was introduced in the department of processing and insulator:

- *Sort-* We were red tagging and moving goods and equipment out of the department which created extra space in the store.
- *Set in order-* They arranged the work station to ensure clear visibility of the items needed, improve job performance efficiency, minimize downtime, and increase productivity.
- *Shine -* The value of keeping this station is essential and awareness has been created among the partners who hold them accountable for their specific work station.
- *Standardize-* The task and responsibility are allocated to the worker for daily cleanup activity.
- *Sustain -* Proper knowledge, proper processes and procedures, worker and management support, 5S adaptability is essential for continuous improvement.

The space saving is 12.91 percent after introducing 5S in the processing department and some process waste is also minimized.

2.4 Inventory management system [2]:

Nazar Sohail and Tariq Hussain Sheikh in their paper have putforth a relationship between the inventory management and company performance in a small scale industry, which was determined based on inventory days and return on asset (ROA) analysis. They have summarised some of the techniques such as:

- ABC analyzes which classified different inventories into three sets or groups based on priority items such as class A, class B, class C and cumulative annual value consumption total are expressed as a percentage of total consumption value.
- Economic Order Quantity calculations provided the ordering cost of the item.
- VED Analysis defined in the Critical Important and Desirable Analysis is carried out primarily for the management of spare parts with respect to production criticality.
- Re-order level which provided the stock level at which the fresh order for that item must be put in order to obtain fresh supplies.
- Safety stock is ascertained in inventory as a part because there is always an uncertainly involved in time lag usage rate or other factors.

Inventory Turnover Ratio The inventory of a business will be moved over the course of the year. Since inventories are the least liquid form of property, a high stock turnover ratio is generally positive that used to solve a few inventory problems such as unorganized inventory arrangements, a large number of inventory days / no period counts and no reliable records balance due to unqualified work.

The Bosch Group is a leading global supplier of technology and services. The company is headquartered in Bangalore its facilities are located at Bangalore in Karnataka, Nasik, Jaipur, and Goa. In order to facilitate its future expansion and development, German automotive major Bosch Limited recently

relocated its Bangalore plant from Adugodi to a larger facility in Bidadi.As a virtue of which it faced some miscellaneous inventory issues in the camshaft department. As part of an internship program, a team of industrial engineering students were deployed to rectify these problems and smoothen the workflow in the department using appropriate approaches that has been discussed further in the next section.

3.Methodology

This paper provides results undertaken from the observational research on the stock levels in the Camshaft department at the Bidadi facility of Bosch, to re-organize their inventory levels to ensure minimized inventory space, ease the inaccessibility of parts based on their frequency of usage, reduce lead time, etc.

3.1 Camshaft department:

The **camshaft** is a mechanical component of an internal combustion engine. It opens and closes the inlet and exhaust valves of the engine at the right time, with the exact stroke and in a precisely defined sequence. The camshafts are specified based on the number of cylinders. The camshaft department works on numerous types of camshaft such as:

Table 1: Types of Camshaft

SL.NO	TYPES
1	2 Cylinder
2	3 Cylinder
3	4 Cylinder
5	6 Cylinder
6	8 Cylinder
7	10 Cylinder
8	12 Cylinder

Each camshaft was given a particular number for identification which was termed as STANDARD PART NUMBER (SNP) by the company. The main function of the camshaft department is to convert the semifinished parts into super finished camshafts through various processes such as:

- Drive end Grinding
- Non drive end grinding
- Cam grinding – L1
- Cam grinding – L2
- Final inspection
- Magnetic particle inspection (MPI)
- Supermarket

Figure 1: Flow Chart of Camshaft Department
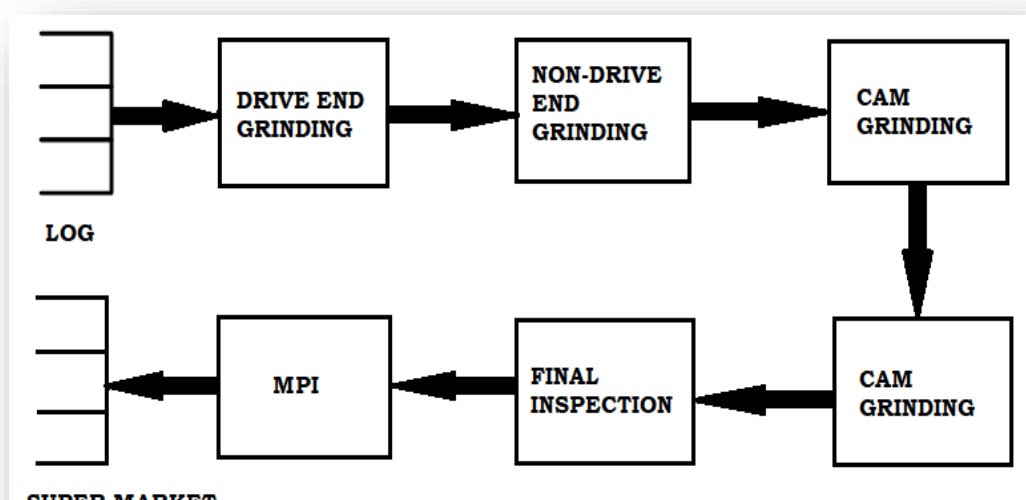
3.2 *Material handling standards for supermarket :* The various material handling standards in bosch are:

Table 2: Material Handing Standards

MATERIAL HANDLING STANDARDS	QUANTITY
Half containers	2,3 and 4 cylinder -16nos 8 cylinder - 80 nos
Trays	2,3 and 4 cylinder - 8 nos 6 Cylinder - 4 nos
Dolly + tray	2,3 and 4 cylinder -160nos 6 cylinder – 80 nos

3.3 *Supermarket:*

 BOSCH enumerates its inventory of parts as supermarkets. The supermarket is a defined and stable inventory used to regulate the upstream production process. The super finished camshafts after its MPI were stored in the supermarkets, which acts as an access point for the internal customers of the plant Super market configuration:

- A supermarket acquires a floor space of length of 2 meters and breadth1.5 meters.
- Each supermarket is divided into 4 racks with appropriate spacing between them.
- These racks are further divided into 4 lanes lengthwise, where each lane can accommodate 4 sets of trays where each set contains 4 trays as shown in figure 2 and figure 3.
- In total, one supermarket holds a total of 256 trays.

```
1SUPERMARKET = 4 RACKS
1 RACK = 4 LANES
1 LANE = 4 SETS
1 SET = 4 TRAYS
1 TRAY = 4 CAMSHAFTS (6, 8 CYLINDER),
```

8 CAMSHAFTS (2, 3, 4 CYLINDER).
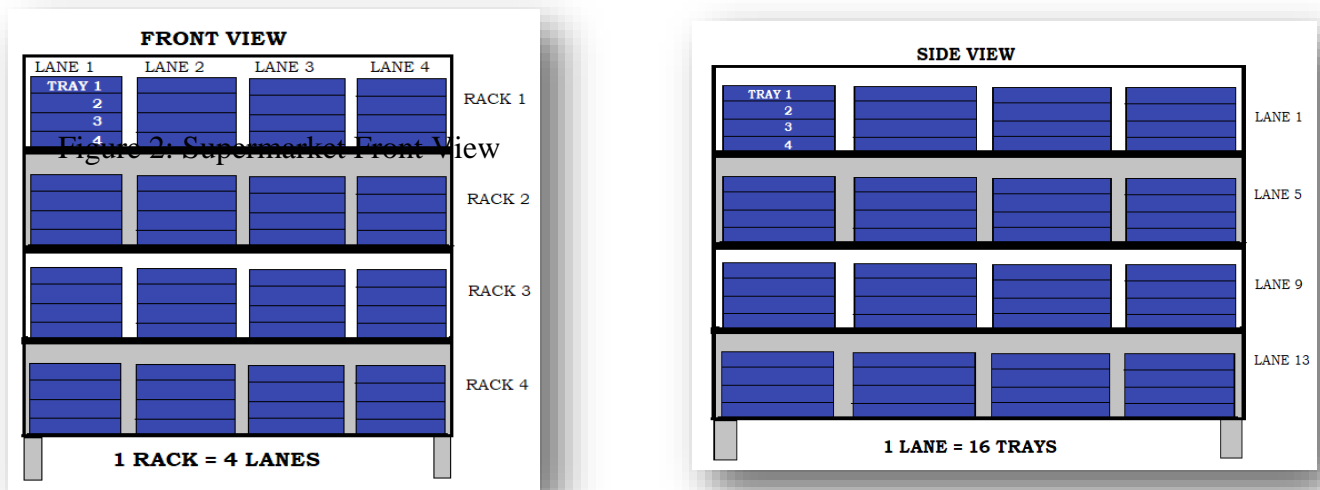
Figure 2: Supermarket Front View

3.4 Gaps identified :

The miscellaneous problems observed in the supermarket were:
1) Excess inventory space.
2) Undefined SNP (Standard number of parts) and mixed up part numbers was supplied to defined inventories.
3) The finished parts were placed in undefined places of supermarket.
4) Each supermarket had multiple repeated parts and part lines causing increase in inventory space.
5) The parts were not placed as per the frequency of usage and were mixed up causing a lot of confusions on used and unused parts, accessibility issues and time delay.
6) No proper information flow for loading and unloading of camshafts between logistics and camshaft department.
7) After superfinishing process the camshafts were not accessed according to their order of loading causing bottleneck issue.

3.5 Supermarket leveling using 5s :

Supermarket leveling is the process of resolving these issues by using the 5S lean tool - A tool that a manufacturing company commonly uses to create an efficient, safe, and organized working environment to boost productivity, reduce costs, and raise quality standards.5S Contains five Japanese words, Seiri, Seiton, Seiso, Shutsuke and Seiketsu. [1].
5S programs in companies and around the world have been introduced as a means of improving production values. Thanks to its versatility, the 5S approach can be applied to most workplace situations in a short time [1].

3.5.1 SEIRI- Divide unwanted products and frequently sort and dispose of unneeded goods at home.
The process of separation helps identify current or future items and should be stored in a designated storage are[1]

Approach:

- In the beginning, the camshaft production stock details chart was designed for 12 days in July (1-July to 12-July) which contained all the SNP.
- Daily inspection of camshaft supermarket stock was recorded in the camshaft production stock details

chart as shown in the figure 4.

- The excess production and stock requirement details are known by subtracting the daily recorded data with the total.
- The difference gave us values which were both negative and positive, where positive represents stock required and negative represents excess production.

- Where,

  Blank column – Excess production | -ve value |

  Pink column – Stock required | +ve value |

Figure 4 : Daily production sheet

p	Camshaft	Exotic /Repeater	Grand total	1-Jul	GAP	2-Jul	GAP	3-Jul	GAP	4-Jul	GAP	5-Jul	GAP	6-Jul	GAP	8-Jul	GAP	9-Jul	GAP	10-Jul	GAP	11-Jul	GAP	12-Jul	GAP	13-Jul	GAP	15-Jul	GAP

THE PART NUMBERS ARE NOT DISPLAYED DUE TO COMPANIES CONFIDENTIALITY

| | GRAND TOTAL | | 16952 |

Outcome:
- As a result, parts located in different lanes in the supermarket are identified and were placed in one or two lanes based on their quantity.
- Camshafts with different part numbers and less quantity were given a single lane. This helped us to reduce the inventory area, allot defined places for every part number in supermarket and SNP numbers were defined.
- The positive and negative details obtained helped us to provide production quantity details to the camshaft department.
- Employees will no longer have to toil in search of required parts that ease their work.

3.5.2 ***SEITON***: The main objectives of Seiton is arranging segregated item in a standard fashion such that anyone can retrieve any item anytime with minimum search time so that they do not get damaged or dysfunctional through careless storage[1].

Approach:

- After defining the places for the particular part numbers we segregated the whole stock into different groups.
- The groups that were identified and formed are:
  1. Runners supermarket
  2. Repeaters supermarket
  3. Exotic/stranger supermarket

  Runner: Daily based production of camshafts in high quantity.
  Repeater: Production done on alternate days in a particular rhythm**.**
  stranger: There is no rhythm in production, it is done as per the requirement of the customer.

- Camshafts that were used daily are placed runner supermarket.
- Camshafts which were not frequently used are placed in exotic and repeater supermarket

Outcome:
- This helped to locate or trace required camshafts in minimum time by an employee in the department.
- Systematic arrangement assisted in easy accessibility of parts based on their frequency of usage.
- Permanent locations were provided for runners, repeaters, and exotics, which left no ambiguity in the identification of camshafts.
- Led to arrange a store to ensure clear visibility of the items needed, improving job performance.

3.5.3 *SIESO* : Point outs the need and necessity of a clean and neat workplace. Cleaning should become a daily activity. The dust, dirt, and wastes are the source of untidiness, indiscipline, inefficiency, faulty production and work accidents. Therefore the workplace should be cleaned at regular intervals[1].

Approach:

- Identifying the untidy supermarkets and cleaning it twice in a week.
- Cleaning of supermarket floor area was carried out twice a day to ensure that there is no oil leakage on the floor which might lead to serious injuries
- The importance of keeping each station was paramount and awareness is created among the associates holding them accountable for their specific work station.
- Trash bins were labeled and located at a convenient location to ease the implementation process.

Outcome:

Figure 5: Trash bins

- This helped in ensuring no dust, dirt or any other miscellaneous objects which might cause any damage to the camshafts.
- Quick information about damages in the supermarket were communicated.
- Improved work environment.
- Elimination of the accidents.

3.5.4 *SEIKETSU*: It is the fourth step of the 5S method. It means "standardization". To achieve standardization, visual controls and checklists were developed by the team for repetative tasks.

Approach:

PRODUCTION LEVELING PLAN :
The team suggested following production leveling plan shown in Figure 6 below.

Figure 6: Production Levelling Plan

CAMSHAFT LIST (Plan and Actual)

Part Number	Plan	Actual	08-Jul P	08-Jul A	09-Jul P	09-Jul A	10-Jul P	10-Jul A	11-Jul P	11-Jul A	12-Jul P	12-Jul A	13-Jul P	13-Jul A	15-Jul P	15-Jul A	16-Jul P	16-Jul A	17-Jul P	17-Jul A	18-Jul P	18-Jul A	19-Jul P	19-Jul A	20-Jul P	20-Jul A	22-Jul P	22-Jul A	23-Jul P	23-Jul A
1	5																													5	
2	6																							3		3					
3	3								3																						
4	2																	2													
5	200		16		16		16		16		16		16		16		16		16		16		16		16		8			
6	3										3																			
7	1														1															
8	1														1															
9	1														1															
10	3												3																	
11	0																													
12	200		16		16		16		16		16		16		16		16		16		16		16		16		8			
13	100		8		8		8		8		8		8		8		8		8		8		8		8		4			
14	1																		1											
15	130		8		8		8		8		8		8		8		8		8		8		8		8		16		18	
16	0																													
17	0																													
18	100		8		8		8		8		8		8		8		8		8		8		8		8		4			
19	3		3																											
20	0																													
21	3				3																									
22	9																												9	
23	9																												9	
24	210		16		16		16		16		16		16		16		16		16		16		16		16		16		2	
25	0																													
26	2																												2	
27	857		64		64		64		64		64		64		64		64		64		64		64		64		64		25	
28	10						10																							
29	20		20																											
30	118		8		8		8		8		8		8		8		8		8		8		8		8		8		14	
31	5																												5	
32	20				20																									
33	0																													
34	0																													
35	35																												35	
36	1						1																							
37	470		32		32		32		32		32		32		32		32		32		32		32		32		32		54	
38	100		8		8		8		8		8		8		8		8		8		8		8		8		4			
39	6																		3		3									
40	0																													
41	14																												14	
42	2																												2	
43	70																		10		20		20		20					
44	2						2																							
45	50																										43		7	
46	0																													
47	60												10		20		20		10											
48	30										20		10																	
49	30						10		20																					
TOTAL	2892		207		207		207		207		207		207		207		207		207		207		207		207		207		201	

- A production plan was designed for 14 days in July (8-July to 23-July) which consisted of planned versus actual production of repeaters and exotic camshafts for each day.
- This chart consists of the planned total quantity provided by the Bosch production system based on consumer demand as shown in the above figure 6 .
- This total quantity was divided by the number of working days (14 working days) and the value thus obtained is the total requirement for each day.
- The total quantity was divided into the number of working days based on dolly capacity (8 trays per dolly). Hence, the production requirement for large quantity camshaft parts for each day was in multiples of eight.
- The part numbers with small quantities were kept the same in such a way that the summation is balanced as show in the figure 6 .
- The planned production quantity for all the parts was entered in the plan column which was referred by the camshaft department to produce accordingly,the after production quantity was noted in the actual column.
- If any variations were noticed in actual quantity produced compared to the planned quantity, the supervisor of the department was instructed to undertake required measures and make sure that the planned quantity requirement was met.

Formulation:

Step 1: Data collection for the planned total quantity.

Step 2: Spread sheet design with list of total number parts and days.

Step 3: Calculation
1. Grand total $= \sum(planned\ total\ quantity) = \underline{2892.}$

2. Plan for each day $= \dfrac{\sum(planned\ total\ quantity)}{total\ number\ of\ days} = \dfrac{2892}{14} = 206.57 \approx \underline{207\ parts.}$
   These values were entered in the last row of each plan column.

Step 4: Quantity estimation of each part for 14 days
1. Large quantity production leveling: For example, 5th part in the above spreadsheet (figure 6) has total planned quantity of 200 units.
   - ✓ This value is divided by the whole span to obtain a days plan quantity.
   - ✓ Plan quantity per day = 400/12=14.28.
     this value was approximated in multiples of 8 since each dolly capacity limit is eight trays.

2. Hence the value is taken as 16 units per day, this value is assigned in the table as shown in the figure 6 to 20th July.
3. The summation of 16 units per day up to 20th July resulted in 192 units.
4. The remaining 8 units were assigned to the next day. This summed up to 200 units which satisfied the planned total quantity. Hence there was no production requirement on the last day.
5. Small quantity production leveling: For example, the 19th part in the above spreadsheet has a total planned quantity of 3 units. As the quantity value is less than eight the same was retained.

Step 5: The production leveling for all the parts was done in step 4 and the assigned values of camshaft units for each day were summed up to get 207 as the plan for each day. If this requirement was not met the parts with small quantities was shifted accordingly in the given period to meet the 207 total units per day criteria

Outcome:

- This resulted in efficient information exchange between the camshaft department and the supplier.
- Production was standardized.
- There was neither surplus nor dearth of camshafts produced.
- Reduced superfluous wastage.

3.5.5 SHITSUKE : Train disciplined workers to follow the 5S method on an ongoing basis to maintain the organization's behaviors and culture.This is the hardest S to execute and accomplish by far.
Following the successful implementation of the 5S system, the sustainability discipline is
proper knowledge, proper systems and processes, worker and management support, adaptability to 5S is
necessary for continuous improvement [1].

Approch:

- The 5S observation sheet, i.e. the development plan, is prepared to help execute the 5S system.
- The production plan acted a checklist, where employees followed it every day to scrutinize if the actual production was equivalent to the planned production
- The observation was done daily and the results are analyzed.

Outcome :

- Previously listed abnormalities were collected and analyzed.

- The production plan was maintained as specified.
- The segregation of part numbers based on quantity was sustained and continued.
- No ambiguity and stoppages in the whole production process of the camshaft department.

5S IMPLIMENTATION CALCULATION:

Before the implementation of the above mentioned 5S lean method, there were 7 supermarkets in the camshaft department. On implementing sorting, systematic arrangement, spic and span, standardization and self- discipline methods resulted in a reduction of one supermarket. Thus the calculation for the observed percentage improvement is shown below:

✓ Supermarket dimension :
$$\text{LENGTH} = 2 \text{ m} \quad \text{BREADTH} = 1.5\text{m}$$
$$\text{AREA} = \text{L x B} = 2 \times 1.5 = \underline{3\text{m}^2}$$

✓ Total number of supermarkets before implementation = 7 supermarkets.
Area consumed by 7 supermarkets $= 7 \times 3 \text{ m}^2 = \underline{21 \text{ m}^2.}$

✓ Number of supermarkets reduced after implementation = 1 supermarket.

✓ Total number of supermarkets after implementation $= 7\text{-}1 = 6 \text{ supermarkets.}$
Area consumed by 6 supermarkets $= 6 \times 3 \text{ m}^2 = \underline{18 \text{ m}^2.}$

The reduction of supermarket led to the savings in floorspace area. Hence, the land cost per sq ft. in bidadi is taken as a parameter to calculate the percentage savings.

✓ Land cost per sq ft. in Bidadi = 60,000 INR.
✓ Land cost for 7 supermarket $= 7 \times 60,000 = \underline{12,60,000 \text{ INR.}}$
✓ Land cost for 6 supermarket $= 6 \times 60,000 = \underline{10,80,000 \text{ INR.}}$
✓ SAVINGS $= (12,60,000 - 10,80,000) \text{ INR} = \underline{1,80,000 \text{ INR.}}$

✓ PERCENTAGE SAVINGS $= \dfrac{SAVINGS}{LAND\ COST\ OF\ 7\ SUPER\ MARKETS} \times 100$

$$= \dfrac{1,80,000}{12.60,000} = 14.28 \approx \underline{15\%}$$

4. Conclusion

Due to the implementation of 5S and production leveling plan, there was an improvement in space utilization leading to reduced inventory space, the undefined parts were defined, camshafts with defined part numbers were supplied to specific inventories.This helped in easy accessibility of parts based on their frequency of usage and reduced time delay. The fewer quantity parts were combined and placed in a single lane leading to the reduction of 16 lanes which resulted in the cancellation of one supermarket. The results of the implementation of 5S are 3m^2 space saving in the department which brought about 15% capital savings. This paper's contribution is to illustrate all the relationships between the independent variables that are stock strength and the dependent variable that is floor space.

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Risk Factors involved in Indian Mechanical Web based SCM

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Abstract -

Risk management control issue considered an important region for researchers in this fastest exploring e-market. These include increased globalization of trade, quality guidelines, Environment concerns, Govt. regulation, Changing customer preferences, large set of criteria, Internet connectivity, and increased technical capabilities. Major studies found in this context, even then the chances of occurrence of uncertainties and risks are high enough. By providing certain fundamental modifications in the risk management, it becomes feasible to review the previous study to determine its significance in taking decision of e-supplier selection. This research includes reviews, interprets, and classifies 42 related studies which have appeared in past twenty years. Specific attention is given to those factors used in e-Supplier selection selection process. In the last, conclusions and significant areas for future research are presented.

Keywords: *Risk management, Risk Factors, web based SCM, E-SCM, Indian mechanical sector.*

1. Introduction

The implementation of new market strategies such as on-time delivery, wide-ranging non-core activities, and suppliers' rationalization programs when linked with the globalization, centralization, and distribution weaken the network of supply chain (Kumar, et al. 2019). So it became important to identify and categorize risk factors. Managing risk emerged as an essential topic for researchers in E-supplier selection. Examiners are more dedicated towards improving the performance by justifying the web based SCM risks. Technological transformation, continuous exploration, and Competitive environment are the key issues for attaining competitive benefit in executing risk management (Brindley, 2004). Managing risks perform an important role in management decision and control (Giannakis, et al. 2004). Internet technology improves the competences level of users for arranging the significant information of one with another prior to buying (Ranaweera, et al. 2008). In the earlier researches it has been verified that risks create undesirable effects on the processes of companies (Craighead et al., 2007). These risks may be arises from external factors (e.g. Economic growth), or internal (e.g. Coordination procedures and defective planning) in the supply chain (Oehmen, 2009).
Earlier researches proves that research conducted over the supply chain risk issues is not adequate and there are very limited research found on Indian mechanical web based supply chain

risk issues. India is a Progressive country and fast growing market. The manufacturing sector of India is very large and which is still expanding with consumer demand. E-SCM system enhances the capacity, reduce the complexity, and advance the system. It is necessary to work upon e-SCM risk issues for the smooth and running brake free. Hence, the finding of this research will helps in filling the gap up to some extent by identifying the risk variables for the effective operation of e-supply chain. Manufacturing industries mostly depends upon Mechanical manufacturing. So, the objective of current study is to discover and classify the risk problems related to mechanical sector in India. This Survey includes only those papers which are issued in main journals and are available in English. Working papers, Master's theses, books, Doctoral theses and non-English articles were excluded from it. All effort has been incorporated still any mistakes are found is unintentional and to be apologize for.

2. Review of Existing Literature

To explore and identify the different area research work, and to know the state-of-the-art, widespread literature is collected in various domains of manufacturing. To recognize and understand the prior research on various aspects related to the construction of the present research issues, the literature exists related to risk management is considered.

2.1 Research Methodology

The sources considered for this research work comprises of scientific journals (referred International and National), doctoral dissertations, textbooks, and conference proceedings, Publications in referred journals with English language were only included for this study.

The organization of this research work categorized the articles based on the 42 Risk factor as shown in Table 1. This table summarizes the significance of the 42 factors of E-Supply chain.

3. Risk related to E-supply chain

In this current scenario, the concept of "risk" has become an important area of study in science, engineering, and corporate atmosphere (Chopra & Sodhi, 2004). Risk shows vulnerability and as per the definition, it can be expressed as "A condition involving exposure to danger". The chances of Risk can be created through any source; known or unknown. The risk is also explained as "the possibility of an unusual incident to happen, and this incident will affect negatively over the system" (Khan & Burnes, 2007).

E-SCM risk also describes as the potential outcome with respect to effect and vulnerability. The e-SCM risk is also termed as "the event occurrence uncertainty which could influence the process of achieving company business objectives" (Tang, 2006). Risk associated with e-supply chain also referred as "the possible discrepancy of outcome influencing the drop of value added in any supply chain activity, where the consequence is described through the quality and quantity of merchandises in the supply chain on a particular time and at a particular location" (Bogataj & Bogtaj, 2007).

The philosophy of risk and its management covered in various domains of finance, strategy, and economics (Manuj & Mentzer, 2008). Risk can be defined as the likelihood of variance from the objective and subjective source in the outcome (Spekman & Davis, 2004). Improper

management of risk is prone to imprecise forecasting, lower quality product, poor relationships among members, loss of reputation, share price downfall and turnover, and conflict within the organizational members (Cousins et al., 2004). So, it becomes essential for the Firms to enforce methodologies related to risk management to exclude and reduce their aftereffects (Manuj & Mentzer, 2008).

Several classifications of supply chain risks have been covered by investigators from the literature. These issues are further distributed among sub-factors, for example, intellectual property, systems, procurement, disruptions, inventory, delays, forecast, and capacity (Chopra & Sodhi, 2004). Risk are of two types in supply chain: Internal and external, internal covers issues like , regulations, organizational factors, information delays, and capacity variations and external covers includes factors such as manufacturing yield, market prices, competitors moves, supplier quality, political concerns, and manufacturing expenses (Cucchiella & Gastaldi, 2006).

Internet usage in the supply chain improves the development prospects and change of pace but also simultaneously increases the network complication and risk occurrence. E-business usage has carried a key technical change in purchasing also enhance the business profits such as transaction costs, savings in inventory reduction and communication link among consumers and sellers (Deeter-Schmelz et al., 2001). Customer's perceived risk for making purchase decision is better in web based spending instead of conventional spending (Samadi & Yaghoob-Nejadi, 2009). Technological risks supported by various issues such as Incompatible application, integration, and unpredictable atmosphere related security issue.

3.1   Classification of Supply chain Risk

Supply risk is connected with the commercial environment and organization segregated into different groups (Bogataj & Bogtaj, 2007). For the proper organization of risk, criticalness of risk can be measured depending on its root cause (Norrman & Jansson, 2004; Peck, 2005). Root causes related to risk involves organizational, environmental creates an impact on the resulting issues in the supply chain (Juttner et al., 2003). These e-supply risks split into two categories (Kleindorfer & Saad, 2005). Firstly, chances of risks arise because of mismanaging in between supply and demand the second category cover those issues which arise from the disruptions in the regular working cycle.

Supply risk also be divided into three categories: 1) Belongs to supply system but not belonging to the firm, 2) Belong to firm internally and 3) internally not belong to the system (Christopher & Peck, 2004). Broadly seven distinct types of risks causes are available which involves supply chain members, supply chain configuration, organizational policy, industry features, environmental features, problem-related issues, and decision-making unit (Ritchie, 2007). Risk issues can be categorized on uncertainty basis: a) competitor moves, b) information delays, c) quality of supplier, d) available capacity, e) political atmosphere, f) internal organization, g) manufacturing yield, h) stochastic cost, i) customs regulations and change in rate (Cucchiella & Gastaldi, 2006). The development of a structure which is secure against disruption and variation is possible but it becomes difficult to secure it from disaster. Tang (2006) categorized supply chain risks in two sets, i.e. disruption and operational risks. Similarly, Wagner & Bode suggested five different types of causes related to supply chain risk: demand, regulatory, infrastructure supply, disastrous and bureaucratic/lawful. (Wagner & Bode, 2006). Categorization of risk is also possible according to the incident leading to risk-disaster, variation,

and interruption (Gaonkar & Viswanadham, 2007). Moneymaking prospective and new e-market increases the progress rate along with the complexity in the network of the supply chain but also consequently enhance the level of risk. E-business technology usage has introduced a key source of technical improvement in purchasing and offers to the organizations with various profits like transaction charges saving, inventory reduction and the network formation between sellers and purchasers (Deeter-Schmelz, et al. 2001).

E-business risks are the outcomes of vulnerable business activities that are originated through implementing irrelevant factors which increase the difficulties in the implementation of technology (Vaidyanathan & Devaraj, 2003). Therefore, different measures belong to the e-supply chain risk used in this paper. Various e-supply chain issues which were extracted by the investigators from the literature are available in Table 1.

Table: 1. Various Factors (Issues) related to e-Supply Chain Risk

Issues	Sub-Factors	References
Information & Policy Risk (IP)	(f1) Strategic uncertainty	Sofyalıoglu & Kartal (2012), Bavarsad et al.(2014), Gross-Claypool et al. (2015), Ravasizadeh et al. (2011),), Kumar et al. (2019a), Cucchiella & Gastaldi (2006),), Faisal et al. (2007), Tang (2006), Tapiero (2007), Murtaza et al. (2004), Choy et al. (2007), Rao et al. (2005), Wu et al. (2006), Wagner & Bode (2006), Gaudenzi & Borghesi (2006), Sheffi & Rice (2005), Peck (2005), Sodhi (2005), Christopher & Peck (2004),), Giunipero & Eltantawy (2004), Norrman & jansson (2004), Hallikas et al. (2002), Zsidisin (2003), Simons (1999), Dyer (2000), Johnson (2001).
	(f2) The extent of acceptable information	
	(f3) Information Sharing Privacy	
	(f4) Intellectual property risk	
	(f5) Information Security	
Environmental Risk (ER)	(f6) Government Regulation	Gross-Claypool et al. (2015), Matotek et al. (2015), Avelar et al. (2014), Bavarsad et al. (2014), Kumar et al. (2019), Ouabouch & Amri (2013), Thun & Hoenig (2011), Ravasizadeh et al. (2011), Rao & Goldsby (2009), Ziegenbein & Nienhaus (2004).
	(f7) Political Stability	
	(f8) External and uncontrollable risk	
	(f9) Social	
	(f10) Macroeconomic risk	
	(f11) Natural disasters	
Operation & Supply Risk (OS)	(f12) Transit time	Gross-Claypool et al (2015), Matotek et al. (2015), Avelar et al. (2014), Bavarsad et al. (2014), Ouabouch & Amri (2013), Sofyalıoglu & Kartal (2012), Thun & Hoenig (2011), Ravasizadeh et al. (2011), Blome & Schoenherr (2011), Jiang et al. (2009), Manuj & Mentzer (2008), Zsidisin et al. (2004), Chopra & Sodhi (2004), Giunipero & Eltantawy (2004), Zsidisin (2003), Johnson (2001), Hallikas et al. (2002), Dyer (2000).
	(f13) Supplier opportunism	
	(f14) Asset & Tool Ownership	
	(f15) Risk affecting supplier	
	(f16) Product quality and safety	
	(f17) Inventory ownership	
Relation & dependence degree of inter-organization Risk (RDDIO)	(f18) Commitment capability	Gross-Claypool et al. (2015), Avelar et al. (2014 Bavarsad et al. (2014), Ouabouch & Amri (2013), Rao & Goldsby (2009), Ravasizadeh et al. (2011), Jiang et al. (2009), Spekman & Davis (2004).
	(f19) Lack of honesty in the relationship	
	(f20) Competitiveness	
	(f21) Interrelationship risk	
	(f22) Commercial Exploitation	
Infrastructure Risk (IR)	(f23) Technological Risk	Gross-Claypool et al. (2015), Avelar et al. (2014), Bavarsad et al. (2014), Ouabouch & Amri (2013), Thun & Hoenig (2011), Ravasizadeh et al. (2011), Blome & Schoenherr (2011), (2007), Jiang et al. (2009).
	(f24) Economic	
	(f25) Appropriate e-market	
	(f26) Transaction Delay	
	(f27) Implementation risk	
	(f28) Credit	
Demand Risk (DR)	(f29) Drastic change in fashion	Gross-Claypool et al. (2015), Matotek et al. (2015), Avelar et al. (2014), Bavarsad et al. (2014), Sofyalıoglu & Kartal (2012), Ouabouch & Amri (2013), Thun & Hoenig (2011), Ravasizadeh et al. (2011), Blome & Schoenherr (2011) (2011), Manuj & Mentzer (2008), Ellis et al. (2010), Ziegenbein & Nienhaus (2004), Peck (2005), Johnson (2001), Simons (1999), Svensson G (2002).
	(f30) New product acceptance risk	
	(f31) Demand variability	
	(f32) Competitor moves	
	(f33) Short product life	
	(f34) Sudden cancelation of order	
	(f35) Forecast error	
Organizational Risk (OR)	(f36) Currency risk	Thun & Hoenig (2011), Ravasizadeh et al. (2011), Blome & Schoenherr (2011), Cucchiella & Gastaldi (2006), Rao & Goldsby (2009), Wagner & Bode (2006), Gaudenzi & Borghesi (2006), Wu et al. (2006), Tang (2006), Sheffi & Rice (2005), Rao et al. (2005), Peck (2005), Sodhi (2005), Christopher & Peck (2004), Norrman & jansson (2004), Spekman & Davis (2004), Chopra & Sodhi (2004),), Murtaza et al. (2004),
	(f37) Operating risk	
	(f38) Reputation risk	
	(f39) Culture risk	
	(f40) Leadership	
	(f41) Lack of expertise	

	(f42) Legal issues	Zsidisin et al. (2004), Svensson G (2002), Zsidisin (2003), Simons (1999).

So, a total of 42 sub-factors was extracted from the literature belong to supply network. After detail discussion with the experts of this field, 38 sub-factors were found suitable according to mechanical manufacturing supply network in Indian context which include in this practice is given in table 2.

Table: 2.   List of Risk factors/ Sub-factors included in this study

Risk Sub-Factors	Definitions
Information Security risk	Risk rises from the Software and hardware Incompatibility that exposes a system to compromise.
The extent of Acceptable information risk	Information accurateness reliability that is achieved from a business companion.
Intellectual property risk	Risk arises due to intangible property that is a result of creativity e.g. patent, copyright, trademark.
Macroeconomics risk	Financial risk associated with macroeconomics or political factors.
External and uncontrollable risk	The uncontrollable event happened out of the company
Political risk	Risk arises from fluctuations in political stability
Government action risk	Loss or risk arises from government regulation
Natural disaster risk	Risk of loss arises due to nature
Supplier Opportunism risk	It related to the lack of trustworthiness in transactions in such activities as misrepresenting statistics with the intention to deceive and failing to complete the commitment
Transit time risk	It related to the average time or variability of time spent in transfer including port clearance and transportation time
Risk affecting supplier	Risk rises from the supplier side
Lack of honesty in the relationship	Risk arises if a commercial companion intentionally not to behave as per the commitment
Commitment and capabilities risk	Risk arises due to the agreement that business partner have because of company plan but not capable of doing work accordingly
Commercial Exploitation	Product demand exploited by the market
Strategic uncertainty risk	It affects business strategy implementation
Interrelationship risk	Risk arises if the business agreements are increased among the firm and its business companion; the risk caused by process reduction also will be increased interrelationship
Competitiveness risk	It influences a company competency to distinguish its articles/product from its opponents
Operating risk	It affects the manufacturing and supply capacity of goods due to breakdown
Currency risk	It arises due to the change in the exchange rate.
Culture risk	The work tradition follows in an organization
Reputation risk	The general estimation that a market has for a firm
Lack of expertise	It affects due to the skill level limitations
Legal Issues	Risk related to legal policies
Leadership risk	Risk arises due to the activity of leading
Credit risk	It affects the money available for investment in business
A drastic change in fashion risk	Risk arises due to a change in trend or advancement
New product acceptance risk	It refers to flexibility according to change or advancement
Demand variability risk	Risk arises due to fluctuations in demand
Competitor's moves	Risk arises due to the competitor's business strategy
Forecast Errors	Risk arises due to wrong assumptions in demand
The sudden cancellation of orders	The risk arises due to order cancelation suddenly from the commercial partner
Short product life	It relates to product life
Economic	It related to a firm economy
Technological Risk	It refers to the results of security issues, integration issues, and incompatible application related to the unstable web system
Implementation	Risk related to implementing new technology and policies
Appropriate e-market	An inter-organizational network that permits buyer and seller to interchange information about product, processes, and goods
Product quality and safety	Risk related to product quality and safety
Inventory ownership	The possibility such as price change will cause the value of an inventory to decrease

4. Summary and Conclusion

There is an attitude of risk factors which are after varying, conflicting, sometime complimenting and many times are non-expressible in commensurable units. A need exists to hypothesize and structure the numerous components of the evaluation problem into an analytic framework that may facilitate understanding and to devise a selection tool that can harmonize the combinations of both qualitative and quantitative criteria into consideration, as desired.

The aims of the above summary of these existing methods are to fulfill the objectives (qualitative and quantitative) of risk factors. There no direct technique can be used to solve risk factors as per the different organizations with different qualitative factors. On the current review basis, it would not illogical to propose that the risk factor recognition required further care with the intention to synchronize the combination of qualitative and quantitative factors to construct the best decision building models of risk factors related to e-SCM.

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Cost optimization in liner shipping networks through Liner Network Costing Model (LNCM)

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Abstract -

Container shipping or liner networks are foremost components in global supply chains, where cost minimization has become essential practice. Competitive business environment has led the carriers to optimize their networks in order to cut down extra costs and increase revenues. This study proposed Liner Network Costing Model (LNCM) to calculate savings per teu (Twenty feet Equivalent Unit or a 20ft shipping container) a shipping line can make by calling a particular port. The objective is to minimize total costs made up by ship operating costs and costs at ports. The model is tested on few main line services calling Colombo port. LNCM can be of great help to the shipping lines in order to understand their costs and optimize the same. Developed model can also be used by a port to demonstrate Shipping lines about savings per teu they can make by calling that particular port which is in competition with other ports in a country or region, as the case may be.

Keywords: Container Shipping, Shipping Lines, Cost optimization, Network Costing, LNCM

1. Introduction and background

Feeling the heat of competition, numbers of researchers have worked upon optimizing liner shipping networks (Midoro et al., 2005; Ducaruet et al., 2010, Davies, 1986; Rimmer, 2002). Most of them have focused on explaining various costs incurred in liner networks and maximizing revenues (Tran and Haasis, 2015; Wang et al., 2015; Chen and Zeng, 2010). Heaver (2002) says that in this intensely competitive market, the primary motive of shipping lines is to strategize their business in such a way that they can minimize their costs and maximize revenue. Understanding the fact that, capital and operating cost in the liner shipping industry are very high and therefore network planning becomes a sensitive decision (Fagerholt, 1999; Lam and Dai, 2012; Hsu and Hsieh, 2007). A main line shipping network consists of ships voyaging from one main trade to another e.g. Asia to Europe. So the shipping line will plan in prior about which all

ports it will call in mentioned two regions (Imai et al., 2009). Not just this, it will call many other ports while voyaging from Asia to Europe and vice versa mentions Wang and Meng (2014) in their study on liner shipping networks design. Now, here comes strategic, tactical and operational planning of the network which is not new to liner shipping business but it is getting aggressive with time (SteadieSeifi et al., 2014; Crainic, 2000; Schmidt and Wilhelm, 2000). Shipping line in this case will figure out best possible ports (financially profitable) of call in the network where they can get maximum cargo while spending as less as possible (Chou, 2007; Guy and Urli, 2006). Now, that's where this study gains importance by attempting a deep dive to understand the situation and proposed LNCM to calculate savings per teu which can be earned by shipping line by calling a particular port. No study like this is even been attempted earlier. LNCM can be used by shipping lines to decide on port of call in a country or region. Also, the model can be presented by ports to its stakeholders for demonstrating that it offers more revenue per teu then its rivals.

1.1 Research motives

The research has framed following research motives from maritime supply chain perspective which has the potential to grow its container shipping sector;

- To identify the key variables of the liner network structure.
- To develop the liner network costing model (LNCM).
- To suggest managerial and practical insights.

To fulfill our desired objectives we are proposing decision making support by identification of the key variables to develop the liner network structure. Thereafter modelling of the liner network is done and optimized it. The unique contribution of this study to the container shipping development and management literature therefore is the identification of industry specific variables of liner network development and optimization of container shipping development and management and the exploration of their practical implications for the industry as well as their stakeholders.

The remaining composition of the article is as follows. Section two provides literature review on themes like liner network costing and modelling costs in liner networks. Section two also

discusses research gaps that motivated present research. Liner network cost is provided in section three and LNCM and its assumptions have been discussed in section four. Section five presents conclusion and future scope of the research article.

2. Review of Literature

Container shipping or liner shipping network planning is a matter of concern for shipping lines as how much we earn at the end of the day is what matters in business. Primary aim of a liner shipping network is to create revenue and minimize the cost by not compromising with quality of the service. This research proposed LNCM that calculates savings per teu per service a shipping line can earn. Current research is one of its types and no researcher has proposed a model to calculate savings per teu but in this section we have attempted to review studies done on network costing and revenue generation. Shintani et al. (2007) mentions about the motive of liner networks is to maximize the profits which are gained by appropriate designing of networks as in which port to call in which region. Shipping lines forecasts cargo demand at each port and then considers other factors in order to decide which port they have to call. Primarily, they perform cost-benefit analysis and then design their network. Brouer et al. (2014) suggested a generalized network cost model, however the model does not calculates network cost in transshipment services. Liner shipping market is very competitive and volatile and therefore shipping lines redesign their services in every three to six months in order to minimize operating costs and to generate more revenues (Liu et al., 2014). The model prepared by Liu et al. (2014) calculates both inland transport costs and seaborne shipping costs but do not gets into finding revenue per teu gained by calling a certain port in network. Wang and Meng (2012) considers speed in container shipping a very important aspect to look into and talks about optimal speed to minimize bunker costs and maximize profits. Number of ships deployed in a liner network is also a strategic decision which impacts overall costs. As per Song et al. (2005), to increase revenue in survive in highly competitive container shipping market, both shipping lines and port authorities are implementing cost cutting strategies very aggressively. In this study, mixed integer linear programming model (MILPM) combines network design and fleet assignment problems in order to minimize the overall cost. Reinhardt and Pisinger (2012) proposed MILPM which combines network design and fleet assignment problems in order to minimize overall cost incurred by the shipping lines, however it doesn't talk about revenue or savings per teu earned by calling a port.

A network cost model developed by Feng and Chang (2008) talks about optimization techniques for minimizing the cost but in case of empty containers only. Agarwal and Ergun (2008) mentions about the routes selected by shipping lines are based on cargo forecast and thus determining the cost and revenue which can be generated by the service network. Ting and Tzeng (2004) refer to container shipping and states that the primary focus of this industry is now absolutely on reducing the costs. Therefore, with increasing vessel supply capacity, cost management has become a vital aspect. Gelareh and Pisinger (2011) performs research in the area of revenue management in container shipping and suggests that it becomes necessary for shipping lines to optimally allocate vessels on trade routes through strategized vessel chartering for minimizing the operating cost. Adding port calls in liner service network generates additional revenue but only if the port has got sufficient cargo and the increased costs due to added port calls are lesser than revenue generated by adding those calls (Notteboom, 2006). Karsten et al. (2015) performs a brief study on liner shipping and evaluates the cost/revenue of the network. Brouer et al. (2014) talks about how optimizing liner shipping networks plays important role in maximizing the revenues by ensuring better capacity utilization in the network. In study presented by Plum et al. (2014) talks about revenue generation in liner network while operational costs and penalty for not flowing the cargo are subtracted from total generated revenue. Notteboom and Merckx (2006) gives a break of various costs shipping lines pay in running network and gives emphasis on freight integration strategies for revenue generation. All the studies we reviewed in this section talks more or less on minimizing network costs and maximizing revenues by optimizing liner networks. However, none of the study proposed any model which calculates revenue or savings per teu a shipping line can generate by adding a particular port in its network. Therefore, this study attempts to fill this gap by proposing LNCM that calculates savings per teu generated by adding a port in liner shipping network. Below table presents some recent studies performed on minimizing costs and revenue generation in liner shipping networks:

Table 1: Some recent studies performed on minimizing costs and revenue generation in liner shipping networks

S. No.	Author/s	Area, Country	Methodology	Objective	Dimension covered

1	Notteboom and Vernimmen (2009)	North Europe–East Asia loop	Cost model	Analysis of liner service Schedules with the help of cost model.	Fuel costs, Bunkers Liner services, Container shipping
2	Ducruet and Notteboom (2012)	In general	Descriptive study	Analysis of the global liner shipping network in 1996 and 2006.	Liner Shipping, Network analysis, Nodal regions, Port hierarchy, Spatial change
3	Agarwal and Ergun (2010)	In general	Mathematical programming and Game Theory	Analysis of transportation networks and operational problems such as the allocation of limited capacity.	Transportation, Liner shipping alliances, Resource allocation, Inverse optimization.
4	Meng and Wang (2011)	Experiments based on realistic Asia–Europe–Oceania trade	Mixed-integer linear programming model solved by CPLEX	A mathematical model based study on network design with empty container repositioning.	Liner shipping network design, Hub-and-spoke, Multi-port-calling, Transshipment, Empty container repositioning.
5	Gelareh et al. (2010)	In general	Mixed integer programming formulation	Study on competition between a newcomer liner service provider and an existing dominating operator and how optimal liner networks are designed.	Hub-and-spoke network design, Liner shipping Competition, Mixed integer programming, Lagrangian relaxation, Enumeration.
6	Lam and Yap (2011)	Evidences drawn from Shanghai, Busan, Kaohsiung and Ningbo.	Descriptive study	Analysis on inter-port relationships among the four container ports from liner shipping network's perspective.	Liner shipping, Shipping network, Port connectivity, Supply chain, Container shipping, East Asia
7	Mulder and Dekker (2014)	Asia–Europe trade lane	Linear programming model	Analysis of combined fleet-design, ship-scheduling and cargo-routing problem.	Transportation, Liner shipping, Network design, Scheduling

2.1 Research Gaps and highlights

With increased competition in liner shipping industry, profits generated by liner networks are shrinking day by day. Market has become very volatile and trends/processes are changing every now and then; especially ports are exposed to changing trends in shipping industry. Therefore, to remain attractive to shipping lines, ports need to stay ahead in competition by offering quality services. On the other hand, shipping lines are struggling to maintain and increase market share. Intense competition and increased bunker cost have impacted revenues. Number of studies on liner network design and optimization are given e.g. Wang and Meng (2012) closes the gap between bunker consumption and sailing speed in a liner network. Lam and Yap (2011) talks about existence of research gap in port business competition in liner network. Similarly, most of the studies are executed in order to minimize costs and maximize revenues but no study proposed a model that provides a mechanism to calculate revenue or savings per teu a shipping line can earn by adding and calling a port in network. Therefore, to fill this gap, we have proposed LNCM to calculate savings per teu – which is what the primary motive of this research is.

2.2 Geographical scope of this research

This paper investigates the literature on revenue generation in liner shipping networks and therefore finds that no model is proposed which gives a scope to calculate revenue or savings per teu a shipping line can earn while calling a port. Therefore, this research developed a model that can be utilized by shipping lines in any part of the world to optimize their network and to do cost-benefit exercise. Therefore, the implication and scope of this research is global and not restricted to a particular country or region.

3. Liner Network Costs

Liner shipping networks are planned, designed and brought in action to meet the growing demand of containerized freight transport (Verny and Grigentin, 2009). The main ingredients of liner networks are frequency of liner services, accessibility, transit time, size of vessels and regions served (Yeo et al., 2008). Expansion or networks is done by increasing loops operated,

maximizing frequency, vessel upsizing or by deploying extra loaders. More economic activities generate more cargo to transport which impacts vessel size, liner services' schedules and overall structure of liner shipping (Notteboom and Rodrigue, 2005). While designing liner networks, shipping lines aims to generate maximum profits out of operations but in the meantime they need to maintain balance between customers' requirements and their cost (Imai et al., 2006). A higher demand for shipping services may look like an increased opportunity but it brings a lot of complexity with it (Celik et al., 2009). Shippers may demand direct connections between their port of origin and destination but if the cargo is not enough at the said port of origin or destination then it may not be profitable for the vessel to call such a port (Low et al., 2009). Hence, in this case cargo is first transported to the nearest hub port. Therefore, demand puts immense pressure of the liner schedules (Notteboom and Winkelmans, 2001; Notteboom, 2001). Also, the service schedules are designed in such a way that carriers maximize the utilization rate of the vessels and thus cargo owners enjoy hassle free services (Jin and Kite-Powell, 2000; Lim, 1998). A region may have number of ports which claims to handle bigger vessels with lesser turnaround time at lesser cost says Notteboom (2006). Therefore, carriers need to make best choice for a port of call by analyzing various criteria (Wiegmans et al., 2008; Guy and Urli, 2006).

The competition among shipping lines has increased to capture more market share and thus in this intense competition, minimizing cost is an important criteria to maintain profit margins (Junior et al., 2003). However, LNCM proved to be a decision making tool for a shipping line when they decide whether to serve a market direct or by transshipment. But it network cost which stands out most critical tool to add a port in service voyage or not. The foremost motive of LNCM is to calculate savings per teu earned by calling a certain port. The proposed model considered various port charges and calculates how much profit can be made in a certain port call. There are various components in network cost model:

- Charter Cost
- Bunker Cost
- Port Charges
- Admin and other landside cost
- Canal Charges (if any)

Out of above mentioned cost, bunker cost and port charges are the most important criteria when a carrier decides to add a port in main line calls instead of adding it in round voyage. However, to all costs are very important start a service except admin and other landside cost which is least critical for carriers. Below is the calculation table to derive slot cost where we have inserted dummy cost '$XX':

Table 2: Summary of Estimated Cost per Round Voyage (US$ per TEU)

Charter Cost	$XX
Canal Transit Cost (Round Trip)	$XX
Port Costs (Vessel related)	$XX
Admin and other Landside Costs	$XX
Base Rate	$XX
Bunker Cost (per share of direction)	$XX
Slot Cost	$XXX

4. Liner Network Costing Model (LNCM)

The liner shipping business can be compared with bus lines and trains where the operational schedules are fixed and predefined. A service in liner shipping is a round trip which consists of a certain number of ships which are calling a series of ports (from country to country or region to region, as the case may be) at a certain frequency. Similarly, a liner network accommodates number of routings from origin to destination ports varies based on transit time and cost. Different shipping lines offer different itineraries, transit times and freight rates between same regions. All this involves huge amount of monetary investments by shipping and even by ports for that matter. Therefore, it becomes very vital for a shipping line to look into costs and benefits before designing liner networks. When determining whether to serve a market direct or by transshipment, lines consider the following important factors:

- Ability of port to handle mainline vessels

- Berth availability

- Reliability and productivity

- Network cost effects

- Market growth prospects

- Customer impact (frequency, transit times, reliability)

In considering the network cost effects, lines compare the marginal cost of a direct call against the cost (normally the marginal cost) of feeding and transhipment. Incremental voyage costs might include charter hire (if an additional vessel is added to a service), bunkers, and port charges.

Feeding costs will include feeder slot cost and transhipment handling at the hub. The feeder slot cost might be that paid to a third party or it might be the voyage costs of operating the feeder if a line is operating its own dedicated feeder service.

Criteria favouring a direct call are:

- Proximity of the port to main sea lanes;

- Market size and growth

- Ability to handle right size of vessel

- High productivity and reliability.

Our approach to this analysis is to consider the direct call and transhipment options in the same way as the line. Therefore, We:

- Calculate the incremental voyage cost of a direct call

- Determine the cost per teu of feeding and transhipping

- Calculate the breakeven volume V at which:

    V x (feeder rate + T/S rate) = Incremental voyage cost

We then assess what volume a line or alliance might be able to achieve per call, based on a reasonable market share assumption. We can then determine the financial viability of the call and the likelihood of the line choosing to call direct. Below model exemplifies network costing, an

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example where possibility of main line call on Port of ABC is calculated which is in competition with Port of XYZ.

Table 3: Liner Network Costing Model (LNCM)

Trade Route	Sample Service	Current Routing Main Line Cost (US$) - calling Port of ABC	New Routing: With transhipment at port of XYZ	Cost Differential between New and Current Routing (US$)	Feeder Cost Per Slot (US$)	T/S THS (US$)	Estimated Break -even volume (teu)- One Way	Market Share	Potential weekly volume - TEU	Expected financial effect (US$)	Savings/ Teu ($)
		A	B	(B-A)							
Asia-US East Coast	THE Alliance - EC5	XXXX	XXXX	XXXX	XX	XX	XXX	XX%	XXXX	XXXX	XX
Asia-US East Coast	Zim - Z7S	XXXX	XXXX	XXXX	XX	XX	XXX	XX%	XXXX	XXXX	XX
Europe-South Asia	MSC/SCI - Himalaya Express/IS ES	XXXX	XXXX	XXXX	XX	XX	XXX	XX%	XXXX	XXXX	XX
Middle East-Africa	CMA CGM - Mtwara Express	XXXX	XXXX	XXXX	XX	XX	XXX	XX%	XXXX	XXXX	XX

Asia-South Asia	Wan Hai/MOL - CH3/HSX	XXXX	XXXX	XXXX	XX	XX	XXX	XX%	XXXX	XXXX	XX

4.1 Key Assumption

- Please note that the numbers mentioned in the table are "XX" and can be replaced with real time situation in order to calculate savings per teu.

- Savings per teu for profitable loops is based on the forecast volumes and also the deadlines and costs of ongoing projects are kept under consideration.

- For achieving a profitable amount of savings per teu, shipping lines have to achieve market share ranging between 25%-40% (In general, may vary country to country/region to region).

- The transhipment THCs (Terminal Handling Charges) are compared for all the possible ports in a country/region. However, shipping lines get discounts on standard rates, which could vary for each line. Therefore, estimated savings can vary, depending on the discounts offered to the shipping line/alliance. Feeder cost paid by the shipping line to feeder operators is also included in the model.

- In above table, five services named THE Alliance - EC5, Zim - Z7S, MSC/SCI - Himalaya Express/ISES, CMA CGM - Mtwara Express and Wan Hai/MOL - CH3/HSX are considered which may call Port of ABC and thus savings per teu is calculated for each service.

➢ Break-even volume: This volume is calculated by dividing the additional cost of a main line call through Port of ABC by total feeder and transshipment cost incurred by a main line currently for handling transshipment containers at Port of XYZ. The feeder and transshipment cost of the break-even volume is equal to the additional main line cost.

➢ Expected financial impact: A main line call will generate savings if it is able to handle containers more than its break-even volume. This would mean that its feeder and transshipment cost for the achieved volumes are higher than the incremental cost of calling at Port of ABC. Therefore, the savings vary for each loop and trade lane depending on the break-even volumes required.

> Additional main line calls: Based on the 2020-21 forecast volumes (Drewry's Maritime Research Database), while certain loops will be profitable for mainline calls, few loops might not be profitable immediately as feeder and transshipment costs at estimated market share and volumes is less than the incremental main line cost. However, an increase in volumes or shift in market share on some of these trade lanes could make a direct call feasible in future. Therefore, this model helps shipping lines in finding the feasibility of main line calls at ports.

> Candidate services: The sample services mentioned in the model have below loading region and destination region:

- Asia-US East Coast

- Europe-South Asia

- Middle East-South Asia

- Asia-South Asia

Therefore, with the help of LNCM, shipping lines can calculate savings per teu ($) which will help them to take decision over which port to choose for a call. Competition has lessened the number of carriers in liner shipping and thus existing carriers are focusing costing factor in order to maintain profits. Hence, this study becomes very important for any shipping to calculate its costs and benefits.

6. Conclusion and future work

In this paper, we have calculated total cost incurred to a shipping line, reason why shipping line needs LNCM that derives savings per teu. All the factors considered in the paper are derived from real world and not assumptions. In past, numbers of authors and researchers have worked upon liner shipping networks but none of them suggested a model which calculates savings per teu for shipping lines. The proposed model can be of great help to shipping lines or shipping alliances on busy routes which costs and savings are in tussle with each other. To list down all the possible costs and revenue generating activities and then deriving savings/TEU will help in shredding extra costs and this is what current research's motive was. By using LNCM, shipping

lines can take strategic decision like which port to include and which one to omit while preparing liner shipping networks. Not just optimizing costs but by proposing this model, we have created a method of benchmarking ports in a country or region that can be compared with each other for the fact that who offers cost effective services to the shipping lines. However, being cost effective cannot ensure attractiveness and there are number of factors behind the scene as well, which can be studied and connected to this model in future. In future, model based study will hold greater prospective because of various commercial necessities which are not included in this table. We anticipate that this study will act as a cornerstone for integrating and stimulating future work in designing even more optimized liner shipping networks, which at present is an uphill task for shipping lines.

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SECTION – 2
FLEXIBILITY

Assessing the Role of Risk-taking, Teaching Pedagogy and Entrepreneurship Education in Self-efficacy Development

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Abstract-

Entrepreneurship is a cognitive process of individuals' behavior. It is majorly dependent upon the entrepreneurial readiness of an individual which can be groomed with relevant experience, training and education. The success of any training and education program relies upon the structure and systematic delivery of the content, and there are various methods for that. The research highlights how teaching pedagogy and Entrepreneurship education helps in self-efficacy development. This study also investigates the effect of risk-taking behavior on individuals' self-efficacy. Previous research claims that course specialization has a significant role in changing entrepreneurial mindset. The data was collected from selected reputed institutions, and final year undergraduate and postgraduate of science, technology, engineering, management and entrepreneurship courses for the purpose. The results support previous research findings in this field and highlight the need for entrepreneurship education in HEI. The paper highlights the need for better entrepreneurship education for Indian Higher education institutions to foster startup growth.

Keywords: Teaching pedagogy, Entrepreneurship Education, Risk-taking behavior, Self-efficacy, Higher Education Institutions.

1. Introduction

In these times, entrepreneurship is being significantly evolved in to the educational system. The transformation process is visible and is evident in developed, developing and emerging economies. The relational existence of the entrepreneurship and entrepreneurial development has led to a positive impact upon innovation, commercialization, new job creation and economic development (Lackeus, 2015). Entrepreneurship development in a country is a process involving many internal external factors. Apart from education, entrepreneurship can be influenced by various psychological and environmental factors. In the behavioral context, Individuals' self-efficacy is very influential variable which helps in the entrepreneurial process and intention.

The concept of self-efficacy as defined in (Kickul, Wilson, & Marlino 2008) is "perception of individual's skill set or ability to perform a certain task, and reflects the confidence in abilities, to complete such task". Entrepreneurial self-efficacy revitalizes individual aspiration, priorities, determination during difficult time (Boyd and Vozikis, 1994), and impart a key role in entrepreneurial intention formation (Mueller and Dato-On, 2008). In this regard, previous research has highlighted that high entrepreneurial self-efficacy enhances the intention of entrepreneurship (Kickulet al., 2008; Wang et al., 2002).

According to Owusu-Ansah and Flemin (2002), in traditional education system students learn to obey, copying from other thing and the primary focus is on getting a good job. While as entrepreneurship education helps them in decision making and fosters them for new venture creation. Chang (2008), suggested an effective curriculum for entrepreneurship education. Generally, it should cover all the aspects of general education, content for career choices, participatory involvement and professional as well entrepreneurial development. Further,

innovation in entrepreneurship courses requires content up-gradation with suitable text, new teaching pedagogies, different pedagogies, experienced trainers and mentors and supportive campus environment. In addition to the statement Raposo and Paco (2011), opposed that entrepreneurship education includes identifying abilities, creative and critical thinking, innovativeness and managerial capabilities. Furthermore, Karmarkar (2014), suggested on the entrepreneurship course by highlighting the importance of skill-building subjects like creative thinking, leadership, negotiations, technological innovation and new product development.

This research is designed to esses the role of the teaching pedagogy, entrepreneurship education, risk-taking propensity and Entrepreneurial education in self-efficacy development. This study also investigates the role of different course specialization in entrepreneurial self-efficacy development. The data was collected from final year undergraduate and postgraduate students of science, technology, engineering, management and entrepreneurship (STEME) courses. The results confirm previous studies in this field and highlight the need for entrepreneurship education and improvement in teaching pedagogy for HEI. The research highlights the vitality for entrepreneurship education for India's startup growth.

2. Literature Review and Hypothesis Development

2.1. Teaching Pedagogy and Self-Efficacy

Successful entrepreneurship education is the outcome of a precise and clear Pedagogical approach and content of the study (Fayolle, 2010). Entrepreneurship education (EE) is helpful in the development of entrepreneurial skill and attitudes. EE is followed by university support for co-curricular activities like student-run ventures, incubators, accelerators, elevator pitch, designing a business plan, entrepreneurial clubs, mentorship and community support (Maritz and Brown, 2013). Various researchers identify that using different pedagogy techniques and in the streams of science, technology, engineering and mathematics Morris et al. (2013) has helped student entrepreneurial growth. The primary reason for holding this education is to enhance the new venture creation possibility for students and youngsters (Reynolds, 2015).

In the traditional teaching method, usually lectures are the conventional way of teaching but, the direction of delivery has changed over many years. Educational pedagogy now plays a dominant role in individual career development. Modern techniques include case study, class presentation, class assignment, group project, a group discussion, formal lecture, seminar, action learning, guest speaker, video methods and web-based learning (Lonappan et al., 2011; Potter, 2008). Other innovative ways include business simulation, game-based learning, project development, business setup, competitions, study tours, workshops and presentations are found innovative and more appropriate methods for fostering entrepreneurial attributes among participants (Mwasalwiba, 2010; Arasti et al. 2012; Sharif et al., 2011).

Oyelola (2013), suggested process-oriented teaching and problem-based teaching, Torben (2010), agreed with entrepreneurship camps as teaching methods. Ton and Frank (2006) focus on the problem-oriented learning and active learning. Mojalal et al. (2011) more agreed with the utilization of problem-solving, practical learning task, creative exploration, new idea development, specialized workshops. Moreover, Kowsari and Norouzzadeh (2009), highlighted, different pedagogy such as real-life experience, flexible learning environment, continuous mentorship with entrepreneurs as a teaching method. In the same manner, Yadollahi et al. (2009), Underlined on the practical pedagogical approach including seminars, workshops, entrepreneurs' interview, and motivational speeches. In this context, related to various method and teaching approach, teaching pedagogy is a process providing the mix of enterprising skills

and develop behaviors, required for creating and managing an enterprise. Based on previous literature we hypothesized that:

Hypothesis 1: *There is a significant influence of teaching pedagogy on self-efficacy development among university students.*

2.2. Entrepreneurship Education and Self-Efficacy Development

Krueger and Brazeal (1994) contended that entrepreneurship education enhances students' knowledge, helps in confidence-building and foster self-efficacy, by supporting their perceptions for entrepreneurship career. Based on social cognitive theory entrepreneurship education has a significant positive influence on entrepreneurial self-efficacy. Moreover, self-efficacy is formed in four ways which include maple mastery, role modelling, social persuasion, physiological states (Rachel et.al.2014; Wood and Bandura, 1989). The theory also claimed that students' in entrepreneurship courses should have a positive impact on their entrepreneurial self-efficacy. Several studies have highlighted the impact of entrepreneurship education on self-efficacy development (Bergman et al., 2011; 2010; Von Graevenitz et al., 2010; Zhao et al., 2005 Peterman and Kennedy, 2003). Unexpectedly, results regarding the role of entrepreneurship education in entrepreneurial self-efficacy formation remain unclear. Several studies have highlighted the positive impact of entrepreneurship education on individuals 'entrepreneurial self-efficacy (Von Graevenitz et al., 2010; Peterman and Kennedy, 2003; Zhao et al., 2005), others claimed no significance in relations (Bergman et al., 2011; Oosterbeek et al., 2010), and other found negative association (Cox et al., 2002). In this context, Chen (2013) has specified that an entrepreneurship program develops understanding towards the entrepreneurial career and increase the learning efficiency their future jobs. Thus, we propose the following hypothesis:

Hypothesis 2: *There is a significant impact of entrepreneurship education on self-efficacy development among university students.*

2.3. Risk-Taking and Self-Efficacy

Risk-taking behavior has been measured as a personality attribute and also explored in different combinations considering as most associated with "big five" personality traits (Bolten and lane, 2012; Zhao and Siebert, 2006). Miller (2011) believes that "besides uncertainty, risk-taking also implies investing significant capital over time, suggesting that this construct has a size and a time dimension". Risk-taking behavior is widely used in firm-level context to measure entrepreneurial orientation and intention. The limited studies justify the association between risk-taking behavior and entrepreneurial self-efficacy. Zhao et al. (2005) explored the relationship between risk propensities on entrepreneurial self-efficacy and found a positive relationship. Whereas Barbosa et al. (2007) highlight a positive relationship the risk-taking and opportunity-identification entrepreneurial self-efficacy among undergraduate students. But due to limited research findings, in this sense the connection of risk-taking and entrepreneurial self-efficacy is still unclear. Thus, based on limited understanding, to identify the relationship between risk preference and self-efficacy, we state following hypotheses:

Hypothesis 3: *Risk-taking behavior has a significant impact on self-efficacy development Among STEME students.*

Hypothesis 4: *Teaching pedagogy, entrepreneurship education and risk-taking have a collective positive impact on self-efficacy development among STEME students.*

2.4. Educational Background and Self-Efficacy Development

The present literature reveals a positive influence of entrepreneurship education program on ESE of high school students (Sanchez, 2013), undergraduate (Nowiński et al., 2017; Karlsson & Moberg, 2013; Byabashaija and Katano, 2011), postgraduate (Kubberød and Pettersen, 2017; Wilson, Kickul, and Marlino, 2007) and other groups (Kerrick, Cumberland, and Choi, 2016; Lee et al., 2016) as well. Literature also highlights the attention of researches on gender context (Dempsey and Jennings, 2014; GEM report 2013 Díaz-García and Jiménez-Moreno, 2010). Hodzic, Ripoll, Lira, and Zenasni (2015) have established that entrepreneurial training leads to higher levels of ESE with comparison to control the group who did not impart in training modules. In addition to this, Zhao et al. (2005) also identified a positive association between risk-taking and entrepreneurial efficacy among MBA students and similar kind of relationship is identified by Zhang and Cain (2017) for graduate dental students. But the involvement of teaching pedagogy, entrepreneurship education, risk-taking behaviour, efficacy among management and entrepreneurship with comparison to science, technology and engineering (STE) is still unclear. This leads us to propose the following hypothesis:

Hypothesis 5: *There is a significant impact of the teaching pedagogy, entrepreneurship education, risk-taking behavior on self-efficacy development Among STE students.*

Hypothesis 6: *There is a significant impact of teaching pedagogy, entrepreneurship education, risk-taking behavior on self-efficacy development among ME students.*

3. Research Methodology
3.1. Research Design and Sample

The theory building and hypothesis above makes it inevitable to survey students to understand the relationship between the variable. The primary data was collected from students of multidisciplinary streams in Indian higher learning institutions. Students of engineering, management and social science streams of final year undergraduates and postgraduates. The survey was conducted online by sending an e-mail questionnaire to students in different higher learning Institutions which resulted into a total of 520 responses. The age bar of respondents was between 18 and 30 years. After cleaning of data and finalizing the sample for analysis, the total remaining sample used for analysis was 398 respondents. The data was collected from the institutions of three distinct regions of India to show the diversity in the sample. Gujarat, Karnataka, Madhya Pradesh, Utter Pradesh and Uttarakhand states presented the majority of the responses, and the data was collected in September 2017.

3.2. Variables and Measures

Dependent Variables: Researchers measure Entrepreneurial self-efficacy with different theories and various models. Entrepreneurial self-efficacy in youths or university student was measured by using the models proposed by the various researchers (Newman et al., 2018). The questionnaire was built using several peer-reviewed types of research to strengthen the construct validity. Entrepreneurial self-efficacy, as the dependent variable, was measured with a five-point Likert-scale. The measures for self-efficacy are based on six items and were collected from various studies. Independent variables: Teaching pedagogy is measured with a Likert scale of 10 items, risk taking behavior with three items and entrepreneurship education with 8 items. All the research items have opted from research papers, including Lu et al. (2015), Keat et al. (2011); Geri (2013); Walter et al. (2013); Afolabi, et al. (2017).

A pilot study is conducted using 50 samples for study which verifies the reliability of the constructs. All the dimensions have reliability (alpha value) greater than 0.7, which explains the instrument is fit for the study (Streiner 2003; Nunnally 1978; Nunnally and Bernstein 1994).

4. Results and Discussion

4.1. Mean, SD, and Correlation

Table 1 below highlights the results of the correlation analysis among two different groups; 1) M and ETP students enrolled into management and entrepreneurship courses, 2) STE represent the group enrolled into science, engineering and technology courses in selected universities/ institutions. Both groups show a significant and positive correlation between teaching pedagogy (TP), risk-taking (RT), and Entrepreneurship Education (EE) and entrepreneurial self-efficacy (SE).

The results reveal the STE students have higher and positive relationship between teaching pedagogy, risk-taking (RT) and entrepreneurial self-efficacy in comparison to M and ETP students. In addition to this, M and ETP students show a high correlation between entrepreneurship education and self-efficacy compared to SET students. The teaching pedagogy and risk-taking tendency show a high positive relationship with self-efficacy among STE students. However, entrepreneurship education has higher correlation with self-efficacy among M and ETP students.

Table 1: Means, Standard Deviation and Matrix Correlation

DEGREE SPECIALIZATION		MEAN	SD	N	TP	RT	EE	SE
M and ETP	*Teaching Pedagogy*	36.56	4.758	201	1			
	Risk Taking	20.01	2.89	201	.376**	1		
	Entrepreneurship Education	39.42	5.041	201	.450**	.352**	1	
	Self-Efficacy	23.75	3.161	201	.247**	.446**	.406**	1
STE	*Teaching Pedagogy*	33.93	6.488	197	1			
	Risk Taking	18.31	3.718	197	.449**	1		
	Entrepreneurship Education	34.43	6.843	197	.452**	.434**	1	
	Self-Efficacy	22.04	4.508	197	.479**	.502**	.350**	1
Group= 398 (M&ETP=201, STE=197) Sig: ** (<=0.05), *(<=0.10), two tails.								

4.2. Multiple Regression

A comparison across the analysis in table 2 emphasized that risk-taking was the direct and robust predictor for self-efficacy development across independent variables. Risk-taking obtained the highest beta value for model 4 (β = 0.35, p<.001), model 5(β = 0.35, p<.001) as well model 6 (β = 0.34, p<.001), demonstrating that it made the most significant contribution to regression equation, while holding all other predictor variables constant.

Table 2 Regression Analysis for Self-Efficacy

Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5 (M&ETP)	Model 6 (STE)
Teaching Pedagogy	0.429***			0.19***	-.015	0.296***
	9.442			3.820	-.211	4.274
Risk-Taking		0.509***		0.348***	0.35***	0.338***

		11.762		7.147	5.196	4.935
Entrepreneurship Education			0.416***	0.164***	0.289***	.069
			9.102	3.284	4.151	1.011
R^2 Value	0.184	0.259	0.171	0.326	0.27	0.336
Durbin-Watson	1.815	1.954	1.801	1.931	1.962	1.8
No. of Observations	398	398	398	398	201	197
*Sig: ***(< =0.001), ** (<=0.001), *(<=0.05), two tails*						
Predictors: (Constant), Entrepreneurship education, Risk-taking orientation, Teaching Pedagogy						

Model 1 shows a significant impact of teaching pedagogy on self-efficacy with R^2 value of (0.184). Model 2 in this table highlights the risk-taking behavior in the students, which predicts 25.9 per cent of the regression equation. In model 3 shows the relation of entrepreneurship education and self-efficacy with $R^2 = 0.171$. It shows that only 17.1 per cent of the total variation is explained by entrepreneurship education.

In addition, model 4 explained the beta value of joint effect of Teaching Pedagogy ($\beta = 0.19$, p<.001), risk-taking ($\beta = 0.35$, p<.001) and entrepreneurship education ($\beta = 0.16$, p<.001), have a significant positive relation with Self-efficacy development. These independent variables together depict an R^2 value of (.326). Therefore, findings of this regression analysis indicate that teaching pedagogy, risk-taking, and entrepreneurship education among students have a highly significant positive impact on SE development.

Model 5 and 6 highlights difference in two group, in model 5, there is a positive and significant impact risk-taking ($\beta = 0.35$, p<.001) and entrepreneurship education ($\beta = 0.28$, p<.001) on dependent variable with R^2 value= 0.27. Model 6 (STE students) shows the positive relation of teaching pedagogy ($\beta = 0.29$, p<.001) and risk-taking ($\beta = 0.34$, p<.001) with self-efficacy development, total regression coefficient of model 6 R^2 value= 0.336 which is slightly higher than predicting power of model 5. The risk-taking and entrepreneurship education are powerful predictors of entrepreneurial self-efficacy among them. In addition to the results, Model 6 (STE students) shows no significant impact of entrepreneurship education on self-efficacy. The results also suggest the teaching pedagogy and risk-taking have positively associated with self-efficacy among science, engineering and technology students.

4.3. Discussion

The goal of this paper was to analyse the impact of teaching pedagogy, risk-taking behavior and entrepreneurship education on self-efficacy development. We examine the role of educational background as control variable to understand the phenomenon between independent and dependent variables. The variables teaching pedagogy, risk-taking behavior and entrepreneurship education, as individual and jointly have significant and positive impact on self-efficacy which is supported by previous literature. These variables represent their significant impact in SE development and emphasizes the importance of teaching pedagogy, entrepreneurship education for educators and policymakers seeking to enhance self-efficacy. The analysis highlights the following important issues.

Teaching pedagogy seems to affect SE when used as an individual independent variable and controlled for STE background students. This finding explains that teaching pedagogy has their positive relationship with SE development, supported by previous literature (Morris et al., 2013; Palmer, 2006; Van Auken et al., 2006). The control group analysis found a positive and significant relationship between TP and SE, where this relationship does not exist in STE background students. This may indicate that the current teaching pedagogies could be improved for positive influence. The search for more effective pedagogical tools is enduring. The current

situation is marked by an agreement on the teaching pedagogies to deliver the most active entrepreneurial learning (Lonappan et al., 2011; Potter, 2008). and by innovative pedagogical tools (Mwasalwiba, 2010; Arasti et al. 2012; Sharif et al., 2011)

Similarly, risk-taking behavior is positively associated with SE among university students. The result indicates the risk-taking behavior is profoundly influencing factor in M &ETP and STE groups. It has found that students form M& ETP background have slightly higher determination to take risk than students for STE students. This may indicate that the risk-taking behavior has explanatory power which significantly motivates students during self-efficacy development, supported by previous research (Barbosa et al., 2007; Zhao et al., 2005).

The role of entrepreneurship education in self-efficacy development is widely explored and found positive in self-efficacy development (Reynolds, 2015; Shinnar, Hsu, & Powell, 2014; Wilson, Kickul, & Marlino, 2007; Chowdhury & Endres, 2005). The findings of our research show that entrepreneurship education as an individual independent has a significant impact on SE. The same relationship exists with other independent variables and when controlled for M& ETP background students. Whereas, the impact of EE was not found significant in STE background. It reflects that current EE is less effective in self-efficacy development.

5. Conclusion and Future Research Directions

Finally, comparing the results of overall model and controlled groups. The joint effect of teaching pedagogy and entrepreneurship education, risk-taking on entrepreneurial self-efficacy, indicates positive and significant strong relationship. The first controlled for M and ETP background reflects the substantial effect in risk-taking behaviour and entrepreneurship education on SE and insignificant impact of teaching pedagogy. The second controlled for STE background highlights the significant effect of teaching pedagogies and risk-taking behavior where the EE has no contribution to SE development. This indicates that there is a need for opting innovative pedagogies (Balan, Maritz and McKinlay, 2018; Mukesh, Pillai and Mamman, 2019) for M and ETP background students, and suggest for better development in EE (Ismail, Sawang, & Zolin, 2018) for STE background students for better entrepreneurial activities.

The study is designed by understanding the previous literature to strengthen the research base in entrepreneurship concerning self-efficacy. This study is focused on Indian universities and data is collected from various selected institution to reduce the sample bias, highlights the reliability of this study to contribute to literature. Findings reveal the significance among the variables. The entrepreneurial efficacy is active in the majority of students pursuing some entrepreneurship courses at selected HEIs.

The future research can be conducted to measure the role of other factors like region, university ecosystem, age, family background, experience, qualification level and their impact on individuals' entrepreneurial self-efficacy. The research is limited to students in selected HEIs from various regions which suggest that further research should include more students of Indian higher education institutions in other areas also. Individual entrepreneurial self-efficacy imparts a significant role to foster new venture creations, provides essential resource for policymakers for Indian higher education institutions, facilitating them to design the suitable and innovative pedagogies and updated curriculum for entrepreneurship education and implementation of new entrepreneurship policies.

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Identification of Critical Success factors for projects: A select case study in an R&D Organization

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Abstract-

India has set a target of becoming a 5 trillion-dollar economy by 2025. Research & Development (R&D) in premier national institutions is strategically an important factor with the potential to influence stated growth objectives. Project management in R&D projects is differentiated from conventional project management due to the inherent high uncertainties, technological dependencies on international relations and the requirement of heavy investments as well as the availability of talented scientific human resources. Successful, strategically significant R&D projects should ensure adherence to scope, time and quality. Identification and sourcing correct and affordable technologies is the key to ensuring competitive advantage in product development. Developing an innovative culture in R&D laboratories is vital for the sustainable success of the organization. In order to nurture a motivated, talented scientific/ technical resource pool, HRM practices need to be effectively incorporated. This study pertains to projects handled by selected R&D organizations. It has also identified some critical factors which directly or indirectly influence the successful performance of projects.

Keywords: R&D, Innovation, Quality, HRM, Success Factors

1. Introduction

Success is the aim of all human endeavors. Sir C V Raman had famously stated that courageous devotion to the task lying in front can bring success. For a nation aspiring to become an economic powerhouse and progressing towards all-round development, successes in all projects in general and publically funded projects in particular stands to have paramount importance. There exists only very few studies on the publically funded R&D projects in Indian scenario. Identifying the critical factors that can positively impact success of projects is an earnest attempt to study, analyze and contribute in this area.

On 27th March 2019, in the aftermath of the first ever successful launch of A-Sat missile, Shri Narendra Modi, Prime Minister of India stated that the work that India has done in the space sector relates to security, economic development and technological progress. A-Sat mission is important towards protection of these three pillars. This speaks volumes about the importance and impact of successful indigenous R&D projects in nation building and national security. This also reiterates nation applauds successful outcomes from R&D establishments.

1.1 Contemporary scenario

Public funded R&D organizations nowadays are functioning in a dynamic environment signified by higher expectations of flexibility and scalability from stakeholders, competitive pressure as

regards to complex technologies, and constraints of budget allocation as well as time available for completion of targets. Needless to say, R&D Organizations need to rise above theoretical research and strive to deliver new products and services that can provide time bound and realizable benefits to its stake holders. Success of R&D Projects depends on enormous cross-functional processes, such as planning, design, procurement, resource management, product development, quality evaluation, quality assurance, user acceptance, product support and life cycle management etc.

1.2 Technology Management

Strategic governance is needed for organizations to work towards the delivery of planned benefits. (Paul D Gardiner, 2005). Management functions in the areas of R&D and/or Technology involves Strategy, Forecasting, Road mapping and Portfolio making. Adequate managerial attention is needed to ensure that, over the passage of time, these technological and administrative processes do not become out-dated, overstretched, unnecessary, unreasonably expensive, inaccurate, and inflexible to the demands of a flexible environment. Research transforms of resources into knowledge. Innovation transforms knowledge into realizable benefits. Technology Management addresses both these aspects.

1.3 Critical Success Factors (CSFs): Management of R & D Projects

Critical Success Factors for an R&D organization (Pinto & Slevin 1989) are those explicitly prominent areas that should "get right" in order to attain its vision and mission. A literature review in different publications dealing with similar issues reveals some of the CSFs of successful project implementations as follows.

1) Top management Support 2) Project Mission 3) Project Plans/ schedules, 4) User Involvement, 5) Teamwork & team development, 6) Rich Communication & awareness, 7) Technical Tasks, 8) Monitoring & feedback, 9) Change management & Flexibility, 10) Project management competence, 11) Continuous improvement, 12) Employee empowerment &Training, 13) Environment, 14) Funding & other resources, 15) Collaboration, 16) Mutual trust and understanding, 17) Shared values, 18) Time management.

1.4 Motivation for Study of CSFs for Projects

A project is defined as a temporary endeavor undertaken to produce a unique product, service or result (Lewis, J. P., 2007). The study of critical success factors (CSFs) shall provide a comprehensive understanding about successful projects and failures across many industry sectors. This knowledge and associated information flow will essentially assist project managers to steer their organizations towards long-term existence and growth. In order to identify and demystify Critical Success Factors for projects, a case study in select R&D Organizations is undertaken and evaluation carried out with statistical methods and frameworks. Typical R&D Project Management consists of following characteristic features – a cross functional team, an

organization structure, a resource plan, a procurement plan, a realization / manufacturing plan, a quality, reliability & safety plan and a risk management plan followed by documentation/ record keeping and a decision taken on extension/ closure of the project.

R&D projects involve systems engineering where products and services are being developed for the first time. In such a case, there can be inevitable changes, and hence time and cost management and immunity from their over runs is an important aspect. Deficiencies in managing this shall deem a project to be a failed one. Projects handled in a chaotic environment are prone to time - cost overrun and also the scope creep.

Failed R&D projects fall in the category of delayed projects, cancelled projects, short closed projects /dropped projects, stage closed projects, final closure of the project (administrative closure/techno-managerial closure).

2. Literature review

Projects are conducted in phases which commence with defining the requirement and progress through the planning, implementation, monitoring, and completion phases. See "Fig 1" Project lifecycle (Dennis Lock, 2007).

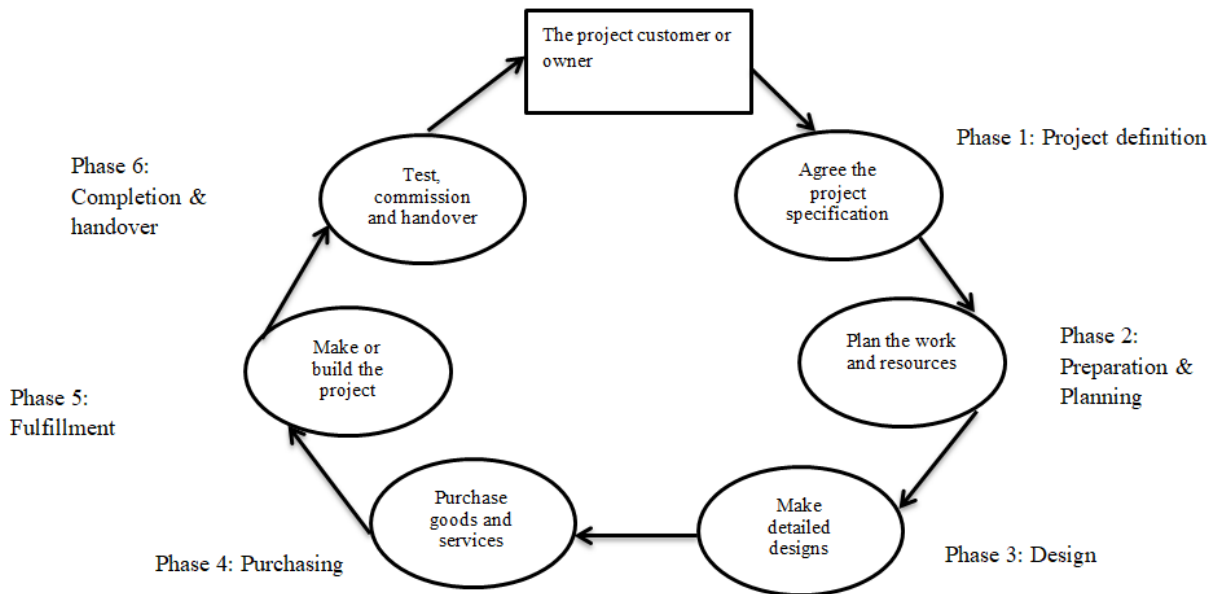Fig 1: Project Lifecycle (Dennis Lock, 2007)

For Project Management excellence, the Project Manager Selection Criteria will be governed by the requirement of Leadership Style, Corporate Understanding, Executive Commitment for planning and control and Organizational Adaptability (Harold Kerzner, 1987). Innovation attained in the R&D area enhances chances of sustainable economic growth to their respective

national economies.(Hulya Ulku, 2004). However, from the studies, it can be fairly assumed that there is very less focus given to managing Defence R&D in publically available literature.

2.1 CSFs of projects across industries

The different areas where CSFs for projects were comparatively studied included Business Excellence, Construction Industry, Defence, IT & Information Systems, Interdisciplinary Design Projects, Knowledge Management, Process management, New Product Development, Project Implementation, Project Performance, Quality management, R&D Projects etc.

2.1.1 Leveraging R & D projects for rapid growth of GDP

Science and Technology has the potential to enhance economic growth and development and shall help nations to achieve sustained and rapid growth. Setting up of profit-seeking Research & Development centers and Research & Training institutions by investors should be encouraged. Ideas, knowledge, and skills should be allowed to come from anywhere. Initiatives like Start-up India, Stand up India, Digital India by the Government of India has created a helpful ecosystem for germination and development of new generation products and services in the country. Meanwhile, Public funded R&D institutions also play a vital role by working in strategically significant but commercially unavailable & unviable technologies. In that sense, public-funded R&D projects aims at enhancing the national scientific/technological capabilities. Critical success factors of such nationally important projects in select R&D establishments have been analyzed as part of this study project.

2.1.2 Internal Validity; External Validity & Construct Validity of the study of CSFs

Internal validity means that a particular cause results in a certain effect. External validity means that the degree to which research findings can be generalized to other people, places and times. Construct validity means that the researcher is expected to really measure and manipulate the constructs (parameters under observation) he thought he was measuring and manipulating (Mitchell, Jolley -1988).

2.1.3 Success factors of progressive organizations

The common constant factors for any organization to achieve competitive advantage are: leadership, free and open communication, strategic flexibility, decision-making, passionate work culture etc. These parameters should be inherent, inbuilt and incessant. (Sumati, 2010)

2.1.4 Focus on a premier Research & Development Organization

Basic research, which is a vital component of innovation and development, generally happens in a university environment. Public and private R&D establishments with a strategic vision and mission help to make Technology to emerge from basic research with a targeted development of products and services. Indigenization of technologies is a national priority as far as Defence

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technology development is concerned. (DRDO Golden Jubilee Conference on Managing Defence R&D, Proceedings, 2008)

System Engineering and System Engineering management is discussed at length in the curriculum of Technology Management area of Defence Institute of Advanced Technology, Pune. Process flow between Technical and Managerial efforts in System Engineering is shown in Fig 2. Apart from the conceptual and theoretical discussions, the participants from diverse professional backgrounds in Defence services and Defence Research shared their case studies and related their experience and expertise in the class room discussions.
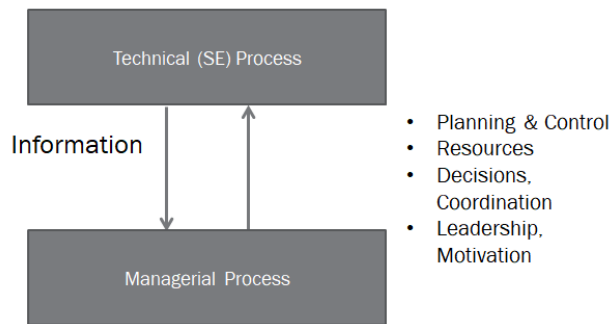
Fig 2: Process flow between Technical and Managerial efforts in System Engineering

The participants, having close association and hands on involvement with R&D efforts in the projects undertaken by Defence Research and Development Organization (DRDO) could discuss the Critical Success Factors observed in various on-going Defence projects. The spans and spread of DRDO across complex projects, products and services gives a vast canvas for studies on critical success factors for projects. The outcome of the study can be easily ported to a wide spectrum of R&D establishments, especially in India.

2.2 An Insight into DRDO

DRDO began its operations in 1958 with about ten laboratories. Today, DRDO has grown to a strong network of more than 50 laboratories spread across the country dealing in a wide spectrum of science and technology. DRDO is the single largest scientific and technical organization in the country with diverse professional skills, budget and manpower. (DRDO Golden Jubilee Conference on Managing Defence R&D, Proceedings, 2008)

DRDO is headed by Secretary DD R&D who is also designated as the Chairman. DRDO is organized into seven clusters, based on their technology areas as shown in Fig 3.There are three certification agencies within DRDO. A deemed university also functions under DRDO management. Technology clusters are headed by a cluster Director General or DG. DRDO headquarters (HQ) at Delhi, controls and coordinates the integrated functioning and acts as an interface between the cluster HQs and laboratories and Government.

DG (Cluster)	Laboratories & Establishments
DG (AERO)	ADE, ADRDE, CABS, GTRE
DG(ACE)	ARDE, CVRDE, DTRL, HEMRL, PXE, R&DE(E), SASE, VRDE
DG (ECS)	CHESS, DARE, DEAL, DLRL, IRDE, LASTEC, LRDE
DG (LS)	DEBEL, DFRL, DIBER, DIHAR, DIPAS, DIPR, DRDE, DRL(T), INMAS
DG (MED &CoS)	ANURAG, CAIR, JCB, MTRDC, SAG, SSPL
DG (MSS)	ASL, DRDL, ITR, RCI, TBRL
DG (NS&M)	DLJ, DMRL, DMSRDE NMRL, NPOL, NSTL

Fig 3. Structure of DRDO (Ministry of Defence, Annual Report 2018-2019)

As per the Ministry of Defence, Annual Report 2018-2019, the total strength of DRDO is 24,732 employees. 7,329 employees out of them are working in Defence Research and Development Services (DRDS) whereas 9,105 employees are working in Defence Research and Technical Cadre (DRTC) and 6,255 employees are working in Admin & Allied Cadre.

DRDO currently has 372 on-going projects amounting to approximately Rs 78,135 crore (including User share). DRDO is working in close collaboration with tri-Services, industries and academia. Apart from this, DRDO has collaboration with other public funded R&D organizations like Department of Space (DoS), Department of Atomic Energy (DAE) and Council of Scientific and Industrial Research (CSIR). (Ministry of Defence, Annual Report 2018-2019).

The classifications of DRDO Projects are as under:-

 Mission Mode (MM) Projects: These are based on Users' requirements. These have stringent time lines and may involve many labs. Users have a greater say in the course of the project.

Technology Demonstration (TD) Projects: DRDO initiates these projects as a kind of feeder technologies for future. Through TD projects, development, testing and demonstration of a particular technology take place.

Science & technology (S&T) Projects: Involves basic research/applied research projects taken up to meet needs of future technology.

Product Support (PS) Projects: This category deals with upgradation or maintenance/technical support of a system for a limited period;

Infrastructure Facility (IF) Projects: These projects involve creation of advanced test & qualification facilities. Capital investment has a major role in validating the technology/system generated/developed;

User Trials (UT) Projects: This category includes conduct of User trials and the support extended for the same.

CARS Projects: Those projects through which DRDO gives Contract for Acquisition of Research Services (CARS) to academia.

2.2.1 Selection of Projects in DRDO

This includes design of a concept, analysis of readiness followed by a review, estimation of costs, a plan for procurement, a plan for risk management etc. Before sanctioning a project, the proposal is examined; proposal has to be submitted with routing and timelines and then the sanction letter is issued. Project execution involves preparation of project execution plan, necessary review mechanisms and sufficient guidelines on design, manufacturing and testing. Project Closure comprises of Probable Date of Completion/Cost extension and Administrative and technical closure. (Nabanita Radhakrishnan, 2009)

DRDO projects are formulated basically by two major considerations- (1) the Armed Forces Services considerations which include 15 years Long Term Integrated Perspective Plan (LTIPP), five-year Services Capital Acquisition Plan (SCAP) and two-year roll-on Annual Acquisition Plan (AAP)

(2) DRDO's own technology forecasting is based on global developments. DRDO planning process for projects is depicted in fig. 4.
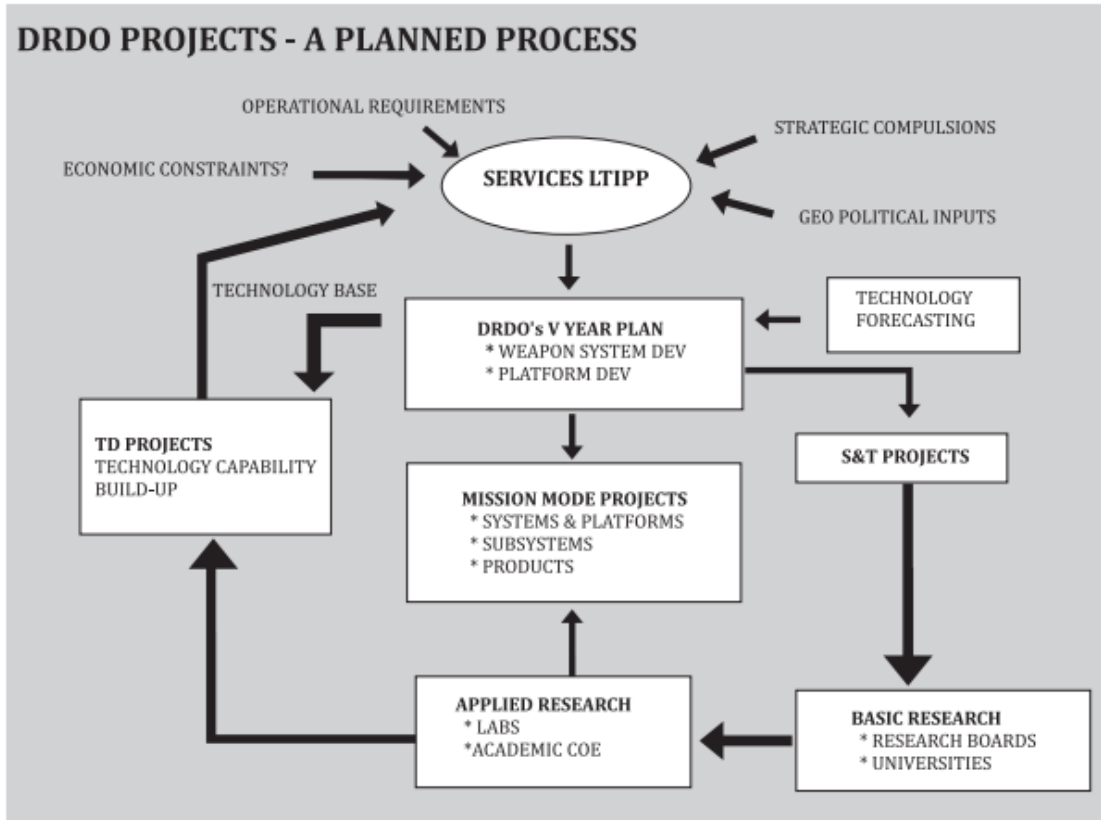
Fig.4. Planning Process for different types of DRDO projects (Nabanita Radhakrishnan, 2009)

2.2.2 Technology Development in DRDO

DRDO operates with a three step formula in the Defence technology development process:

Identification of Critical Technologies: The technology developments that are happening globally as well as and user's long term plans and missions are taken into consideration. Both these are co-ordinated & aligned to determine critical technologies for future.

Assessment of Technology Readiness Level (TRL) in the Country: TRLs are widely used in the R&D establishments of USA and Europe. DRDO uses a modified and adapted version of the same called with the Module Readiness Levels (MRLs). MRLs are effective as aids for decision making in technology evaluation during the stage of project proposal.

MRL levels are depicted below at Table 1.As can be seen, they are derived from the scale 1 to 10 based on stages of the proposed project. This is applicable for subsystems, modules, algorithms, processes etc.

Table 1. Description of Module Readiness Level (MRL)

MRL Level	Definition
1	Ab-Initio research to start
2	Basic technologies assessed and reported
3	Concept design document formulated and vetted by expert committee
4	Similar module made earlier and proved at breadboard/ Lab level
5	Similar module made earlier and proved at actual environment
6	Required module manufactured as prototype with preliminary test in lab/ test rig
7	Required module proved as prototype in test bed and qualified
8	Required module integrated in system and proved in test bed
9	Required module integrated and proved in actual environment
10	Module in production/ Commercially Off the Shelf (COTS)

Modalities are worked out for Technology Development. If Technology acquisition is required, partners are identified.

2.2.3 Research classifications in DRDO:

Basic Research: in academia concentrating on physics, chemistry, electronics, materials etc. Technology readiness levels will be mostly at baseline of 1-2.

Applied Research: generally takes place in labs in collaboration with academia. Technology readiness levels will be at 2-4. Applied research implies having a certain amount of knowledge base at start. The outcome shall be the development of certain level of products. These are generally undertaken by technology labs of DRDO. Centers of Excellence funded by DRDO are a natural choice for research partnership in such cases.

International Collaboration: These are special cases. Developed countries are generally not forthcoming to collaborate on critical technologies. Thus they protect their strategic advantages. Such collaboration, even if materializes, always has a risk of getting withdrawn if the ibid foreign policy undergoes changes. DRDO has been viewing International Collaboration as "equal partners with complementary skills" (Nabanita Radhakrishnan, 2009)

2.2.4 Project Stage Evolution in DRDO

The stages of evolution in DRDO projects can be envisaged as that of

Inspection Agency → Scientific Research→ Technology Generation → Design & Development → Prototype Development → Trials & Acceptance → Product Realization & Delivery → Technology Export.

2.3 Critical Success Factors: R&D projects

The traditional four criteria and six attributes for project success are represented by the Fig. 4 below. The four criteria are Scope, Time, Quality and Cost, while the six attributes are performance, competitiveness, effort, viability, need, value and effort.
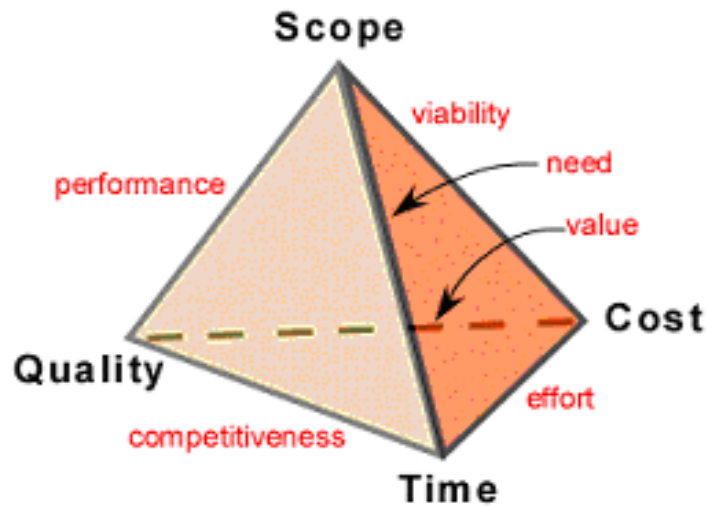
Fig 5. Four Criteria and Six Attributes of Project Success

R&D projects need to be monitored throughout the life of their projects due to the higher possibilities of uncertainties in technologies, human conflicts, scope creep, pressures on time available and constraints on budgets. The life cycle stage in which the project presently exists has an important implication about prioritizing the success factors. The discussions and interviews carried out with scientists and officers who have deputation experience in R&D projects revealed the following factors being critical to the success of projects. The same was corroborated from the published journals gone through during literature survey carried out.

2.3.1 Project Mission and the clarity of its communication to all stakeholders

This is considered to be the most important factor towards project success. (Slevin, Pinto, 1989). Public funded R&D projects like DRDO projects are mission oriented and generally user driven, users being the defence services as well as the strategic technology development requirements of the country.

2.3.2 Top management support

It is essential as a means to ensure strategic alignment and assured commitment of resources. It also ensures that the project team get adequate attention, motivation and recognition.

2.3.3 Project planning and scheduling

It identifies the key inputs and outputs such as material, data, information, procedures, equipment and other processes etc. in a definite timeline. This stage needs maximum attention from the R&D management. Planning sets the course of work for the way forward and is the

stage where resources requirements are finalised and then deployed. Hence meticulous planning and scheduling will immensely impact the success of projects.

2.3.4 User Consultation

Through adequate communication and involvement with users, a project manager can ensure acceptance of the evolving product/ service even as the development process is going on.

2.3.5 Team building

It involves recruitment, selection, training and skill development on and off the job which is needed to make available a competent group of reliable people who can deftly handle the project.

3. Methodology

Focused discussions with eminent faculty from the fields of R&D Management and Technology Management at Defence Institute of Advanced Technology, Pune, interactions with senior scientists heading DRDO laboratories during an advanced training on Project Management at Institute of Technology Management, Mussorie helped form the foundation for this paper. Service officers who were on deputation to R&D establishments could also provide an insight into the critical success factors as regards to the success of projects they were involved in. With this background, a literature survey was carried out to relate the published work in comparison with the discussions carried out and insights received at academic and training institutes. The following aspects were analysed in depth.

A sample size of 30 persons consisting of top and middle level scientists and defence officers took part in the interviews and discussions. The sample questions covered the major topics as under:

- Project Mission is understood fully by stake holders or not
- Technology/ Module Readiness Levels are assessed or not
- Project Managers leadership competence is adequate or not
- Customer involvement is adequately done or not
- Human resource capabilities
- Risk management plan
- Quality control
- Project closure

3.1 Policy Flexibilities

The policy of Make in India, defence offsets programmes, greater public private partnership, along with an operational environment demanding tangible outputs in definite timeframe guides the R&D establishments to reorganize themselves and reinvent the processes leading to project management at hand. The establishment of laboratories/ centres to be headed and

staffed by young scientists to address development of new technologies like artificial intelligence was a path-breaking organizational shift implemented by DRDO.

3.1.1 HR initiatives

Dr. P. Rama Rao committee constituted by Government of India has suggested for a revamping of HR structure of DRDO. The measures included hiring of an eminent HR expert who will examine radical issues like freedom to induct talented persons, by Lab Directors. Within laboratories a system of rewarding and recognizing outstanding performance exists. Scientists and subordinate staff have the flexibility of self-assessment of their annual performance as well as to identify their training needs. Promotions to higher grades are governed by flexible complimenting scheme where merit is given precedence over vacancies.

3.1.2 Organizational Culture

(Hofstede, G 1991) describes culture as the collective programming of the mind which distinguishes the members of one organization from another. "The way we do things here"- is a major cliché in organizations. Organizational culture deals with the shared, ideologies, expectations, attitudes and beliefs of a team. Culture enforces the type of behavior is that is acceptable and expected out of team members., in turn, becomes Added effects of organizational culture felt by the entire organization is called organizational climate.

3.1.3 Measurement of R&D performance

It is difficult to manage R&D. It is even hard to measure R&D performance. A study into CSFs of R&D environments looks at identification of such factors that has an effect on innovation capabilities of R&D teams. Barriers and drivers to innovative team performance are segregated. This can help in suggesting the organizational environment and managerial leadership that is conducive to R&D team performance. It is interesting to note that many of the performance variables fall outside of the R&D organization itself. Project leadership style impacts significantly on creativity thereby affecting R&D performance.

3.2 Success Attributes

The conventional attributes of perceived project success as obtained from the literature reviewed in this paper is tabulated at Table 2 as follows:

Table 2. Success Attributes

Dimension		Attribute	Source
Overall perceived level of project success	1	Quality (deliverables with good quality)	Chow & Cao(2008)
	2	Scope (meeting all requirements and objectives)	Chow & Cao(2008)
	3	Time (delivering the products to meet the deadline)	Chow & Cao(2008)
	4	Cost (Meet the requirements in terms of cost and effort)	Chow & Cao(2008)

3.2.1 Success Factors

A summary of some of the measurable success factors from literature reviewed in this paper are divided in three dimensions namely, organization, people, and process are tabulated at Table 3 against the dimensions and success factors as under:

Table 3. Dimensions and Success Factors

Dimension		Success Factors	Source
Organizational	1	Strong top management support	Chow & Cao(2008)
	2	Committed project manager	Davis (2002)
	3	Cooperative organizational structure instead of hierarchical	Morris & Pinto(2004)
	4	Oral culture placing high value on face to face communication	Chow & Cao (2008)
	5	Organisations where agile methodology is universally accepted	Chow & Cao (2008)
	6	Collocation of the whole team	Hofstede (1991)
	7	Flexibility with proper agile-style work environment	Chow & Cao (2008)
	8	Reward system appropriate for flexibility	Pinto & Slevin (1989)
People	9	Team members with high competence and expertise	Hofstede (1991)
	10	Team members with great motivation	Dennis (2007)
	11	Managers knowledgeable in agile process	Chow & Cao (2008)
	12	Managers who have adaptive management style	Pinto & Slevin (1989)
	13	Coherent, self-organizing team work	Dennis (2007)
	14	Good relationship with users	Pinto & Slevin (1989)
Process	15	Following agile-oriented requirement management process	Chow & Cao(2008)
	16	Following agile oriented project management process	Chow & Cao(2008)
	17	Strong communication focus with daily face to face meetings	Pinto & Slevin (1989)
	18	Honouring regular working schedules and no overtime	Chow & Cao(2008)

3.2.2 Failure Attributes

A summary of some of the measurable failure factors from literature reviewed in this paper are divided in three dimensions namely, organization, people, and process are tabulated at Table 4 as dimensions and failure attributes as under:

Table 4. Dimensions and Failure Attributes

Dimension		Failure Attributes	Source
Organizational	1	Lack of executive sponsorship	Chow & Cao(2008)
	2	Lack of management commitment	Davis (2002)
	3	Organizational culture is too traditional	Chow & Cao(2008)
	4	Organizational size is too large	Chow & Cao(2008)
	5	Organisational culture is too political	Hofstede (1991)
	6	Lack of logistical arrangements	Pinto& Slevin (1989)
People	7	Lack of necessary skillset	Chow & Cao(2008)
	8	Lack of project management commitment	Dennis (2007)
	9	Lack of teamwork	Morris & Pinto(2004

	10	Resistance from groups or individuals	Pinto& Slevin (1989)
	11	Bad customer relationship	Chow & Cao(2008)
Process	12	Ill-defined project scope	Pinto& Slevin (1989)
	13	Ill-defined project requirements	Morris & Pinto(2004)
	14	Ill-defined project planning	Pinto& Slevin (1989)
	15	Lack of agile progress tracking mechanism	Chow & Cao(2008)
	16	Lack of customer presence during development	Chow & Cao(2008)
	17	Ill-defined customer role	Pinto& Slevin (1989)

3.2.3 R&D spending trends

"There is a positive change led by the government. There is a new focus and emphasis towards science and technology"

-Rajiv Kumar, Vice chairman, Niti Aayog, 04 Apr 2019

Budget constraints have hindered many good ideas and innovations from bearing fruits. Top management grants necessary authority to the R&D project manager, controls needed resources and rewards final results. It is the top management who can convince the higher stake holders to release necessary budgets for R&D spending. During execution of actual work of the top management should facilitate necessary resources like money, manpower and other resources for the project as they are needed. Project managers should have confidence in top management that they will support them during all kinds of unforeseen difficulties or crises. Thus, the role of top management plays a major part in successful project implementation. (Slevin, Pinto, 1989)

3.2.4 Difference between Project Success and Project Management Success

Project success is measured against the overall objectives of the project, whereas project management success is measured against traditional measures of performance such as cost, time, scope and quality (Cooke-Davis, 2002). Success criteria, the measures by which success or failure are judged is differentiated from success factors, which are the inputs to the management system that lead directly to the success of the project. The development of Critical Success Factors is related to finding answers the following questions: "what factors lead to project management success?", "what factors lead to a successful project?" and "what factors lead to consistently successful projects?" In another opinion, we see that the best overall criterion for project success is when the user, project manager and system development group all think their expectations were met or exceeded (Nicholas JM, 1989).

The interviews and discussions carried out on a cross section of subjects also validated the importance in distinguishing between project success and project management success. Whereas project success deals with tangible and measureable outputs, project management success concerns about the soft factors, enablers and social processes that are part of the project manager's effectiveness.

3.2.5 Creating an environment in which Projects can succeed (Pinto and Morris, 2004)

Project management effort is linked to long-term organizational effectiveness. The performance and success is achieved through people and their relationships in the project process. The management of people; i.e. the ability to influence, encourage and motivate individuals and teams, is a necessary skill for project managers (Pryke and Smyth, 2006). We have the examples of great visionary leadership like Dr. APJ Abdul Kalam, Homi J Bhabha and Vikram Sarabhai who played stellar exemplary roles of successful R&D management in their respective R&D establishments, namely DRDO, BARC and ISRO.

4.   Results and Discussions

Critical success factors (CSFs) encompasses many elements, which have to be synchronized to ensure the project delivery on time. Project Management Action, Project Procedures, Human Factors, External Issues and Project Related Factors form a major part of the vital factors influencing project success. The perceived importance and challenging nature of the project is found to be a major motivator for the team members. R&D management and Technology Management are still in a growing phase in the academic as well as industry spheres. More studies and discussions in this field is the need of the hour.

5.   Conclusion

This study investigated the critical success factors that affect project success in public funded R&D projects using academic discussions and interviews with project participants. The data collected were analyzed and categorized in three dimensions - Organization, Process, and People. From the results of analysis, the observed factors that significantly influenced project success are (1) a clear project mission definition, (2) a strong top management commitment (3) a thorough project planning and scheduling, (4) a strong customer involvement, (5) Capable and committed team members . This study suggests that the above factors can be considered to be the key for effective project management.

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A Framework for Managing Internal Employability by Leveraging Motivating Job Characteristics - Role of Promotion and Prevention Focused Job Crafting

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Abstract-

Dynamic changes in business environment may significantly influence existing job roles, extent of job choices available to employees and their perception about job stability and security. Under such situations, a high level of perceived internal employability may help them in managing these uncertainties in a more effective manner and reduce their job related stress. By analyzing the data collected from 497 executives working in Indian public sector energy companies and using regulatory focused, job demands-resources and conservation of resources theories, this study examines role of promotion and prevention focused job crafting - a proactive and flexible approach of managing job demands, in enhancing perceived internal employability in presence of motivating job characteristics.

The study found a positive relationship between motivating job characteristics, promotion focused job crafting and perceived internal employability. These relationships were non-significant in case of prevention focused job crafting. Further, promotion focused job crafting partially mediated the relationship between motivating job characteristics and perceived internal employability. Significant theoretical contributions and practical implications have been discussed.

Keywords- *Flexibility, VUCA, regulatory focus, job insecurity, public sector*

1. Introduction

Modern business environment is largely characterized by high volatility, uncertainty, complexity and ambiguity (VUCA) (Yarger, 2006). Such circumstances force organizations to undertake many changes in their systems and processes. The existing job roles also become dynamic and employees have to manage new job demands on regular basis. To manage these job demands, employees are required to exude flexibility, make additional, and more proactive efforts (Rousseau, Ho, & Greenberg, 2006). One of such mechanisms could be in the form of job crafting which is a proactive effort towards job customization or job-demand management at workplace (Tims & Bakker, 2010; Wrzesniewski & Dutton, 2001).

There are various forms of job crafting, however traditionally they can be categorized into two popular approaches as suggested by Wrzesniewski and Dutton (2001) and by Tims and Bakker (2010). Wrzesniewski and Dutton (2001) defined it as a proactive behaviour of redefining meaning associated with the job , customizing tasks, and social relationships at work , which are respectively known as cognitive, task, and relational crafting. Tims and Bakker (2010, 2012) proposed four forms of job crafting namely job crafting by increasing structural job resources, social job resources, challenging job demands and decreasing hindering job demands (Tims & Bakker, 2010,2012). This conceptualization was based on job-demands resources theory (JD-R) which explains the process of managing various job demands by mobilizing structural, social and other job resources at workplace (Bakker & Demerouti, 2007, 2014).

The traditional forms of job crafting have been found to have many significant positive influence on organizational and personal outcomes namely job performance (Petrou et al., 2015; Rudolph, Katz, Lavigne, & Zacher, 2017), meaningfulness (Wrzesniewski, 2003, Wrzesniewski , LoBuglio, Dutton, & Berg, 2013; Tims, Derks, & Bakker, 2016), work engagement (Bakker, Tims, & Derks, 2012; Bruning & Campion, 2018), and increased person-job fit (Berg, Dutton, & Wrzesniewski, 2013; Kooij, van Woerkom, Wilkenloh, Dorenbosch, & Denissen, 2017; Tims et al., 2016; Wrzesniewski & Dutton, 2001).

Although the aforementioned traditional approaches capture various ways of job crafting, they do not explicitly explain why individual pursue one form of job crafting more frequently and effectively than the other forms. Considering these conceptual gaps, a new approach of job crafting namely promotion and prevention focused job crafting, which is collectively known as regulatory focused job crafting, has been proposed recently by Lichtenthaler and Fischbach (2016a, 2016b, 2018). This approach has been developed based on the JD-R and regulatory focus (Higgins, 1997) theories. The regulatory focus theory explains the goal oriented behaviour of individuals by primarily focusing on efforts towards maximizing gains (i.e. promotion focused orientation) or avoiding losses (i.e. prevention focused orientation) (Higgins, 1997). In this context, promotion focused job crafting (PFJC) involves customizing jobs and managing job demands by increasing social and structural job resources and taking up challenging job demands while prevention focused job crafting (PrevFJC) is performed by reducing hindering job demands (Lichtenthaler and Fischbach, 2016).

Dynamic changes in business environment may significantly influence existing job roles, extent of available job choices for employees and their perception about job stability and security. Under such situations, a high level of perceived internal employability (IEMP) may help them in managing these uncertainties in a more effective manner and reduce their job related stress. IEMP is referred to as a "capability of retaining the job one has in hand or to get the job one desires within the present organization" (Rothwell & Arnold, 2007). It means that a highly internally employable individual may be able to retain or obtain his / her preferred job more easily than others and manage job insecurity more effectively (e.g. Shoss, 2017). Thus, internal employability may act as a useful job resource under such situations in accordance with the conservation of resources (COR) theory (Hobfoll & Freedy, 1993).COR theory states that individuals work towards either enhancing their useful resources or conserving the available ones so that they could use these resources at the time of need, including for managing stress.

Job roles and job characteristics have a complementary relationship. Depending on perception about job attributes and ones regulatory focus, individuals may either consider these job features as an important structural job resources and/or sources of job demands or accordingly show specific behavioural dispositions. Therefore, to provide a comprehensive understanding of the job demand management process, the study should also incorporate motivating job characteristics (MJC) namely job autonomy, task identity, task significance, skill variety and performance feedback (or feedback) as one of the central study variables (Hackman and Oldham, 1975, 1980). Past studies have examined the relationship between some of the job characteristics such as job autonomy, job control, task interdependence and traditional form of job crafting, but considering regulatory focused job crafting as a better and more advanced approach of job crafting, it is prudent to study these relationships afresh using new and recent job crafting conceptualization. As job crafting acts as a useful coping tool for employees during organizational changes (Petrou, Demerouti, & Schaufeli, 2015), therefore it will be also

interesting to understand this coping process through enhanced internal employability (IEMP) in presence of MJC.

Considering the relevance of job crafting in management of dynamic job demands and likely significant influence on other organizational outcomes, the present article tries to explain its mechanism by conceptualizing job characteristics as both – resource provider and job demand creator, and examine its contribution in enhancing various job related choices in the form of internal employability to manage overall job stress. To the best of our knowledge, these aforementioned aspects of the two new forms of job crafting – PFJC and PrevFJC, have not been studied in past and therefore this study aims to fill up this research gap in addition to providing a practical solution to the complex issue of job demand management.

2. Conceptual Model

2.1. *Relationship of MJC with regulatory focused job crafting (i.e., PFJC & PrevFJC)*

Motivating job characteristics include job autonomy, task identity, task significance, skill variety and performance feedback (or feedback). According to JD-R theory, these job features can act both as job resources as well as source of job demands. For example, job autonomy may act as a job resource as it provides flexibility to individuals for scheduling their tasks and priorities in their own way and optimise use of other available resources, such as their time at workplace, in a more efficient manner. On the other hand, task identity makes the job easily identifiable for the individuals performing those jobs. If the job is performed in the desired way, such individuals may receive accolades from the organization while in case of poor execution or failure, they may also be easily criticized. We argue that these job characteristics may provide a great extent of freedom as well as responsibility to individuals and encourage them to act in a certain way depending on their dominant regulatory foci.

When individuals are promotion focused, they make efforts considering 'maximization of gains' in mind. According to the regulatory focus theory, these gains could be in the form of promotion, career advancement, recognition etc. These individuals may capitalize various features of motivating job characteristics in the form of job resources and use them to further increase their other social and structural job resources and also take up challenging job demands. Such behaviours are termed as PFJC and are a form of proactive or self-initiated behaviours. Similarly, when individuals are prevention focused, they make efforts considering 'minimization of losses' as an objective. They try to manage job requirements with the present level of job resources and try to avoid putting additional efforts towards resource enhancement or mobilization. When they are confronted with a set of complicated or high responsibility tasks, they view such job demands as posing a challenge to their existing comfort (e.g. resources) and thereby hindering their otherwise normal day to day job roles. Anticipating these changes, such individuals start decreasing these hindering job demands, a self-initiated behaviour known as PrevFJC. They may start exploring use of many supportive features of motivating job characteristics such as skill variety, autonomy and task significance, for the same.

Thus, combining the regulatory focus and JD-R theories, it may be argued that individuals may undertake both forms of job crafting depending on their dominant form of regulatory foci by leveraging motivating job characteristics for their advantage. Past studies also indicate a positive relationship between job characteristics and proactive behaviour (Grant and Parker, 2009; Tornau and Frese, 2013). Thus, based on aforementioned arguments and theoretical support, following hypotheses are being made:

Hypothesis 1 (H1): MJC will be positively related to PFJC.
Hypothesis 2 (H2): MJC will be positively related to PrevFJC

2.2.   *Relationship of regulatory focused job crafting (i.e., PFJC & PrevFJC) with IEMP*

PFJC is a job-demand management process, and is 'gains' oriented (Higgins, 1997; Lichtenthaler and Fischbach, 2016). While pursuing this form of job crafting, individuals make necessary efforts to mobilize required job resources and, if required, may also volunteer for undertaking even other challenging job demands. These individuals are more likely to manage their dynamic jobs more effectively because of their ability to mobilize required job resources, as supported by JD-R theory. These instances of effectively managing jobs indicate high competence and proven capabilities of these individuals and therefore their behaviours are appreciated and perceived favourably at workplace. Because of their proven competence, they are more likely to be considered as an important organizational resource and therefore valued more by their organization. These job crafters may also be a very effective in coping with organizational changes (Petrou et al., 2015). Organizations also want to retain these capable individuals with them in order to ensure continued performance and growth. Therefore, they also start accommodating job related choices of such employees. Thus, such employees are likely to have high internal employability.

As aforementioned, internal employability provides job related choices to individuals within the same organization / set up. Therefore, it may act as a useful job resource for managing job insecurity or instability related situations and minimize consequential stress. This linkage is also supported by COR theory. In line with similar theoretical support, it may be argued that individuals may like to put in extra efforts by mobilizing structural and social job resources and show self-initiatives in taking up challenging job demands (i.e., undertake PFJC) so that it helps them in managing their job demands in a better manner and enhance their internal employability (e.g., a job resource).Thus, PFJC may be considered to help in enhancing internal employability as an important job cum personal resource. In view of the foregoing arguments and support from JD-R and COR theories, following hypothesis is being made:

Hypothesis 3 (H3): PFJC will be positively related to IEMP.

PrevFJC involves decreasing hindering job demands. These job demands are also inherent constituents of the day to day job requirements at workplace and organizations expect their employees to adequately fulfill these job demands as well. In accordance with the JD-R theory, when individuals don't mobilize required job resources to manage these hindering job demands, then such job requirements remain unfulfilled. Therefore, when they make frequent and overt efforts to reduce these hindering job demands instead of doing the needful to manage them, such job behaviour is perceived as job avoidance and generally not appreciated by their organization. Under such situation, these individuals may also be viewed as a poor job performer and therefore may also negatively influence their goodwill at workplace. These collective perceptions may result into reduction in their internal employability. Thus, based on the above arguments and theoretical support (JD-R theory), it may be posited that PrevFJC may be negatively related to IEMP. Hence we hypothesize the following:

Hypothesis 4 (H4): PrevFJC will be negatively related to IEMP

2.3. Relationship of MJC with IEMP

Motivating job characteristics present a variety of job features such as job autonomy, task identity, task significance, skill variety and feedback, in the designed job. Due to these features, the existing job provides ample opportunities to individuals to explore their best abilities to manage their job demands. In accordance with JD-R theory, these motivating job characteristics act as enabler in aligning the job requirement with the available personal (e.g., individuals' abilities, skills etc.), structural and social job resources (viz., autonomy, feedback). This congruence may help in better job demand management which ultimately may help in enhancing internal employability (see explanation given for hypothesis 3 also). Therefore, we hypothesize the following:

Hypothesis 5 (H5): MJC will be positively related to IEMP.

2.4. Regulatory focused job crafting i.e., PFJC & PrevFJC, as mediator

Motivating job characteristics is likely to encourage individuals to go for PFJC (refer hypothesis 1) and which in turn may enhance their IEMP (see hypothesis 3). Thus, apart from the direct relationship between motivating job characteristics and IEMP (refer to hypothesis 5), it is argued that when individual's leverage these motivating job features for doing PFJC, the effect of motivating job characteristics on internal employability may even rise further. It is important to note that job characteristics by itself may not result into enhancement in internal employability. Rather, individual's efforts such as PFJC may be required to be done in order to exploit these enabling job characteristics for raising internal employability. This indirect linkage is also supported by COR theory as IEMP may be one of the job resources that an employee would like to possess more in order to manage their job related stress. Therefore, they may feel a need to undertake PFJC for generating, conserving or enhancing this important resource by leveraging motivating job characteristics. In view of the aforementioned explanations and theoretical support, we hypothesize the following:

Hypothesis 6 (H6): PFJC will mediate the relationship between MJC and IEMP

By combining hypotheses 2, 4 and 5, it may be argued that PrevFJC can also mediate the relationship of MJC with IEMP. However, considering hypothesis 5, it may be argued that PrevFJC, as a mediator, may suppress the positive effect of MJC on IEMP.

Hypothesis 7 (H7): PrevFJC will mediate the relationship between MJC and IEMP

Based on the seven hypotheses proposed in this article, a conceptual model has been developed which is provided in Fig.1.
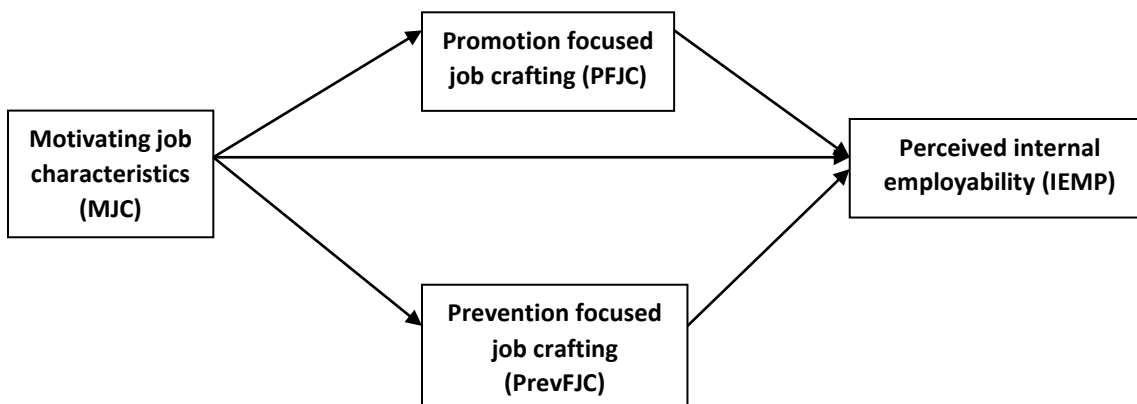
Fig. 1: Conceptual Model

3. Methodology

The study has been conducted on executives working in central public sector enterprises (CPSE) of India operating in energy business. This sector is witnessing an unprecedented scale of transformations due to the influx of many foreign players and increased focus of government to fundamentally change the structure, conduct and performance of this industry. Under such dynamic business environment, a study on job crafting seems to be very relevant.

The study has been conducted using a cross-sectional research design. A combination of purposive and snowball sampling was used to collect responses from 507 executives through survey questionnaire (in both online and offline mode). Participation and identity disclosure were optional in this survey. Data was collected during May 2018 and Feb 2019.

After screening data for large scale missing values and multivariate outlier issues, 497 samples (165 & 332 collected through online and offline mode respectively) were selected for final analysis. Some of these respondents did not share their demographic details viz. gender, age, marital status, academic qualification, work experience and job level. The final sample consisted of 91.3 % males and 8.7 % females (out of 481 reported); 44.5%, 49.3% and 6.2% respectively belonged to the junior, middle and senior management level (out of 467); 16.7 % unmarried & 83.3 % married (out of 474); 1.3%, 40.5%, 48.5% and 9.7 % respectively had doctorate , masters', graduation (engineering) and other degrees (Chartered Accountancy, diplomas) (out of 472). The average age of respondents was 37.7 years (SD = 10.1) with their average work experience in the organization being 12.40 years (SD=9.15).

Data analysis was done using Covariance Based Structural Equation Modelling (CB-SEM) through AMOS software (Arbuckle, 2014).

3.1. Measures

Motivating job characteristics (MJC) was measured using a 15-item job diagnostic survey (JDS) (Hackman and Oldham, 1975). Certain questions of section one and two of the JDS measures five dimensions of MJC namely job autonomy, task identity, task significance, skill variety and feedback. Each of these job features were measured using 3-items of the JDS. The summated score of each of these five sub-factors (dimensions) of MJC were used for measuring overall MJC, a reflective latent variable, as also been followed in the recently published studies (e.g., Agarwal and Gupta, 2018). Cronbach's alpha of the overall MJC scale was 0.88.

Perceived internal employability (IEMP) was measured using 6 item scale of Rothwell and Arnold, (2007) on 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).. Due to poor loading, 3 items were dropped. Cronbach's alpha of the scale was 0.72.

Promotion focused job crafting (PFJC) is a second order construct consisting of three first order factors namely increasing structural job resources, increasing social job resources and increasing challenging job demands. The construct was measured on 5-point Likert scale ranging from 1 (never) to 5 (very often) using 15 items of job crafting scale of Tims and colleagues (2010, 2012) having 5 items each for these three factors. These sub-scales are frequently used in

studies on job crafting using JD-R theory. Due to poor loading, 1 item in each of these three first order factors was dropped. Cronbach's alpha of the overall scale was 0.83.

Prevention focused job crafting (PrevJC) was measured using 6 item subscale (decreasing hindering job demands) of Tims and colleagues (2012). The items were measured on 5-point Likert scale ranging from 1 (never) to 5 (very often). Due to poor loading, 2 items were dropped. Cronbach's alpha of the scale was 0.73.

3.2. Control variables

Demographic characteristics namely gender, age, marital status, education, work experience and job level were used as control variables in the study. Age and work experience was measured in number of years. All other remaining demographic attributes were considered as categorical variable and coded accordingly viz. gender (female=1, male=2), job level (1=junior management, 2= middle management, 3= senior management), marital status (unmarried=1, married=2), education (1= graduation, 2= Chartered accountancy / others, 3 = masters, 4= doctorate).

3.3. Validation of measures

All of the scales had adequate internal consistency as Cronbach's α statistic was above the recommended reliability coefficient of 0.70 (Nunnally, 1978). Discriminant validity was tested using Fornell and Larcker's criteria (1981) according to which square root of AVE of the corresponding construct is should be more than its correlations with the associated constructs. As mentioned in Table I, this criterion has been fulfilled in our case, supporting sufficient discriminant validity of the constructs. Additionally, a confirmatory factor analysis (CFA) was conducted with the four latent constructs (MJC, IEMP, PFJC and PrevFJC) to evaluate the convergent validity of the model constructs. All items loaded significantly on respective constructs and the model had satisfactory goodness-of-fit statistics ($\chi 2$ (240) =478.28, p<0.001, TLI=0.941, CFI=0.949, RMSEA=0.045, SRMR=0.0523) in line with the recommendation by Hu and Bentler (1999).

3.4. Common method bias

Considering that the current study is cross-sectional in nature, there may be instances of common method bias (Podsakoff, et al., 2003). However, we followed some recommended steps such as communicating respondents that their participation is purely on voluntary basis, there are no desirable or undesirable answers, and emphasizing anonymity of respondents and use of data on aggregate basis.

Post-hoc analysis for assessing effect of common method variance was conducted using marker variable (Lindell and Whitney, 2001). A latent variable 'promoting gender diversity' measured using 2 items was used as the theoretically unrelated marker variable. The CFA analysis of the model containing four latent constructs and marker variable showed quite similar goodness of fit indices (Model with Marker variable: $\chi 2$ (284) =548.32, p<0.001, CFI=0.946, TLI= 0.934, RMSEA=0.043, SRMR=0.050, AIC=739.53; Model without Marker variable = $\chi 2$ (240) =478.28, p<0.001, CFI=0.949, TLI=0.941, RMSEA=0.045, SRMR=0.0523, AIC=646.277).

Additionally, we also compared the two models – the four factor model having all four latent constructs (as used in the study) and a single factor model. The single factor model had very poor fit ($\chi 2$ (249) =2522.39, p<0.001, TLI=0.46, CFI=0.51, RMSEA=0.136, SRMR=0.1253).

Above analysis indicated that common method bias was not a major issue in our study. Even then, we assessed structural model and carried out hypotheses testing by including marker variable in the model so that the final results are common method variance adjusted.

4. Data analysis and results

Table 1 provides details on means, standard deviations, correlations of variables and reliability coefficients. The relationships between the four latent constructs were assessed using structural equation modeling (SEM), through AMOS 23 software. Structural model was estimated by including marker variable in the model in order to take care of common method variance. The model containing four study variables and the control variables showed very good fit with the data ($\chi 2$ (411) =744.33, p<0.001, CFI=0.948, TLI=0.933, RMSEA=0.040). The results of the path analysis along with the standardized path coefficients are provided in Table 2.

From the results mentioned in Table 2, it is clear that the relationship of PrevFJC with MJC (H2) and IEMP (H4) is not significant. While the same between MJC and PFJC (H1) and IEMP (H5) and between PFJC and IEMP (H4) are significant. Thus, hypotheses H1, H3 and H5 are supported by data while hypotheses H2 and H4 are rejected.

Table 1: Means, standard deviations, reliabilities and correlations of the study variables

Variable	Mean	SD	CR	AVE	1	2	3	4	5
1. Age	37.72	10.11							
2. Gender	1.91	0.29			0.082				
3. MaritalS	1.83	0.38			.488**	.171**			
4. Education	1.94	0.97			.198**	-0.028	0.079		
5. Exp	12.40	9.15			.920**	0.064	.429**	0.076	
6. Job Level	1.62	0.61			.494**	.113*	.313**	.139**	.427**
7. MJC	4.98	1.05	0.90	0.630	.191**	0.049	.113*	0.088	.157**
8. PFJC	4.02	0.52	0.79	0.560	0.071	0.010	0.018	0.061	0.071
9. PrevJC	3.55	0.79	0.73	0.410	0.003	.158**	0.017	-.101*	0.022
10. IEMP	3.95	0.71	0.74	0.490	.195**	0.080	.152**	-0.023	.206**
11. PGD_MV	4.06	0.97	0.85	0.737	-.146*	-.150*	-.141*	0.021	-.128*

Table 1 (Continued): Means, standard deviations, reliabilities and correlations of the study variables

Variable	Mean	SD	CR	AVE	6	7	8	9	10
1. Age	37.72	10.11							
2. Gender	1.91	0.29							
3. MaritalS	1.83	0.38							
4. Education	1.94	0.97							

	Mean	SD	CR	AVE					
5. Exp	12.40	9.15							
6. Job Level	1.62	0.61							
7. MJC	4.98	1.05	0.90	0.630	.133**	(0.79)			
8. PFJC	4.02	0.52	0.79	0.560	.180**	.286**	(0.75)		
9. PrevJC	3.55	0.79	0.73	0.410	-0.033	0.017	.274**	(0.64)	
10. IEMP	3.95	0.71	0.74	0.490	.237**	.314**	.466**	.139**	(0.70)
11. PGD_MV	4.06	0.97	0.85	0.737	-0.084	0.011	.198**	.121*	.234**

Note: Note: **$P < 0.01$ level (2-tailed); *$P < 0.05$ level (2-tailed); MJC = motivating job characteristics, PFJC = promotion focused job crafting, PrevFJC = prevention focused job crafting, IEMP = perceived internal employability, PGD_MV = promoting gender diversity, a marker variable. SD = standard deviation, CR = composite reliability, AVE = average variance extracted. Age and work experience (Exp) was measured in number of years. All other remaining demographic attributes were considered as categorical variable and coded accordingly viz. gender (female=1, male=2), job level (1=junior management, 2= middle management, 3= senior management), marital status- MaritalS (unmarried=1, married=2), education (1= graduation, 2= Chartered accountancy / others, 3 = masters, 4= doctorate). Square root of AVE is mentioned in parentheses along the diagonal.

Table 2: Path Analysis for Direct Relationships

Hypotheses	IV	DV	β	P-value	S.E	Remarks
H1	MJC ---->	PFJC	0.323	<0.001	0.021	Hypothesis supported
H2	MJC ---->	PrevFJC	0.015	0.784	0.044	Hypothesis rejected
H3	PFJC ---->	IEMP	0.521	<0.001	0.146	Hypothesis supported
H4	PrevFJC ---->	IEMP	-0.005	0.922	0.041	Hypothesis rejected
H5	MJC ---->	IEMP	0.169	0.001	0.034	Hypothesis supported

To test mediation effect, we used SPSS macro PROCESS developed by Hayes (2013). Imputation procedure of AMOS was used on the measurement model containing four study latent variables along with marker variable and the latent scores thus obtained were used for analyzing mediation effect by following the procedure suggested by Hayes (2013). Model 4 of SPSS Process macro was used for the analysis. The results of indirect effect of MJC on internal employability through PFJC are provided in Table 3.

Table 3: Mediation effect of motivating job characteristics (MJC) on perceived internal employability (IEMP) through promotion focused job crafting (PFJC)

Total effect of MJC on IEMP

Effect	se	t	p	LLCI	ULCI
.2212	.0251	8.8170	.0000	.1719	.2706

Direct effect of MJC on IEMP

Effect	se	t	p	LLCI	ULCI
.0824	.0198	4.1588	.0000	.0435	.1214

Indirect effect(s) of MJC on IEMP through PFJC

	Effect	BootSE	BootLLCI	BootULCI
PFJC	.1388	.0248	.0968	.1927

Partially standardized indirect effect(s) of MJC on IEMP through PFJC

	Effect	BootSE	BootLLCI	BootULCI
PFJC	.2818	.0483	. 2008	.3894

Completely standardized indirect effect(s) of MJC on IEMP through PFJC

	Effect	BootSE	BootLLCI	BootULCI
PFJC	.2422	.0327	.1805	.3080

Note: SE = standard error, 95% Confidence Interval, LLCI = Lower Limit of CI, ULCI = Upper limit of CI, Boot strap = 5000.

Similarly, the results of mediation effect of MJC on IEMP through PrevFJC are provided in Table 4.

The mediation analysis results in Table 3 & 4 indicate that, in case of PrevFJC, the 95% ULCI and LLCI of standardized indirect effect of MJC on IEMP (LLCI = -0.0166, ULLCI = 0.175) includes zero, therefore the indirect effect is non-significant and hypothesis 7 is not supported (H7). However, the same in case of PFJC is significant as 95% CI is 0.1803 (LLCI) & 0.3080 (ULCI) (H6). Thus, hypothesis H6 is supported by the data while H7 is rejected.

From results of path and mediation analysis, it is evident that the relationships involving PrevFJC are not significant (refer to hypotheses H2, H4 and H7). It means that when job characteristics have motivational ingredients (i.e. MJC), individuals pursue PFJC and not PrevFJC. Also, when PFJC is pursued leveraging MJC, then it significantly enhances ones IEMP which is also evident from the fact that the indirect effect of MJC on IEMP through PFJC (β=0.1388, p= 0.001) is larger than its direct effect (β=0.0824, p<0.001) on IEMP.

Table 4: Mediation effect of motivating job characteristics (MJC) on perceived internal employability (IEMP) through prevention focused job crafting (PrevFJC)

Total effect of MJC on IEMP

Effect	se	t	p	LLCI	ULCI
.2212	.0251	8.8170	.0000	.1719	.2706

Direct effect of MJC on IEMP

Effect	se	t	p	LLCI	ULCI
.2218	.0248	8.9401	.0000	.1730	.2705

Indirect effect(s) of MJC on IEMP through PrevFJC:

	Effect	BootSE	BootLLCI	BootULCI
PrevFJC	-.0005	.0048	-.0092	. 0105

Partially standardized indirect effect(s) of MJC on IEMP through PrevFJC:

	Effect	BootSE	BootLLCI	BootULCI
PrevFJC	-.0010	.0097	-.0186	.0212

Completely standardized indirect effect(s) of MJC on IEMP through PrevFJC:

	Effect	BootSE	BootLLCI	BootULCI

| | PrevFJC | -.0009 | .0082 | -.0166 | .0175 |

5. Discussions

The aim of the study was to empirically explore role of motivating job characteristics (MJC) in promotion and prevention focused job crafting (PFJC & PrevFJC) and their influence on perceived internal employability (IEMP). The study provided interesting results. Positive relationship of MJC with PFJC and IEMP was observed in the study. Also, PFJC had positive direct relationship with IEMP in addition to having a significant partial positive mediating effect on the relationship between MJC and IEMP. This indirect effect on internal employability was more substantial than its direct effect, suggesting critical intermediary role played by PFJC in the whole process.

Contrary to our expectation, no such significant relationships were observed in case of PrevFJC. It means that PrevFJC is not influenced by MJC. Also, such behaviours may not have any effect or association with internal employability (IEMP). It is important to note that these results were examined when the same individuals were also performing PFJC, meaning that when one does more of PFJC (mean score = 4.02) than PrevFJC (mean score = 3.55), then the relationship of PrevFJC with internal employability (IEMP) may not be significant. While analyzing mediation effect of PrevFJC (by without including PFJC in the mediation model), we found that although the indirect effect of MJC through PrevFJC was non-significant, yet the relationship between PrevFJC and IEMP was significant (coefficient= 0.1125, p=0.0011, LLCI = 0.0451, ULCI= 0.1800) suggesting that the ability to reduce hindering job demands may also be very helpful in enhancing ones internal employability. However, PFJC significantly outweighed this effect.

Combining JD-R, COR and regulatory focus theories, we had conceptualized MJC, both as job resources or source of job demands depending upon regulatory foci in the present study. For example, promotion focused individuals may consider these motivating job characteristics more as a job resource than a job demand. Further, internal employability was presented as a job resource.

The study found positive relationship between MJC, as job resource / demands, and PFJC which includes increasing structural and social job resources and increasing challenging job demands. Thus, the results provide empirical evidence that MJC type resources may also encourage individuals to collectively go for increasing structural and social job resources both, in addition to increasing challenging job demands (i.e. PFJC). These findings are different from the past results that suggested a positive relationship only between crafting structural resources and increase in structural job resources; between crafting social resources and increase in social job resources and between crafting challenging demands and increase in challenging job demands (Tims, Bakker and Derks, 2013).

In accordance with regulatory focus theory, prevention focused individuals may consider MJC both as a job resource and a job demand depending upon specific characteristics of the job. So, while they may view job autonomy as a resource; task identity may be considered as a demand. The present study found that collectively job autonomy, skill variety, task identity, task significance and feedback (i.e. MJC) has no association with PrevFJC (also known as decreasing

hindering job demands). In past study, the relationship between crafting hindering demands and decrease in hindering job demands were also found to be non-significant. Thus, findings of the present study are partially similar to the past findings (Tims, Bakker and Derks, 2013). However, because PFJC and PrevFJC are fundamentally different type of job crafting conceptualizations than the JD-R theory based job crafting conceptualization of Tims and Bakker (2010), we argue that the results of the present study are substantially unique.

6. Theoretical and practical implications

The unique findings of current study as afore explained, contribute significantly to both theory and managerial practice. First, it combines three theories namely *regulatory focus*, *JD-R, and COR theories* to explain the process of enhancing IEMP using PFJC by leveraging MJC. By doing so, the study integrates these three theories in regulatory focused job crafting approach and expands their application even further in such research.

Second, the results indicate that individuals are more inclined to use MJC for performing PFJC. It means that they put more efforts towards mobilizing additional social and structural job resources required to manage job demands or take up new and more demanding jobs when the job has motivating job features like autonomy, task identity, task significance, skill variety and performance feedback (or feedback). This finding suggests that these job characteristics certainly have encouraging effect on individuals' positive behaviour irrespective of gender, work experience, job level and marital status. This finding is even more important for organizations as it indicates that their efforts towards improving job characteristics by incorporating the aforementioned five job features may have significant positive effect among individuals and therefore likely to be more successful.

Third, unlike PFJC, PrevFJC was found to be non-significantly related to both MJC and IEMP. It means that the individuals who wish to reduce their hindering job demands in order to manage their job requirements; they in fact are not so successful in leveraging positive attributes of the job characteristics effectively for their advantage (i.e.to achieve personal goals with minimum efforts and feel less stressed). Their efforts actually go in vain as there is no significant relationship between PrevFJC and MJC or IEMP. It also hints that if they had put these efforts in performing PFJC, they would have been rather more successful in enhancing their internal employability and manage job uncertainty related stress more effectively.

Fourth, we found that MJC was positively related to IEMP. It indicates that individuals may perceive better chance of pursuing their preferred jobs when the job is rich in terms of the aforementioned five important job characteristics. It means that with multiple attributes already present in the existing job, it becomes easier for individuals to manage their job demands more efficiently and in the process enhance their internal employability even further. This finding of the study is quite unique as it indicates that organizational support in the form of MJC alone may help individuals to enhance or conserve their important personal and job resource such as internal employability which can be gainfully used at the time of need or crisis for managing job related stress or instability as explained by COR theory.

Fifth, by establishing the mediation effect of PFJC, the study also explains how MJC enhance IEMP. This explanation of the mechanism involved significantly enhances our understanding of

the job crafting process. Not many studies, even though some of them have been performed using traditional job crafting approaches, have examined and explained similar role of job crafting particularly in a specific work context and individual oriented outcomes such as internal employability.

Sixth, there are very few empirical studies conducted on these two forms of job crafting (Bruning & Campion, 2018; Lichtenthaler & Fischbach, 2016a, 2016b, 2018a, 2019a, 2019b; Parker & Bindl, 2016) and none have been undertaken in public sector context. Therefore findings of this study also extend our contextual understanding and knowledge of job crafting process further and expand its existing literature.

Seventh, considering the positive and significant role played by Individuals with high internal employability in managing difficult situations that organizations face due to complexity and uncertainties in business environment (Sanchez-Manjavacas, Saorín-Iborra, & Willoughby, 2014), organizations should provide motivating job characteristics (MJC) as an inherent and given aspect of the pre-designed jobs which are allocated to an individual. Further, past studies indicate that there is a positive relationship between opportunities to job craft and actual job crafting. By providing additional support such as better work environment, organizations can further increase such opportunities and encourage individuals to pursue more of PFJC which will ultimately enhance their internal employability and in turn lead to increased organizational productivity (De Grip, Van Loo, & Sanders, 2004).

Thus, as mentioned above, there are many unique and significant contributions and implication of the findings of the present study which can be further utilized by not only researchers in their future studies but also by both organizations and individuals in their efforts towards coping effectively in a dynamic and complex business environment.

7. Limitations and areas of future studies

In present study, we examined the linkage between four study variables – motivating job characteristics, perceived internal employability, promotion and prevention focused job crafting. However, considering the role of individual level factors in the job crafting process, it could be argued that the results of this study might be more comprehensive if some of these factors are included in the study. Although certain individual level factors, particularly demographic variables, were included in the study as control variables, yet by including variables such as personality traits and work orientations, the results of the study could be more generalizable. Other organizational level variables such as human resource management practices, job allocation system etc. may also affect the relationships between study variables, as they influence job demand and resources availability. However due to scope limitation; we did not study them in the present case. The same may be considered in future studies.

The study has been conducted using a cross-sectional research design, and therefore the limitations of this design, including uncertainty linked to cause–effect association and presence of common method bias, are also applicable to the study. The results of the study show that common method bias is not a matter of concern here, however, the influence of biasness could not be completely ruled out.

As job crafting in general and regulatory focused job crafting in particular is only a newly proposed concept, there exists ample opportunity to explore its various aspects including

potential antecedents and consequences. Therefore we encourage researchers working on job designing, to explore this new conceptualization of job crafting even further.

8. Conclusion

Modern organizations are operating in a very complex and ambiguous environment. This may have a significant influence on existing job roles and extent of available job choices of their employees. These uncertainties in job roles may also generate negative perception about their present job stability and security. Under such situations, a high level of perceived internal employability may help employees in managing these uncertainties in a more effective manner and reduce their job related stress. This ability of employees will also be very useful for their employers in successfully implementing organizational changes as well as adapting to new operating environment (Sanchez-Manjavacas *et al.,* 2014). Therefore, organizations may work towards creating an enabling ecosystem such as by providing motivating job characteristics in the designed job so that their employees are encouraged to undertake promotion focused job crafting and enhance their internal employability and consequently bring positive outcomes for both – their organization and self.

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An analysis of factors influencing the performance of service organizations: An approach of interpretive structural modelling

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Abstract-

This paper outlines the factors influencing the working performance of service organizations. The factors responsible for the performance of service organizations are gathered from the literature review and in consultation with the industry experts. A large number of factors have been observed from the literature. The main problem is to observe the relationship that how they are related to each other and influence the performance of the organization. The interpretive structural modelling (ISM) modelling approach is used to seek out the structural relationship among the success factors of the service organizations. These factors are divided based on two categories dependence and driving power. Finally, a relational hierarchy of the factors has been prepared using Interpretive Structural Modelling (ISM). This network modelling is applied to promote innovations and improve the organization performance. The empirical results suggest that top management commitments, policy and vision have a major impact on the operations of any service organization to provide quality services.

Keywords: Service Organization, performance measurement, Interpretive Structural Modeling (ISM), Success Factors, MICMAC analysis.

1. Introduction and Background

Nowadays, service organizations play an important role in the overall economy of a country. Therefore, excellence in the performance of a service organization has become a great challenge for the management. This study helps in the linking the factors influencing performance of an organization. Total eighteen factors have been identified from literature review and the experts from industry. The relationships between these factors are based on the opinion of the industry experts. The most common opinions are incorporated in this analysis. Then, Interpretive Structural Modeling (ISM) approach is used to obtain the structural relationship among these factors. ISM has been used by many researchers in the analysis and linking of factors in different types of the industrial applications. Attri and Grover (2017) used the ISM approach in linking the factors considered for facility layout at design stage. Some of the important applications have been summarized in Table 1.

Table 1: Some of the important applications of ISM

Authors	Application
Mandal and Deshmukh (1994)	Vendor Selection
Jharkharia and Shankar (2005)	IT enabled supply chain
Ravi and Shankar (2005)	Reverse logistics
Faisal et al. (2006)	Risk mitigation in supply chain
Qureshi et al. (2007)	Logistics outsourcing relationship
Barve et al. (2007)	Modelling of the barriers in the third party logistics services.
Raj et al. (2012)	Modelling the factors affecting FMS (Flexible Manufacturing Systems)
Attri et al. (2012)	Modelling the enablers of TPM (Total Productive Maintenance)
Raj and Attri (2010)	Quantification of barriers in TQM (Total Quality Management)
Chidambaranathan et al. (2009)	Critical success factors for supplier development.
Thakkar et al. (2008)	Analysis of buyer-supplier relationships
Kumar et al. (2008)	Flexibility in global supply chain: modelling the enablers.

The top management commitment is one of the important success factors for the excellent performance of the organization. The main directions of the organization regarding the operations of various activities are based on the policy of the top management consisting of the vision and mission of the organization. Service quality is one of the parameters of the performance of the organization. Masrurul (2019) related to five measurements of service quality in particular, Reliability, Responsiveness, Assurance, Empathy and Tangible. Responsiveness, Tangibles, Assurance, Empathy, and Reliability are picked as free factors while consumer loyalty and customer satisfaction are considered as the needy factors. However, in this study, responsiveness of the service provider towards the customer complaints regarding services are given more importance.

The customer satisfaction and customer loyalty are the important parameters to judge the service performance. However, considering financial success, customer loyalty and customer satisfaction are not always related closely (Williams & Nauman, 2011). There are various reasons and factors such product, market segment and price that can influence customer behaviour. Some of the important references for the various factors considered in the performance analysis in the paper are summarized in Table 2.

Table 2: Factors influencing the performance of service organization

S. No	Factors	Author	Remarks
1	Responsiveness	Masrurul (2019), Masarrat and Jha (2014), Jones et al. (2002)	Responsiveness of the service providers are related to the resolving the customer complaints regarding the services.
2	Customer retention	Williams and Nauman (2011), Kuo et al. (2009), Kotler and Keller (2016), Dordevic et al. (2016), Deng et al. (2010), Suhartanto (2011), Kim et al. (2015), Hossain and Suchy (2013), Kumar and Vandara (2011)	Customer retention is the mirror of the service performance and customer relationship management. It is indicator of the provision of better services at lower cost.
3	Lead time reduction	Twana and Atanas (2015), Wang and Gerchak (2000), Ray et al. (2012), Karki (2012), Ketokivi and Heikkila (2003), Zhengping et al. (2012), Kuhlang et al. (2011)	Lead time reduction is related to reducing the time for various activities and minimizing the cost of production of the product or services.
4	Quality improvement	Au and Choi (1999), Prajogo and Sohal (2001), Lemak and Reed (2000)	The quality of the services is an important part of the performance of the service organization. It must be improved continuously and focused on the customer.
5	Brand image/market reputation	Suartanto (2011), Kotler and Keller (2016), Keller and Lehmann (2006), Smit et al. (2007)	Brand image or market reputation depends on many factors. It relates the overall performance of the service providers including the cost.
6	Flexibility	Jonsson (2007), Goodwin (2002), Altuzarra and Serrano (2010), Tros and Wilthagen (2004), Wachsen and Blind (2011), Herzog et al. (2014)	Flexibility is the ability of the organization to change the system on the basis of the requirement/need of the customers.
7	Cost minimization	Vickery et al. (1993), Beamon and Balcik (2008), Meier et al. (2013)	Cost minimization is also an important part of the performance measurement. Cost-cutting involves the innovation, technology and effort of the management.

7	Employee satisfaction and Retention	Yamamoto (2011), Self and Dewald (2011)	Employee satisfaction also plays an important role in the organization dealing customer directly. It is indicator of better employer-employee relationship.
8	Employee empowerment	Bateman and Snell (2007), Fay and Luhrmann (2004)	Employee empowerment is the part of total quality management. It is an indicator of the total quality of the organization, including quality of services, processes, systems, and individuals/personnel.
9	Employee participation	Hellriegel et al. (1999), Karakas (2010), Pradhan and Jena (2017), Mone and London (2009)	Employee participation in the problem solving depends on the employee satisfaction and retention.
10	Job security	Murthy (1992), Rao and Pareek (1982), Roznowski and Hulin (1992), Backes et al. (2010)	Job security leads to the motivation of employees and develop a sense of belongingness to the organization.
11	Use of IT	Chen et al. (2012), Bauer et al. (2008)	Information technology is equally important for both services as well as manufacturing organization. It helps in e-commerce and reducing the lead time of information flow in the supply chains.
12	E-Commerce	Jankalová and Jankal (2018), U.S. Census Bureau News (2018), Hossain (2018), Bratt (2011)	E-commerce is based on the business activities performing electronically. It may include e-marketing, B2B, B2C etc.
13	Top management commitment	Zakuan et al., (2012), Arshida and Agil (2012), Omware (2012), Baidoun (2003)	Top management commitment relates the vision and the effort of the management to achieve the goal. It provides the leadership and direction to the middle and low-level management for future movement and operations.
14	Corporate social responsibility (CSR)	Johnson et al. (2008), Hopkins (2007), Dess et al. (2010), Elkington (1997), Carroll (1991), Hediger, (2010)	Corporate social responsibility is concerned with the social connectivity of the organization. How does the organization take

			care of the social welfare, such as management of food, education, and clean water etc. for the poor people? How the management thinks about the welfare and healthcare of its employee.
15	Transparency	Wayne et al. (2007), Rawlins (2009), Stirton and Lodge (2001), Cotterrell (2000), Tapscott and Ticoll (2003)	Transparency in customer dealing and ethics in business activities are important for survival of the organization.
16	Respect for rule of law	Zurn et al. (2012), Ginsburg (2011)	Many rules and regulations related to environment, ethics, social responsibility are in existence. The respect for the rule law affects the organizational performance.

2. Research Methodology and case Illustration

The major factors influencing the performance of service organizations have been taken from the literature review and the expert opinion from the industry as already discussed in the introduction. The relationship among the various factors are established with the help of the experts from the service industry and analyzed with ISM approach. Following steps are used in the development of ISM model:

(i) Identify the factors concerned with the problem through literature survey, interviews and discussions with the relevant person's factors are selected.
(ii) The contextual relationship is established between the variables.
(iii) Develop a Structural self-interaction matrix (SSIM) of components of the research area. This matrix demonstrates the pair-wise relationship among the components.
(iv) The matrix is checked for transitivity; otherwise, the reachability matrix is revised.
(v) The reachability matrix finally created from SSIM is partitioned into different levels.
(vi) Convert the reachability matrix into conical form.
(vii) The digraph can be drawn on the basis of the relationship given in reachability matrix and removing transitive links.

The ISM system recommends the utilization of the expert's decisions depends on different technical strategies, for example, conceptualizing, nominal group technique, and so on for developing the relationship among the factors. Considering the contextual relationship away every factor and presence of a connection between any two components (i and j). The underneath four characters are utilized in the analysis as shown in Table 3.

On the basis of the above analysis, a structural self-interaction matrix (SSIM) has been developed as shown in Fig. 1. In the next step, SSIM is changed into the initial reachability matrix by substituting the four characters (V, A, X, or O) of SSIM by 1s or 0s in the initial reachability matrix as shown in Table 4. The standards for this substitution are as per the following:

Table 3: The symbols used in the self –interaction matrix

V	Factors i leads to j but j does not lead to i
A	Factors j leads to i but i does not leads to j
X	Factors i and j will lead to each other
O	Factors i and j have no relationship

- If an entry (i, j) in the SSIM is indicated by V, then the (i, j) and (j, i) entries in the initial reachability matrix become 1 and 0 respectively.

- If an entry (i, j) in the SSIM is indicated by A, then the (i, j) and (j, i) entries in the initial reachability matrix become 0 and 1 respectively.

- If an entry (i, j) in the SSIM is indicated by X, then both the entries (i, j) and (j, i) in the initial reachability matrix become 1.

- If an entry (i, j) in the SSIM is indicated by O, then both the entries (i, j) and (j, i) in the initial reachability matrix become 0.

S. No.	Enablers	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	Performance of service organization	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
2	Customer retention	A	A	A	A	A	A	A	A	A	A	V	A	A	A	A	A		
3	Responsiveness of service providers	O	A	O	A	A	A	O	O	O	A	V	O	O	V	V			
4	Lead Time reduction	O	O	O	A	A	A	O	O	O	A	V	V	O	O				
5	Quality improvement	A	A	O	A	O	A	O	A	A	A	V	V	A					
6	Employee participation	O	O	O	A	O	O	A	A	X	O	O	O						
7	Cost minimization	O	O	O	A	A	A	O	O	O	A	V							
8	Brand image / market reputation	A	A	A	A	A	A	A	A	A	A								
9	Flexibility	O	O	O	A	A	A	O	O	O									
10	Employee satisfaction and Retention	A	A	A	A	O	O	A	A										
11	Employee empowerment	O	O	A	A	O	O	O											
12	Job security	O	O	A	A	O	O												
13	Use of IT	O	O	O	A	V													
14	E-Commerce	O	O	O	A														
15	Top management commitment	V	V	V															
16	Corporate social responsibility (CSR)	X	V																
17.	Transparency in customer dealing	A																	
18	Respect for rule of law																		

Fig. 1: Structural Self-Interaction Matrix (SSIM)

The transitivity concept is implemented in the reachability matrix to incorporate the indirect relationships, and the final reachability matrix is obtained as in shown in Table 5. The reachability set and antecedent sets, and intersection sets of factors are derived for each factor as shown in Table 6.

Table 4: Initial reachability matrix

S. No.	Enablers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1.	Performance of service organization	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.	Customer retention	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3.	Responsiveness of service providers	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
4.	Lead Time reduction	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
5.	Quality improvement	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
6.	Employees participation	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
7.	Cost minimization	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
8.	Brand image / market reputation	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
9.	Flexibility	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0
10.	Employee satisfaction and Retention	1	1	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0
11.	Employee empowerment	1	1	0	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0
12.	Job security	1	1	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0
13.	Use of IT	1	1	1	1	1	0	1	1	1	0	0	0	1	1	0	0	0	0
14.	E-Commerce	1	1	1	1	0	0	1	1	1	0	0	0	0	1	0	0	0	0
15.	Top management commitment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16.	Corporate social responsibility	1	1	0	0	0	0	0	1	0	1	1	1	0	0	0	1	1	1
17.	Transparency in customer dealing	1	1	1	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0
18.	Respect for rule of law	1	1	0	0	1	0	0	1	0	1	0	0	0	0	0	1	1	1

The common factors of the reachability and antecedent sets are known as intersection sets as which is shown in fourth column of Table 6. On the basis of commonality of the reachability set and intersection set, the final reachability matrix obtained is then iterated into various levels as shown in Table 7 (Final Iteration). The reachability set consists of the factors that are influenced including the factor influencing them. The antecedent set consists of the factor and the other factors that are influencing it. The top-level is achieved by the factors for which the reachability and the intersection sets are the same. With the identification of the top-level factor, it is removed from all the other sets in the first iteration and the next levels of the factors are found. Then, the same iteration is done again and again till leveling of all the factors. These levels are then arranged to get a digraph and the ISM model.

MICMAC analysis was developed by Michel Godet in 1975. The objective of the MICMAC analysis is to analyze the driver power and the dependence power of the variables. For MICMAC Analysis, conical matrix is produced by dividing the factors into four clusters: Autonomous, Dependent, Linkage and Independent (Driver) as shown in Fig. 2. The clustering is based on the driving power and dependence which is already calculated in the final reachability matrix. The summations of the columns and rows in the final reachability matrix are known as driving power and dependence respectively.

Table 5: Final reachability matrix

S. No.	Enablers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Driving Power
1.	Performance of service organization	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2.	Customer retention	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
3.	Responsiveness of service providers	1	1	1	1	1	0	1*	1	0	0	0	0	0	0	0	0	0	0	7
4.	Lead Time reduction	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	5
5.	Quality improvement	1	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	5
6.	Employees participation	1	1	0	0	1	1	1*	1*	0	1	0	0	0	0	0	0	0	0	7
7.	Cost minimization	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	4
8.	Brand image / Mmarket reputation	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
9.	Flexibility	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	8
10.	Employee satisfaction and Retention	1	1	0	0	1	1	1*	1	0	1	0	0	0	0	0	0	0	0	7
11.	Employee empowerment	1	1	0	0	1	1	1*	1	0	1	1	0	0	0	0	0	0	0	8
12.	Job security	1	1	0	0	1*	1	0	1	0	1	0	1	0	0	0	0	0	0	7
13.	Use of IT	1	1	1	1	1	0	1	1	1	0	0	0	1	1	0	0	0	0	10
14.	E-Commerce	1	1	1	1	1*	0	1	1	1	0	0	0	0	1	0	0	0	0	9
15.	Top management commitment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	18
16.	Corporate social responsibility	1	1	1*	0	1*	1*	0	1	0	1	1	1	0	0	0	1	1	1	12
17.	Transparency in customer dealing	1	1	1	1*	1	1*	0	1	0	1	0	0	0	0	0	0	1	0	9
18.	Respect for rule of law	1	1	1*	0	1	1*	1*	1	0	1	1*	1*	0	0	0	1	1	1	13
	Dependence	18	16	8	7	13	8	12	17	4	8	4	4	2	3	1	3	4	3	

This clustering shows the high driving power and high dependence of the factors. High driving power factors are of high strategic importance which influences the other factors. The high dependence factors show the high dependencies on the other factors and they are relatively of less strategic importance. The MICMAC analysis helps in sorting out the factors of different level of importance.

On the basis of the, levelling of factors through the iterations and using the final reachability matrix, hierarchy of the factors influencing the performance of service organizations has been produced as shown in Figure 3. It has been observed that the top management leadership and commitment plays an important role to lead the organization. It shows the motives of the management that where they want to see their organization within the planned period. Top management commitment means devotions towards the organizations and leads the people in the right direction for better performance and fulfilment of customers' requirements.

Table 6: Intersection of reachability and antecedent sets of factors

Enablers	Reachability Set	Antecedent Set	Intersection Set	Level
1	1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1	1
2	1,2,8	2,3,4,5,6,7,9,10,11,12,13,14,15,16,17,18	2	
3	1,2,3,4,5,7,8	3,9,13,14,15,16,17,18	3	
4	1,2,4,7,8	3,4,9,13,14,15,17	4	
5	1,2,5,7,8	3,5,6,9,10,11,12,13,14,15,16,17,18	5	
6	1,2,5,6,7,8,10	6,10,11,12,15,16,17,18	6,10	
7	1,2,7,8	3,4,5,6,7,9,10,11,13,14,15,18	7	
8	1,8	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	8	
9	1,2,3,4,5,7,8,9	9,13,14,15	9	
10	1,2,5,6,7,8,10	6,10,11,12,15,16,17,18	6,10	
11	1,2,5,6,7,8,10,11,	11,15,16,18	11	
12	1,2,5,6,8,10,12	12,15,16,18	12	
13	1,2,3,4,5,7,8,9,13,14	13,15	13	
14	1,2,3,4,5,7,8,9,14	13,14,15	14	
15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	15	15	
16	1,2,3,5,6,8,10,11,12,16,17,18	15,16,18	16,18	
17	1,2,3,4,5,6,8,10,17	15,16,17,18	17	
18	1,2,3,5,6,7,8,10,11,12,16,17,18	15,16,18	16,18	

Table 7**:** Final iterations and levelling of factors

| Iterations	Enablers	Reachability Set	Antecedent Set	Intersection Set	Level
I	1	1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1	I
III	2	1	2,3,4,5,6,7,9,10,11,12,13,14,15,16,17,18	2	III
VI	3	3	3,9,13,14,15,16,17,18	3	VI
V	4	4	3,4,9,13,14,15,17	4	V
V	5	5	3,5,6,9,10,11,12,13,14,15,16,17,18	5	V
VI	6	6,10	6,10,11,12,15,16,17,18	6,10	VI
IV	7	7	3,4,5,6,7,9,10,11,13,14,15,18	7	IV
II	8	8	2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	8	II
VII	9	9	9,13,14,15	9	VII
VI	10	6,10	6,10,11,12,15,16,17,18	6,10	VI
VII	11	11,	11,15,16,18	11	VII
VII	12	12	12,15,16,18	12	VII
IX	13	13	13,15	13	IX
VIII	14	14	13,14,15	14	VIII
X	15	15	15	15	X
VIII	16	16,18	15,16,18	16,18	VIII
VII	17	17	15,16,17,18	17	VII
VIII	18	16,18	15,16,18	16,18	VIII
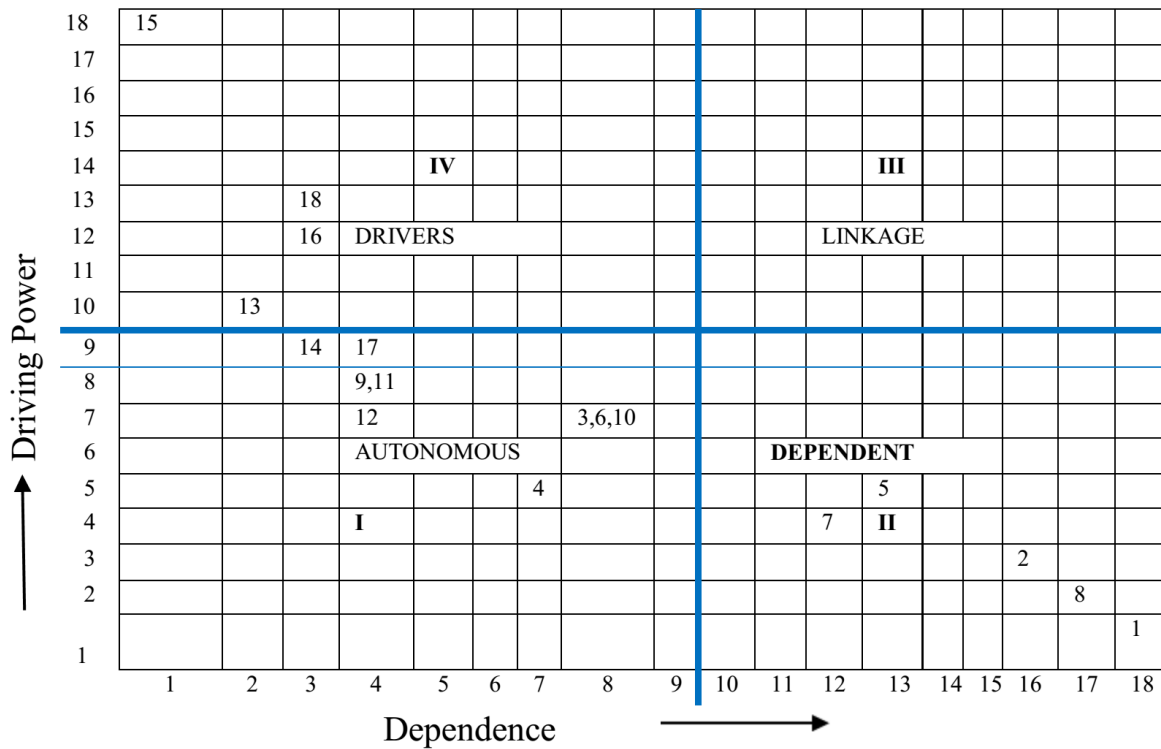
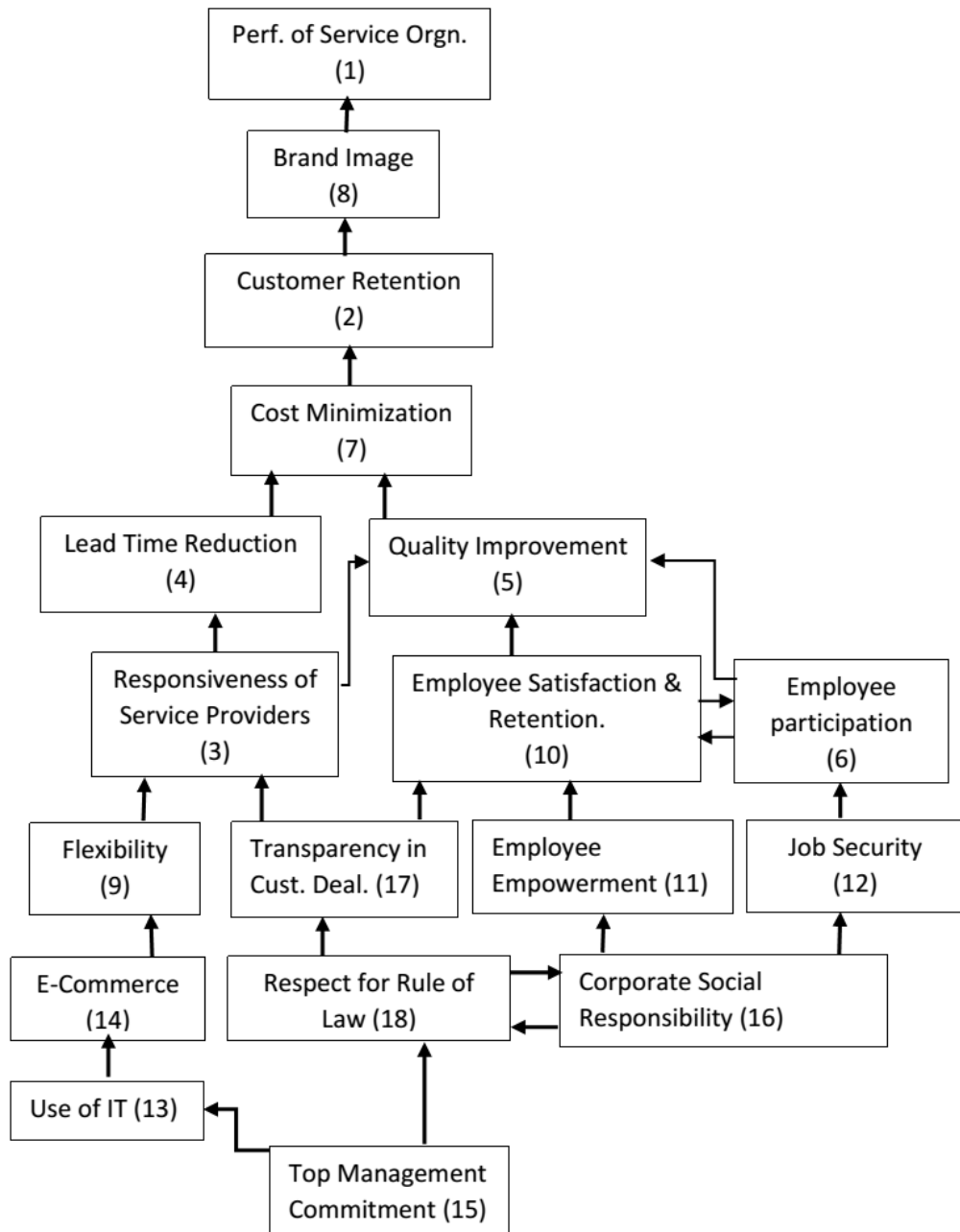
Fig. 2: Driving power and Dependence diagram

Fig. 3: Interpretive Structural Modelling (TISM) hierarchy of the factors for performance management of a service organization

3. Result and Discussion

These factors must have relationship to get the best performance results of the service organization according to their driving power and dependencies as shown in the Figure 3. Top Management Commitment (Factor-15), is the most important factor among all the factors for better performance of the service organization. It lies at the bottom of the ISM based hierarchy and in the fourth cluster of the dependence-driver diagram. This factor is found to be very important as Kumar et al. (2008), Zakuan et al., (2012), Arshida and Agil (2012), and Kumar et al. (2018) have also observed the same.

Use of information Technology (Factor-13) is the second most important factor and influences most of the factors. It lies at 9th level of the hierarchy and in the fourth cluster of the dependence- driver diagram. In ISM based hierarchy of the factors influencing the performance of the organization, Respect for rule of law (Factor-18), Cooperate social Responsibility (Factor-16) and E-commerce (Factor-14) lies at the 8th level of the hierarchy. The first two factors lie in the fourth cluster and the third factor lies in the first cluster of the driver-dependence diagram, predicting that these are causal factors. Initial two factors lead to sustainability and the last one leads to efficiency in operations.

At the 7th level, we have factors, flexibility (Factor-9), Transparency in customer dealing (Factor-17), Employee empowerment (Factor-11) and Job security (Factor-12). Employee empowerment and job security are related to human resource management; flexibility and transparency in customer dealing are related to the customer and demand management. These factors have a significant role in the performance of service organizations. "Employee Participation" (Factor-6), "Employee Satisfaction & Retention" (Factor-10) and "Responsiveness of service providers" (Factor-3) are at 6th level. These are the drivers lie in the first cluster of the dependence-driver diagram. They have very high driving power but weak dependence.

Lead-time reduction (Factor-4) and quality improvement (Factor-5) lies at the fifth level of the hierarchy and in the first and the second cluster of dependence-driver diagram respectively. Lead-time reduction has high driving power, however, the quality improvement has high dependence. Cost Minimization (Factor-7) lies at the 4th level of the hierarchy. It is one of the important dependent factors and lies in the second cluster of the dependence-driver diagram. Cost minimization depends on the many factors.

Customer Retention (Factor-2) lies at 3rd level of the hierarchy. Customer retention indicates the complete satisfaction of the customer with the services provided by the service organization. It depends on the quality of the services as well as the caring attention of the service providers towards the customer. Brand image (Factor-8) lies at the 2nd level of the hierarchy and in the dependent cluster of dependence-driver diagram. It depends on many factors, including the operations, customer satisfaction, employee retention, quality, market position etc. Performance of service organization" (Factor-1) is at the top level of the hierarchy and in the dependent cluster of the dependence-driver diagram. The factor lies at the top level means it is the most dependent factor and has negligible driving power.

4. Conclusion

The hierarchical model based on interpretive structural modelling has been used to analyze the interactions among different factors that affect the working of a service organization.

This will help the decision-makers to identify the interactions among the factors and the actions to be taken in addressing these factors for successful operations of various activities in the service organizations. The result indicates that Top Management Commitment has highest driving power. All the other factors are driven by the top management commitment and the internal linkage are also shown in the ISM hierarchy. The second most important factor is the use of IT. Nowadays, information technology is required at every step of the organizational activities to improve the efficiency and the effectiveness of the organization. Similarly, all other factors responsible for the performance of the service organization have been shown at the different level of the hierarchy as per their dependence and driving power. It may also be observed in the dependence-driver diagram.

Limitations and Scope of Future Work

In this paper, the authors have tried to accommodate some of the important factors in an ISM-based hierarchical model. There may be some more issues responsible for the better performance of the service organization which may not be considered in this study. The expert's suggestion and in-depth literature reviews are required for selection and analysis of the driving and the dependence power of enablers for excellent performance of service organizations. Again, the entire analysis is based on the experts' opinion. There may be minor variation in the opinion.

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Impact of Consumer Electronic Communication and Purchase Intention – A Framework of Consumer Socialization

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Abstract -

Consumer electronic communication has developed as an emerging marketing popularity. This article examines the role of identification with peers, tie strength as antecedents involving peer communication, involvement, product attitude, electronic word-of-mouth (E_WOM), trust aspects and value co- creation on Purchase Intention. A survey containing 508 respondents involved in E_WOM about products or service over social media. The survey confirms that product attitude, E_WOM, value co-creation (VCC) and trusting beliefs have influence positively on Purchase Intention. E_WOM impacts Purchase Intention indirectly and directly by reinforcing trust beliefs and VCC. These results have influential managerial and theoretical implications.

Keyword: Tie strength, peer group identification, peer communication, involvement, attitude, E_WOM, trust measures

1. Introduction

Social media network have realised as a medium for changes among customers (Hennig et al. 2004). Millions of people lives with business practices that are combined by Social Media (Okazaki et al.2009). Peer groups are predominantly connected through social media to a network of friends, enabling communication (Ahuja et al. 2003). Social media emergence provoked a change in decision making by consumers and in interactive communication (Hennig et al. 2011).

Product reviews thriven social media have a substantial impact on marketing (Hennig et al. 2004). Such media electronic communication modifies consumer information dispensation and enrich the quality of marketing messages (Kozinets et al. 2010). A new form of marketing strategies, in particular E_WOM over social networking has a impact on intention of purchase (Cateleyn et al. 2009). People involve social media for socialization (Lueg et al. 2006). The possibility for research on electronic communication incorporating peer communication and E_WOMs is limited though it is accredited as a key factor (Moschis et al. 1979).

2. Literature review

Affective, behavioral and Cognitive attitudes are exaggerated by consumer communication as projected by the socialization theory (Ward 1974). Consumptions related attitudes and skills in the marketplaces are accomplished by consumers. Socialization framework skeletons the knowledge processes and the eccentric of consumers in society (Churchill et al. 1979).

Social learning theory and cognitive model (Moschis et al. 1978) offers two perspectives on predicting consumer-to-consumer transmission information. Psychological and Cognitive aspects are the focus and the highlights the environmental sources of learning or socialization agents. Motivations, norms

and behaviors are communicated by socialization (Kohler et al. 2011). Socialization process among non-family associates has been enlightened by the socialization theory on consumer (Ahuja et al. 2003). Product placement attitudes is influenced by acquaintances and friends circle. Peer communication envisages the association of attitudes and placement behaviour on product.

Social media sites provide a virtual medium for communication by the Internet (Kohler et al. 2011). Socialization of consumers is fortified by conditions like messages through communication and skill through interaction with other members. Consumer practice social networking websites for consumption related decisions (Lueg et al. 2006). They provide massive information as well as evaluation quickly (Gershoff et al. 2006). Socialization of consumer impact the consumers and transform them into shoppers.

Social media networking has impact on trusting beliefs of consumers and influences (Dellarocas 2003) to buy. Reviews and rating behavior for firms can be portrayed by peer consumers through their consumer-supplier value relationship. These social media networking can be used by potential consumers for trusting the firm's product. Positive communications induces positive belief about the product and the service. Hence, the online consumer communications generates and develops trusting beliefs of consumers and triggers the intention to purchase (Kim et al. 2009).

Prior literature reviews report the E_WOM created in different forms like forum, e-mails (Xia et al. 2008), blog and virtual community etc.(Bailey, 2004) and their competence to buy. Prahalad et al. (2004) have developed value co-creation notion. The value of product or value of service is not formed by a manufacturer or by a supplier alone but also produced by the consumers through solicitation of their expertise (Vargo et al. 2008). The value co-creation is established by the emotional engagement (Payne et al. 2008) of customer with the brand. Prior studies have been conducted most in the area of online retailing, commercial websites, shopping etc., but a few studies have been found to be in the area of incorporation of consumer electronic communication socialization.

3. Research Methodology

Primary data was collected using a questionnaire survey done in Chennai, India. The sampling unit is an individual having social networking sites account. The questionnaire has section-A and section-B.

Demographic profile of the respondents like gender, age, occupation, education, monthly income, etc., were included in Section A. Section-B contains questions about the responses to variables or factors.

Construct and items of research were implemented from published articles, with some petty changes to the social media framework. Tie strength (TS) was adopted with four items by De Bruyn et al. (2008). Identification peer group (IPG) five items scale was modified from Hermann et al. (2005). Peer communication (PC) was measured using scale adaptations of (Moschis et al. 1978), involvement (PRI) was measured from (Zaichkowsky 1985), attitudes (PA) from (Crites et al.1994), and intentions to purchase (PI) from (Taylor et. al. 1975). Likert scales were used to response the items varying from strongly disagree (1) to strongly agree (7). Electronic word-of-mouth communication (E_WOM) was measured from Shu-Chuan Chu et al. (2011), disposition to trust (DTT), institution based trust (IBT) and trusting beliefs (TBS) items were adopted from Mcknight et al. (2002), value co creation (VCC) was revised from Leuthesser et al. (1995) and from Xia.Wang et al.(2012) respectively. Latent variables were measured by Likert scale representing "1" specifies "strongly disagree" and "7" specifies "strongly agree". The questionnaire was validated by a survey with 20 respondents.

PLS-SEM has been utilized to analyze the research data. The CFA is used for computing reliability and for instigating the measurement model in determining the factor loading of the latent variable. The following propositions are developed based on antecedents, process and outcome factors.

H1.   TS is positively related with IPG.

H2.   TS is positively related with PC.

H3.   IPG is positively related with PC.

H4.   PC is positively related with PRI.

H5.   PC is positively related with PA.

H6.   PRI is positively related with PA.

H7.   PA is related positively to PI.

H8.   PRI is positively related with E_WOM.

H9.   E_WOM is related positively to PI.

H10.   E_WOM is positively related to TBS.

H11.   E_WOM is positively related to VCC.

H12.   E_WOM is positively related to IBT.

H13.   DTT is related positively to IBT.

H14.   DTT is related positively to TBS.

H15.   IBT is related positively to TBS.

H16.   TBS is related positively to VCC.

H17.   VCC is positively related to PI.

H18.   TBS is positively related to PI.

4. Results and Findings

4.1 Descriptive Analysis

Demographic summaries of 508 survey respondents are shown in Table 1. 56.8% of respondents are users of the social networking site Facebook.17.1%,10.1% and 7.1% have used Google Plus, LinkedIn, Twitter and 8.9% used other social networking sites. There are 369(72.6%), 139(27.4%) males and females. Most of them, 305(60%) are in 17-26 category age and 120(31%) respondents show an annual of income of 2.4 lakhs. Among them, 335(65.9%), 130(25.6%) had a bachelor's degree and master's degree. 10(2%) completed high school and 33(6.5%) completed other categories including diploma education. 388(76.4%) of respondents are employed and 120(23.6%) are students. 15.6% of the participants consumed more than 3h per day on their chosen social networking site, and 10.1% consumed 2-3h per day, 60.2% consumed 1-2h per day, and 14.2% consumed less than an hour per day. The demographic specific related to the total Chennai population represents a higher level of young and educational respondents.

Tab.1 Demographic Profile

Items	Categories	Frequency	%	Cumulative (%)
Gender	Male	369	72.6	72.6
	Female	139	27.4	100
Age	17-26	305	60	60
	27-36	158	31.1	91.1
	37-46	33	6.5	97.6
	$\geq$47	12	2.4	100
Education	High School	10	2	2
	Bachelor	335	65.9	67.9
	Master	130	25.6	93.5
	Other	33	6.5	100
Occupation	Government	61	12	12
	Private	310	61	73
	Other	137	27	100
Annual Income	$\leq$ 1.20	30	8	8
(Lakhs)	1.21-2.40	120	31	39
	2.41-3.60	106	27	66
	3.61-4.80	36	9	75
	$\geq$4.81	96	25	100
Social Networking Sites	Facebook	383	56.8	56.8

(Multiple choice)	Google Plus	115	17.1	73.9
	LinkedIn	68	10.1	84
	Twitter	48	7.1	91.1
	Other	60	8.9	100
Frequency of use per day	<1hr	72	14.2	14.2
	1-2hr	306	60.2	74.4
	2.1-3hr	51	10.1	84.4
	>3hr	79	15.6	100

Tab.2 Age of social media users and its impact on purchase decision.

To analyze the relationship between age of social media users and its impact on purchase decision an ANOVA output is presented below.

Hypothesis:- Age of social media users has no significant impact on purchase decision.

	ANOVA				
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	118.626	35	3.389	1.28	0.135
Within Groups	1241.584	469	2.647		
Total	1360.21	504			

Tab.3 Education of social media users and its impact on purchase decision.

To analyze the relationship between education of social media users and impact on purchase intention an ANOVA output is presented below.

Hypothesis:- Education of social media users has no significant impact on purchase decision

	ANOVA				
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.999	3	1.666	0.616	0.605
Within Groups	1358.874	502	2.707		
Total	1363.874	505			

The hypothesis reported above reveals that there is no significant impact between the demographic profile and purchase intention of users.

4.2 Reliability Analysis and Item statistics

Inter reliability on variables is mostly measured using Cronbach's Alpha Test for reliability. Its value is more than 0.70 for an instrument to have satisfactory level of reliability (Glien et al. (2003). In this study of five research latent variables, Cronbach's Alpha coefficient value is bigger than 0.70 for all the variables under study. Validity and reliability of the research instrument can be evaluated through item reliability, convergent validity and discriminant validity (Chin et al. 1998). Convergent validity can also be evaluated through item loadings.

Tab. 4 Reliability Test

Constructs	Mean	Standard Deviation	AVE	Composite Reliability	R Square	Cronbachs Alpha
DTT	4.1	1.63	0.43	0.84	-	0.78
IPG	4.1	1.72	0.46	0.81	0.32	0.70
IBT	4.3	1.71	0.47	0.84	0.30	0.77
PC	4.3	1.78	0.53	0.85	0.23	0.78
PRA	4.8	1.94	0.64	0.84	0.35	0.71
PRI	4.6	1.98	0.56	0.87	0.14	0.80
PI	4.6	1.89	0.67	0.86	0.33	0.76
TS	3.9	1.70	0.52	0.81	-	0.70
TBS	4.1	1.65	0.57	0.87	0.37	0.81
VCC	4.0	1.64	0.60	0.86	0.35	0.78
E_WOM	4.2	1.84	0.52	0.86	0.14	0.81

Tab. 5 Confirmatory Factor Analysis results are shown below.

Items	1	2	3	4	5	6	7	8	9	10	11
Disp_T3	**0.70**	0.35	0.29	0.31	0.25	0.17	0.25	0.33	0.21	0.36	0.40
Disp_T4	**0.75**	0.34	0.27	0.27	0.20	0.14	0.19	0.35	0.17	0.42	0.35
Disp_T5	**0.75**	0.37	0.27	0.32	0.26	0.12	0.19	0.28	0.22	0.44	0.39
Disp_T6	**0.70**	0.36	0.28	0.26	0.26	0.16	0.16	0.28	0.22	0.39	0.33
E_WOM1	0.28	**0.67**	0.28	0.33	0.38	0.26	0.28	0.29	0.22	0.36	0.38
E_WOM2	0.32	**0.74**	0.32	0.30	0.36	0.21	0.22	0.27	0.25	0.39	0.38
E_WOM3	0.36	**0.73**	0.31	0.33	0.33	0.21	0.25	0.33	0.22	0.41	0.43
E_WOM4	0.40	**0.69**	0.35	0.28	0.36	0.20	0.23	0.28	0.26	0.43	0.37
E_WOM5	0.34	**0.69**	0.34	0.33	0.37	0.18	0.23	0.25	0.26	0.48	0.43
E_WOM6	0.38	**0.68**	0.35	0.29	0.34	0.14	0.19	0.27	0.27	0.38	0.42
E_WOM7	0.33	**0.67**	0.37	0.26	0.36	0.27	0.28	0.29	0.26	0.40	0.38
E_WOM8	0.32	**0.65**	0.35	0.33	0.26	0.25	0.26	0.31	0.20	0.42	0.36
E_WOM9	0.32	**0.66**	0.34	0.33	0.32	0.21	0.29	0.30	0.23	0.37	0.39
Iden1	0.28	0.36	**0.74**	0.22	0.31	0.09	0.19	0.20	0.40	0.33	0.28
Iden3	0.25	0.35	**0.73**	0.09	0.35	0.14	0.16	0.20	0.50	0.31	0.27
Iden4	0.28	0.33	**0.66**	0.19	0.30	0.17	0.14	0.24	0.37	0.26	0.31
Iden5	0.28	0.32	**0.70**	0.21	0.33	0.13	0.15	0.18	0.35	0.30	0.22
Ins_T2	0.25	0.37	0.26	**0.70**	0.28	0.23	0.28	0.29	0.21	0.39	0.29
Ins_T3	0.30	0.27	0.20	**0.70**	0.23	0.16	0.22	0.27	0.15	0.34	0.28
Ins_T4	0.34	0.30	0.12	**0.71**	0.17	0.21	0.23	0.33	0.16	0.39	0.28
Ins_T5	0.28	0.33	0.19	**0.74**	0.17	0.21	0.19	0.29	0.10	0.38	0.33
Ins_T6	0.27	0.34	0.20	**0.73**	0.19	0.25	0.27	0.34	0.16	0.33	0.30
Peer1	0.27	0.36	0.38	0.18	**0.67**	0.19	0.25	0.15	0.31	0.32	0.29
Peer2	0.23	0.31	0.36	0.28	**0.76**	0.27	0.30	0.23	0.29	0.28	0.28

Peer3	0.23	0.39	0.29	0.17	**0.75**	0.27	0.28	0.25	0.29	0.28	0.30
Peer4	0.22	0.35	0.32	0.16	**0.77**	0.24	0.27	0.21	0.22	0.25	0.31
Peer5	0.26	0.40	0.33	0.25	**0.70**	0.27	0.27	0.26	0.27	0.25	0.34
Pro_A1	0.18	0.30	0.18	0.24	0.34	**0.82**	0.48	0.37	0.19	0.23	0.24
Pro_A2	0.12	0.23	0.15	0.21	0.23	**0.80**	0.43	0.35	0.14	0.22	0.25
Pro_A3	0.18	0.21	0.13	0.26	0.23	**0.77**	0.47	0.37	0.13	0.27	0.24
Pro_I1	0.19	0.24	0.21	0.25	0.28	0.41	**0.68**	0.27	0.16	0.26	0.24
Pro_I2	0.18	0.23	0.16	0.25	0.29	0.44	**0.73**	0.24	0.17	0.24	0.27
Pro_I3	0.20	0.28	0.14	0.21	0.27	0.48	**0.78**	0.33	0.20	0.23	0.22
Pro_I4	0.23	0.29	0.20	0.27	0.28	0.46	**0.78**	0.33	0.21	0.27	0.26
Pro_I5	0.22	0.31	0.20	0.27	0.29	0.39	**0.78**	0.29	0.21	0.27	0.27
Pur_Int1	0.37	0.35	0.26	0.36	0.26	0.43	0.35	**0.85**	0.25	0.38	0.35
Pur_Int2	0.40	0.36	0.24	0.35	0.24	0.31	0.30	**0.78**	0.22	0.36	0.37
Pur_Int3	0.28	0.32	0.21	0.34	0.24	0.37	0.31	**0.83**	0.21	0.35	0.30
Tie1	0.23	0.18	0.34	0.15	0.19	0.06	0.10	0.16	**0.65**	0.22	0.23
Tie2	0.21	0.35	0.48	0.19	0.33	0.17	0.24	0.24	**0.76**	0.26	0.28
Tie3	0.19	0.22	0.37	0.11	0.26	0.13	0.16	0.19	**0.71**	0.23	0.24
Tie4	0.20	0.23	0.43	0.17	0.29	0.18	0.20	0.22	**0.76**	0.30	0.20
Tru_B10	0.38	0.37	0.26	0.35	0.21	0.20	0.23	0.28	0.23	**0.69**	0.41
Tru_B3	0.40	0.42	0.30	0.40	0.29	0.21	0.21	0.30	0.24	**0.71**	0.32
Tru_B4	0.43	0.49	0.33	0.40	0.28	0.24	0.31	0.38	0.28	**0.73**	0.42
Tru_B5	0.38	0.43	0.33	0.33	0.28	0.23	0.23	0.32	0.20	**0.71**	0.39
Tru_B6	0.36	0.42	0.31	0.36	0.30	0.19	0.20	0.33	0.27	**0.71**	0.42
Tru_B9	0.41	0.35	0.30	0.34	0.24	0.21	0.27	0.27	0.27	**0.70**	0.39
Val_C2	0.38	0.45	0.28	0.29	0.34	0.26	0.29	0.38	0.24	0.43	**0.81**
Val_C3	0.41	0.42	0.29	0.33	0.31	0.20	0.26	0.26	0.28	0.43	**0.76**
Val_C4	0.37	0.41	0.32	0.34	0.34	0.27	0.25	0.33	0.27	0.41	**0.78**
Val_C6	0.40	0.47	0.30	0.32	0.30	0.22	0.23	0.29	0.23	0.43	**0.74**

4.3 Results

SmartPLS 2.0 was employed to analyse the model. Structural paths and R^2 determines the validity of the research. The path coefficients (β) are significant at 0.05 levels.

Tab 6 Relationship among constructs

Hypotheses		Relationship among constructs		t value	β value
H1	TS	⟶	IPG	17.07	0.56

H2	TS	→	PC	03.14	0.18
H3	IPG	→	PC	05.97	0.35
H4	PC	→	PRI	09.36	0.38
H5	PC	→	PA	03.57	0.14
H6	PRI	→	PA	11.03	0.53
H7	PRA	→	PI	06.89	0.31
H8	PRI	→	E_WOM	08.50	0.36
H9	E_WOM	→	PI	02.13	0.12
H10	E_WOM	→	TBS	06.94	0.33
H11	E_WOM	→	VCC	07.10	0.38
H12	E_WOM	→	IBT	06.55	0.33
H13	DTT	→	IBT	04.78	0.24
H14	DTT	→	TBS	06.21	0.29
H15	IBT	→	TBS	04.37	0.25
H16	TBS	→	VCC	06.46	0.33
H17	VCC	→	PI	02.64	0.14
H18	TBS	→	PI	04.04	0.20

The coefficient value of this model shows tie strength has a positive relation on IPG (t-value=17.07, β=0.56) and peer communication (t-value=3.14, β=0.18). Identification with peer have positive relation on peer communication (t-value=5.97, β=0.35). Peer communication have positive relation on product involvement (t-value=9.36, β=0.38) and product attitude (t-value=3.57, β=0.14). Product involvement has positive relation on product attitude (t-value=11.03, β=0.53) and E_WOM (t-value=8.50, β=0.36). Product attitude has relation on purchase intention (t-value=6.89, β=0.31). E_WOM as having a positive effect on Purchase intention (t-value=2.13, β=0.12), Trusting beliefs (t-value=6.94, β=0.33), VCC (t-value=7.10, β=0.380) and IBT (t-value=6.55, β=0.33). DTT has positive relation on IBT (t-value=4.78, β=0.24) and trusting beliefs (t-value=6.21, β=0.29). IBT has positive relation on trusting beliefs (t-value=4.37, β=0.25). Trusting beliefs has positive relation of VCC (t-value=6.46, β=0.33) and purchase intention (t-value=4.04, β=0.20). Value co-creation has a positive relation on purchase intention (t-value=2.64, β=0.14). All the constructs have positive relation and confirms the hypotheses significantly.

Hence, all the eighteen hypotheses are accepted. The projected coefficient indicates a linear association between the predicted variable (purchase intention) and ten other predictor variables (tie strength, identification with peer group, peer communication, product involvement, product attitude, electronic word-of-mouth, institutional-based trust, disposition to trust, value co-creation and trusting beliefs).

4.4 Conclusion

The study reveals that social media users appear not to have diverse impact on demographic segments. Hence, demographic profiles may not be apt in segmenting users of consumer electronic

communication on purchase intention. However, psychographic factors explain 34% of the variance of the purchase decision, which can be considered as moderate. Therefore we conclude that our model has adequate predictive power for purchase decision. It is also inferred that electronic word-of-mouth has direct impact on purchase intention and indirect impact from different facets of trust and value co-creation. This research reinforces our understanding of social networking and its impact on purchase intention through E_WOM which echo the research study of TAM model. In particular, this study is the initial one on E_WOM influencing purchase intention through value co-creation with empirical justification. The study has practical inferences along with limitations.

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A Study on Mergers and Acquisition and Its Impact on Operating Efficiency with reference to Jindal Poly Films-ExxonMobil Chemical Merger

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Abstract-

Merger and Acquisition (M&A's) is treated as the tool for expanding the business operation at global level. It is generally applied in case restructuring the sick entity or loss making organisation Organizations embrace mergers and acquisitions dependent on vital business inspirations that are, in head, monetary in nature. This study attempts to evaluate the impact of pre and post financial performance of the selected case. Jindal Poly Films-ExxonMobil Chemical Merger will be consider as sample for the study .3 years pre & post-merger data will be analyze with the help of ratio analysis and t-test.

Keywords: Merger, Acquisition, chemical sector, operating performance, efficiency

1. Introduction

Indian packaging industry is a highly growing industry and growth rate of 22 to 25 % per year. It is one of the favourite business hubs in context of packaging items. At present India it is the 5th main sector in respect to Indian economy. The industry has made a significant growth with increasing growth rate for last few decades and provides various potential opportunities such as expansion of business process especially in case of export marketing. Processing cost and packaging of edible items can be less than 40% part of the Europe which collectively with resources available to Indian environment which is skilled in nature and make the avenue very lucrative for the purpose of investment decision. A high level of potential exists for practically all client fragments which are growing apparently prepared nourishments, hard and soda pops, foods grown from the ground items. The Indian bundling industry has made an imprint with its fares that contain levelled jars, printed sheets and parts, crown plug, haul tops, plastic film covers, create paper, paper board and bundling hardware, while the imports incorporate tinplate, covering and coating mixes and others. In India, the quickest developing bundling portions are overlays and adaptable bundling, particularly PET and woven sacks.

Company Profile

Jindal Poly Films Limited is a holding organization. The Company is a maker of polyester and biaxially situated polypropylene (BOPP) films (plain, metalized and covered), which are for the most part utilized in the adaptable bundling industry. Its portions incorporate Plastic Films, Photographic Products and Nonwoven Fabrics. It offers adaptable bundling film, metallised films, covered films, polyester chips, photograph realistic shading paper and restorative X-beam, among others.. BOPP films are reasonable for nourishment items, for example, nibble nourishments, rolls, pasta, dried food sources and woven polypropylene sacks. BOPP film is likewise utilized in over wrapping of cigarettes, scent kid's shows, readymade suitcases, glue tapes and print cover.

Exxon Mobil Corporation: A Brief Introduction

Exxon Mobil Corporation, cooperating as ExxonMobil, is an American worldwide oil and gas organization headquartered in Irving, Texas. It is the greatest direct relative of John D. Rockefeller's Standard Oil, and was surrounded on November 30, 1999 by the merger of Exxon (in the past the Standard Oil Company of New Jersey) and Mobil (in the past the Standard Oil Company of New York). The association was situated ninth comprehensive in the Forbes Global 2000 summary in 2016. ExxonMobil was the tenth most profitable association in the Fortune 500 of each 2017. Beginning at 2018, the association situated second in the Fortune 500 rankings of the greatest United States organizations by hard and fast pay. Generally, 55.56% of the association's offers are held by establishments.

2. **Brief Review of**
   Literature

Dr. Yaduveer Yadav (2019) the investigation needs to make sense of the impact of the securing on the offer capitalisation estimation of the Acquirer Company and anomalous return because of the procurement. The investigation demonstrated that Indian securities exchange demonstrates that the market is productive in its semi-solid structure as both the verifiable and publically accessible data are scattered in the stock costs and bank's speculator can procure stomach muscle typical/overabundance return.

Stephen L. Weiss,(2019) in this investigation acquaints a safeguard arrangement with the transference of investor incentive to clashed parties by giving supreme straightforwardness into activities embraced by a Board of Directors consequently adequately expanding commitment by reserve administrators with their portfolio organizations.

Mohammad Fuad and Ajai S. Gaur(2019) this paper was directed to consider the effect of arrangement declaration and section timing inside a cross-outskirt procurement (CBA) wave on the probability of securing completion.Our results, saw through the frictional focal point, are predictable with earlier writing on arrangement deserting.

Anastasia Step nova, Vladislav Savelyev, and Malika Shaikhutdinova (2018) this examination was led to analyzed the nearness of the reference value impact in mergers and acquisitions in Russia, The discoveries affirm the nearness of the securing predisposition in assessing the impact of a merger or procurement declaration by Russian financial specialists

N.M. Leepsa and B. P. Bijay Shankar (2018) this examination is to discover different determinants of the installment techniques for M&AS that influences the choice of installment strategies in M&As. The investigation uncovers that positive just as negative outcomes in connection to organization execution identifying with money, stock and blended installment technique.

Robert Anderson and Jeffrey Manns (2017), This Study features the advancement of merger and securing understandings after some time and to give proof of drafting Inefficiency. Study uncovers that M&A understandings, rather than uniting on standard literary structures, quickly float away from their progenitors and from each other, possibly undermining the advantages of institutionalization in market terms.

Sachin Sharma and Dr. Priyanka Verma (2017) This examination was to research the possible results and perils for different key players, for instance, client, Telecom Service Providers (TSP) and Regulatory body approved by government.study gather that there is the probability of gigantic number of M&A in Indian Telecom Market and if it happens only 3 or 4 Telecom Company will persevere.

Research Methodology Adopted

Aim of Research Paper: To know the impact of Merger and acquisition on financial performance of selected companies.

HYPOTHESIS

H0: There is no significant difference between Net Profit Margin of Jindal Poly Films ExxonMobil Chemical in pre and post-merger time.

H0: There is no significant difference between Return on capital employed of Jindal Poly Films-ExxonMobil Chemical in pre and post-merger time.

Sample size

A merger case of Jindal Poly Films-ExxonMobil Chemical has been taken as sample

Type of data

The study has been based on secondary data which is collected from annual reports and journals, websites of selected companies and other research articles.

Tool for analyzing data

(a).Ratio analysis

(b).t-test

Duration of study

For the purpose of analysis of data, three years data has been taken into consideration.

For Pre-merger – 2009-2010, 2010-2011, 2011-2012

For Post-merger- 2015-2016, 2016-2017 & 2017-2018

Analysis and Interpretation

Ratios	Pre Merger period								Post Merger period							
	Jindal poly films				Exxon Mobil chemical				Jindal Poly Films				Exxon Mobil chemical			
	Mar-10	Mar-11	Mar-12	Avg.	Mar-10	Mar-11	Mar-12	Avg.	Mar-16	Mar-17	Mar-18	Avg.	Mar-16	Mar-17	Mar-18	Avg.
Profitability Ratios (in %)																
Net profit margin	5.58	4.72	7.23	5.84	2.32	2.11	2.34	2.26	7.78	3.65	4.90	5.44	3.27	4.32	2.78	3.46
Operating profit ratio	12.44	9.76	15.14	12.84	7.76	6.28	8.98	7.67	14.13	8.71	10.26	11.33	6.88	7.12	8.67	7.56
Return on net worth	12.45	6.76	7.58	8.93	12.51	9.88	10.89	11.09	11.41	5.26	8.01	8.23	6.34	15.52	19.78	13.88
Return on capital employed	12.58	7.56	9.56	9.90	12.97	8.96	12.29	11.41	13.95	6.98	10.29	10.41	18.60	16.42	11.00	15.34
Efficiency Ratios(in times)																
Stock turnover ratio	7.28	4.56	8.02	6.62	8.34	11.45	8.86	9.55	10.57	8.86	7.20	8.87	9.03	9.55	10.17	9.58
Debtor turnover ratio	17.88	14.54	21.66	18.02	12.50	11.34	15.48	13.10	20.62	23.48	24.48	22.86	13.64	11.14	14.23	13.00
Total assets turnover ratio	1.76	.86	1.26	1.29	.78	1.26	1.76	1.27	1.07	.98	1.14	1.06	.86	1.23	1.78	1.29
Liquidity Ratios																
Current ratio	.97	.77	.87	.87	.46	.73	.98	.72	.83	.71	.68	.74	.88	.82	.85	.85
Quick ratio	.67	.82	.91	.80	.89	.54	.91	.78	.96	.68	.70	.78	.54	.90	.74	.73
Market Test Ratio																
Earnings per share	36.00	32.00	7.41	25.14	6.25	8.44	9.71	8.13	47.00	21.64	3.32	23.99	1.88	4.64	4.89	3.81

Profitability ratios in Pre Merger

Axis Title

	Mar-16	Mar-17	Mar-18	Avg.	Mar-16	Mar-17	Mar-18	Avg.
	— Jindal Poly Films				Exxon Mobil chemical			
	Post Merger period							
■ Net profit margin	7.78	3.65	4.9	5.44	3.27	4.32	2.78	3.46
■ Operating profit ratio	14.13	8.71	10.26	11.33	6.88	7.12	8.67	7.56
■ Return on net worth	11.41	5.26	8.01	8.23	6.34	15.52	19.78	13.88
■ Return on capital employed	13.95	6.98	10.29	10.41	18.6	16.42	11	15.34

Profitability ratios in Post Merger

Axis Title

	Mar-17	Mar-18	Avg.	Mar-16	Mar-17	Mar-18	Avg.	
				Exxon Mobil chemical				
■ Net profit margin	3.65	4.9	5.44	3.27	4.32	2.78	3.46	
■ Operating profit ratio	8.71	10.26	11.33	6.88	7.12	8.67	7.56	
■ Return on net worth	5.26	8.01	8.23	6.34	15.52	19.78	13.88	
■ Return on capital employed	6.98	10.29	10.41	18.6	16.42	11	15.34	

1.   Net profit ratio which is 2.08 % for Jindal Poly Films in pre-merger where as it is (-21.32 %) in case of ExxonMobil Chemical. Post-merger net profit ratio of Jindal poly films is 5.44% and 3.46 % in case of ExxonMobil Chemical which clearly indicates less rise in level of earnings because paid high integration cost in the merger period.

2.   Operating profit ratio is 12.84 % for Jindal poly films pre-merger where as it is 7.67% in case of ExxonMobil Chemical. Post-merger ratio Jindal poly films is 11.33% and 7.56 % in case of ExxonMobil Chemical which depicts that company has paid some expenses which might be incurred during the merger period.

3.   Return on net worth is 8.93 % for Jindal poly films pre-merger where as it is 11.09 % in case of ExxonMobil Chemical. Post-merger ratio is Jindal poly films is 8.23 % and 13.88 % in case of ExxonMobil Chemical which states that when there is rise in the risk of bankruptcy, then the chances to pay back the debt is next to impossible.

4.   Return on capital employed is 9.90 % for Jindal poly films pre-merger where as it is 11.41% in case of ExxonMobil Chemical. Post-merger ratio is Jindal poly films is 10.41% and 15.34 % in case of ExxonMobil Chemical which shows how viably resources are performing while at the same time thinking about long haul financing.

Efficiency Ratio in Post Merger Period

■ Stock turnover ratio ■ Debtor turnover ratio ■ Total assets turnover ratio

Jindal Poly Films: Mar-16 (10.57, 20.62, 1.07), Mar-17 (8.86, 23.48, 0.98), Mar-18 (7.2, 24.48, 1.14), Avg. (8.87, 22.86, 1.06)

Exxon Mobil chemical: Mar-16 (9.03, 13.64, 0.86), Mar-17 (9.55, 11.14, 1.23), Mar-18 (10.17, 14.23, 1.78), Avg. (9.58, 13, 1.29)

Post Merger period
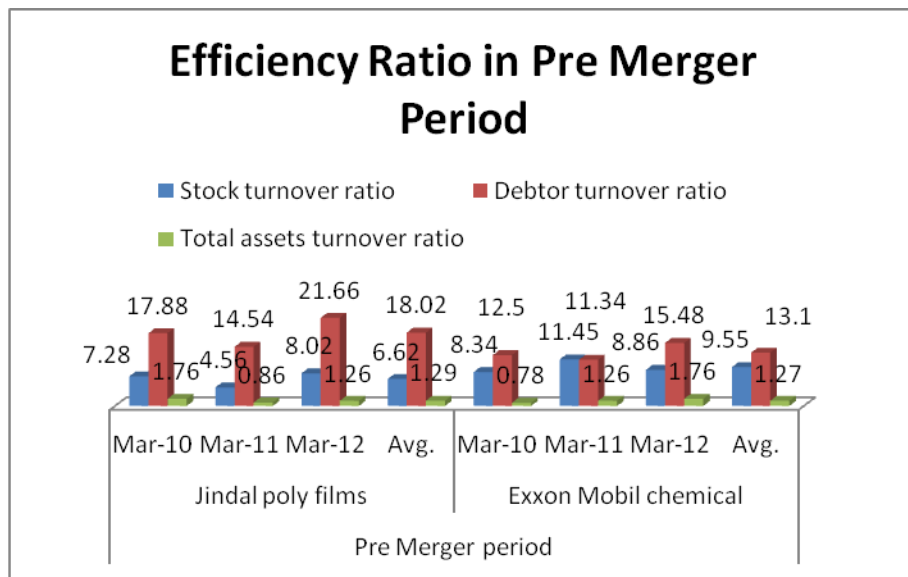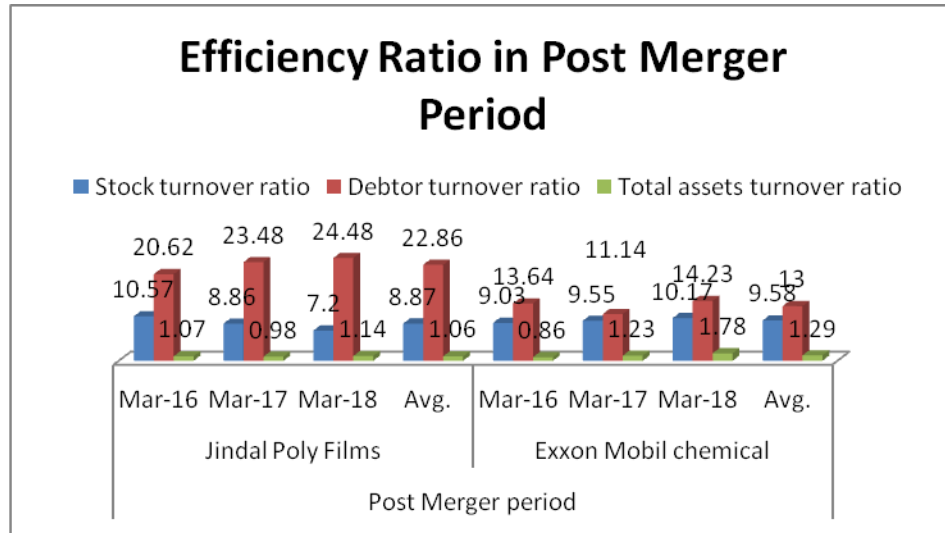
5. Inventory turnover ratio is 6.62 times for Jindal Poly Films pre-merger where as it is 9.55 times, In case of ExxonMobil Chemical. Post-merger ratio of Jindal poly films is 8.87 times and 9.58 times in case of ExxonMobil Chemical which shows how effectively inventory is managed by comparing cost of goods sold with average inventory for a period.

6. Debtor turnover ratio is 18.02 times for Jindal poly films pre-merger where as it is13.10 times in case of ExxonMobil Chemical. Post-merger ratio of Jindal poly films is 22.86 times and 13 times in case of ExxonMobil Chemical which clearly indicates that number of times on the average receivable is turnover in each year. High ratio shows efficient management of debtors or vice versa.

7. Total Assets turnover is 1.29 times for Jindal Poly films pre-merger where as it is 1.27 times in case of ExxonMobil Chemical. Post-merger ratio of Jindal poly films is 1.06 times and 1.29 times in case of ExxonMobil Chemical, a higher ratio is indicative of greater efficiency in managing fixed-asset investments; there is not an exact number or range that indicates whether a company has been efficient at generating revenue from such investments

Liquidity Ratios in Pre Merger Period

Current ratio ■ **Quick ratio** ■

Jindal poly films: Mar-10 (0.97, 0.67), Mar-11 (0.77, 0.82), Mar-12 (0.87, 0.91), Avg. (0.87, 0.8)

Exxon Mobil chemical: Mar-10 (0.46, 0.89), Mar-11 (0.73, 0.54), Mar-12 (0.98, 0.91), Avg. (0.72, 0.78)

Pre Merger period

Liquidity Ratios in Post Merger Period

Current ratio ■ **Quick ratio** ■

Jindal Poly Films: Mar-16 (0.83, 0.96), Mar-17 (0.71, 0.68), Mar-18 (0.68, 0.7), Avg. (0.74, 0.78)

Exxon Mobil chemical: Mar-16 (0.88, 0.54), Mar-17 (0.82, 0.9), Mar-18 (0.85, 0.74), Avg. (0.85, 0.73)

Post Merger period

8. Current ratio is .87:1 for Jindal Poly Films pre-merger where as it is 2.06:1 times in case of ExxonMobil Chemical. A post-merger ratio Jindal poly film is 10.41% and 15.34 % in case of ExxonMobil Chemical. it depicts that high current ratio may not generally have the option to pay its present liabilities as they become due if an enormous bit of its present resources comprises of moderate moving or outdated inventories or the other way around.

9. Quick ratio is .80:1 for Jindal poly film pre-merger where as it is .78:1 times in case of ExxonMobil Chemical. Post-merger ratio Jindal poly film is .78:1 and .73:1 in case of ExxonMobil Chemical which demonstrates that the organization is putting an excessive number of assets in the working capital of the business which may all the more gainfully be utilized

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somewhere else.
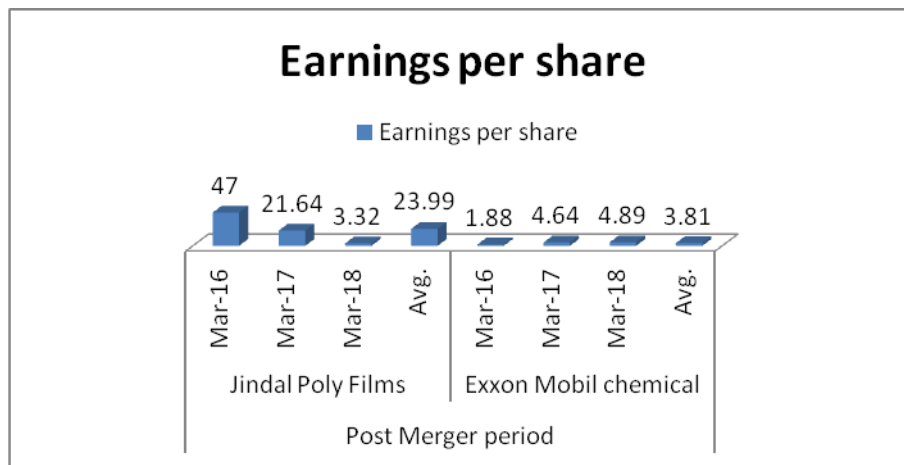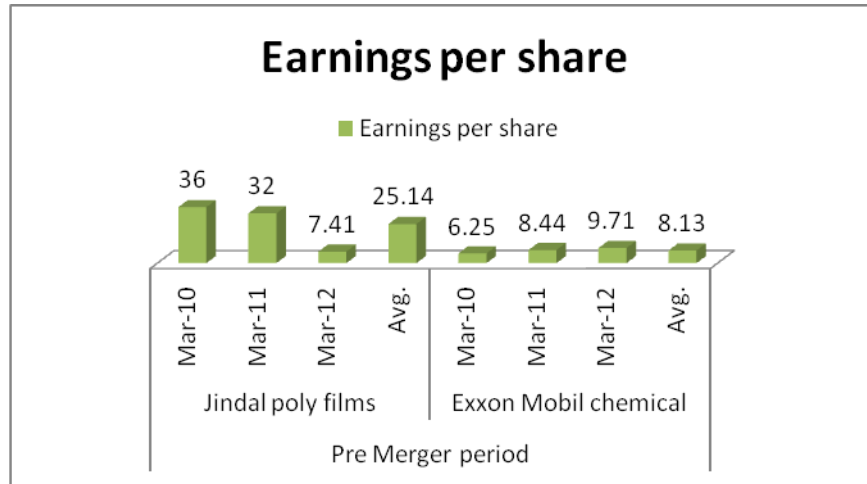
10. Earnings per share is a noteworthy marker of the present capacity of an organization to deliver an incentive for its investors; it is ascending after merger which unmistakably shows that organization can produce more an incentive to its definitive investor.

	N	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
NPRPRE	3	4.72	7.23	5.8433	.73644	1.27555	1.627	.889	1.225
NPRPOST	3	3.65	7.78	5.4433	1.22279	2.11793	4.486	1.078	1.225
PreNPR	3	2.11	2.34	2.2567	.07356	.12741	.016	-1.684	1.225
POSTNPR	3	2.78	4.32	3.4567	.45425	.78679	.619	1.008	1.225
PREROCE	3	7.56	12.58	9.9000	1.45909	2.52721	6.387	.594	1.225
POSTROCE	3	6.98	13.95	10.3767	2.01400	3.48836	12.169	.227	1.225
ROCEPRE	3	8.96	12.97	11.4067	1.23898	2.14598	4.605	-1.538	1.225
ROCEPOST	3	11.00	18.60	15.3400	2.25941	3.91341	15.315	-1.147	1.225

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Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	NPRPRE	5.8433	3	1.27555	.73644
	NPRPOST	5.4433	3	2.11793	1.22279
Pair 2	PreNPR	2.2567	3	.12741	.07356
	POSTNPR	3.4567	3	.78679	.45425
Pair 3	PREROCE	9.9000	3	2.52721	1.45909
	POSTROCE	10.3767	3	3.48836	2.01400
Pair 4	ROCEPRE	11.4067	3	2.14598	1.23898
	ROCEPOST	15.3400	3	3.91341	2.25941

Descriptive statistics

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	NPRPRE & NPRPOST	3	.120	.924
Pair 2	PreNPR & POSTNPR	3	-.972	.152
Pair 3	PREROCE & POSTROCE	3	.997	.046
Pair 4	ROCEPRE & ROCEPOST	3	-.082	.948

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	NPRPRE - NPRPOST	.40000	2.33814	1.34993	-5.40826	6.20826	.296	2	.795
Pair 2	PreNPR - POSTNPR	-1.20000	.91110	.52602	-3.46329	1.06329	-2.281	2	.150
Pair 3	PREROCE - POSTROCE	-.47667	.98521	.56881	-2.92406	1.97072	-.838	2	.490
Pair 4	ROCEPRE - ROCEPOST	-3.93333	4.61515	2.66456	-15.39801	7.53134	-1.476	2	.278

Interpretation

From the above paired t- test table, the researcher explored that net Profit has no significantly changed after merger and acquisition, p-value comes to .795(Pair1),.150(Pair 2) .490(pair 3) .278(Pair4), which is more than 0.5 , this depicts that H_o is comes under acceptance region . Analysis depicts that there is no modification in net profit and Return on capital employed which arises between pre and post-merger time.

Findings

1. Net profit ratio which is clearly indicates less rise in level of earnings because paid high integration cost in the merger period.

2. Operating profit ratio is described that company has paid off some expenses which may be arise at the time of merger.

3. Return on net worth expresses that when there is ascend in the danger of liquidation, at that point the odds to pay back the obligation is by unimaginable.

4. Return on capital is demonstrates how adequately resources are performing while at the same time thinking about long haul financing.

5. Stock turnover proportion which shows how successfully stock is overseen by contrasting expense of products sold and normal stock for a period..

6. Debtor activity ratio which plainly demonstrates that number of times on the normal receivable is turnover in every year. High proportion demonstrates effective administration of indebted individuals or the other way around.

7. Total Assets turnover a high ratio signifies that the additional major ability in control fixed-resource ventures; there is not such an precise standard or range that shows whether an organization has been productive at creating income from such speculations.

8. Current ratio is portrays that high present proportion may not generally have the option to pay its present liabilities as they become due if an enormous segment of its present resources comprises of moderate moving or old inventories or the other way around.

9. Quick ratio is which exhibits that the association is placing an inordinate number of benefits in the working capital of the business which may even more productively be used elsewhere.

10. Earnings per share is an immense marker of the present limit of an association to convey a motivating force for its speculators; it is climbing after merger which clearly exhibits that association can make progressively a motivator to its authoritative financial specialist.

Suggestions

1). Company should try to reduce the expense because it ultimately affect the level of earning and profit of the company.

2).Company efforts to manage its assets in effective manner so desire return on assets can be achieved easily after merged period.

3). Organization is putting such a large number of assets in the working capital of the business which may all the more beneficially be utilized somewhere else.

Conclusion

Merger and Acquisition (M&As) is treated as the method for expanding the business operation at global level. It is generally applied in case restructuring the sick entity or loss making organisation. The Indian bundling industry has made an imprint with its fares that contain leveled jars, printed sheets and parts, crown plug, haul tops, plastic film covers, create paper, paper board and bundling hardware, while the imports incorporate tinplate, covering and coating mixes and others. This study shows that there is no modification in net profit and Return on capital employed which arises between pre and post-merger time.

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Acquisition of techno-pedagogic competencies among pre-service teachers: An exploratory study

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Abstract-

Koehler & Mishra's (2008) TPACK framework explains seven kinds of knowledge which is required by the teachers for integrating technology in their teaching. The functional knowledge of TPACK is regarded as the techno-pedagogic competencies. The study presented in this research paper focus on creating and testing a learning design which could develop TPACK among pre-service teachers. The study is based on the design based research (DBR) paradigm. The design is created taking insights from various learning and instructional theories. The design was implemented on 36 B.Ed. first year pre-service teachers who have 'Critical Understanding of ICT in Education' course as the part of their program at CIE. The findings of the study revealed that the learning design has strongly effected (Eta squared = 1.089) the development of the techno-pedagogic competencies among the pre-service teachers. The mean score for post-test of pre-service teachers on the techno-pedagogic competencies (M=186, SD= 23.414) differ significantly (t=13.738, df=35, two-tailed p= 0.000) from that of the pre-test(M=122, SD=20.859).

1. Introduction

Technological advancement in 21st century had brought the paradigm shift in the nature of the society. The society has evolved from an industrial niche to a digitally connected knowledge hub. The mere knowledge of 3R (Reading, wRiting and aRithmetic) is not sufficient to cope up with the technologically advanced knowledge society. Advent of information and communication technologies (ICTs) in every sphere of life has compelled the mankind to enable them to use technologies. Therefore, all over the globe understanding of ICTs had become an integral part for most of the higher education programmes. Bachelor's in Education (B.Ed) is a two year teacher training programme having one such practicum course on ICTs. The course aimed at developing techno-pedagogic competencies among teachers. Techno-pedagogic competencies are referred to as the summation of all the skills and knowledge required by the teachers to successfully integrate the technology in teaching process. Integrating technology in the initial teaching-learning phase of the teacher's life is the best way to prepare them for the future requirements of ICT enabled teaching. Though the B.Ed programmes has added ICT in their curricula, there is no clear guidelines or teaching strategies for teacher educator that could help them in transacting the curricula. Therefore the study is aimed at conceptualizing a learning design for the development of techno-pedagogic competencies among pre-service teachers. A learning design is referred to the creation and sequencing of pedagogically informed learning tasks supported with appropriate tools and resources that would enable the learner to construct knowledge (Kooper, 2007; Edutech, 2009; Dalzeil et al., 2016).

The objectives of the study are-

1. To construct a learning design for development of techno-pedagogic competencies
2. To evaluate the effectiveness of the constructed learning design

1.1 Techno-pedagogic Competencies

Almerich, Orellana, Suarez-Radriguez, & Diaz-Gracia (2016) suggested ICT competency model, that broadly categories the competencies for integrating the technology for teaching into two; technological competency and pedagogical competency. Technological competencies refer to the knowledge and skills through which teachers can learn various technological resources needed for their teaching. Pedagogical competencies refer to the summation of knowledge and skills that enable teachers to employ technological resources for teaching. Koehler & Mishra's (2009) TPACK framework suggested seven types of knowledge that a teacher should possess for teaching with technology. The core knowledge domain of TPACK framework are; content (what to be taught), pedagogy (how to be taught) and technology (knowledge to use various technologies). The intersection of these three core knowledge give rise to another four knowledge domain; pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and synthesis of these three knowledge domain leads to technological pedagogical content knowledge (TPCK). A teacher needs practical understanding of the technological pedagogical content knowledge for teaching with technology (Koehler et al., 2014). The conceptualized learning design will aim at developing the functional technological pedagogical content knowledge (TPCK) in pre-service teachers.

2. Research Methods

The study adopted design based research paradigm (Design based research collective, 2003). Plomp (2010) mentions that design based research is an approach to design, develop and evaluate the educational interventions to address the complex problems of the educational practice for which no clear guidelines are available. As no prior guidelines for development of techno-pedagogic competencies were mentioned in the teacher training curriculum (NCFTE, 2009) therefore the study adopted Design based research methodology. There are three phases in the design based research in the context of education; preparation of the design, teaching experiment (where the design is implemented) and analysis (to evaluate the effectiveness of the design. The teaching experiment adopted pretest-posttest one group experimental design.

2.1 Research Hypothesis

The study aimed to prove that the learning design enhances the acquisition of techno-pedagogic competencies among pre-service teachers. The null hypotheses along with their alternate hypotheses are stated as

H_01: There is no statistically significant difference in the mean of pre-test and post-test TPACK scores of pre-service teachers.

$H1$: There is statistically significant difference in the mean of pre-test and post-test TPACK scores of pre-service teachers.

H_02: The learning design has no significant effect on the TPACK score of pre-service teachers.

$H2$: The learning design has significant effect on the TPACK score of pre-service teachers.

2.2 Participants and Setting

Participants for the study are thirty six pre-service teachers which are enrolled in first year of B.Ed programme. The learning design is partly executed in the computer lab of Department of Education (face to face mode) and partly through the learning management systems (online mode).

2.3 Tool and data collection

A five point rating scale is constructed to measure the techno-pedagogic competencies of pre-service teachers. The scale contains forty six items measuring all seven domains of knowledge as mentioned in TPACK framework (Kohler & Mishra, 2008). The overall value of the reliability coefficient is 0.991 for all items (N=46) which denotes higher internal consistency. Criterion validity of the scale is assured by comparing it another validated scale measuring TPCK.

The scale is administered on the participants thrice; before the teaching experiment (1TPACK), after the completion of module 1 (2TPACK) and at the end of the teaching experiment (3TPACK).

2.4 Data analysis

The data is analyzed quantitatively with the help of SPSS statistics software, version 20. Paired sample t-test and repeated measure ANOVA are used to test $H_0 1$ and $H_0 2$ respectively.

3. Learning Design for developing techno-pedagogic competencies

The Larnaca Declaration of the learning design-2013 (Dalziel et al., 2016) proposed a conceptual map which guides the development of Learning Design. The Learning Design-Conceptual Map proposes seven basic elements of any Learning Design, which interacts to produce a pedagogical scenario. The seven elements of the Learning Design-Conceptual Map are; challenge, Educational Philosophy, Theories and Methodologies, Learning Environment, Teaching Cycle, Level of Granularity, Learning Design, Implementation and Learner Response.

Conceptual map of the constructed Learning Design for developing techno-pedagogic competencies among the pre-service teachers is illustrated in figure 1.
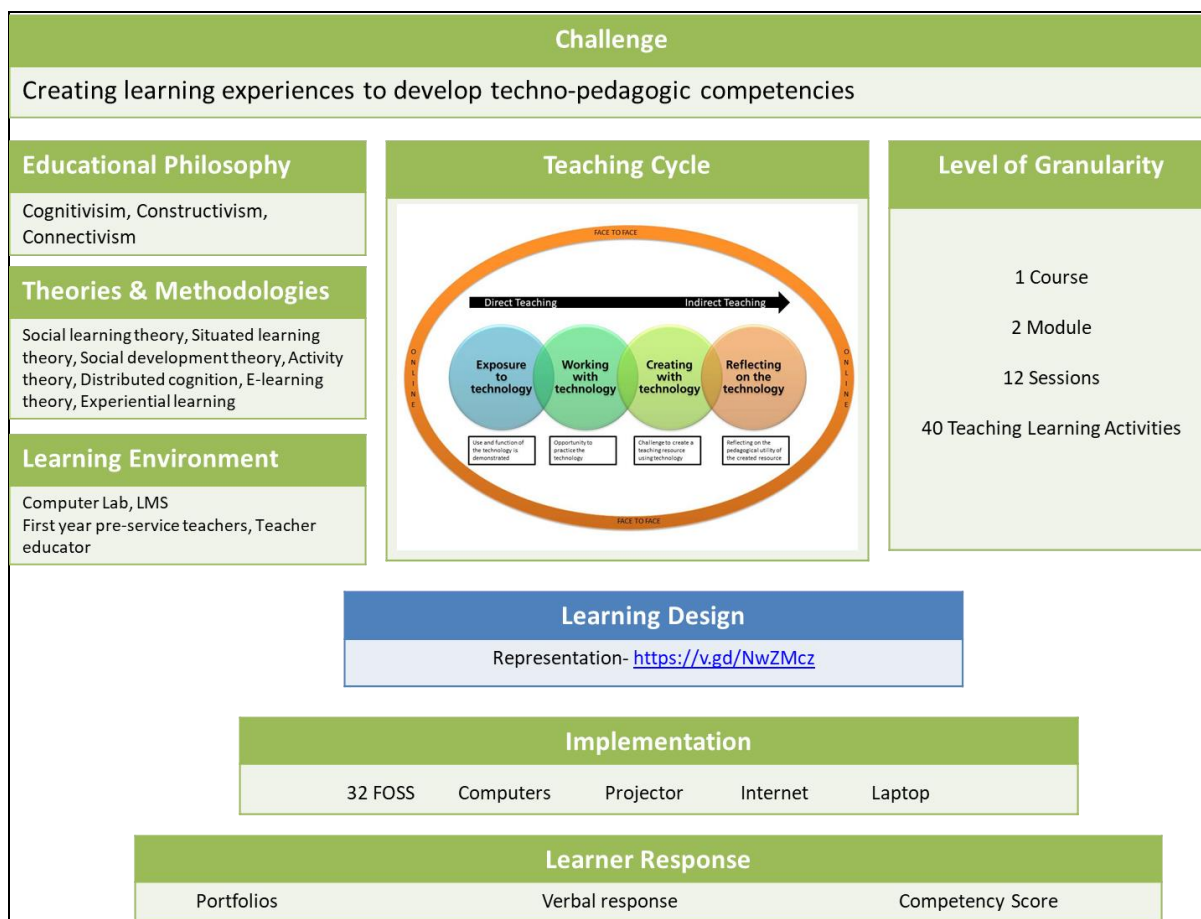
Fig 1: Conceptual Map of Learning Design for developing techno-pedagogic competencies

Challenge of the conceptualized Learning Design is to cultivate techno-pedagogic competencies in pre-service teachers. The Learning Design adopted the educational philosophy of cognitivism, constructivisim and connectivism. The cognitivism explains the process of knowledge construction (Spector, 2012), constructivism describes the mediation of tools and social context in the process of knowledge construction (Olson & Hergenhahn, 2016) and connectivisim defines the role of ICTs in learning. Learning theories provides insights for designing teaching cycle and learning environment of the Learning Design. The considered theories are social earning theory (Bandura, 1977), situated learning theory (Lave, 1988), social development theory (Vygotsky, 1978), activity theory (Engerstrom, 1987), distributed cognition (1991), connectivism (Siemens, 2005), anchored instruction (Brandsford, Hasselbring, Kinzer & Williams, 1990), communities of practice (Lave & Wenger, 1991), e-learning theory (Mayer, Moreo & Sweller, 2015), communal constructivist theory (Homles et al., 2001) and experiential learning theory (Kolb, 1984). Learning theories explains how individuals learn and what kinds of practices are required to make them learn. Review of learning theories highlights that individuals learn by practicing the observed behaviour (social learning theory) and learning is mediated by social interaction and tool (social development and activity theory). Experiential learning theory asserts that learning occurs when individuals are engaged in problem solving activities, transforming their concrete experience to abstract concepts. Anchored instruction, communal constructivist theory, activity theory and distributed cognition highlights that the use of ICTs extends the learning environment beyond classroom and reduce cognitive load. Therefore the learning environment of the Learning design is comprised of both face to face and online classes (via

learning management system). Learning theories suggest that individual learn through observation of modeled behaviour and by engaging in self-exploration activities therefore the learning environment offers both directed and open-ended (Brown & Green, 2016) learning opportunities. Physical setting of the learning environment includes a computer lab with internet facility and projector. The learners are pre-service teachers who aspire to develop techno-pedagogic competencies. The instructor has to be a teacher educator who is well acquainted with the Learning Design. Teaching cycle of the Learning Design comprised of four sequenced learning phases moving from direct teaching method to indirect teaching method. The four phases of the teaching cycle are exposure to technology, working with technology, creating with technology and reflecting on the technology. Level of Granularity defines the breakup of the course into modules, sessions and teaching-learning activities. There are twelve major topics in the Learning Design which are delivered by forty teaching-learning activities. Module one of the course consist of first eleven topics which are common for all the pre-service teachers. Last topic of the course (module 2) is subject specific which varies according to the teaching subject opted by pre-service teachers. Teaching-learning activities of the Learning Design are represented via a free online authoring tool- Learning Designer. The timeline representation can be accessed from https://v.gd/NwZMcz. Implementation of the Learning Design requires thirty two free and open source software, computers, projector and internet. The learner response is gathered by interview, rating scale and portfolios.

4. Findings and Discussions

One sample Kolmogrov test certain that the pre-test (p = 0.575, Z =0.781) and the post test score (p = 0.815, Z = 0.636) are normally distributed therefore H_01 can be test by applying paired t-test on the pre and post scores. The table 1 gives the result of paired t-test.

Table 1: Paired Samples Test

	Paired Differences					**t**	**df**	**Sig. (2-tailed)**
	Mean	*Std. Deviation*	*Std. Error Mean*	*95% Confidence Interval of the Difference*				
				Lower	*Upper*			
Post-test Pre-test	64.000	27.952	4.659	54.542	73.458	13.738	35	.000

The mean score for post-test of pre-service teachers on the variable techno-pedagogic competencies (M=186, SD= 23.414) is significantly more than (t=13.738, df=35, two-tailed p= 0.000) from that of the pre-test(M=122, SD=20.859), therefore H_01 is not confirmed and H1 is accepted. The calculated effect size (r) is 1.089, which signify strong effect (Cohen, Manion, Morrioson, 2015). The pre-service teachers who are trained through the learning design have found to develop more techno-pedagogic competencies at the end of the session than those who were not. This indicated that learning design has led to the development of techno-pedagogic competencies.

The H_02 is tested by repeated measure ANOVA (Cohen, Manion, Morrison, 2015). One sample Kolmogorov-Smirnov Test (p = 0.815, Z = 0.636) confirmed the normal distribution

of scores. The second assumption for applying repeated test ANOVA is of sphericity which is tested via Mauchly's Test of Sphericity and results are given in Table 2.

Table 2: Mauchly's Test of Sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
Time	.924	2.700	2	.259

The statistical significance (p = 0.259) is greater than 0.05, hence the assumption of sphericity is confirmed (Kerr, Hall & Kozub, 2002) and the repeated measure ANOVA can be applied to the scores to measure the effect of the learning design on their development of techno-pedagogic competencies over the course of time. The results of the test are given in the tables 3.

Table 3: Tests of Within-Subjects Effects
Measure: TPACK

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Sphericity Assumed	74341.407	2	37170.704	79.257	.000	.694

The mean scores for the TPACK differ significantly over time (F = 79.257, p = 0.000). The effect size of the difference is moderate (5 = 0.694) (Cohen, Manion & Morrison, 2015). Therefore the H_02 is not confirmed.

The difference between the three time points is calculated via Post hoc test is given in Table 4.

Table 4: Pairwise Comparisons
Measure: TPACK

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
1	2	-37.056[*]	5.762	.000	-51.543	-22.568
	3	-64.000[*]	4.659	.000	-75.714	-52.286
2	1	37.056[*]	5.762	.000	22.568	51.543
	3	-26.944[*]	4.823	.000	-39.073	-14.816
3	1	64.000[*]	4.659	.000	52.286	75.714
	2	26.944[*]	4.823	.000	14.816	39.073

Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

The repeated measure ANOVA depicts that the mean concentration of TPACK scores differed significantly with respect to time (F = 79.257, p = 0.000). Post hoc tests highlights that the learning design has significantly (p = 0.000) increased the TPACK concentration (r = 1.089), though the TPACK concentration in the phase one i.e. from 1TPACK to 2TPACK (r = 0.542) is slighter higher from than the phase two i.e. from 2TPACK to 3TPACK. Hence it can be concluded that learning design has significantly lead to the development of the techno-pedagogic competencies.

5. Conclusion

The conceptualized Learning Design has significantly enhances the development of the techno-pedagogic competencies in pre-service teachers. There is significant increase in the mean TPACK score from pre-test to post-test. There is a significant gradual increase in the mean concentration of TPACK score over time. The gain in the mean score of TPACK score after the completion of module one is slighter greater than the gain after the completion of module two. However the Learning Design has a positive effect on the acquisition of the techno-pedagogic competencies by the pre-service teachers.

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Platform Ecosystems: Exploring the role of platform capabilities to improve the competitiveness of IT service firms in India

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Abstract -

The digital platforms are rapidly emerging across industries and geographies leading to an increased number of businesses organizing around platforms. Major IT service firms in India are also seen shifting their focus towards products and platforms from legacy business offerings to adapt to customer's changing needs. It is observed that major IT service firms are still largely dependent on revenues generated from their traditional software service solutions and are struggling to scale-up their early stage platform offerings. So, the objective of the research is to examine the present platform capabilities of Indian Origin IT service firms and provide insights on how they can leverage the best practices to scale-up their platform offerings and gain international competitive advantage. This study also intends to identify the best platform capabilities which can be leveraged for international competitiveness. This research draws on facts from benchmarking Indian IT firms and their platform offerings with international platform product and service firms. The selected Indian origin IT service firms are evaluated using select competitiveness criteria such as R&D spends, patents and platform capabilities. The analysis also highlights current IT engagement trends in digital platform service offerings.

Keywords: Platform ecosystems, platform capabilities, international competitiveness, IT service firms, flexibility

1. Introduction and Background

The volatile world presents challenges as well as exciting opportunities for innovation. Traditional technology product companies such as Microsoft, IBM, and Oracle that offered proprietary software products are actively involved in offerings customizable digital solutions and platforms which are integrated in the enterprise systems within businesses. Major software service firms of Indian origin (FIOs) have leveraged this opportunity and are acting as service integrators providing digital integration solution to clients (Ramachandran, Krishna Murthy and, Garg, 2016). Such digital integration services are still contributing less to the overall revenue of the FIOs (NASSCOM, 2018) and on the other hand with the present uncertain economic conditions and business transformations are causing slow growth in the IT industry. The ongoing US-China trade war and speculations over H1B visa grant to Indian IT service firms have increased threats of major business disruption. Technology disruption with automation everywhere is changing the way we work. Changing business demands are driving India's 4 million technology workers (NASSCOM, 2018) to get retrained with new

digital skills that customers are demanding. The competitive advantage for Indian businesses has been diminishing slowly due to improvements in the other economies (WEF Report, 2019). Therefore, there is a need for FIOs to identify and adopt innovative ways of doing business to climb up the ladder of international competitiveness (Momaya, 2014) e.g. by moving up the value curve (Umamaheswari and Momaya, 2018).

Technological platforms (Gawer, 2014) and digital platforms are transforming every industry (Reuver and Sorensen, 2018), and IT firms of Indian origin can facilitate such transformation and scale-up. The main function of technology firms is changing from an operational enabler to a driver of competitive advantage and competitiveness. The market valuation of digitally born platform companies such as Amazon, Microsoft, Lyft and Google is more than USD 4.3 trillion (Evans and Gawer, 2016) creating business opportunities and challenges for regions, for nations, for industries, and for companies (Evans and Gawer, 2016). The software-based platform is described as an extensible codebase for a software based system that provides an environment shared by the interoperating modules and the interfaces through which they communicate (Baldwin and Woodard 2009; Eisenmann et al. 2006).The combination of the platform and the platform specific modules refers to a platform's ecosystem (Cusumano and Gawer 2002). Not every technology or service becomes a platform and for a technology to emerge as a platform, it needs to satisfy two conditions. 1) It should solve at least one essential technological problem within the industry. 2) It should be easy to connect to or to build upon (Gawer and Cusumano, 2008).

The emergence of new technologies and changing business needs have fueled the traditional IT service firms to focus on new ways of doing business resulting in an increase in digital offerings and a gradual slowdown in legacy services. Over the years, most Indian IT service firms are very successful in reacting and responding to problems that were already identified. These companies have focused on delivering pre-identified solutions. However, the growing importance to platform way of running the business with new business models expects these IT service firms to play a vital role in identifying the right business needs to be addressed and help to implement innovative and emerging technology-led solutions. FIOs are facing stiff competition from digitally born startups and foreign firms and are feeling the risk of being left behind. To address and adapt to the changing business environment, companies are establishing their own platforms by acquisitions, alliances and providing a wide range of cloud-based applications and services. Empirical studies have shown that firms which respond quickly and come up with innovative actions to business environmental changes have been able to improve their performance (Ferrier, 2001).

The research community has widely accepted that technology firms must innovate to survive and thrive (Banker, Wattal & Plehn-Dujowich, 2011). Researchers in India and abroad have conducted less research on how leveraging platform technologies can help IT service firms gain competitive advantage and competitiveness. Major opportunities of improvement in competitiveness for IT firms were identified (Shee and Momaya, 2001; Umamaheswari and Momaya, 2008).

Indian firms in select industries have demonstrated their abilities to reach high levels of export competitiveness, net forex and TCI (Manthri et al, 2016) (e.g. Software: TCS, Infosys,

Wipro, HCL). Even bigger opportunities are waiting for them (e.g. to climb up the value curve (Umamaheswari and Momaya, 2008) and other firms in the era of digital innovations. Innovating platform-based business models for sharing economy (e.g. Airbnb, Ola) is one such opportunity, but even capable FIOs seem to lag on that. We, keen learners of new innovation platforms, want to learn from a polar comparative case of a FIO and a global giant.

It is true that platforms are nothing new to this world; they exist for last 20 years in their basic form. Today, changing business nature of Information technology services is an important field for the analysis of platforms because: (a) Information technology platforms act as fundamentals upon which a wide range of applications and related activities can be built (Fichman, 2004); and (b) they are shared by many complementary products that together operate with the main technology platform adding new features (Tiwana et al. 2010). For example, UBER platform (OLA's highly successful rival in India) allows a variety of additional functionalities such as ride sharing, food delivery, healthcare, and freight and these functionalities interact with the platform and among themselves helping in generating significant business value. Information technology has an important role to play in laying the foundations and creating business opportunities for everyone involved in the ecosystem

A database approach has been used to identify differences in growth patterns of Indian origin IT service firms and select foreign firms in the context of developing platform solutions taking advantage of the emerging platform economy. The paper consists of the following sections; a review of the literature to link the various related research carried out to understand success factors for Indian IT service firms to attain global leadership; a description of the methodology used in the paper; case studies of some global leaders who are successful in the platform economy.

1.1 Research Problem

Global top performing companies namely Apple, Microsoft, Google and Amazon each have $100+ billion in annual revenues and all these companies are digital platform businesses. The market capitalization of top 15 public platform firms around the world account for nearly $ 4 trillion. Today, every industry is trying to embrace digital platforms as a key part of their business strategy according to a report published by Accenture research team. This change offers an opportunity for IT service firms to tap into the emerging platform businesses.

Leading Indian origin IT giants namely TCS, Wipro, and Infosys are also spending on digital technologies to meet the disrupted client demands. According to Peter Bendor-Samuel, CEO, Everest Group, Indian IT service firms shifting to new digital businesses poses a serious threat, with digital offerings including platform solutions still accounting for 30% of their revenues and growing at over 20% (per year) while legacy offerings are accounting for 70% of the total, shrinking at about 2% annually.

2. Literature review

We begin with understanding theories related to the competitiveness of Indian origin IT service firms in the past and in the present digital era where platforms play a key role in gaining competitiveness.

2.1 Indian IT Service firms competitiveness

The past research work on competitiveness of FIOs carried out during the period 2000 to 2010 have described and highlighted the factors contributing to the improved competitiveness of FIOs in many ways. For example, Momaya and Umamaheswari in their work on exploring the role of marketing to achieve competitive edge have highlighted various success factors including the role of creative marketing, innovation, R&D investments and the need for FIOs to climb the value curve to become global leaders (Umamaheswari and Momaya, 2008). On the other hand, new research studies indicate the competition is no longer about how to control the value chain but about attracting platform related activities (De Reuver, Sorensen, 2018). The IT software industry firms in India are required to think beyond their legacy offerings and update their traditional business strategy that focused on long-term revenue generating service offerings such as application maintenance and business processes (Ramachandran, Krishna Murthy and, Garg, 2016). The research says that by 2020, demand for these services is expected to decline as major clients are focusing on transforming their business operations into digital.

These findings remain the fundamental requirements for any company even today but as new sources of competitive advantage evolve over the time due to changes in the business environment such as digital disruption and the rising importance of platform way of running the business. These changes have encouraged us to research and identify the current gaps between FIOs and global majors in adapting to the digital platform economy.

2.2 Platform definition and its classification

In the literature, there are multiple synonyms for the term "platform" such as technology platforms, digital platforms, platform ecosystem, innovation platforms; internal platforms, industry platforms (Reuver et al., 2017; Cusumano, Gawer, and Yoffie, 2018) and the definition of each type vary with the specific industry characteristics. Platforms exist in almost all the sectors and thus it is difficult for the researchers to give a general definition of the term platform. We found a number of researchers who have defined platforms for technology companies. In this study, platforms are examined from a technology company perspective in order to compare and analyze the position and relevance of FIOs in the emerging platform economy. Gawer defines platforms as products, technologies or services which provide the basis on which external businesses can develop their own supportive products, technologies, or new services in the ecosystem (Gawer and Cusumano, 2002; Gawer, 2009). Internal platforms are new products and service developed by a firm for the internal purpose and that meet the needs of a particular group of businesses (Gawer and Cusumano, 2008; Gawer, 2012). Leading FIOs such as Wipro Ltd and TCS are found to have such internal platforms e.g. Wipro's "Holmes" and TCS "Ignio" and "iON". Industry platforms are defined as foundation technologies developed by one or more firms to solve an essential technology problem, and upon which other firms which are part of the ecosystem

can build complementary services or technologies. The combination of platform owner and complementors form an ecosystem to create high value for the whole platform (Gawer and Cusumano, 2008). Table 1 shows a few other select sample definitions that describe technology-platforms.

Table 1: Platform definitions

Source	Platform Definitions
Tiwana (2015)	Platforms refer to an extensible basis of technology and the interfaces used by extensions that collaboratively operate with it.
Fichman (2004)	Fichman describes IT-platforms as general-purpose technologies that allow a family of applications and related business opportunities to get associated with it.
Saarikko (2014)	The platform is described as a set of attributes that can be extended to the benefit of both adopters and back-up firms by applications or supplements.

The Windows operating system is one of the earliest examples mentioned (Cusumano, 2002). The real value comes from the many products and services of third parties running on Windows (Eastwood, 2019). Michael Cusumano and Annabelle Gawer in their work on comparison between performances of the platform and non-platform companies have classified platforms into innovation platforms, hybrid platforms and transaction platforms (Cusumano, Gawer, and Yoffie, 2018).

Innovation platforms enable platform owners and their partners in the ecosystem to share common building blocks to create innovative features and functionalities (which are referred to as complements by authors) making the whole system highly valuable. Operating systems such as Windows Microsoft, Android Google, iOS Apple, and Amazon Web Services along with cloud computing services are classified under innovation platforms (Cusumano, Gawer, and Yoffie, 2018). The second type of platform i.e transaction platforms are described as foundational entities in which goods and information can be exchanged. The examples under transaction platforms include Amazon ecommerce business, UBER, OLA, and social media platforms such as Facebook, and YouTube. The last and the third type is hybrid platform, firms under this category behave as both innovation and transaction platforms (Cusumano, Gawer, and Yoffie, 2018). Our study focuses on the innovation platforms and their characteristics which can be adopted by Indian IT service firms to be classified under innovation platform firms in future and become the market leaders in the digital economy.

2.3 Platform innovation and competitive advantage

In the current digital economy, firms with a platform model have the ability to build on externally. Most valued companies at present have adopted external partners that build value on their platform. For example, app stores, platforms like YouTube, and Facebook. The concept of leveraging external partners is slowly being adopted in every industry to gain a competitive edge over others (Avagyan, Moioli). Competition is moving more and more towards fighting for platform-centered ecosystems (Katz and Shapiro, 1994). The platform economy which is supported by tools, capabilities, and frameworks based upon the power of information and cognitive computing is ruling our economic and businesses. IDC report

suggests that companies and industries have to shift their focus to compete in the emerging and larger platform business economy (IDC, 2019).

3. Research Methodologies and Approach

The paper uses a database and case study approach to identify differences in growth patterns of FIOs and select foreign firms in the context of developing platform solutions taking advantage of the emerging platform economy.

This research is being carried out in two steps. In the first step, the evaluation of performance of FIOs is carried out considering their market share, R&D spend, the number of patents filed and other financial parameters. The FIOs figures are compared with the global IT firms. Second, evaluation using case studies with literature support to explore how leading IT service firms are engaged in the platform economy to climb up the value chain. The case studies of companies selected to study are focused on exploring how companies are building platform solutions. The cases studied were: IBM — software, hardware products, and IT services from consulting to outsourcing; and Microsoft. Wipro Ltd, Infosys and Tata Consultancy Services (TCS) are the major IT firms in India which are considered in this study to identify the important platform capability gaps.

This research draws on facts from benchmarking Indian IT firms with global top performing companies. The selected Indian origin IT service firms will be evaluated using competitiveness criteria such as platform capabilities and offerings, digital revenue partnerships and digital spends. The study was conducted using data collected from secondary sources from the annual reports of select companies, literature, published articles, websites, and reports published by IDC and NASSCOM. The qualitative and quantitative data collected from various sources were analysed to detect the patterns.

4. IT service sector and its changing nature

As of 2018, India's export revenue is USD 126 billion which accounts for 10% of the global IT service market which is 1.24 trillion USD (IBEF, NASSCOM, 2018). IBM and Accenture are major competitors for Indian IT service leading firms and these global companies are successful in capturing the larger share in the global IT market. These facts (Table 2) provide us an idea about the position of Indian IT service firms and their financial performances.

Table 2: Market share of IT service firms

IT Service Firm	2018 revenue (US $ mn)	Market share (%)
IBM	79,591	6.42
Accenture	39,573	3.19
TCS	18,923	1.53
Infosys	10,840	.87
Wipro Ltd	7,895	.64

Source: Annual reports, NASSCOM reports 2018

4.1 What are good examples of innovation platforms offered by IT service firms from India competing internationally beyond software services?

Most of the Indian origin IT service export firms use digital as an encompassing term to include platform solutions which are powered by Automation and AI. It is seen that some traditional leading IT export firms have been establishing separate units to focus on platform related offerings (Table 3).

Most of these platforms (Table 3) were launched during the period 2014-2015 and were initially used for internal operations to save on costs. After 4 years these platforms have now started attracting global companies to offer solutions as part of other digital offerings. Indian IT firms are still struggling to scale-up the standalone platform offerings because firms still lack experience and are unsure of the results of these platforms. These platform services are offered under digital service segment and none of these firms separately mention about the revenue generated by these platforms. Only TCS mentions that its Ignio platform has generated around 60 million USD for the year 2018 and it expects to generate around 100 million USD by 2020.

Table 3: Platforms offered by FIOs

S. No	Parent Company	Entity Name	Platforms	Number of Clients	Technologies
1	Tata Consultancy Services	Digitate	Ignio AI Platform HOBS	HOBS: 30 Ignio: 50 fortune 500	Machine Learning AI
2	Infosys	Edgeverve Systems	Nia - AI Platform	50	Automation, AI AI Applications
3	Wipro	Holmes for Business	Holmes	350	AI
4	HCL	DRYiCE	iAssure, MTaaS	No data	AI

Source: Company annual reports

4.2 What Value Are These Platforms Creating?

According to the description given by each of these companies about these platforms (Ignio, HOLMES and Nia) these solutions offer prediction, recommendation and automation task on one platform, which is valuable for their associated clients who are trying to gain competitive advantage. These platforms provide rule-based reasoning along with pre-built intelligence to give an accurate prediction.

The vice president and global head of Wipro Holmes, Rohit Adlakha, mentions that Holmes platform is working on revenue prediction models that drive more accurate budgeting and planning for enterprises (MIT Technology review, 2018).

The platform solutions offered by major FIOs are still in their early stages and possess the qualities of internal platforms to an extent (Gawer and Cusumano, 2008) and they do not leverage the power of the platform ecosystem to create higher value in the industry (Please refer to Table A1 in appendix). According to Gawer, as the interfaces of platforms become more open, more players will be attracted into the platform ecosystem and the platform

owner will be able to access a larger set of complementary innovative capabilities (Gawer, 2014).

On the other hand all the leading firms are engaged in platform ecosystem where other players in the ecosystem build complementary services or technologies.

4.3 Technological performance of IT firms

Cusumano and Gawer have classified Microsoft and Google as Hybrid platform companies as their offerings are into both innovation and transaction types. Authors have classified IBM as an innovation platform as it offers IBM Watson (Cusumano, Gawer, and Yoffie, 2018). For Microsoft, the R&D expenditure represented more than 13% of their revenue in the fiscal year 2018 (Table 4). The firm has plans to continue investing heavily in a wide range of research and development activities to remain as the global leader in technology innovation.

A comparison of the R&D expenditure of leading platform firms and other IT Service firms (Table 4) indicate that there is still a huge scope for Indian IT service firms to improve in their research on developing innovative technology services and products in order to meet the current digital platform economy expectations and to be classified under innovation platform category.

Table 4: Comparison of R&D expenditure

Company	Firm Type	R&D Expenditure ($ mn, 2018)	Revenue ($ mn, 2018)	R&D as % of revenue (2018)
Infosys	IT service	114.9	10,840	1.06%
TCS	IT service	230.5	18,923	1.22%
Wipro	IT service	47	7,895	0.59%
Accenture	IT service & Consulting	791	39,573	**2.00%**
IBM	Innovation Platform	5,412	79,591	**6.80%**
Microsoft	Innovation & Transaction (Hybrid)	14,700	1,10,360	**13.32%**
Google (Alphabet)	Innovation & Transaction (Hybrid)	21,419	1,36,819	**15.65%**

Source: Company annual reports

Patents are also an important part of the competitive strategy of a business in the digital world. Companies use patents strategically as useful tools to defend their intellectual property or as defense mechanisms to help them gain access to new technologies and open innovations (Somaya, 2003).

Rajesh Gopinathan, Chief Executive Officer at Tata Consultancy Services explains that TCS is focusing on the three Ps - patents, products and platforms - to strategically place TCS in the leading position in IT service outsourcing business. On the other side in the changing business environment, leading platform companies (Microsoft & IBM) have rapidly

expanded their patent portfolios over the years to remain competitive in the digital business world (Fig.1). Although in the recent times FIOs are also experiencing an increase in the number of IT related patents being filed, they still need to travel a long way to reach the leading firms patent numbers.
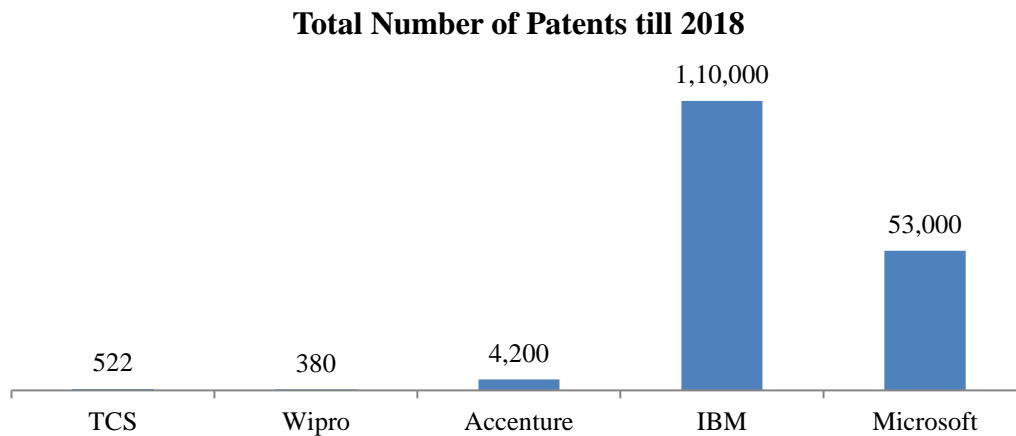
Total Number of Patents till 2018

Fig.1: Comparison of total number of patents granted till 2018
Source: Company annual report, Statista 2018

As listed in the earlier section of this paper, leading IT service firms in India are gradually shifting their focus towards offering proprietary platforms (Nia, Ignio, Holmes) which are mainly AI and automation based. In this view, we listed out firms with the most number of AI patents (Fig.2) and we found that platform companies lead the chart here as well making it very clear that patents are very important to improve the firms 'competitiveness.

Number of AI patents till 2018
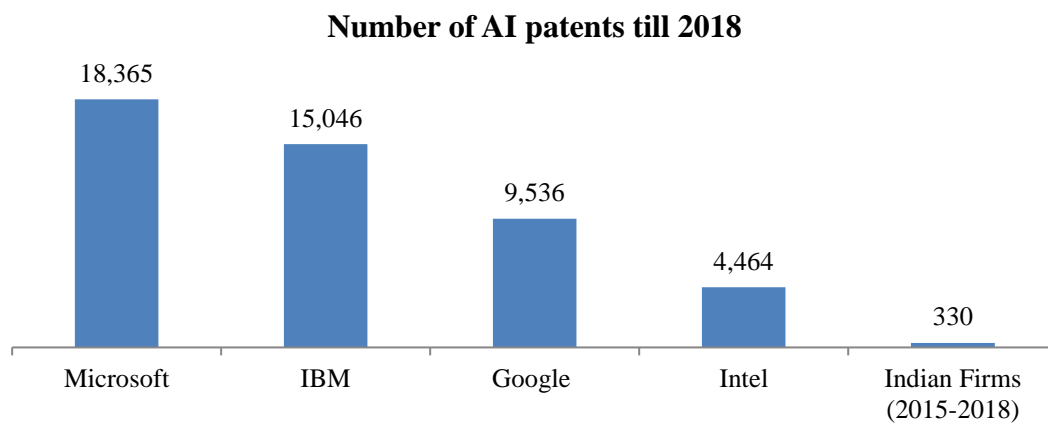
Fig.2: Comparison of total number of AI patents granted till 2018
Source: Statista report 2018, company annual report

5. Lessons from IBM

We have only considered the IBM case to understand their growth over the years and their platform offerings. Cases from FIOs were not considered due to the limited advancements of these companies in offerings platform solutions.

Cusumano and Gawer have classified IBM Watson under innovation platform and IBM has been the case of considerable study by many economists and business management professors to find out the secret of its longevity. For more than a century IBM has dominated

the technology and innovation space. The company which formed from three small firms has emerged as a multi-billion dollar information technology services company today. The company has experienced many ups and downs along the way offering some great insights into the global technology industry and also can provide some business lessons for Indian IT service firms who are far younger than IBM.

In its initial existence, IBM's basic platform products were punch-card, card sorters, card readers, yielding tabulators, and the IBM Card. Later the basic technology platform products were computers, including mainframes, minicomputers, PCs, and laptops. Slowly the computer sales declined affecting its total revenue and IBM transitions to providing software services and management consulting.

Today, more than 50% of IBM's revenue comes from services and software and the company is constantly progressing towards developing high-value technology services. From the past 5 years, IBM has been transforming its business and addressing the changing needs of its global clients, while continuing to innovate in technology offerings. IBM is thinking beyond becoming more than traditional hardware and IT service company; it is gradually emerging as an AI-based cognitive solutions and cloud Platform Company. The current strategy of IBM is to create a competitive advantage by leveraging data analytics, cloud based platform business models, and mobile and social technology-driven individual engagement.

Continuous investment by IBM in innovative technology is helping the company to remain competitive and maintain a balanced profit margin over the years. IBM with its capabilities and offerings in the digital technologies such as artificial intelligence, cloud, analytics, and cybersecurity account for more than half of its total revenue for 2018, accounting for about $40 billion in revenue. The company has invested more than $5 billion in R&D and created thousands of groundbreaking technologies in the recent times with 9100 patents issued to IBM in 2018, more than 1600 of which were linked to artificial intelligence and around 1400 to technologies around cybersecurity.

As part of its platform offerings, IBM Watson platform solutions are able engage with a good number (20,000, IBM annual report) of clients across 20 industries. Total revenues from its cloud offerings were more than $19 billion in 2018 with other focused division include IBM Blockchain with 500 client engagements, IBM security offerings with 17000 client engagements and IBM services. Over the last few years, IBM has been focusing on investing on these high-value IT industry segments and prioritizing their strategies to build advanced technologies in areas such as hybrid cloud, enterprise artificial intelligence, analytics, cybersecurity and blockchain together with business-specific platform applications and solutions serving specific industries across financial and healthcare services. As a result, IBM sold its traditional software assets to HCL for USD 1.8 billion in the year 2018 to slim down its legacy business and on the hand IBM acquired Red Hat for USD 34 billion to deliver next-generation hybrid multi-cloud platforms together with red Hat.

These developments at IBM clearly indicate that the company is more strategically focused towards offering next-generation solutions and platforms surrounded by industry specific artificial intelligence offerings, cloud, data analytics, and blockchain technologies. In order to achieve this IBM is continuously investing in research and development, intellectual

property, people, platform acquisitions and divesting the legacy products to focus more on high-value enterprise solutions for the future.

6. Discussions

Next-generation technology provides users with new, advanced functionality that often renders the past technology obsolete, opening a window of opportunity for challengers (e.g. Cennamo, 2018). While such opportunities were leveraged quite well by challenges from Japan (e.g. in automotive industry by Honda and Toyota), Korea (e.g. in Electronics by LG, Samsung) and ICT to E-com giants (e.g. Baidu, Huawei, Alibaba and Tencent), potential of firms of Indian origin (FIOs, incl. ones given in examples in this paper) have built on specific layer of ICT industry (Momaya et al., 2009). They have excellent skills on select layers such as software services and massive human capital. Platform strategies adapted by sharing-focused firms such as Air BnB, Uber indicate that it is not necessary to have hardware competencies to thrive in platform economy. Achieving platform status requires organizations to take some bold and strategic decision to open up the existing internal digital platforms to third party complementors (Gawer and Cusumano, 2008).

7. Concluding Remarks

ICT firms of Indian origin have several factor advantages and have potential to climb-up the value curve, including on emerging segments such as AI platforms. Since 2016, IT service firms of Indian origin (FIOs) – Infosys, TCS, Wipro, and HCL have increased their number of patents being filed. However, the number of patents related to next- generation IT solutions (AI platforms, Cloud) is still limited and firms need to accelerate. The IT companies have to learn and adapt technological strategies from global leaders. For example, IBM's continual investment in innovation, R&D, patents, divestment in legacy offerings and its focus into the next generation high-value offerings is an exciting case.

Leading FIOs have launched their AI-based platforms but the significance and flexibility of these platforms is limited. As it can be inferred from various platform offerings of leading platform companies around the globe, the artificial intelligent technology capabilities act as supporting technology for various platforms. Global platform firms such as Microsoft, Alphabet, Facebook, Apple Inc., Amazon, and IBM are investing their time and capital into developing the next generation tech-savvy capabilities. However, FIOs need to adopt newer ways of doing business and become more flexible (Sushil, 2005) to the changing nature of IT business environment by improving their innovation capabilities and offerings supported by platform technologies using artificial intelligence.

It is important that FIOs understand the changing client expectations and prepare themselves to respond to the same in a shorter period of time. This challenging process requires some fundamental shifts in the way FIOs have operated all these days. For leading FIOs, some of these changes are difficult to achieve because of their size and require strong organizational determination. For international competitiveness, firms need to focus on being flexible to

adapt and develop innovative ways to leverage platform technologies and involve the players in the ecosystem to deliver a differentiated value to the clients.

8. Limitations and need for further research

The objective of this study was to understand how software firms of Indian origin (FIOs) can leverage platform capabilities to remain competitive in the digital economy. In literature, theories and definitions of platforms have remained fragmented but no literature exists on this specific topic. Thus, in this initial stage of the study, we highlighted some of the existing AI platform capabilities of IT service firms in India and compared them with leading digital firms and their solutions to understand how FIOs can leverage the best platform capabilities to gain competitiveness in the digital economy. We have made an initial effort to fill the research gap in this area. However the findings of this initial research require further empirical validation. The study presented a comparative case of only one firm and it requires considering and studying more cases from FOIs and other international firms to verify the findings. Areas of further research could include analyzing which platform capabilities are most important for IT service firms in India to climb up the value curve and gain international competitive advantage. In addition, other research areas would be to study the flexibility of FIOs to participate and manager players in the ecosystem.

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Appendix

Table A1: Platforms participating in the ecosystem to create increased value

S. No	Company	Platforms	Does it satisfy the Industry Platform definition?
1	Microsoft	Microsoft Azure	Yes
2	IBM	Watson, Bluemix	Yes
3	Amazon	Amazon Web Service	Yes
4	Wipro	Holmes	**In process**
5	Infosys	Nia	**In process**
6	TCS	Ignio	**In Progress** (Plans to open AI platform Ignio to third-party developers to build application on it)

Source: Company annual reports

Factors affecting Financial Flexibility of Central Public Sector Enterprises

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Abstract-

Financial flexibility is a capability of firm's to acquire the financial resources in response to meet the future financial obligation and to maximize the firm's valuation. The purpose of this study is to investigate factors influencing the financial flexibility based on CPSEs listed on PSU index of Bombay Stock Exchange. For this reason 23 manufacturing CPSEs and 230 observations during the years 2006-07 to 2017-18 have been screened. The result of multiple regression and logistic regression showed that, financial leverage variables in the sample enterprises don't have significant impact on financial flexibility and the current ratio, Return on assets have a positive and significant impact on financial flexibility. Sizes, Return on Sales, Growth variable have a negative and significant impact on financial flexibility.

Keywords: financial flexibility, financial leverage, Central Public Sector Enterprise, size, profitability.

1. Introduction

Financial flexibility is a firm's capacity that can mobilize financial resources towards financial obligations to maximize the value of firm. Financial flexibility is an ability to raise financial resources to handle any future unexpected events and to maximize the firm's valuation (Bion, 2008). Modigliani and Miller (1963) were defined flexibility, as a "company's ability to maintain 'a substantial reserve of untapped borrowing power." In other words flexibility is the accessibility of external financing, since this is the one of the fastest growing and gaining importance in raising fund under the firm's capital structure decisions. According to Graham and Harvey (2001) financial flexibility is popular because it helps firm to make future strategic decision related to acquisitions, diversification, etc. The definitions given by Byoun (2008) "the degree of capacity and speed at which the firm can mobilize its financial resources in order to take reactive, preventive and exploitive actionsto maximize firm value." Byoun (2008) put forward the concept of flexibility through the proportion of debt and equity payouts. Marchica and Mura (2010) concluded that firm with higher levels of flexibility records improved levels of investments. Flannery and Rangan (2006) confirmed that firms identify and pursue targeted capital ratios. The changing behavior is estimated with the occurrence of cyclical changes in financial conditions and setbacks and how the firms adopt strategies to return to their target levels. Researchers have discovered that this flexibility can serve as a mediator between the external borrowing power and the implementation of profitable projects on-time and in-line with the competition. We used interpretations relating to firm size, financial assets, retained profits, operational cash flows and dividends paid. The question of financial flexibility's presence is

essential for CPSEs because the developing economies like India stimulate new investment opportunities and cause managers to find tools for increasingthe flexibility, in order to attract additional resources for their businesses' development. The purpose of this study is to examine a relationship between financial flexibility and the factors affecting the flexibility in the CPSEs.

2. Research Question:

What are the factors influencing the Financial Flexibility of the select CPSEs.

3. Hypothesis:

Financial leverage, liquidity, profitability, firm size and Growth Opportunity do not have significant impact on financial flexibility.

4. Review of Literature

The detailed research in reference to the study conducted by DeAngelo and DeAngelo (2007) flexibility is the key concept in the overall theories of capital mix. Goyal (2009) studied the factors influencing the financing decisions, such as size, growth, profitability and many others, that can influence corporate leverage. Marchica and Mura (2010) provide evidence that a traditional approach of maintaining the low leverage helps the firm in restoring their financial resources, which guides firm to showcase advanced performance in their investment abilities. Flexibility provides the managers the prospect to predict the growth probability in the future and expand the level of their long term investment expenditure. Arslan-Ayaydin et al. (2014) observed that firms in the East Asian region, in the study period from 1994 to2009 maintained their flexibility through a defensive leverage policy and by their cash holdings, which resulted as a cushion in the time of uncertainty. Financial flexibility is being maintained primarily through leverage decisions (Graham and Harvey 2001; Bancel and Mittoo 2017).

5. Research methodology

The sample in our research consists of manufacturing Central public Sector Enterprises over the period from 2006-07 to 2017-18. The sample size was selected from 57 government undertakings, which are part of sectorial indices of BSE i.e. BSE-PSU index. Out of 57 enterprises, the researcher has selected all 23 holding CPSEs, as a sample size by using census method. This study is exploratory in nature and depends on the secondary data. The major data source is the PE Survey published by the Department of Public Enterprises, Government of India.

5.1 Multiple Linear Regressions:

Regression analysis is a powerful statistical tool to analyse associative relationships between dependent variable and one or more independent variables. In order to know the factors influencing the failure of CPSEs, multiple regression analysis is used.

$$flix_{it}=\beta_0+\beta_1 Lev_{it}+\beta_1 Cr_{it}+\beta_1 Roa_{it}+\beta_1 Size_{it}+\beta_2 Ros_{it}+\beta_3 Growth_{it}+\varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where,

$flix_{it}$ = financial flexibility in an i firm at the time of t

Financial flexibility = operational cash flows / total of assets.

Lev_{it} = current ratio in an *i* firm at the time of *t*

Current ratio = current asset / current debt.

Roa_{it} = net profit / total of assets

Size_{it} = firm size (log of total assets)

Ros_{it} = return in sale net sale / total sale.

Growth_{it} = Book value of equity – (total assets + market value) / total of assets

ε_{it} = errors

5.2 Logistic Regression:

To understand the probability of failure of the selected CPSEs a logit regression model is used. This model uses a binary dependent variable, a dummy variable for failure. The dummy variable is o if the CPSE is non financial flexible, and 1 for financial flexible.

$$y = \begin{cases} 1\ financial flexible \\ 0\ non\ financial flexible \end{cases}$$

The probability estimation of thismodel will be between 0 and 1.

$$(y = 1/x) = (y = 1/x1,\ x2,...,k)(\text{Wooldridge, 2014}).$$

Since the dependent variable is binary, it doesn't satisfy the assumptions of liner regression like normality, linearity and homoscadasticy of independent variable. Failure is measured on an ordinal scale, thus logit model is the appropriate technique. This model is being used by Ohlson, 1980; Daily, et.al 1994; Bernhardsen, 2001; Wooldridge, 2014. The logit model based on function to maximize the probability of observed y values, o and 1 (Tufte, 2000). The maximizing problem is estimated by finding the co-efficient, which gives the highest probability to estimate dependent variable.

6. Results and Discussion:

In order to know the factors influencing the failure of CPSEs, multiple regression analysis is used. The results are tabulated in table 1, table 2 and table 3.

Table 1shows the r^2 value of 0.856, which provides an indication of the percentage of variance in the dependent variable (85.6 %) explained by independent variable.

Table 1: Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.980[a]	.856	.763	.378

Note: a. Predictors: (Constant), Lev, CR, ROA, Size, ROS, Growth

The result for F-test is significant as tabulated in **Table 2**, this shows that dependent variable is statistically influenced by the independent variables.

Table 2: ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	11.344	90	.756	9.103	.000[b]
	Residual	3.656	140	.083		
	Total	15.000	230			

Note: a. Dependent Variable: flexibility
Lev, CR, ROA, Size, ROS, Growth

Table : Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.620	.148		4.202	.000
	Lev	.628	.092	.360	2.473	.617
	CR	.103	.168	.423	.612	.044
	ROA	.702	.067	-.876	-1.065	.029
	Size	-.056	.080	.340	.704	.049
	ROS	-.007	.027	-.032	-.276	.007
	Growth	-.048	.058	1.112	.832	.004

Note: $p < 0.05$

As seen in the above table, Financial leverage (0.617) is insignificant and have less influence on financial flexibility and rejected at a 5 percent level of significance. The improvement in unit of financial leverage, financial flexibility increased by 0.628 unit. The results in table 3 shows that the Current ratio, Return on Assets has a positive and significant impact on financial flexibility, and Size, Return on sales and Growth is negative predictor but have significant impact on financial flexibility.

6.1 Logistic Regression:
The effect of the variables on the financial flexibility can be determined through logistic regression. Q_1 is the proportion of financial flexible enterprises in the sample and H_1 is the proportion of non financial flexible enterprises.

$$logL = \sum_{i=1}^{N} w_i logF(q_i(\alpha_i + X_i\beta))$$

$$y = \begin{cases} 1 \ financial flexible \\ 0 \ non \ financial flexible \end{cases}$$

H_0 = an enterprise is likely to be financial flexible =1
H_1 = an enterprise is not likely to be financial flexible = 0

Table 4: Analysis of Logistic Regression

Variables		B	S.E.	Sig.
	Lev	.486	0.670	.017
	CR	.408	1.279	.049
	ROA	.211	.121	.038
	Size	-.452	.807	.027
	ROS	-.731	1.419	.006
	Growth	-.107	1.473	.029
	Constant	9.601	5.115	.061

Table 4 shows, the co-efficient of Leverage (0.486), Current Ratio (0.408), Return on Assets (0.211), Size (-0.452), Return on Sales (-0.731), Growth (-0.107) is significant at 5 percent level of significance, the $p<0.05$ shows significant impact on the financial flexibility.The study shows that factor have significant impact on financial flexibility. The type I error occurs when the null hypothesis is rejected, type II errors occurs when null hypothesis is not rejected; in our study this would be predicting that an enterprise is likely to be financial flexible, when in the reality they are not.

7. Research and Managerial Implication

The model developed in this study is significant and it can be used for predicting the failure of an enterprise. An elaboration of large sample from different sectors could provide more accuracy for the model. Developing a model using longer panel data would make it less biased. This study continues and expands the research into the conceptual framework of financial flexibility. The research focused on the connections between financial flexibility and the factors influencing flexibility. Financial flexibility is mostly unidentified and ignored in the capital mix decisions that have a substantial role in the efficient performance of firm. This model we have formulated can give the insight on financial flexibility, if the indication and influencing factors are timely established and proper measures will be taken to improve the financial position but the complexity of model make it some degree uncertain. The factors considered in the study and working on these factors will definitely enhance the chances of better performance by the CPSEs. The application of logit model based on factors scientifically better approach to the user for timely detect the CPSE's financial flexibility and avoid the erosion of investment and value of firm.

8. Conclusions

The study identifies the role of different financial factors in the financial flexibility of firm. The conventional debt equity proportion allows firms to raise more funds by avoiding high levels of risk– this provides the opportunity for them to spend more on their investment projects - something the inflexible CPSEs cannot afford to do. The linking of size and flexibility registered low significance as the small firm can opt debt financing, as the financial institutions can see their stability and hence are less hesitant to provide funds to the projects. The higher levels of returns on assets, return on sales is the rationalization for the negative association between the financial flexibility and investment related to the large CPSEs resulted it inability in managing number of assets and hence in undertaking the big leap in investment less often. The results include conclusions regarding the link between flexibility and factors, as well as the impact of external and internal factors on this relationship.

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Analyzing Financial Performance of Private Banks in India: Application of CAMEL Model

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Abstract-

The present study focuses on the evaluation of the performance & financial soundness of selected Private Banks in India for the period 2014-2018. The financial strength of the selected banks are examined with the help of CAMEL-Model approach the statistical tools used to conclude the study are Standard Deviation, Composite Rankings, Average, and Compound annual growth rate. These tools are used to aggregate the comparative and significant parameters of CAMEL-Model approach. The ANOVA test signifies that there is significant difference in the performance of selected private banks in India.

Keywords: CAMEL-Model, financial-performance, managerial efficiency, private banks, profitability.

1. Introduction

Banking sector is an important component of financial system plays a key role in the economic development of countries and it helps in stimulation of Capital formation, innovation and monetization in addition to facilitation of monetary policy (Said & Tumin, 2011). Indian banking industry has undergone several changes during the liberalization process. Indian banking sector has been dominated by public sector banks since 1969 when all major banks were nationalized by the Indian government.

2. Review of Literature

Misra (2013) and Ramya (2017) measured the financial soundness and performance of State Bank Group using CAMEL Model approach. As per the findings of this study, Asset quality, Capital Adequacy, Debt Equity, Operating Profit, Non Interest Income to Total Income must be improved for upgrading its position. Also, there was significant relation between each category of CAMEL Model and Q Tobin's ratio as bank's performance ratio as per (Rostami, 2015). Majumdar (2016) measured the financial performance of 15 banks in Bangladesh for the period 2009 to 2013 determining a significant difference in the performance of selected banks.

3. Research Methodology

This Descriptive research aims to collect information with regards to the existing position of

the phenomena. Topmost five private sector commercial banks, HDFC Bank, ICICI Bank, Yes Bank, Axis Bank, IndusIand Bank; as per their market capitalization are selected from the listed banks on BSE. This study is purely based on secondary data which is collected from annual reports of above mentioned banks, Capitalized database and Reserve Bank of India from 2014 to 2018. CAMEL Model approach has been used to examine the financial strength of the above mentioned banks. Certain ratios have been calculated under each acronym of CAMEL Model and Composite Rankings, Average, and Compound Annual Growth Rate through the comparative analysis and significance analysis of various parameters of CAMEL Model. In order to perform comparative analysis, spread sheets are interpreted through the rank based on average of the sub Parameters of each parameter of the adopted CAMEL Model then the ranks were summed-up to attain group average of individual banks for every parameter of CAMEL Model. Finally, banks' composite rankings were calculated through computing average of these group averages. Hypotheses have been tested trough ANOVA test by using SPSS.

4. Objectives of the study:
To study the financial performance of the Private Banks
To compare the financial performance of selected Private Banks

5. Hypothesis:
Ho: There is no significant difference in the performance of the selected Private Banks.

6. Results and Discussion:

6.1. Capital Adequacy of Selected Banks
Capital-Adequacy specifies that the bank has sufficient capital to engross sudden losses. It is needed to uphold depositors' confidence and stopping the bank from being bankrupt. Indian scheduled commercial banks are instructed to uphold a CAR of 9% while public sector banks of India are instructed to uphold a CAR of 12%.

Table 1: Capital Adequacy Ratio

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	16.57	14.95	15.29	15.09	16.07	15.594	0.696477	0.007689
HDFC Bank	14.82	14.6	15.53	16.79	16.07	15.562	0.900428	-0.02004
Yes bank	18.4	17.07	16.5	15.6	14.4	16.394	1.508204	0.063197
ICICI Bank	18.42	17.39	16.64	17.02	17.7	17.434	0.67947	0.010018
Indusland Bank	15.03	15.31	15.5	12.09	13.83	14.352	1.421661	0.02102

Table 1 indicates that Capital Adequacy ratio is highest in case of ICICI Bank (17.4) and Indusland Bank has lowest Capital Adequacy (14.352). The standard deviation shows that Yes Bank is more volatile as compare to other bank. The study also shows that HDFC Bank has registered high CAGR in the said period.

6.2. Assets Quality of Selected Banks
Bank's financial soundness is determined by quality of assets possesses by that bank. The primary dictum behind calculating quality of assets possessed by the bank is to establish the

elements of Non-Performing Assets (NPAs) as a percentage of the total assets.

6.2.1. Net NPA to Net Advance
The overall financial soundness of banks is computed with the help of Net Nonperforming Assets to Net Advances Ratio. Net NPAs are computed by dropping collective balance of provisions outstanding at the end of the period plus some adjustments in interest part, from gross NPAs.

Table 2: Net NPA to Net Advance

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	4	2	1	0	0	1.4	1.67332	0.0000
HDFC Bank	0.41	0.4	0.44	0.43	0.44	0.424	0.018166	-0.0175
Yes Bank	1	1	0	0	0	0.4	0.547723	0.000
ICICI Bank	5	5	3	2	1	3.2	1.788854	0.495349
Indusland Bank	1	0	0	0	0	0.2	0.447214	0.000

Net NPA to Net Advance ratio (Table 2) shows that Induslnd Bank (0.2) Low value of NPA whereas Axis Bank has highest Net NPA to net advance (1.4). ICICI Bank has the highest standard deviation i.e.1.788. It has been seen that the quality of assets of Induslnd Bank is far superior with comparison with other Banks. Higher ratio shows high increase in volume of bad quality of loans. This obviously shows the quality of advances that the bank has provided to customers to generate income from interest. Thus, quality of assets clearly postulates the category of the debtors that banks have in their balance sheet.

6.3. Managerial Efficiency to Selected Banks
Another main factor of the CAMEL Model is efficiency of Management which is responsible for growth and survival of any Bank. While the remaining factors of CAMEL Model can be computed easily from current financial statements, management quality is a somewhat indefinable and subjective measure, so the efficiency of Management is vital for success of any Banks.

6.3.1. Return on Equity
The Return on Equity ratio specifies profitability of a bank in comparison with its net income to its average shareholders' equity.

Table 3: Return on Equity

	2018	**2017**	**2016**	**2015**	**2014**	**Mean**	**st.dev**	**CAGR**
Axis Bank	0.54	7.22	17.49	15.52	13.23	10.80	6.91	-0.55
HDFC Bank	33.69	28.39	24.32	20.38	17.67	24.89	6.37	0.18
ICICI Bank	5.27	8.41	8.36	9.64	8.49	8.04	1.63	-0.11
Indusland Bank	6.01	4.79	3.84	3.39	2.68	4.14	1.29	0.22
Yes Bank	9.17	7.30	6.04	4.80	4.49	6.36	1.93	0.20

Table 3 results shows HDFC Bank is more competent Bank in earnings and utilizing its equity base to create healthier return is to investors as compare to other Banks because of its highest mean i.e. 24.89 on the other hand Induslnd Bank has lowest mean i.e. 8.04.CAGR. If a

bank can mobilize deposits at a lower rate and advance these to customers to generate higher returns than the cost of deposits.

6.3.2. Business-Per-Employee
This ratio shows the competency of employees of the bank in generating business for the bank.

Table 4: Business Per Employee

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	0.952	0.993	1.004	1.038	0.897	0.977	0.054	0.015
HDFC Bank	1.082	0.968	0.811	0.753	0.720	0.867	0.153	0.107
ICICI Bank	0.888	0.908	0.943	0.924	0.756	0.884	0.074	0.041
Indusland Bank	0.871	0.734	0.645	0.633	0.651	0.707	0.100	0.076
Yes Bank	1.398	1.023	1.083	1.468	1.330	1.260	0.197	0.013

The highest ratio of Yes Bank signifies that it is efficient bank management as compare to other Banks, i.e. Business per employee is highest in Yes Bank followed by other banks as its mean is 1.260. CAGR of HDFC Bank is better than other banks. Whereas Indusland Bank has lowest business per employee ratio i.e of 0.707.Yes bank ranks 1st in comparison of other selected private Banks (Table 4).

6.3.3. Profit-Per-Employee (PPE)
This ratio shows the surplus earned each employee. A high ratio clearly signifies efficient management. A vertical management can motivate and inspire each employee for earning more profit for the bank.

Table 5: Profit Per Employee (PPE)

	2018	2017	2016	2015	2014	Mean	St.Dev	CAGR
Axis Bank	0.005	0.065	0.164	0.174	0.147	0.111	0.073	-0.579
HDFC Bank	0.198	0.173	0.140	0.134	0.124	0.154	0.031	0.123
ICICI Bank	0.083	0.121	0.135	0.168	0.136	0.129	0.031	-0.116
Indusland Bank	0.143	0.113	0.099	0.094	0.090	0.108	0.021	0.121
Yes Bank	0.232	0.165	0.169	0.216	0.184	0.193	0.029	0.059

After comparison it is stated that YES Bank high ratio which clearly signifies its efficient management. i.e. Profit per employee the mean of Yes Bank is highest than other followed banks. Whereas Indusland Bank has lowest profit per employee ratio i.e. 0.108. Yes Bank ranks first among all the selected private banks.

6.3.4. Return-on-Net-Worth
This Ratio shows of how effectively a company is using the money invested by shareholders.

Table 6: Return on Net Worth

	2018	2017	2016	2015	2014	Mean	St. Dev	CAGR
Axis Bank	0.43	6.59	15.46	16.46	16.26	11.04	7.220384	-0.59674
HDFC Bank	16.45	16.26	16.91	16.47	19.5	17.118	1.352727	-0.04163
ICICI Bank	6.63	10.11	11.19	13.89	13.4	11.044	2.916656	-0.16131

Induslnd Bank	15.36	14.15	13.21	17.51	16.3	15.306	1.701332	-0.01474
Yes Bank	16.4	15.09	18.41	17.16	22.71	17.954	2.918703	-0.07816

Yes Bank has the highest ratio as it is state that the high the ratio is significant for return on net worth. It is i.e. 17.954 for Yes Bank whereas Axis Bank has the lowest ratio of 11.04 for return on net worth. Yes Bank ranks 1st among all the selected private banks (Table 6).

6.3.5. Earning Quality of Selected Banks
The quality of earnings mostly defines the profitability of Bank and explains about its growth and sustainability in future context.

Table 7 Net Profit Margin

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	0.6	8.26	20.06	20.73	20.29	13.988	9.13903	-0.58532
HDFC Bank	21.79	20.99	20.41	21.07	20.61	20.974	0.530547	0.014016
ICICI Bank	12.33	18.09	18.44	22.76	22.2	18.764	4.175216	-0.13672
Indusland Bank	20.86	19.9	19.74	18.5	17.05	19.21	1.470476	0.051714
Yes bank	20.84	20.27	18.76	17.32	16.2	18.678	1.949364	0.06499

HDFC Bank have the highest average of net profit margin as it indicates the management Net Profit Margin is highest of HDFC Bank i.e. of 20.974 whereas Axis Bank has lowest Net Profit Margin i.e.13.988.

6.3.6. Return-on-Assets
ROA is calculated to measure the efficiency in the management its assets to generate earnings.

Table 9 Return on Assets

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis-Bank	0.082	0.65	1.720	0.079	0.083	0.523	0.713	-0.004
HDFC-Bank	0.073	0.078	0.083	0.080	0.083	0.079	0.004	-0.029
ICICI-Bank	0.075	0.083	0.081	0.078	0.075	0.078	0.004	-0.002
Induslnd-Bank	0.083	0.088	0.090	0.094	0.100	0.091	0.007	-0.046
Yes-Bank	0.068	0.080	0.083	0.085	0.093	0.082	0.009	-0.074

It is stated that the highest average ratio among the above suggested that its management is most efficient to use assets to generate earnings. Axis Bank has the highest Return on Assets ratio of 0.523 whereas HDFC Bank has the lowest ratio i.e. of 0.079.

6.4. Liquidity of Selected Banks
Liquidity of any Bank shows significance of financial soundness. It tells about capacity of bank to encounter its financial commitments.

6.4.1. Cash Deposit Ratio
Table No. 10 Cash Deposit Ratio

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	7.64	6.89	6.2	6.11	5.97	6.562	0.699192	0.063603
HDFC Bank	9.95	5.71	5.77	6.46	6.02	6.782	1.795402	0.133853

Yes Bank	5.35	5	5.43	5.92	5.58	5.456	0.335604	-0.01047
ICICI Bank	6.17	6.45	6.74	6.85	6.54	6.55	0.264858	-0.01445
Indusland Bank	6.73	5.59	5.12	6.28	6.69	6.082	0.706449	0.001491

Table 10 stated that the higher the average ratio among the above suggested banks will be most efficient for cash deposit ratio. From the above calculation HDFC Bank has the highest average ration among all the other banks i.e. of 6.782. Whereas Induslnd bank has lowest average ratio among all.

Table 11: Credit-Deposit-Ratio

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	93.63	92.17	91.1	84.71	80.03	88.328	5.755495	0.040017
HDFC Bank	84.68	85.64	83.24	81.71	81.79	83.412	1.741341	0.008719
Yes bank	97.73	90.53	85.64	79.33	72.71	85.188	9.696129	0.076734
ICICI Bank	92.92	98.69	105.08	104.72	100.71	100.424	4.988299	-0.01993
Indusland Bank	92.75	91.77	94.06	92.02	86.74	91.468	2.788901	0.016889

Table 11 state that the higher the average ratio among the above suggested Banks will be most efficient for Credit Deposit Ratio. From the above calculation ICICI Bank has the highest Credit Deposit Ratio i.e. of 100.424.whereas HDFC Bank has lowest Credit Deposit Ratio.

Table 12 Investment Deposit Ratio

	2018	2017	2016	2015	2014	Mean	St.Deva	CAGR
Axis Bank	32.57	32.47	37.38	40.75	42.6	37.154	4.625855	-0.06491
HDFC Bank	31.88	31.79	33.13	35.13	35.05	33.396	1.634833	-0.02342
Yes Bank	34.47	38.83	47.04	52.95	59.46	46.55	10.16603	-0.12742
ICICI Bank	34.68	35.32	44.32	52.43	55.79	44.508	9.631795	-0.11207
Indusland Bank	31.19	30.93	33.55	34.48	35.96	33.222	2.154593	-0.03495

Table 12 stated that the higher the average ratio among the above suggested banks will be most efficient for Investment deposit ratio. From the above calculation Yes Bank has the highest average ratio among all the other banks i.e. of 46.55 Whereas Induslnd bank has lowest average ratio amongst all i.e. 33.222.

6.5. Result of Hypothesis

Table 13: One Way Anova

TREATMENT 1	TREATMENT 2	TREATMENT 3	TREATMENT 4	TREATMENT 5
0.6	8.26	20.06	20.73	20.29
21.79	20.99	20.41	21.07	20.61
12.33	18.09	18.44	22.76	22.2
20.86	19.9	19.74	18.5	17.05
20.84	20.27	18.76	17.32	16.2

SUMMARY OF DATA						
	TREATMENTS					
	1	**2**	**3**	**4**	**5**	**TOTAL**
N	5	5	5	5	5	25
$\sum$X	76.42	87.51	97.41	100.38	96.35	458.07
Mean	15.284	17.502	19.482	20.076	19.27	18.3228
$\sum$X^2	1496.6382	1642.9387	1900.6105	2033.9278	1882.439	8956.554
St.Deva	9.0641	5.2759	0.8469	2.1621	2.5384	4.8452

Table 15: ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	76.1133	4	19.02833	0.780945	0.0501	2.866081
Within Groups	487.3156	20	24.36578			
Total	563.4289	24				

From the SPSS output, the ANOVA table displays the F-value as 0.78095. Since, the probability value is 0.0501 i.e. $p > 0.05$, researcher interprets that the null hypothesis is rejected; concluding that there is a statistically significant difference between the mean values of CAMEL Model ratios. This signifies that there is a significant difference in the performance of the selected private banks.

7. Conclusions

Banking system of any country plays a major role in economic growth of the country. CAMEL Model approach is a significant tool to assess the relative financial strength of private banks and to suggest necessary measures to improve weaknesses of a bank. This study has examined the performance of five private sector selected banks in India during the fiscal year 2014-18 highlighting performance wise ranking of fifteen banks using CAMEL Model ratios.

Based on the Capital Adequacy ratio parameters, the researcher found that for the period of FY 2014-2018, ICICI bank bags the top position compared to other banks, while Indusland bank has the lowest position. However, based on Assets quality parameters, Indusland bank is on top position, while axis bank has lowest position. Also, under Managerial Efficiency has top position bank, while ICICI bank has lowest position. Based on Earning Ability, HDFC bank has top position; whereas Axis bank has lowest position. Based on Liquidity parameters, ICICI bank is on top, while Induslnd bank is on lowest position. Bearing in mind all the parameters of CAMEL Model, ICICI bank is found to be on top position due to its strong performance as measured through CAMEL Model ratios; followed by Axis Bank, HDFC Bank, Indusland bank and Yes Bank. Alternatively, Induslnd Bank has the lowest- position,

due to its poor performance as measured through CAMEL Model ratios. Therefore, it can be concluded that, Induslnd bank needs to work upon its weaknesses and improve the studied ratios of the CAMEL Model.

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Impact Of Merger And Acquisition On Profitability Performance Of Selected Merger(A Case Of Vodafone Idea Merger)

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Abstract-

Mergers and acquisitions are vital choices taken for boost of an endeavor's blast through improving its assembling and promoting tasks. They are Adopt to use and gain advantage power, expand the purchaser base, cut competition or enter into a brand new market or product section. When globalization of the Indian financial system was started out in 1991, it believed that it would suggest foreigners not handiest doing enterprise in India but additionally taking over Indian organizations. The objectives of the paper are to study the case of Vodafone Idea related to M&A's and analyzing its pre and post - performance of company and its impact on the profitability performance of the selected companies. The study is based on an analytical research. The data are taken from secondary sources from the various websites. The duration of the study is one year pre and one year post of the selected companies. The base year is consider as zero. To analyze the profitability performance, ratios and t test has been used as a tool for further analysis of the paper.

Keywords*: Merger, Acquisition, Telecom sector, profitability, Globalization*

1. Introduction

An Overview

Mergers and acquisitions are topics of abundant interest in boardrooms and media currently. Be it associated with the synergies formed by the merger as just in case of Idea and Vodafone merger or be it an intention for dispute as in case of Panaya acquisition by Infosys, news studio are flooded with the problems that relate with M&A's. All industry on reaching its maturity stage begin consolidating. Great players attain the small or niche players and industry is controlled by few big players. This condition was openly visible in the Indian telecom business where the excitement created by Reliance Jio's publicity offer of providing free data and call services improved the competition in the business which was followed by the merger of Idea and Vodafone and also Bharti Airtel saying the acquisition of various minor players.

To study the case of Idea and Vodafone and also analyzed its pre and post - performance of company and its impact on the profitability performance of the selected companies, this paper

presents an overview related to the Vodafone-Idea that we get to hear in media every day. The aim of the paper is to get the valuable knowledge related to the Merger and Acquisition's case of Vodafone-idea. This paper also analyzed the companies' pre and post-performance i.e. the performance before the M&A and after the M&A. The paper throws the light on the Mergers and Acquisitions' impact on profitability performance of the companies.

Merger

A merger is a mix of at least two organizations into one business which could possibly prompt the rise of another element. In this manner, a merger can happen by the method for ingestion or by the method for solidification. Merger by the method for absorption means meeting up of at least two associations where one of the association loses its personality and the different gets by, with their joined resources, liabilities, advances, and organizations. Amalgamation is the term utilized for solidification in India. Union includes the formation of another association by meeting up of at least two associations where the blending associations lose their personality to shape an altogether new association with their consolidated resources, liabilities, advances, and organizations (Godbole, 2013). Meeting up of Holcim and Lafarge to frame Lafarge Holcim, a worldwide bond mammoth is the best case of the merger by combination. The terms merger and securing are utilized as equivalent words in writing yet there is a dainty line of contrast between the two.

Acquisition

The Acquisitions is a procedure through which the procuring organization gets a controlling enthusiasm for the offer capital of the gained organization. In acquisitions, there is an adjustment in the executives of the obtained firm however both the organizations hold their different legitimate personality (Godbole, 2013). Acquisitions can be inviting just as unfriendly. Unfriendly acquisitions are named as takeovers. Acquisitions ordinarily occur inside firms of various sizes. Generally, enormous firms are said to have procured little firms.

Company Profile

Vodafone Idea Limited

Vodafone Idea Limited is an Indian telecom administrator with its headquarter situated in Mumbai, Maharashtra. Vodafone Idea is a container India incorporated GSM administrator offering 2G, 3G and 4G VoLTE portable administrations under two brands named Vodafone and Idea. Vodafone Idea additionally gives administrations including Mobile installments endeavor contributions and diversion, open by means of both advanced channels just as on-ground contact focuses, focuses the nation over. As of June 2019, Vodafone Idea has an endorser base of 320 million, making it the second biggest versatile media communications organize in India and 6th biggest portable broadcast communications arrange on the planet. Vodafone Idea has a broadband arrangement of 340,000 goals, scattering reach of 1.7 million retail outlets. On 31 August 2018, Vodafone India merged with Idea Cellular, and was renamed as Vodafone Idea Limited. In any case, the mixed component continues using both the Idea and Vodafone brand. Starting at now, the Vodafone Group holds a 45.1% stake in the joined substance, the Aditya Birla Group holds 26% and the remainder of the offers will be held by the all-inclusive community. Kumar Mangalam Birla heads the solidified association as the Chairman and Balesh Sharma used to be the CEO. After a make a plunge offer cost of Vodafone Idea by 80% on NSE,

Balesh Sharma gave up refering to singular reasons. Ravinder Takkar, Ex-CEO of Vodafone Romania and the key course of action mediator from Vodafone has accepted command over the guidelines as CEO.

2. **Review of Literature**

S.No.	Name of the Author	Year	Title	Objective of the study	Results
1.	Jinling Jiang	2019	An Empirical Study on M&A Performance: Evidence from Horizontal Mergers and Acquisitions in the United States	• To recognize the horizontal M&A events between 1995 and 2005 when both sides of M&A are registered businesses in the United States. • To compare the volatility of stock prices in the event window of each participant to test the short-term performance of horizontal M&A.	This paper choice the horizontal M&A events somewhere in the range of 1995 and 2005 when the two sides of M&A are recorded organizations in the United States. Occasion study technique is utilized to look at the unpredictability of stock costs in the event window of every member to test the short term level of M&A. The exact aftereffects of this paper demonstrate that the securities exchange in the United States has reacted about seven days before the declaration date of even M&A because of the absence of institutionalization of data divulgence or insufficient administrative methods. Horizontal M&A improve the investor abundance of the objectives for the time being, while cause loss of investor abundance of the bidders on the declaration day of M&A.
2.	Natika Poddar	2019	A Study on Mergers and Acquisition in India and Its Impact on Operating Efficiency of Indian Acquiring Company	• To examine the impact of M & A on the acquirer's operating efficiency. • To understand Macroeconomic environment besides the effects of the Merger,	The results can be attributed to numerous factors including Indian companies paying less than essential attention to integration issues early in a deal. Global organizations, then again, before inking the arrangement, interest for a point by point cooperative energy evaluation and

				which impacts the performance of the Acquirer.	coordination plan. Different variables could be that after the arrangement, the obtained resource may not hold as much consideration and be permitted to rundown in worth and social difference and post-coordination obstacles. Indian organizations still need to enhance abilities required to screen the accomplishment of arrangement while the objective might search for cost reserve funds, cooperative energies for the new course of action.
3.	Atashi Bedi	2018	Post-Acquisition Performance of Indian Telecom Companies: An Empirical Study	To examine and compare the financial performance of the telecom acquirer companies pre and post-merger.	The result of the study showed that however the organizations may have had the option to use the cooperative energies emerging out of the merger and securing bargain, yet they have not had the option to improve their liquidity position, which is obvious from the diminishing Current proportion in a large portion of the cases barring Bharti Airtel and Vodafone. The Profit Margin additionally did not indicate much improvement after the merger which is a significant apparatus as it demonstrates the impact of merger on the benefits of the organization and to legitimize the choice taken by the administration to the investors. Likewise, the dissolvability position of firms was adversely influenced by the merger exercises. The aftereffect of the t-Test directed demonstrated that there was no distinction between the mean score of the different proportions determined in the pre and post-

					merger period. This demonstrated by and large the monetary presentation of the telecom organizations did not improve in short pursue the Merger and Acquisitions.
4.	D Satyanarayana, Dr K Sambasiva Rao and Dr S Krishnamurthy Naidu	2017	The impact of Reliance Jio on Indian mobile industry: A case study on mergers and acquisitions of idea – Vodafone and Airtel – Telenor	• To study the impact of new entrant R-Jio on competitive plans of rivals in the industry. • To evaluate the main variations in Indian telecom industry.	Reliance Jio's free presenting offer makes part of radical and sudden changes in buyer's practices and rival's procedures. The effect of this new contestant influences balance in the versatile business and makes rivals powerless that they resort to mergers and acquisitions in Indian portable system suppliers. Since the leave hindrances are available in the business, they can't escape the business. It will be unreasonably hard for little players in the business to make a noteworthy piece of the pie. The main alternative to end up more grounded to contend with Jio is to make vital coalitions with different contenders The significant goliaths in the business viz, Airtel and Idea deliberately reacting along these lines. To fortify themselves in the business, Airtel and Idea gaining Telenor and Vodafone separately.

Research Gap

Many companies consider Mergers and Acquisitions as a means of development in this competitive world. Later, it becomes significant to know whether mergers of businesses have led to an improved performance or not. Because, only then one can explain the use of mergers as a vital tool of company plan. Numbers of studies are concluded as the performance evaluation of different sectors of industries but the researcher wants to study about the case of telecom companies and to know impact on the profitability performance of the merged company. So, the researcher choose this topic which will be helpful for the further study.

Objectives Of The Paper

1. To study the case of Vodafone Idea related to M&A's.
2. To analyze its pre and post - performance of M&A companies and its impact on the profitability performance of the merged company.

Need Of The Study

In today's times, India's economy is growing very quickly and every businesses wants to increase their business activities at a great level, Merger and Acquisitions is one of the better way to choose as an option to widen the business area. Is Merger and Acquisition beneficial or not? For this researcher study the case of Vodafone Idea after the M&A. So that researcher also need to carry out the research to analyze the impact on profitability performance of the merged company.

Hypothesis Of The Study

H_{O1}: There is no significant difference between pre and post Mergers & Acquisitions on profitability performance of Vodafone Idea.

Research Methodology

➢ The researcher has done descriptive research for case of Vodafone Idea as well as analytical research for pre and post-performance of M&A companies and its impact on the profitability performance of the merged company.
➢ The data is collected from the secondary sources such as various news websites, company site, research paper etc.
➢ The merged year of Vodafone Idea is 2018 and for the analysis purpose, data are taken one year from pre and one year from post of mergers and acquisitions of the selected company. The merged year have been taken as base year and considered as zero.
➢ Idea and Vodafone are taken into the study.
➢ Ratios and t-test are used to measure the pre and post profitability performance of merged company.

Analysis Of The Study

To study the case of Vodafone Idea related to M&A's

The Merger between Vodafone and Idea became approved by way of NCLT Mumbai bench on 30th August 2018 this means that the Merger have become effective from 31st August 2018. As in step with the scheme of association, Vodafone will combine its subsidiary in India i.e. Vodafone India with concept that's listed on Indian stock change. The mixed entity is really worth extra than $23 billion. The deal is said to be the Merger of equals. The two organizations agreed to merge their operation with a change ratio of 1:1 i.e. every one proportion held via shareholder of concept could be exchange by means of one percentage of the merged corporation. The deal has been dependent in one of these way that, on crowning glory of this deal, Vodafone will end up getting 45.1% stake in mixed entity and Aditya Birla organization owned via Kumar Mangalam Birla will personal 26.0% stake in merged entity after obtaining 4.nine% from Vodafone for Rs 3875 crore, whereas, concept's other stake holder will own the ultimate 28.9% stake. Further, Birla organization could have a right to accumulate

extra 9.5% stake from Vodafone over next four year from the date of merger to comply with the condition of "Merger of Equals", but if equalization isn't finished because of incapability of Aditya Birla group to acquire these more 9.5% stake from Vodafone the Vodafone is obliged to promote these extra stake in percentage market. However till equalization is performed, balloting on excess stake held by Vodafone is constrained and is to be exercised jointly as according to the settlement of deal.

The merged entity referred to as "Vodafone concept Ltd" will have 12 directors' consisting unbiased administrators. Identical illustration is being provided to each Aditya Birla organization and Vodafone, the chairmanship being provided to Mr. Kumar Mangalam Birla. The Merger of Vodafone and concept will make it internationals' 2nd biggest telecom organization and India biggest telecom organization.

BENEFITS DUE TO M&A

1. Largest Telecom Operator
   - Generating India's biggest broadcast communications business
   - Mutual Subscriber base of almost 400 million
   - Joint RMS of 40.7%2 and CMS of 35.1%
   - Leadership place (#1/#2 rank) 2 of every 21 (out of 22) telecom circles

2. Complementary Footprint
   - Biggest existing Mobile Voice populace inclusion of 1.1bn Indians
   - Pan India Broadband currently covering ~650mn Indians; resolved to arrive at 1.1bn
   - Strong brand request crosswise over metro, urban, rustic and profound inside business sectors
   - New initiative situations in 7markets (incl. Delhi, UP (W), UP (E) and Punjab)

3. Wide Scale Network
   - Deepest Pan India GSM arrange structure of 273,000 GSM locales
   - Fast expanding current Mobile Broadband system spread of more than 189,000 locales
   - Release of covering hardware for increment of versatile broadband administrations to revealed topographies

4. Largest Spectrum Portfolio
   - Substantial in general range holding of 1,850 MHz1 over numerous groups
   - Auction gained changed range quantum of 1,645 MHz
   - Large broadband (3G/4G) range arrangement of 1,429 MHz
   - Premium 900 MHz band in 17 circles

5. Highest Broadband Capacity
   - 163 portable broadband bearers – most noteworthy among all administrators
   - 3G - Pan India 344 bearers with 2 transporters in 11 initiative telecom markets
   - 4G - Pan India 1294 bearers and capacity to present to 250 Mbps* in 12 markets
   - Large fiber system of around 2, 50,000^ kms

- Ability to assemble huge broadband limit on existing range

6. Business Expansion
    - Higher support in advancing Digital Services including Content
    - Larger canvas for Payment Bank Services to 400mn existing versatile clients
    - Scale up nearness in Fixed Line fragment including FTTH, MPLS and so on.
    - Deeper entrance in the Enterprise – MNC, National, Regional and SMEs

To analyze its pre and post - performance of M&A companies and its impact on the profitability performance of the merged company

Table – 1 Pre and Post analysis of selected companies

S.NO.	PARTICULARS	2017 PRE-PERFORMANCE		AVERAGE OF PRE-PERFORMANCE	2019 POST-PERFORMANCE
		IDEA LTD.	VODAFONE INDIA		VODAFONE IDEA LIMITED
1.	Net Profit Margin	-20.23	-2.35	11.29	-39.90
2.	PBDIT Margin	15.01	29.07	22.04	12.87
3.	PBIT Margin	-10.22	7.25	-1.48	-26.31
4.	PBT Margin	-10.06	-4.02	7.04	-49.53
5.	Return on Net worth/Equity	-5.09	-3.50	4.29	24.48
6.	Return on Capital Employed	6.18	3.24	4.71	-5.56
7.	Return on Assets	-2.35	-0.86	1.60	-6.35
8.	Total Debt/Equity	3.22	2.18	2.7	1.82
9.	Asset Turnover Ratio	5.25	36.83	21.04	16.14

FIGURE- 1 Graphical representation of Pre and Post analysis of selected companies
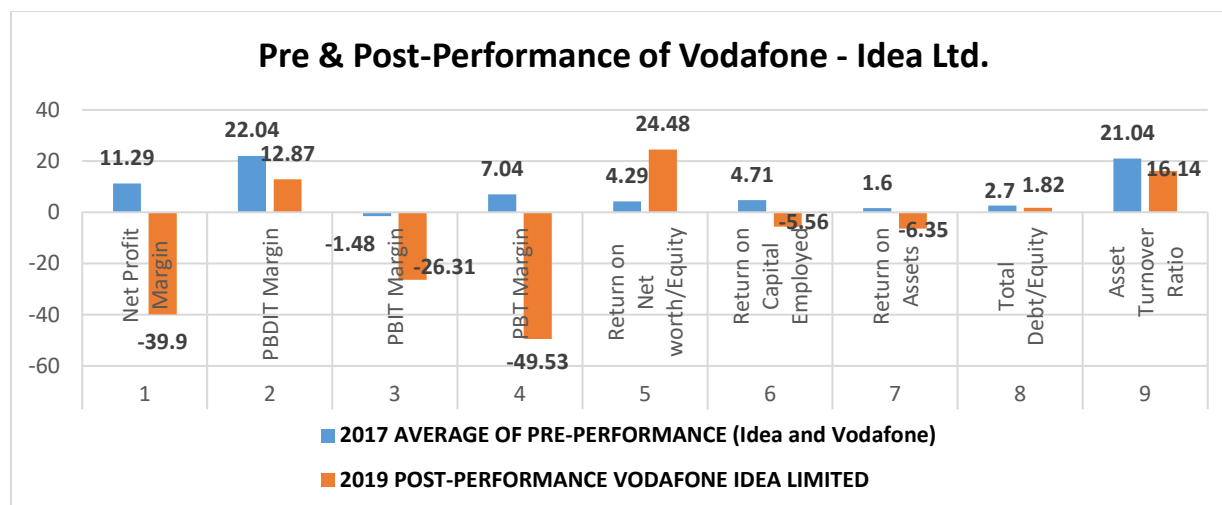
Table – 2 t-Test: Paired Two Sample for Means

t-Test: Paired Two Sample for Means		
	Variable 1	*Variable 2*
Mean	8.136666667	-8.037777778
Variance	70.281175	656.9936944
Observations	9	9
Pearson Correlation	0.305521741	
Hypothesized Mean Difference	0	
Df	8	
t Stat	1.987638863	
P(T<=t) one-tail	0.041036246	
t Critical one-tail	1.859548038	
P(T<=t) two-tail	0.082072492	
t Critical two-tail	2.306004135	

Interpretation

In the case of Vodafone Idea Ltd., Net Profit Margin in the pre performance as well as post performance of M&A is negative that shows the company is unable to recover the cost of the company and also reflect decrease in profit. The PBDIT Margin showed earning capacity of the company which is positive in both performance i.e. pre & post performance of the Vodafone Idea Ltd. The PBIT Margin is negative in pre & post performance of the company that showed the paying capacity of the company is not good. The Return on Net worth/Equity in the pre period is negative but after the M&A between Vodafone and Idea Ltd. performance is positive that showed that company is generated profit from the sale of an equity shares. The Return on Capital Employed in the pre performance is positive that showed both the companies generated their profits from the capital but after the M&A, Return on Capital Employed is negative due to the inefficiency of profits generated from the capital. The Return on Assets is negative that showed the company's assets are unable to generated revenue. The Total Debt/Equity is positive that showed the new company is able to finance its operations through debt and wholly owned funds. The Asset Turnover Ratio is positive in pre and post-performance that showed an efficiency's of a company use its assets in generating sales revenue to the company.

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Above the analysis, the critical t-value at the p = 0.05 significance level for a two tailed test at the probability value is 2.30 and calculated t-value of parent company is 0.08. The calculated t-value is in accepting area so, the null hypothesis is accepted. This showed that there is significant difference between pre and post Mergers & Acquisitions on profitability performance of Vodafone Idea that improve the performance of parent company after the M&A.

Suggestions Of The Study

1. The Vodafone Idea Ltd. needs to reduce the cost of the company and try to find out the way to enhance the profit.
2. The company try to increase the sales from the equity shares and improve the paying capacity of the company.
3. The company needs to improve Return on Assets. So, the company can generated revenue from the assets.
4. The company should increase an investment to get the better return to the company.
5. The Vodafone Idea Ltd. should improve their call facilities, minimize the call drop and call cross connection of call to be stop and enhance the customer satisfaction.
6. The company should upgrade their signal tower for better quality services.

Conclusion

It is concluded that the Vodafone had improved the profitability performance after merged with Idea Ltd. The merged company Vodafone Idea Ltd. had positive impact on the company due to the positive result in asset turnover, total debt/equity, and return on net worth/equity and also have positive result in profit before depreciation, interest & tax after the Merger with Idea Ltd. The company needs to improve the earning, generated revenue from the sales of shares and also try to find out the way to reduce the overall cost of an entire company. At the end, the profitability performance of the merged company improved a lot.

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The Mediating Effects of Economic Growth on Public Expenditure and Human Development in India

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Abstract-

Public finance is the strategic process of organized spending by public authorities. It is essential for proper allocation of resources and to facilitate various public services. Government spending activities are accountable for whole performance of the country which can be measured through the nation's Economic Growth. However, in the present scenario, a country whether developed or developing not only has the basic objective to ensure economic growth but also to achieve Human Development. A nation by providing its citizens with basic amenities like food, clothing, housing along with additional facilities for health, education, better standard of living etc. prepares the path towards development. So, the purpose of this paper is to shed light on the association between the Public Expenditure, economic growth and human development. Although, the previous studies have contributed significantly in this area but, they do not discuss the mediation effect of Economic Growth between Public Expenditure and Human Development. The present study tries to fill this gap in case of India. The results show that there exists a significant linkage between Public Expenditure and Human Development as a mediation intervention through Economic Growth. It is also shown that merely 20% of the changes in Human Development are accounted by Public Expenditure only and 80% are coming through Economic Growth.
Hence, from the results it could be said that the Government spending should be done in such a way which regulates the distribution of income in order to achieve economic efficiency and thereafter Human Development.

Keywords: Public finance, Government expenditure, Social welfare, Economic growth, Human development

1. Introduction

Public finance is the strategic process of organized spending by public authorities for social welfare. The origin of public finance would be said with the beginning of the state itself. This process subsists form last so many years in the history of world economic literature. It acquires evidence from ancient treaties *Arthashastra* of *Kautilya* which covers treasury, sources of revenue, accounts, and audit in a very detailed way (Maria & Kennedy, 2012). He advocated the slogan '*Income should be used to the provision of social infrastructure*'.

Public expenditure was limited to laissez-faire philosophies until 19th century. The idea of laissez-faire policy was restricted with the least government interventions in the functioning of an economy (Naggar, 1977). Thereafter, in the early 20th century Prof. Keynes debated on laissez-faire and emphasized that the government has an imperative role to play in the optimal economic performance. Further, he said that the government could achieve this by stabilizing the existing and incorporating the new economic intervention policies. Then after World War II, government expenditure showed an increasing trend across the world and thus, public finance became essential. Public finance ensures that there should be a proper allocation of resources, distribution of income and stability in the economy (Prest, 1959).

Talking about India, a significant expansion of government participation was observed since 1990's. During that time, the Indian economy was facing significant policy shifts and was emerging with world economies (Upadhyay, 1994). Since India is a democratic nation, where the government is elected by the people so, it must be very much liable for the benefit of the people and of society. The Government ensures the welfare of the people by spending the money in such a way that will provide them with adequate healthcare facilities, education and vocational training either free of cost or at a subsidized rate. Therefore, public sector services or public expenditure are somehow accountable for the performance of the economy and its citizens at large (Lenutha, 2005; Afonso & Furceri, 2010). The performance of the spending activities of the government can be measured through the nation's economic growth which is measured through the Gross Domestic Product (GDP). It is defined as the total value of annual production of goods and services in a country and this leads to a rise in national income. In general, the development of a country was measured in terms of Gross Domestic Product but subsequently, per capita GDP became an important indicator because it provided the measure for economic growth per head (Costanza, Hart, Posner & Talberth, 2009).

However, during 1970-80s the economists started debating that GDP prioritizes growth-oriented vision of economic well-being only, as it measures only fiscal transaction related to the production of goods and services within the country. Accordingly, it provides an incomplete depiction of the system within which the human economy operates. So, the need of the hour was that the emphasis should be on a healthy lifestyle, employability followed by redistribution of income to ensure growth and better living standards (UNDP 1994). They argued that GDP was a determinant for economic quantity, not economic quality or well-being.

Then in 1990's, a new concept evolved which shifted the focus from mere economic growth to human development. In the present scenario, a country whether developed or developing has the basic objective to ensure human development and it can be measured through HDI (Lenutha, 2005). The UNDP report of 1990 defines Human Development Index as "a summary measure of average achievement in the key dimension of human development: a long and healthy life, being knowledgeable and having a decent standard of living. It is the geometric mean of normalized indices for each of the three dimensions". Developing countries (including India) strives hard not only to achieve economic growth but also to ensure human development by providing its citizens with basic amenities like food, clothing, housing along with additional facilities for health, education, better standard of living etc. (Bhatia, 2018). On the other hand, the developed countries want to achieve better human development because they want to provide a better standard of living for their people along with sustainable development (Rains, Stewart &

Ramirez, 2000). Human development is both qualitative as well as a qualitative phenomenon (Stanton 2007; Anand, 2018).

In this paper, we are paying attention towards examining the relationship between public expenditure, economic growth and human development. Further we want to explore, whether government spending ensures human development directly or is it that economic growth plays a mediating role between public expenditure and economic growth.

The scheme for rest of the paper is organized as follows. Section 2 presents the review of literature on the relationship between public expenditure, economic growth, and human development. Section 3 describes the research methodology used, model specification and variables identified for the study. Section 4 analyzes the empirical results of the study and finally, section 5 presents the conclusion and policy implications of the study.

2. Review of Literature

Post World War II, world economies believed that public expenditure is a weapon in the hands of national governments and that can ensure the welfare of the society as a whole. Public expenditure is the key aspect that has an essential role in the course of economic growth of any of the nation (Domar, 1957). As per the theoretical stand, Wagner's Law (1890) stated that increased government spending on public services naturally resulted in economic expansion. In the same line, Feder (1983) conducted a study with a sample of 115 countries, using Granger causality approach. His results showed that a positive relationship exists between government size and economic growth for majority countries. Supporting this was the study done by Ram in 1986, where he said that government size has a positive association between economic performance and growth. Thereafter, another endogenous growth model was given by Barro in 1990, which provided a theoretical understanding of the relationship between public expenditure and economic growth. He debated that the increase in public spending can affect economic growth in either of the ways i.e. positively or negatively. Finally, he concluded that the expenditure should be productive for the attainment of economic growth. In another study done by Hsieh and Lai in the year 1994 for G-7 countries, suggested that the relationship between government spending and growth can vary significantly across time as well as across the major industrialized countries. The results also highlighted that there was no consistent positive association between government spending and per capita GDP. Thereafter, the study done by Ergun & Tuck in the year 2006 found that there exist a causal effect of government expenditure on national income only in the case of the Philippine and not for the other nations under study i.e. for Indonesia, Malaysia, Singapore, and Thailand. Then in the year 2009, Chimobi explained that government expenditure causes an increase in the national income for Nigeria. Later, Mohapatra and Giri in the year 2016 investigated the role of public expenditure on economic growth in India; the data was taken from 1980-2013. They found a significantly positive long term impact of public expenditure on economic growth.

Economic growth translates into human development as a next step process. Human Development Index tells that some other qualitative constraints contribute towards long term standards of living, such as access to health, education, and accessibility of goods (UNDP, 1990; Anand & Sen, 1994). Behrman in 1993 and later in the year 1996 explained that households' spend their income on the items which directly contribute towards human development,

(likewise- food, education, health, and housing). They said that, with the rise in the income of the poor, the proportion of income spent on human development items will also increase. Another study done by Rains and Strewarts in the year 2005 reveled bidirectional relationship among economic growth and human development; one has to encourage both to sustain progress in either. The two-way association between economic growth and human development has been rigorously established in the literature. Qureshi in the year, 2008 stated that the concept of human development puts people at the first priority, which further demands higher level of government commitment to achieving the desired level of human development.

Thereafter, the potential linkage was also studied by Lenuta in the year 2015 and he suggested that government expenditure could be a linking bridge between the nation's income and Human Development. Afterward, Saksena and Deb in the year 2016 explored that the main intention of development is increasingly being recognized as human development instead of economic growth alone. Therefore, the concern of human development in the present is to attain sustainable human development which is the foremost objective of human development (UNDP, 2000; Anand & Sen, 2000).

The purpose of this paper is to shed light on the association between public expenditure, economic growth, and human development. Although, previous studies contributed significantly, however, they do not discuss the relationship between public expenditure, economic growth and human development collectively. From the literature, it is also evident that as compared to other nations, less work has been done for India especially focusing on Human Development. Our work is different from the existing literature, as here an attempt has been made to investigate the mediation intervention of economic growth on government expenditures and human development in the case of India. The analysis can provide a significant contribution to the existing literature.

The objective of the study is:
- To determine the function of economic growth as a mediator between public expenditure and human development in India.

3. Research Methodology

The present study has used data for the period starting from the year 1995-1996 to 2016-2017. The period is of great significance since it was the beginning of the new economic policy and was the introduction of economic reforms (Upadhyay, 1994).

The study hypothesized the mediation effect of EG between PE and HD. GDP per capita and the Human Development Index are the proxies considered for economic growth and human development. The data for total public expenditure was collected from the various volumes of Indian Public Finance Statistics (published by Ministry of Finance); data for GDP per capita was collected from International Monetary Fund and the HDI was taken from United Nation Development Program reports & from Global Data Lab. In order to study the relationship, the data of EG and PE was normalized by transforming them into their natural logarithm.
The hypothesis to be tested is given as follows:
H1: Economic growth acts as a mediator between public expenditure and human development.

The analysis was done in IBM SPSS 24.0, using the PROCESS macro model 4. This model was developed by Preacher and Hayes. It is a provisional method modeling program that utilizes the ordinary least square-based path analytical framework to test the mediation effect (Hayes, 2013). The mediation analysis is a statistical method that tells how an independent variable (in this case PE) affects the dependent variable (i.e. HD in the present case) through an intermediate variable called the mediator (i.e. EG). The effect of PE on HD is referred to as the total effect (TE) and this is represented by "path c" shown in Figure 1 (a). The effect is further portioned into: direct effect and indirect effect. The direct effect (DE) is the effect of PE on HD and is shown in Figure (b), represented by "path c' ". The other is the indirect effect (IE) of PE on HD coming through EG. In Figure 1(b), it is represented by "path a"& "path b" measuring the effect of PE on EG and EG on HD respectively. The indirect effect is calculated by multiplying "path a" by "path b".

Figure 1 (a) Effect of PE on HD without considering mediation
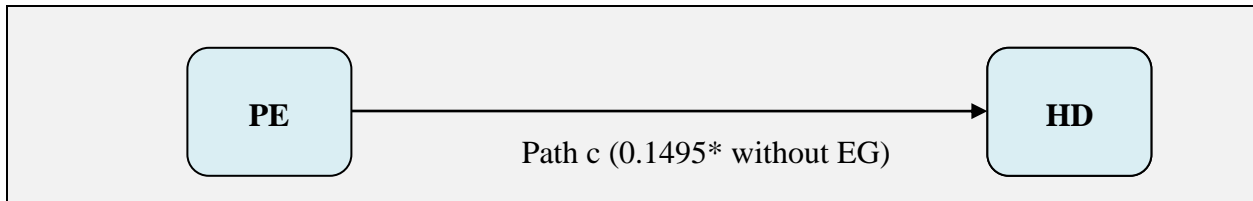
Source: Authors calculation.
Note: Here * means the values are significant

Figure 1 (b) Effect of PE on HD with considering mediation EG
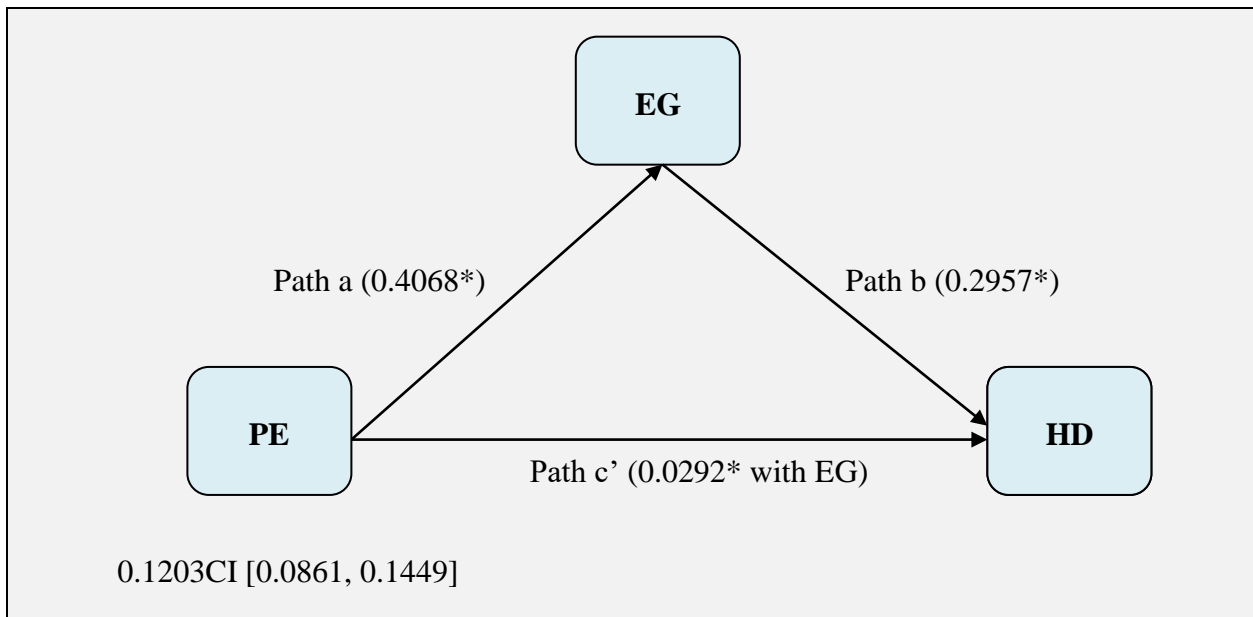
Source: Authors calculation.
Note: Here * means the values are significant
Here PE is public expenditure, EG is economic growth and HD is human development.
The path diagram of the simple mediation analysis is also represented by the following linear equations. In these equations EG is economic growth, PE is public expenditure and HD is human

development. Here, i_M & i_Y are the constants and e_1 & e_2 are the error terms used in equations 1 & 2 respectively.

$$EG = i_M + a\,PE + e_1 \tag{1}$$

The above equation represents Path 'a'. Which shows the effect of PE on EG and it is being measured through coefficient 'a'.

$$HD = i_Y + c'_1 PE + bEG + e_2 \tag{2}$$

This equation represents the direct effect i.e. the effect of PE on HD when EG is kept constant. It is measured through the coefficient c'_1 in the above equation, giving us the value of path c'_1. In this equation the effect of EG on HD is also computed and is measured by coefficient b, giving us the value of path 'b'.

$$c = c' + ab \tag{3}$$

The total effect is measured by equation (3) and is equal to direct effect i.e. "path c' " plus indirect effect i.e. "path a * path b". In the above equation, if the value of path c' is closer to zero then the total effect of PE on HD is said to be coming through the intervention of EG .i.e. EG is then deemed to be a mediator between PE and HD.

4. Results and Discussion

The results of the analysis are shown in the tables below:

Table-1: Total Effect of public expenditure on human development.

Independent Variable PE	Dependent Variable HD	
	Coefficient	P
Constant	0.3601	0.0000***
PE	0.1495	0.0000***

Source: Authors' compilation.
Note: Here *** means the values are significant at 1% level of significance.

The table above shows the total effect of PE on HD. Here, it is found that PE directly affects HD and is found to be significant. This gives us the value of 'Path c' as 0.1495, which means that if PE is increased by 1%, HD will increase by 14.95%. This effect is further studied as a direct effect and an indirect effect.

Table-2: Effect of public expenditure on economic growth.

Independent Variable PE	Dependent Variable EG	
	Coefficient	*p-value*
Constant	2.2625	0.0000***
PE	0.4068	0.0000***

Source: Authors' compilation.
Note: Here *** means the values are significant at 1% level of significance.

The above table (Table-2) shows that PE directly affects EG and is found to be statistically significant. This gives us the value of 'Path a' as 0.4068. It means that if PE is increased by 1%, EG increases by 40.68%.

Table-3: Direct effect of public expenditure on human development when economic growth is kept constant.

Independent Variable PE	Dependent Variable HD	
	Coefficient	*P*
Constant	-1.0291	0.0000***
PE	0.0292	0.0439**
EG	0.2957	0.0000***

Source: Authors' compilation.
Note: Here ** and *** means the values are significant at 5% and 1% level of significance respectively.

The above table (Table-3) shows that PE affects HD directly when EG is kept constant. This gives us the direct effect, which is 0.0292 i.e. when PE increases by 1%, HD will increase by 2.92%. The above table also depicts that EG is directly related to HD and is giving us the value of 'Path b' as 0.2957. It means that if EG increases by 1%, HD increases by 29.57%. All these effects are found to be statistically significant.

Table-4: Indirect effect of public expenditure on human development.

Effect	Lower Limit	Upper Limit
0.1203	0.0861	0.1449

Source: Authors' compilation.

The above table shows that the linkage between PE and HD as a mediation intervention through EG is statistically significant. The value of the indirect effect is 0.1203 and is found to be significant, as zero does not fall between the lower limit and upper limit of the confidence interval (0.0861, 0.1449). This effect of PE on HD can also be compiled by multiplying by "path a" by "path b".

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Further, the direct effect of PE on HD could also be obtained by subtracting the indirect effect (i.e. 0.1203) from the total effect (i.e. 0.1495), which comes out to be 0.0292. This means that merely 20% of the changes in HD are accounted for by PE only and 80% through EG.

5. Implications

The government policy practices through revenue collection (mainly through taxes) and expenditure (spending) mechanism works for the economy's Sustainable and equitable economic growth and development. Here comes great relevance of managing public finances in such a way that standardizes the government expenditure in order to enhance the economic growth and thereafter human development. The government should focus on the quantity as well as on the quality of the expenditure which in turn will improve the economy as a whole.

For ensuring economic growth, first of all, the government requires resources, only then it can provide the required economic and social infrastructure like schools/ colleges/ universities, hospitals, roads, drinking water facilities and housing, etc. To enhance the levels of education and human wellbeing are the main priorities and they should move together directly to enhance economic growth. Subsequently, the allocation of the resources should be done in a way that minimizes the inefficiency and increases the accessibility of these resources for an individual. Further, the Government should identify the relevant sectors (i.e. like agriculture, fishery, small and medium scale industries, and manufacturing) and the required spending should be planned accordingly in order to promote first economic growth and then human development in those very sectors. The crucial emerging lesson should be implemented properly which is the old-fashioned view of "grow first and worry about human development later" (Rains 2004).

6. Conclusions

Sustainable and equitable economic growth is one of the ultimate goals of any economic system across the world, which further leads to human development. At present, countries whether developed or developing want to grasp on their foremost objective i.e. human development. The government uses spending and taxing powers to promote stable and sustainable growth. This can be helpful to speed up the economy's growth rate. Economic growth is a crucial and prerequisite condition for human development which considers human resources first. The main focus of human development is to get better living standards for the citizen. In this study, we found that public expenditure was significantly associated with human development via economic growth. Furthermore, the findings suggest that for the improvement in HD, the government should focus upon the increments in EG which further ensures expansion in human wellbeing. In addition to this, the study suggested that HD issues will have to wait until a country has attained a certain level of EG.

The findings of this study open some directions for future work in economics and finance literature. Future studies are invited to investigate the mediation effects of government expenditure on economic growth and human development in other countries. Another potential area for future research possibly would be to study how the public expenditure in different areas like health, education, and housing could lead to economic growth and ultimately to human development. However, the management of public finance becomes a necessary part to study.

This is especially true in the current financial environment, where governments all around the world are taking on unprecedented levels of debt and other financial risks and responsibilities.

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A Study of Monetary Policy and its impact on GDP Performance(With reference to Indian Economy)

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Abstract-

For maintaining stability and growth in the economy, every nation has to maintain good structure of monetary policies for achieving the country's development goal. Monetary policy affected through various scales like money supply, interest rates, and inflation rate according to these indicators monetary policies dynamically changed to maintain price stability and required economic growth rate.

GDP Referred to national income of the country which determines the economic growth of the country and it depends upon the monetary policy, so it is very important function to establish good balance between monetary and GDP of the country. The present paper emphases on the impact of monetary policies on the GDP, for this associated variable also have been studied for proving hypothesis.

The duration of the study is from year 2014-15 to 2018-19, descriptive analysis, correlation and regression has been done to conclude remarks, and analyzes the influence of Monetary policy on GDP. Secondary data has been taken from RBI monetary policy reports.

Keywords: Monetary Policies, Gross domestic Product, Money supply, Interest Rate, Inflation Rate.

1. Introduction

For a long time, the connection between monetary development and inflation has been one of the most broadly explored studies in macroeconomics. In economics, inflation is characterized as the increment in the degree of costs and economic development and is normally characterized as the Gross Domestic Product (GDP). It gauges the market estimations of a nation's last products in a predefined period: GDP here refers to the = Consumption + Investment + Government Expenditure + Net (Exports – Imports).

An expansion in inflation suggests that expenses have gone up. With an ascent in expansion, there is a decrease in the acquiring influence of cash, which diminishes utilization and in this way GDP diminishes. High inflation can make ventures less alluring, since it makes vulnerability for the future and it can influence the national payment (BOP) since sends out become increasingly costly. Therefore, GDP is diminishing further. Thusly, apparently GDP is contrarily identified with inflation. In any case, there are contemplates showing that there may likewise be a positive relationship. The Phillips bend, for instance, shows that high

swelling is predictable with low paces of joblessness, inferring that there is a positive effect on Economic growth.

As indicated by standard political economy hypothesis, an expansion in the quantity of cash should bring down the loan fees in the economy, prompting more utilization and loaning/getting. In the short run, this should, anyway doesn't continually, partner to a development in complete yield and spending and, evidently, GDP is an imperfect depiction of financial effectiveness and wellbeing, anyway ordinarily, higher GDP is more wanted than lower. Rising monetary efficiency will build the value of money available for use since each unit of cash will a short time later be recorded for extra significant product and administrations. An expansion in inflation implies costs have gone up. With an ascent in inflation, there is a decrease in the buying, influence of cash, which diminishes utilization and in this way GDP diminishes. Accordingly, GDP is diminishing further, so apparently GDP is contrarily identified with inflation. India has slipped one indent at interims the globe Bank's Gross Domestic Product (GDP) rankings in 2018, and is as of now the seventh-biggest economy with the UK and France in front of India, information from the universal money related association previously mentioned.

2. Review of literature

(Rakesh Mohan, 2018) **Indian Monetary Policy in the Time of Inflation Targeting and Demonetization** The research paper focused on the narrative events, from year 2009 to 2013, the study considered the introduction of first time monetary policy transmission launched during year 2013 to 2014, agreement took place between Government of India and RBI with effect of this Flexible inflation targeting system was adopted in year 2016 demonetization phase came during this phase how monetary policy instruments regulated and maintain to combat with the situation. (Lopez-Buenache, 2018) **The evolution of Monetary Policy Effectiveness under Macroeconomic Instability** the study talks about the Monetary Policy Transmission mechanism in the period of Great Recession, what techniques and Models adopted to control, and regulate the flow of Billion Dollars, results of the study shows in Year 2008 there was higher response in the Economy which is well maintained through Monetary Policies.

(Francesco Bianchi, 2018)**The Dire Effects of the Lack of Monetary and Fiscal Coordination** Sometimes monetary and fiscal policy could not be applied blindly to combat inflation. The coordination has to be present in both policies, so that commercial bank will follow up the regulation and amendments one by one. It is found that policy mix is not well coordinated, which reflects the disagreement between the two authorities for example, for taking decision in relation to inflation there are many alternatives which could be implemented by authorities but "Inflation should or not be used to stabilize debt" going in different two directions which ultimately leads to explosive dynamics for inflation output and debt.

(Christian Friedrich, 2018) **Monetary Policy and Financial Stability: Cross-Country Evidence** The study explains the group of responses by central banks to maintained Financial Stability in the nation, which is reflected by risk based Financial Stability Orientation (FSO) contains the legal, framework, and components of central banks with view of monetary policies. The study shows the results for the selected cross-country reveals that the central banks with high FSO increase their monetary policy rates in accordance to mitigate financial stability risks by 0.27%, more than the central banks with low orientation.

Economic Performance Indicators under Different Monetary Policy Frameworks: Evidence from India (Madhvi Sethi, 2019) The objective of the paper is to analyses the performance of economic variables under various money related strategy structures in the post-independence period. The financial exhibition pointers utilized in the study are inflation and output Investigating the month to month information from April 1982 to March 2017, the study reveals that the multiple-indicator and the inflation-targeting regimes have had most success in balancing the twin objectives of growth and inflation.

3. **Need of the study**

Researcher finds gross domestic product (GDP) is the important aspect in formation of economy of the country. There are various studies have been done which are based on the monetary policy. Some studies based on comparing the GDP performance with monetary indicators; some based on analyzing the effect of interest rate and inflation on GDP not included money supply, and least for monetary policy framework in Indian context. However, no such study focuses on the three main indicators, money supply, interest rate and inflation, which affect GDP in different ways. Therefore, researcher carried out the research on title "a study of monitory policy and its impact on GDP performance".

4. **Objective of the study**

To find and analyze the impact of interest money supply and Inflation on gross domestic product of India.

Hypotheses

HO= There is no significant impact of selected macroeconomic variable on gross domestic product

HO_1= There is no significant impact of interest rate on GDP.

HO_2= There is no significant impact of money supply (M2) on GDP.

HO_3= There is no significant impact of inflation rate on GDP

Data Collection

In order to check impact of interest rate, money supply and inflation on gross domestic Product of India. The data are collected from year 2014 to 2018. Which is collected through RBI statistical report

Variables

For analyzing the impact of selected macro-economic variable on GDP. We have to understand each variable relationship with GDP.
- GDP

Which is referred to the sum of all goods and services produced within the geographic boundary of nation during the year.
- M 2(Money Supply)

It is the total amount of money available in the economy in the particular time interval.
- Inflation

Increase of paper money is the increase in the prices of goods and services over time. It is a science to do with the producing, distribution, and using up of goods and work supply stretch of time that means you have to use up more to put in your gas moving armor with guns, give money for a gallon of milk, or get a haircut. Full of air increases your price of living. Increase

of paper money gets changed to other form the getting something for money power of each unit of money used in a country.

- Interest rates

The Bank rate, also experienced as the amount taken off a price rate, is the rate of interest requested by the RBI for making ready funds or loans to the banking system.

Data analysis and interpretation

For analyzing the relationship in relation to responsive variable GDP. For predictor's variables, a regression model has been developed

Source: -RBI Reports

Table 1

Regression model statistics for GDP and selected Macroeconomic Variables

Ho= There is no significant impact of selected macroeconomic variable on gross domestic product

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.793[a]	.628	-.487	.66238	.628	.563	3	1	.725
a. Predictors: (Constant), INT, INF, MS									

Table 1.1

In the above table R = .793 which explains that there is strong relationship of responsive variable GDP with Interest rate, money supply, Inflation. R square refer to the coefficient of

YEAR	GDP	MONEY SUPPLY) M2	INFLATION (INF)	INTEREST RATE (INT)
2014	7.40	77.89	5.88	10.25
2015	8.10	78.01	4.97	9.70
2016	7.10	74.69	2.49	8.20
2017	6.60	74.12	4.85	7.90
2018	7.30	73.49	7.65	8.05

determination is at .628 means approximate 62.8% responsive change in dependent variable is due to change in selected macroeconomic variables, the other 37.2% change in GDP due to other macroeconomic variables. Significant p value is at .725, which is more than 0.05 level of significance hence in this case null Hypothesis is accepted.

Regression model statistics for GDP and Interest rate

H_1= There is no significant impact of interest rate on GDP.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.690ª	.476	.301	.45396	.476	2.726	1	3	.197

a. Predictors: (Constant), interest rates

Table 2.1

Model Summary

In the above table R = .690 which explains that there is strong relationship of responsive variable GDP with Interest rate. R square refer to the coefficient of determination is at .476 means approximate 47.6% responsive change in dependent variable is due to change in Interest rate, the other 52.4% change in GDP due to other macroeconomic variables. Significant p value is at .197, which is more than 0.05 level of significance hence in this case null Hypothesis is accepted.

ANOVAª

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.562	1	.562	2.726	.197ᵇ
	Residual	.618	3	.206		
	Total	1.180	4			

a. Dependent Variable: gdp

b. Interpreters: (Constant), interest rates

Table 2.2

In the above table Regression (sum of squares) is .562 which is lower than the Residual (sum of squares) p value is .197 comparing with 0.05, we find model of regression developed for GDP and interest is not significant.

Regression model statistics for GDP and money supply (M2)

H_2= There is no significant impact of money supply (M2) on GDP.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-6.488	7.630		-.850	.458	-30.770	17.793
	Money supply	.182	.101	.722	1.808	.168	-.139	.503

a. Dependent Variable: gdp

In the above table R = .722 which explains that there is strong relationship of responsive variable GDP with money supply. R square refer to the coefficient of determination is at .521 means approximate 52.1% responsive change in dependent variable is due to change in money supply, which is more than the correlation of GDP with interest rate. Significant p value is at .168, which is more than 0.05 level of significance hence in this case null Hypothesis is accepted.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.615	1	.615	3.268	.168[b]
	Residual	.565	3	.188		
	Total	1.180	4			

a. Dependent Variable: gdp

b. Interpreters: (Constant), Money Supply

Table 3.1

By Anova table. Residual value .565 which is more than regression sum of squares .615. Significant value 0.168 is also more than 0.05 level of significant, so we cannot reject null hypothesis and it reveal that model developed for GDP and inflation is not significant.

Table 3.2

Regression model statistics for GDP and Inflation rate

H_3= There is no significant impact of inflation rate on GDP

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.165[a]	.027	-.297	.61854	.027	.084	1	3	.791

a. Interpreters: (Constant), inflation Table 4

b. Dependent Variable: gdp

In the above table, R is 0.165, which signifies the weaker co relation between GDP and inflation while R square is 0.27 or 27%, which determines that 27% change in GDP is due to the change in inflation rest 73% change in GDP is due to other Macro economic variables. As inflation goes upward or downward does not implies that GDP also change with that proportion. Because As we go for the adjusted R SQUARE which is negative at -297 or approx. 29% which describe that in the selected duration of the study inflation showing the weaker correlation which could be negative with increment of years.

Table 4.1

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.032	1	.032	.084	.791[b]
	Residual	1.148	3	.383		
	Total	1.180	4			

a. Dependent Variable: gdp

b Interpreters: (Constant), inff

Overall, significant impact can be seen through anova table. Residual value 1.148 which is more than regression sum of squares 0.32. Significant value 0.791 is also more than 0.05, so we cannot discard null hypothesis and it can be said that model developed for GDP and inflation is not significant.

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	7.052	.899		7.848	.004	4.192	9.912
inff	.048	.165	.165	.290	.791	-.478	.574

Table 4.2 a. Dependent Variable: gdp

Conclusion

It is concluded at the end by analyzing the selected macro-economic variables impact on GDP by regression analysis, it is find that there is insignificant impact of interest rate, money supply M2 and inflation on GDP during the selected period of study. Inflation have insignificant impact on GDP. No doubt if inflation rises it tends to rise in GDP growth but in the selected period of study we find inflation have not much affect on GDP performance. That's why null hypothesis is accepted with more than 0.5 value that is **.791** at another side we can also say that here inflation is acting like hindrances in the path of GDP growth as it causes rise in the prices of commodities and rates of interest, cost of investment. Money supply M2 and interest rate should also bs taken while computing the GDP growth. M2 and interest rate have insignificant impact on GDP, p value for interest rate **.197**. And M2 is **.168** thus it can be concluded that during the selected period there is no significant impact of these macro-economic variables on GDP.

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SECTION – 3
INNOVATION

Opportunities of Innovation and Competitiveness of Indian Sports: Findings from a case of Inter-IIT Sports

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Abstract-

Importance of sports for holistic development and competitiveness of not only groups, firms and communities, but even cities and states is being recognized too slowly in India and many countries. Taking the case of "Sports in IITs", the leading institutes with significant investments in sporting infrastructure, we attempt to evolve trends and patterns of performance to diagnose problems. Methods of problem structuring and quick benchmarking are adapted to diagnose the root causes. Actor-based root cause analysis can help us identify actors who can initiate actions for a type of innovation depending on the situation. SAP-LAP analysis was also attempted. Since we are interested in longitudinal trends, selected old IITs were focused on. Emerging findings indicate diverse performance for selected IITs. Benchmarking with international institutes indicates vast gaps on multiple fronts—from competitiveness assets to processes—to identify critical success factors. We draw implications to improve the level of "Inter-IIT sports", and give challenge topics such as how innovations related to health and sustainability at universities can drive innovations for cities and states in India in the 21st century. The study can contribute towards practice and research in multiple ways.

Keywords*: International competitiveness; Flexibility and performance; Inter-IIT Sports; Patterns of leading IITs; Sports and sustainability; Hidden champions*

1. Introduction

"Struggle, struggle, was my motto for the last ten years. Struggle, still say I. When it was all dark, I used to say, struggle; when light is breaking in, I still say, struggle." (Vivekananda,1995;4:367)

Sports is important for health, wellness and sustainability of teams and organizations across levels. India is improving rapidly on several fronts including education, economic development, innovation, and has aspirations to improve on health, fitness and sustainability. Sports can play an important role, but major gaps in resources including infrastructure create opportunities for different types of innovations. Innovations can be needed not only in processes or products, but organizations also to address vexing problems in India such as "Slow improvements in health and fitness". Institutes of national importance, aspiring to train leaders of technological and other innovations, can evolve pilots to address such problems. At macro level, there are several developed countries that have leveraged sports to improve the health of communities and cities.

Some of them have also succeeded in leveraging sports for competitiveness of cities. For instance, Tokyo—the only Asian city to host the Olympics twice—can boast of quite healthy teams and competitive MNEs. While Delhi may claim of more sports friendly, cities such as Bengaluru, Chennai, Mumbai and Pune seems to be doing quite well in terms of sports as well as competitiveness (e.g. Momaya, 2016). Indian Institutes of Technology (IITs) are leading technology institutes of India having higher quality talent, sports-related systems and infrastructure and linkages to industrial competitiveness (Momaya, Bhat and Lalwani, 2017). Still, the path for top IITs to climb up the ladder of academics, sports or linkages for business competitiveness is full of the struggle mentioned in the quote above. This article focuses narrowly on competitiveness of Indian sports taking a case of inter-IIT sports.

2. Literature Review and Methods

Importance of sports range from individual and groups to even institutes, cities and states (□□□□, □□□□□□□□, □□□□□□, □□□□; Meena, Divyang, Momaya, 2019). While it is well appreciated in some advanced countries such as Japan, the linkages of sports, health, competitiveness and prosperity are less appreciated in India. For instance, Tokyo seems to have understood the linkages better as Japan signaled its intent about business competitiveness by competing to bring the Olympics to Asia; Tokyo energized well to host the Olympics in 1964 and will become the only city in Asia to host it twice. Since the research on such linkages is at a very exploratory stage and literature is very limited, particularly in India, we will keep literature review very brief.

Some leaders of IITs may be proactive to start events such as "Ïnter-IIT Sports" to spark innovations for the linkages. It can spark investments in identifying and recruiting critical talent such as coaches and basic infrastructure. While technological innovation (e.g. Khalil and Shankar, 2000; Mittal, Momaya and Agrawal, 2013; Momaya and Lalwani, 2017; Schilling and Shankar, 2019) may remain the key focus for many IITs, the importance of other types of innovation such as social and organizational (e.g. Momaya, Manthri and Reddy, 2013), to take the inventions and innovations to the society or market should not be underestimated.

Inter IIT Sports Meet is an annual sports tournament of the Indian Institutes of Technology, with the seven old IITs taking turns to host the event. It is being held since 1961, and is the longest running Inter-collegiate meet. The main aim of our project is to study about the competitiveness levels of different IITs in their journey.

For this study we adapt the qualitative method of problem structuring within which we use quantitative tools like quick benchmarking (QBM). Problem structuring is a powerful method to conceptualize problem in iterative mode, and diagnose root causes and ambiguities (Momaya, Bhat and Lalwani, 2016). Problem should be conceptualized in terms of its attributes, such as the nature of system or sub-systems, people involved, structure of the problem, nature of the desired outcome etc. (Saxena, Sushil and Vrat, 2006) The problem solving and structuring methods have been applied to address vexing problems at country level (e.g. for policy inputs), corporate level to institutional level (e.g. to diagnose strategic issues of IITs {Momaya, Bhat and Lawani, 2016}). For QBM, we collect longitudinal data over decades to discern patterns. Then we use method of "Root Cause Analysis" to find specific root causes, some may be linked to critical success factors related to key actors. Findings from "Action Research" projects such as

the IIT Bombay Biathlon, that have been experimented on for more than a dozen times, provided rich insights about key actors, flexibility, youth mindset and sustainability.

3. Emerging Findings: Patterns in Inter-IIT Sports

All the 23 IITs participate in the Inter-IIT Sports Meet. Tournaments are held in 13 different sports, namely: Athletics, Badminton, Basketball, Cricket, Football, Hockey, Lawn Tennis, Squash, Swimming, Table Tennis, Volleyball, Water Polo, Weightlifting. For each sport (except Athletics) 1st, 2nd 3rd and 4rth place corresponds to 10, 6, 4 and 2 points respectively. For Athletics points gets doubled for each position.

3.1 Overview Of Competitiveness In Inter-IIT Sports

IIT Madras is far ahead of any other IITs (Table 1) with a total of 22 overall wins. IIT Bombay and IIT Kharagpur are both at second place with 12 overall wins. IIT Kanpur and IIT Delhi are at 4th and 5th position with 3 and 2 overall wins respectively.

Table 1: IITs with most overall wins

Name of IIT	First Win	Last Win	Wins in last 10 editions	Total Wins
IIT Bombay	1966	2017	3	12
IIT Delhi	1990	2018	1	2
IIT Kanpur	2013	2016	3	3
IIT Kharagpur	1961	2005	0	12
IIT Madras	1972	2011	3	22

3.2 Journey of Inter IIT Sports

The below Fig.1 clearly shows the journey of Inter IIT Sports. From the figure we can note that IIT Kharagpur was at the top in the first 10 Sports meets with 8 wins but in the next 43 years IIT Kharagpur has only been able to win 5 General Championships.
Fig. 1 shows the number of cumulative wins of each IITs in 10 editions interval. For example at 20th editions IIT Madras is at top with 10 total wins. In 58 years span (1961-2018) there are 53 total editions happened but 20th (1983) and 30th (1994) edition was washed out. So total actual championship of Inter-IIT sports meet is 51 (last updated Dec. 2018)
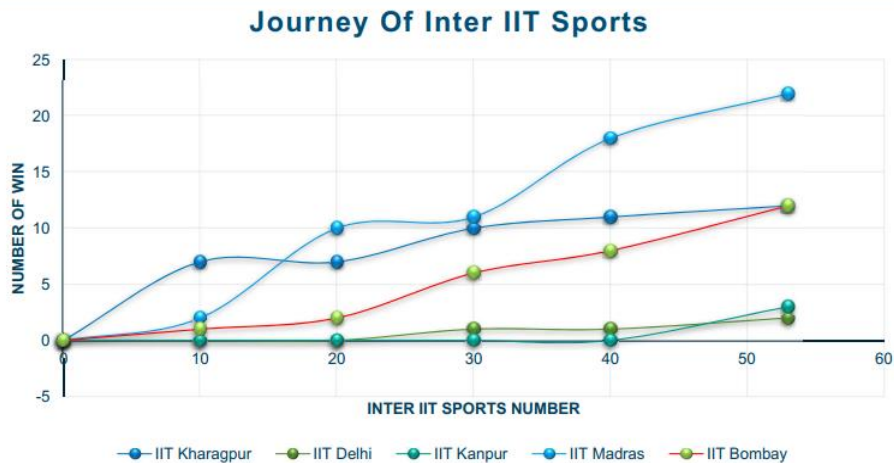
Figure 1: Journey of Inter - IIT Sports y-axis shows the number of cumulative wins and the x-axis is the number of Inter - IIT Editions (Last updated July 2019)

Below Table 2, shows wins in 10 year interval. This table shows good picture of Competitiveness in Inter IIT Sports. In 1971-1980 interval, IIT Madras dominated Inter-IIT sports arena for the entire decade. However in the later decades the championships was lost to other institutes. This can be attributed to increased infrastructure of other IITs and better focus on specialized sports by IITs (Table 3) to develop their niche strengths.

Table 2: Wins of the selected IITs in 10 - year interval

Name of IIT	1961 - 1970	1971 - 1980	1981 - 1990	1991 - 2000	2001 - 2010	2011 - 2018
IIT Kharagpur	7	0	2	2	1	0
IIT Delhi	0	0	1	0	0	1
IIT Kanpur	0	0	0	0	0	3
IIT Madras	0	9	2	3	7	1
IIT Bombay	1	0	4	3	2	2
Actual years InterIIT happened	8	9	9	8	10	7

4. Strengths of Selected IITs in Sports

Each IITs has some sports in which that IIT dominate to other IITs each year and this becomes his strength. Literature suggests that 'Space' and 'place' are concepts central to both geography and sport. Sports are affected by 'Places', means the physical environment and landscape, and 'Space' refers to the infrastructure, facilities and other intangibles which build successful sports teams. (Bale, 2002). This explains why each IIT has better capabilities in a particular sport.

Table - 3 : Strength of individual IITs in specific sports

Name of IITs	Strengths
IIT Madras	Swimming, Waterpolo,
IIT Bombay	TT, Squash, Kho-Kho,
IIT Kharagpur	Weightlifting
IIT Kanpur	Athletics
IIT Delhi	Cricket

Notes: 1. Based on review of medal for the selected IITs in previous 5 years

5. Hidden Champions

Hidden champions (HC) can play a key role in raising the level of competitiveness of an industry. HC are less visible organizations that can have stronger competitiveness processes towards sustainable competitiveness performance (Momaya, 2001). In German context, Simon defined them as a company which is one of the top three in its market and is little known in public.

In the context of IITs, such IIT can be nurturing systems and processes of deeper capabilities that will be visible after a while. While none of IITs can have such international competitiveness and net forex revenues (or trade competitiveness index or TCI, e.g. Manthri et al., 2015), but one which thinks strategically can lead transformation of higher education from India.

The hidden Champions of Inter IIT Sports are some of the new IITs which include IIT Mandi, IIT Dhanbad and IIT Ropar. Although these IITs have never won the Overall Championship or any sport specific championship, but these IITs certainly have the potential to do so. After analyzing the performance of the Athletes from these IITs, we found that some athletes have performed extraordinarily well in some events like 800m, 1500m and 5000m which are non-technical events. This goes to show that they have the talent and willingness to work hard but the lack of facilities and support of Sport council is what is causing them to be not able to dominate overall and win championships. If these IITs get the necessary facilities and support, then certainly the competitiveness in Inter-IIT Sports Meet would increase significantly and the tournament would no longer be dominated by old IITs like IIT Madras.

6. Critical Success Factors (CSFs) for Inter-IIT Sports

Knowledge of critical success factors (CSFs) of an activity or market can help design strategies to improve competitiveness. A critical success factor (CSF) is an ability or an activity required for ensuring the success of a company, team or an organization in a given arena which can be sports or market. From among a long list of CSFs generated, one's that emerged most important based on focus group discussion are discussed in the following sections.

6.1 What Inter-IIT Champions Do Differently: 5 Critical Success Factors

6.1.1 Focus resources on high quality of coaching – Analyzing the performance of teams with different coaches over different years, coaches play a huge role as they are the ones who teach the skill to the students and quality of coaching methods do affect the overall performance of the teams. For example: implementation of modern and more scientific methods have resulted in greater improvement .

6.1.2 Building strong leadership – One of the major task of competing in any sports is to build a good team, find new talents among IITians who are not natural sportsmen and keep the team motivated throughout the year to win and the team captain has a major role to play in it.

6.1.3 Focused approach of the Sports Council and Staff – The support from sport council and staff is a crucial factor as well because they are the ones who have to make sure that the athletes get all the necessary facilities and support to practice efficiently. For example: making sure that physiotherapist is available for the athletes so that they recover fast from injuries.

6.1.4 Better Organization which can improve the level of Inter-IIT – Although the Inter IIT Sports Meet is organized at a very good level but still many improvements can be done in the infrastructure and technology department. For example – Building synthetic tracks and implementation of electronic timing will improve professionalism and make the tournament more competitive and close to state and national levels.

6.1.5 Equal Opportunity to the newer IITs to build capabilities – The tournament is mostly dominated by the old IITs because of the privileged facilities and good coaching they get. The new IITs should also focus on building the required facilities so that they can compete equally and hence the overall competitiveness will increase.

7. In what Sports IITians Can Compete at National and International Levels

Competition level in Inter IIT Sports is grown so rapidly such as players in Inter IIT Sports are giving national level performance. Below table Compares the Records at different Levels :

Table 4 : Records comparison of some events in Inter-IIT, National and International Levels

Event (Mens)	Inter IIT	National	International
100m (in sec)	10.8	10.3	9.58
400m (in sec)	49.1	45.24	43.03
5000m (in min.: sec)	16:12.2	13:29.70	12:37.35
110m Hurdles (in sec)	15.6	13.48	12.8
High Jump (in m)	1.91	2.29	2.45
4*100m Relay (in s)	43.4	38.89	36.84

Notes: 1. acronyms used in above table: m=meters, s=seconds

Can these athletes compete national internationally? Well the answer to this question is Yes and No both. Only very few athletes who have the raw talent can compete at these levels.

Literature suggests that sporting event can have 'positive spillovers' (Smith, 2009). Positive effects of sports facilities and events range from increased employment and income in the city or region in which an event/facility is located, and individuals simply 'feeling good' about themselves. Also some IITians have competed in State Level in sports like Table Tennis and Cricket (Ranji Trophy). So we can conclude that IITians with their quick learning ability of skills can compete in much higher levels other than Inter-IIT Sports (□□□□, □□□□□□□□, □□□□□□, □□□□; Meena, Divyang, Momaya, 2019).

8. Concluding Remarks

Considering the exploratory nature of this less conventional study, we would like to conclude with a few remarks. Inter-IIT sports is a very useful program to encourage linkages among healthy IITians through sports. In times when India is gearing up for major break-outs on many fronts (e.g. corporate competitiveness, Momaya, 2016; Ease of doing business; Innovation indices), including fitness (e.g. Fit India Movement, BusinessLine, 2019), levels of Inter-IIT sports need to be raised significantly.

The level of Inter-IIT Sport may be better than district level. Some inter-IIT players are giving performances comparable to national levels. The reasons for this are many, one of them being the existence of hidden champions among the IITs. They are giving tough competition to other IITs and forcing them to do better in order to win the GC.

We also need to research "critical success factors" of arenas such as university sports. While factors such as infrastructural facilities, support staff, coaches are necessary for successful sporting performances, priorities among these and other factors need to be understood. Sporting activities can have positive spillovers, and it can lead to enhanced competitiveness of groups and

institutes, by inculcating sense of leadership, endurance, team work, effective both on and off the field, in their professional corporate lives.

University sports in some countries have evolved into successful systems which nurture a pipeline of Olympic level athletes. Inter-IIT sports is still at its nascent stage and has a long way to go before it can reach those levels. However, with proper understanding of the CSFs required for competitiveness, IITians can aim to compete at multiple levels (be it corporate, sports, entrepreneurship), representing the country in the 'Big Leagues.' There is no doubt that many more initiatives, investments and innovations are needed, if IITs are to contribute next-generation leaders of entrepreneurship and innovation for competitiveness.

The study can contribute towards practice and research in the following ways. Longitudinal benchmarking can provide insights to proactive leaders at selected IITs to think about the next levels. Analysis and examples of gaps can help sports leaders to innovate for better practices. Despite the presence of talent in India, the vast gaps between India and advanced countries in terms of competitiveness across levels—start-ups, firms, industries including sports—provide some fertile topics of research. Even if India takes few more years or decades to catch-up on football, the following quote by Swami Vivekananda about football can be generalized to other sports beyond cricket.

"First of all, our young men must be strong...You will be nearer to heaven through football than through the study of the Gita. These are bold words, but I have to say them, for I love you."

> —*Swami Vivekananda (2017, p. 14)*

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Adoption of sustainable knowledge management practices in techno-innovative clubs: A case study

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Abstract-

Innovative clubs help bridge the gap between academics and industry. A study conducted by national survey of student engagement shows that around 57% of students in innovative clubs have greater technical knowledge. A few innovative clubs in institutions work on the principles of knowledge management for club sustainability. Knowledge management is the technique of collecting, distributing and efficiently employing knowledge within the organization. It helps in enhancing the organizational agility, student growth as well as development and causes an upsurge of innovation. The Nonaka's epistemological and ontological spirals help to support the transition of knowledge and experience within the club. The epistemological spiral illustrates how explicit and tacit knowledge is generated, transmitted and recreated in an organization. The ontological spirals describe organizational knowledge that can be used by individuals. The epistemological and ontological spirals help in going from individual experience in educational innovation to organizational knowledge. Knowledge management has a diverse array of applications, On one hand it can be applied to large multinational companies and on the other hand in small innovative clubs .This paper discusses a case study on a techno-innovative club which shows that using the above mentioned model of knowledge management, helps in the survival of the club, furthermore it leads to upsurge of innovation. The integrated wheel of knowledge management model discussed in this paper can be picked up by any organization including innovative clubs for sustenance.

Keywords: *knowledge management, epistemological spiral, ontological spiral, techno-innovative clubs, sustainability.*

1. Introduction

Increased understanding, learning and improved decision making are the results of smooth flow of knowledge. Efficient flow of knowledge is achieved through various knowledge management techniques. Knowledge flow is the ease in which knowledge is transferred within and among organisations. The intent of knowledge management is to enhance competitiveness. Knowledge management is the integrative approach to accomplish the organisations objective by efficiently using the knowledge. The purpose of knowledge management is to create an understanding through the alignment of processes, tools and employees within the organisation to improve association and interaction between leaders and organisational members. This in turn helps in taking better decisions with improved versatility and coordination, therefore achieving a position of competitive advantage. Enhanced innovation in an organisation is closely linked to knowledge management.

To achieve knowledge management, the knowledge spirals of Nonaka are integrated as shown in fig 2. The epistemological spiral (conversion of tacit knowledge to explicit knowledge and vice-versa) is used to obtain the ontologies that create the ontological spirals. This results in a twin spiral that makes the conceptual model. Techno innovative clubs can integrate such models for efficient management of knowledge

It is important to describe the relationship between tacit knowledge, explicit knowledge with the Nonaka and Takeuchi's model of knowledge creation [1-3] because the model places tacit and explicit knowledge at its heart.

- Tacit knowledge: It is the knowledge that is difficult to transfer by writing or by verbalising. As it is a result of human experience and sense, it is challenging to document such knowledge. It guides ones behaviour, but is not easily available for scrutiny. This includes one's experience, intuition, personal knowledge, emotions and consciousness. Tacit knowledge of members in an organisation improves over time and provides a long term competitive advantage. Tasks that require physical coordination are considered as tacit knowledge.

- Explicit knowledge: It can be readily expressed, summarised, stored and accessed. This type knowledge is structured, rational and technical. They are easily documented and exist in large volumes. It is the knowledge that is found in books, websites and other oral means. It includes documents, manuals, books, videos, audio recordings and formulas. Explicit knowledge is precise whereas tacit knowledge is imprecise.

Tacit and explicit knowledge can be easily interpreted with an iceberg metaphor. Explicit knowledge is the tip of the iceberg that is clearly visible. This tip refers to the knowledge that can be easily documented and accessed. But there is much more than just the codified and transferable form of knowledge. There is knowledge that is unseen! The rest of the iceberg that is hidden underwater is like tacit knowledge. This is the knowledge that is the result of experience which is much less concrete and difficult to document.

Nonaka (1991) basis his model on the two types of knowledge spiral [4]; epistemological (SECI) spiral and ontological spiral. The SECI model is the network of the four knowledge processes which are socialisation, externalisation, combination and internalisation as explained in fig 1 below. These processes are used to convert tacit knowledge to explicit knowledge and vice-versa.
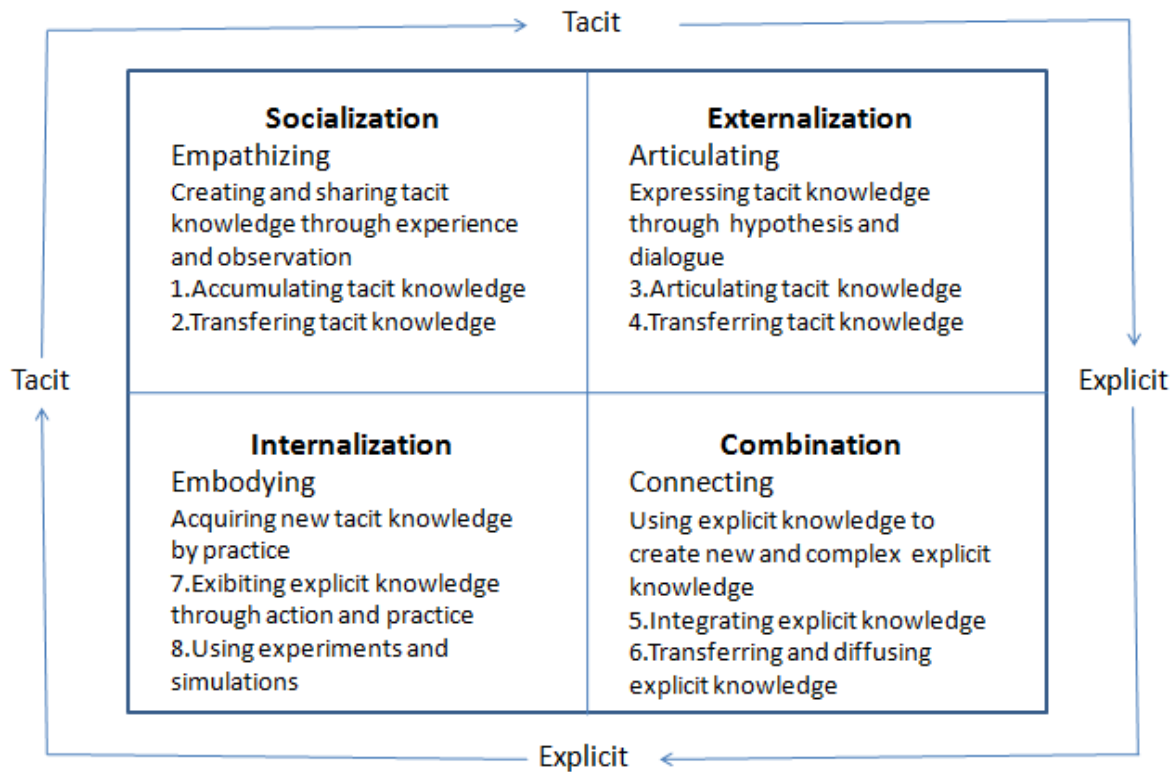
Fig.1: Nonaka and Takeuchi's SECI model. Source [5]

a. **Socialisation (tacit to tacit):** It is the mechanism of remodelling tacit knowledge by sharing experiences through day to day social interaction. Knowledge is passed on through observation, guidance, practice and innovation. Nonaka writes "The key to acquiring tacit knowledge is experience. Without a form of shared experience, it is extremely difficult for one person to project his or herself into another individual's thinking process." Socialisation involves the transference of tacit knowledge.

b. **Externalisation (Tacit to explicit):** This is a process where tacit knowledge is expressed in the form of explicit knowledge. This conversion is challenging but it is the most vital part since it tries to codify experiences, observations into documents or manuals. This ensures that there is no loss of information in the organisation. By converting the tacit knowledge to explicit, it can easily be shared with others and become a basis for new knowledge. Even if experienced members leave the organisation, the knowledge is safe. The tacit knowledge is articulated by metaphor, analogies, diagrams and prototypes.

c. **Combination(explicit to explicit):** It is a process where explicit knowledge is gathered from within as well as outside the organisation, and then combined, edited, processed to form more systematic and complex knowledge. The knowledge is synthesized from different sources into one context. Knowledge is exchanged and reconfigured through meetings, communication networks and documents. The new codified, documented knowledge is then propagated.

d. **Internalisation (explicit to tacit):** Explicit knowledge generated and dispersed throughout an organisation is converted to tacit knowledge. In practical situations, the knowledge gained from research, documents, books can be utilized. Internalisation shares knowledge within an organisation, it broaden and changes the organisation member's mental model. Embodying explicit knowledge into tacit is 'learning by doing'. When explicit knowledge is internalised it becomes a valuable asset, which means it is tacit. Nonaka writes "Explicit knowledge, such as product concept or manufacturing procedures has to be actualised through action, practice and reflection so that it can really become knowledge of one's own."

As explained above, the epistemological spiral is the continuous flow of knowledge that creates ontologies. Ontologies are used to segregate, arrange and organise the knowledge. They allow the transfer of knowledge from individual to group, group to organisation, organisation to sectors and sectors to individuals. This ensures continuous flow of knowledge. The ontological spiral is the continuous flow of individual, group, sector and organisational knowledge.
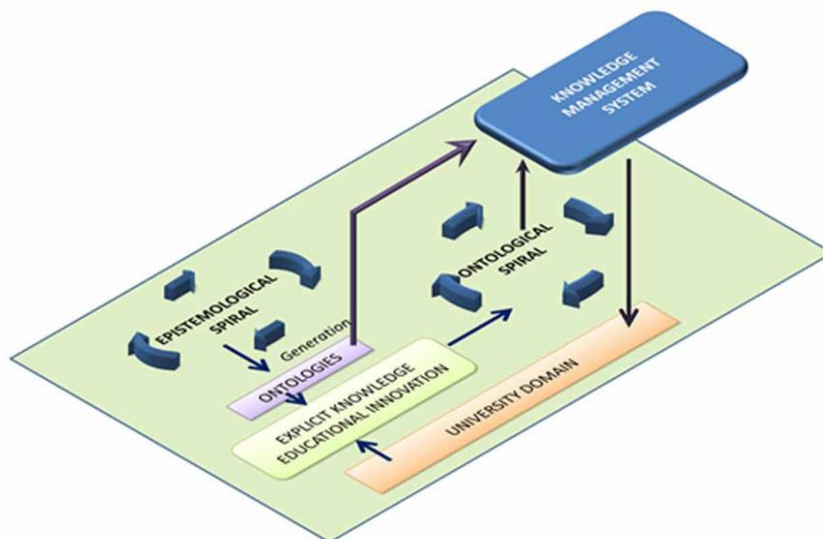
Fig.2: Conceptual model of knowledge management. Source [3]

This paper discusses in detail the integrated wheel of knowledge management which combines the various components and steps of knowledge management along with Nonaka's epistemological spiral. This model is supported by a case study of a techno-innovative club in a technical institution.

2. Literature review

Many authors have dealt with the topic of knowledge management and innovative clubs in institutions. The following are a few relevant works in literature

2.1 R and D unit within an enterprise

Shu Libing, Chen Rong in their paper have discussed about how transfer of knowledge has become a competitive advantage for various organizations. By citing to the Nonaka's and

Takeuchi's knowledge creation spirals a structure was created to explain and analyse the means and approaches to knowledge transfer within an enterprises R&D departments. Most enterprises focus on implementing new technologies and gathering knowledge from external sources. Whereas the rich knowledge assets within the organization are often ignored which leads to a knowledge loss within the organization. The authors say that to speed up the technological innovation process one should rely on knowledge transfer internally in the research and development units. Shu Libing and Chen Rong suggest the following measures can be taken to improve knowledge transfer within research and development units. Firstly, innovation and learning networks should be set up within the units. Second, the internal knowledge warehouse should be well formulated and managed. Third, employee should be encouraged to organize and participate in several communities that practice knowledge transfer. Fourth, an increase in budget and staff in the R&D units can increase the strength of the R&D teams. [6]

2.2 Review on knowledge transfer models

Li Hong Ling from the college of management in his paper has uncovered the mechanism of knowledge transfer in knowledge management using various models. The paper reviews 4the following knowledge transfer models bought forward by Shannon weaver, Szulanski, Nonaka &Takeuchi and Boisot .This paper analyses that knowledge transfer is not confined to an enterprise but can also transmit within the entire society. The relationship between models and says that the models are related in the form of a network not a line. The Shannon weaver model explains the Knowledge transfer using a signal transmission model. Szulanski model considerer's knowledge management as a reconstruction process rather than signal transmission. The knowledge transfer process has the following 4 stages: initialization, implementation, ramp-up, combination. In Nonaka & Takeuchi model the types of knowledge (tacit, explicit), the level of knowledge carrier (individuals, group, organization) are considered to establish two spirals of knowledge management. [7]

2.3 Structured knowledge transfer in small and medium sized enterprise.

Tanja Peherstorfer and Bernhard Schmiedinger in their paper have explained the importance and requirements for structured knowledge transfer. Small company's faces loss of knowledge and incompetent decision making while transferring key or management positions. This knowledge depletion leads to decrease in efficiency, effectiveness of a process and often mis-management. This can be overcome by structured knowledge transfer. Structured knowledge transfer requires coordination between the knowledge receiver and owner. The knowledge transfer process becomes easier when the quality of documented knowledge is high and knowledge transfer process is more structured. Time plays a vital role in deciding the quality of knowledge transfer. Hence, the process of knowledge transfer should be started as early as possible. [8]

2.4 Knowledge spirals in higher education and teaching innovation

Ángel Fidalgo-Blanco María, Luisa Sein-Echaluce ,Francisco J. García-Peñalvo have elaborated in their study as to how Knowledge management helps in transforming different institutional knowledge into organisational knowledge which is pertinent to various sectors, in this case it the higher education sector. Knowledge management helps in segregating, classifying and diffusing the knowledge generated in the organisation. A study of 1000

system users helps in supporting the theory that knowledge management system helps in educational innovation exercise. The knowledge management model includes Nonaka's ontological and epistemological spirals. Individual knowledge can be translated into organizational knowledge. This translation is defined as ontologies. The relation between individual knowledge and sectorial knowledge is highlighted in this paper. It provides a universal view of knowledge, in multiple organizations. The ontologies presented in this paper allow the management of knowledge irrespective of its quantity and diversity. The changing design of ontologies helps in conforming to the indicators according to the good practices ensuring its sustainability over the long run. For future works and expanding the scope of the sector, the integration of best practices in higher education is conceptualized. [3]

2.5 Knowledge management in an organization

Anne Persson and Janis Sterna in their paper have presented multiple patterns and anti-pattern that can be used while implementing knowledge management in an organization. These patterns address two issues (1) on who to involve during this process and (2) initial development of the structure. The number of pitfalls in a pattern is represented as anti-pattern. It is important to have well planned implementation strategy for successful implementation of knowledge management. It is observed that the critical problems are concerned to people and organizing culture. This is due to the fact that people carry out knowledge management and not technology. Convincing the employees and the managers into implementing knowledge management is a difficult task which is addresses from different perspectives in the paper. [9]

Techno-Innovative Club

Ashwa mobility is India's premiere Formula SAE (Formula Society of Automotive Engineers) team, participating out of RV College of engineering, Karnataka was established in 2003. The aim of FSAE events is to bring together various teams which consist of students who conceptualized, design, produce and contest against each other. In the year 2005, Ashwa made its first appearance at formula student Australia. Till date Ashwa has appeared 15 times in the formula student combustion event. The aim of the techno innovative club was to bring in practical experiences and getting the students accustomed to industrial practices. This was achieved through industries aiding the project. In their time in Ashwa, student members perfect their technical and managerial skills and hence become all round achievers .Over 4 years, engineering students from various streams perfect skills to become all round achievers. Some of the achievements of the club include, finishing 2nd place in formula hybrid in 2017 and 2018, having the fastest accelerating internal combustion car in India as well as diversifying into passenger. Students realize their design dreams in the real world through interactions with industry.[10]

Knowledge management that is vital in techno-innovative clubs has been detailed using a case example of Ashwa, as a new batch of students graduate, they take along with them the knowledge established and acquired over 4 years. This leads to loss of knowledge in the upcoming batches if not efficiently transferred over to the junior students. Interest in the sustenance of such clubs led us to focus more towards the knowledge management process

which led to the creation of wheel of knowledge management as discussed in the next section.

3. Methodology

In this section, the wheel of knowledge management (shown in Fig 3) is explained thoroughly using a case study held on ASHWA, a FSAE club.
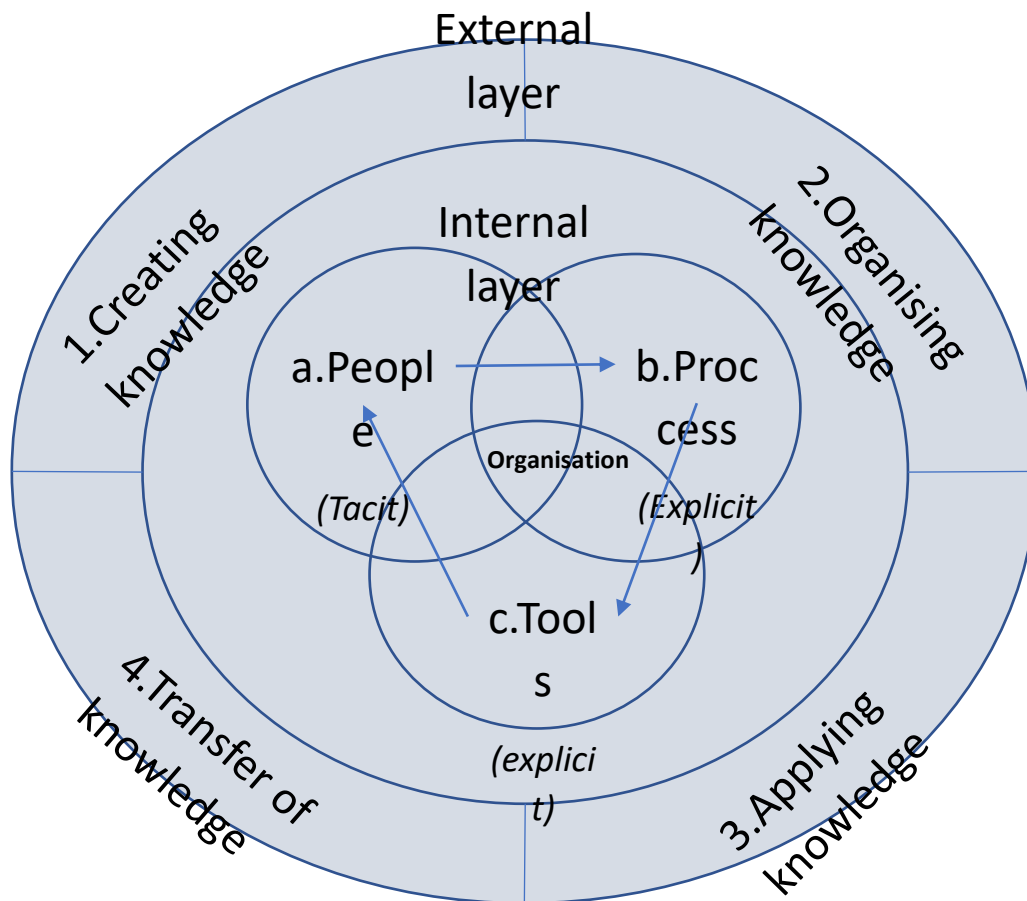

Fig3: Integrated wheel of knowledge management

The internal layer of the knowledge management wheel consists of organisation, people, process and tools. These components [11] are explained below.

Organisation is the core component of the wheel in which people-process-tools operate to combine individual learning as well as organisational knowledge to achieve the objectives. People are composed of various ideas, principles and knowledge. An organisation, with numerous people brings these attitudes and behaviours of individuals together which collectively forms the organisational culture. Interpreting the culture of an organisation provides method by which information, goals and motivation can be examined, allowing the sharing of knowledge to happen smoothly.

   a. **People**

People are the most crucial component for achieving successful knowledge management. This includes the members within and outside the organisation that create, organise, apply and transfer knowledge. The movement of knowledge between people aids them and concentrates on connecting people and building social networks. Tacit knowledge is generated as a result of experience, practice and observation. People are the embodiment of tacit knowledge in an organisation.

b. **Process**

The knowledge management process is unified with the employee's as well as the organisations process, which is used for establishing and conducting operations. This unification ensures the transfer of knowledge between individuals group and organisations. Knowledge transfer can occur both formally through existing procedures and processes. Since processes can be easily documented and codified, processes become a form of explicit knowledge.

c. **Tools**

Information systems, data analysis tools are few of the knowledge management used to organise knowledge. The tools are mainly used to conserve and share information. The tools used in an organisation are also in the form of explicit knowledge. Few tools are:

- Data analysis tools: They are used to find patterns and provide relationship among data
- Search and discover tools: This includes browsers that search for related topics or authors and provides a relation between different topics.

The arrows in the integrated wheel of knowledge management represent the flow of knowledge in an organization. These arrows show the continuous conversion of tacit and explicit knowledge. The conversion of tacit to explicit knowledge is known as externalization .The conversion of explicit to explicit is known as combination. The conversion of explicit to tacit is known as internalisation. The informal flow of knowledge from people to people is known as socialisation. These concepts are explained in detail in section 1 of the paper.

The external layer of knowledge management wheel consists of the steps involved in knowledge management as explained in the knowledge management operations manual 2012 [11] .

a. **Creating knowledge**

In response to knowledge gaps in an organisation, new knowledge has to be created. This can be the process of evolving new knowledge or linking, reconstituting and remodelling existing knowledge. Knowledge is derived from various sources such as new technology along with organisations adapting to the changing environment.

b. **Organizing knowledge**

Organising knowledge involves documenting, segregating and identifying. Organising knowledge makes sure that the members of the organisation can discover and recapture knowledge that is of significance to them with ease.

c. **Applying knowledge**

The main aim of applying knowledge is to ensure knowledge easily accessible to all the users. It creates an environment where users can easily retrieve and administer the knowledge they require. Enabling multiple users to simultaneously retrieve knowledge products helps in collusion of knowledge application.

d. **Knowledge transfer**

Knowledge transfer is an important part of knowledge management process. The root of competitive advantage of many organisations is efficient knowledge transfer. Knowledge transfer can occur at a range of different levels that is in between individuals, between individuals and groups and among groups. For ideal transfer of knowledge, the knowledge provider must be willing and capable to share his or her own explicit and tacit knowledge to the receiver, who must have the competence to comprehend the received knowledge. More details on explicit and tacit knowledge is discussed in the methodology section further. Effective knowledge transfer not only helps in strengthening the individual workers but the entire organisation as a whole.

Integrated wheel of knowledge management applied to techno-innovative club

(i)   The internal layer of the wheel

The integrated wheel of knowledge management places the organisation at its core. Ashwa consists of people, process and tools which are its components. The team of Ashwa form the people component which includes the external and internal members. The internal members are the students in the club and the external members are professionals in industries who provide assistance to the club. The manufacturing of a prototype consists of various processes such as pre-design process, design process, manufacturing process and assembling process. The activities that are carried out during these processes are documented in order to track the progress of the project at each stage as well as for any future reference. A wide variety of technologies such as software, equipments which are used during the various processes form the tools of the techno-innovative club.

 (ii)   The flow of knowledge in the internal layer of the wheel

The flow of knowledge in Ashwa happens in four stages. **Socialisation** (tacit to tacit) is the flow of knowledge that occurs between members of the organisation. In Ashwa, face to face meetings are conducted on a weekly basis where seniors share their experiences in order to prevent mistakes that occur in day to day operations, to be repeated. It is a practice in the club for newly recruited students to work with experienced students and help them in their prototypes for a period of one year. The purpose of this is to ensure that the tacit knowledge is efficiently transferred to the new recruits. **Externalisation** (tacit to explicit). It is the conversion of experiences and observations into documented and codified processes. Another example of this conversion of tacit to explicit knowledge can be seen in an activity that occurs very

frequently; changing the tires of the car. This involves a set of procedures that need to followed, which can be learnt by a few members who will document it. This documented information can be accessed by all other members of the team who were not present during the demonstration. It can also act as a guideline when the task has to be eventually performed again.

Combination(explicit to explicit) is a process where explicit knowledge is gathered from inside and outside the organisation, and then combined, edited, processed to form more systematic and complex knowledge. The final drive ratio calculations for a car are quite complex and time consuming. Observing this, the senior members prepared an excel sheet of all the formulas in such a way that once the basic inputs are provided, the required final answer is obtained thereby saving time. Before any new design is conceptualised, a great deal of research is made on the subject in question. This can be done by referring to textbooks, manuals, research papers, other techno-innovative clubs who have previously implemented the same concept or taking help of professionals for an expert opinion. . This is a crucial step which is responsible for surge of innovation in the club which helps its sustenance and immensely contributes to its growth. **Internalisation** (explicit to tacit), the generated explicit knowledge is converted into tacit knowledge. The explicit knowledge that is gained from extensive research is converted into routines and practices with the aim of diversifying into different prototype platforms. Improving the routines contribute to incremental development of the prototype which aligns with team Ashwa's 'evolutionary and not revolutionary' growth motto.

(iii) The external layer of the wheel

The external layer of the wheel represents the steps involved in knowledge management. In team Ashwa, new knowledge is created by referring to textbooks, manuals and other sources. This created knowledge is organised and distributed subsystem wise such as chassis, drive train, engine, steering and brakes. The knowledge relevant to each member is easily accessible to them since it is distributed subsystem wise. This also allows multiple users from the same subsystem to access it simultaneously. Knowledge is transferred from the seniors onto the junior members in the club. This ensures that no knowledge is lost when experienced members leave the club. As a whole it increases the technical capability of the members therefore giving them a competitive advantage over the other technical clubs.

4. Conclusion

Knowledge, experience, skills, capabilities, relations form the core competencies of an organisation. Embracing the competencies ensures better understanding, visualisation, effective performance and improved learning leading to sustenance of the organization. The integrated wheel of knowledge management which includes the epistemological spiral proposes an efficient method for knowledge transfer between the different components of an organization and is the key to conversion of individual experience into organizational knowledge. This model can be adopted by various organizations and techno-innovative clubs that strive for sustainability and growth. As discussed in the paper knowledge management

helps in enhancing the organizational agility, student growth as well as development and causes an upsurge of innovation.

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Managing Reverse Innovation in India
- Moving Forward by going Reverse

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Abstract-

The world is changing very fast - faster than even our imagination. The Asian Tigers are gradually coming up at the centre stage of this changing economic scenario and are destined to play a more important role than ever before. The role of Innovation has become the pivotal point at this competitive edge. As developing countries are coming at the centre stage, so the importance of Reverse Innovation has becomes more and more imminent. Reverse Innovation is first adopted in poor countries and subsequently adopted in rich countries. Till today, world economy is governed by the developed countries. Now, in the change world, as India and China are becoming the Centre of Gravity of the next economic world, managing Reverse Innovation is of immense importance. Although historically innovation or even Reverse Innovation is nothing new, but reverse innovation has been a hot topic of discussion since 2009 after Govindarajan and Ramamurti formally coined the terminology. Management of Reverse Innovation for continual and sustained economic growth has not yet been much focused till now. Being the developing country, India can fully exploit the potential of Reverse innovation and can utilize the same for managing growth strategy for economic development.

Keywords: Innovation, Reverse Innovation, Emerging economy, Developing countries, India

1. Introduction

Since the inception of Stone Age, people are innovating. They innovated the means of feeding, clothing, shelter, transportation and even signaling - all by themselves and paved the way of future innovations. Innovation is nothing new; of course, managing Innovation in organization is comparatively a new subject. Role of innovation was always important for survival and growth. Now in the organization, innovation has become the key factor to survive, sustain and succeed.

Reverse Innovation is first adopted in a poor country and finally adopted in rich countries. The income gap between developed and the emerging countries drives reverse innovation. China, second largest economy in world, has an average income of only one-tenth American. There is no way that a product designed for American mass market and then simply adapted for China will find buyers. "Buyers in emerging economies demand solutions on an entirely different price-performance curve. They demand new, high-tech solutions that deliver ultra-low costs and good enough" quality" (Vijay Govindarajan & Chris Trimble, 2012). The classical example is Tata Nano car. The Tata Nano is lower in

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quality than lowest priced cars of the rich world. The difference in quality, however, is much less than the difference in prices. Furthermore, the Nano's quality and utility is more than sufficient for Indian consumers making transition from two-wheelers segment to four wheelers segment (Vijay Govindarajan in Future Growth on Reverse Innovation), This innovation which is being done in a developing country and attempt to introduce the same in western market is a breakthrough attempt compared to all types of traditional innovations tried till now. A 1000$ General Electric's Electrocardiogram by GE Bangalore is another classic example of Reverse Innovation. This workable concept and practice is taking ground from developing to developed country.

The key concept of reverse innovation is to create more value for less. The Indian cardiac hospital Narayana Hrudayalaya (NH) is a good example. It offers ultra low-cost services and provides access to healthcare even to the poorest. NH applies the principle of economies of scale. Mass production of heart surgeries significantly lower the cost per patient while simultaneously increasing the quality, allowing the doctors to occasionally operate free of charge for patients who cannot afford the price. If it is possible to offer a major surgery at a dramatically low price like the NH hospital has done, so there is no reason to do the same in Western hospitals. (Martin Aschmoneit & Dijana Janevska, 2013).

There is an enormous opportunity in the emerging economy because reverse innovation is all about reversing the process of innovation. In usual context, Innovation starts with a rich country and goes to a poor country. Reverse innovation acts exactly in the opposite direction. The objective of developing products for low-income group is to create capacity for them to increase their income so that they can afford to consume more. "Building capacity to consume is based on three prime principles: affordability, access and availability" (Prahalad, 2006).

Most global companies recognize till today that emerging markets are the last source of growth. All they do is just modify and export products which were developed in their home country. This is "glocalization" — a strategy bound to under-deliver. The fact that glocalization worked historically was that American companies were taking their products into Europe and Japan (where customers were similar to USA). That strategy will not work now in emerging markets because the market structure and the customer problems are now fundamentally different. To capitalize on the full potential of emerging markets, organizations must head in the reverse direction - innovating specifically by the developing countries, for the developing countries and to create breakthroughs which will finally be adopted at home and next around the globe.

Local companies in the emerging markets are best suitable to do such innovations. After all, they are the people who understand local customers better. If multinationals do not practice reverse innovation, local companies will do and use those innovations to disrupt multinationals in their home markets. According to Immelt and his co-authors, it is necessary to respond to that challenge by reversing the innovation model. This is largely a defensive strategy; "if General Electric doesn't come up with innovations in poor countries, and take them global, new competitors from the developing world – like

Mindray, Suzlon, Goldwind and Haier – will do so". In other words, "reverse innovation isn't optional; it's oxygen" (Immelt et al., 2009). Evidences show that companies can earn the same or even better return on investment for a low-cost product designed for China or India than for a higher cost current product at home. The result is finally win-win at home and abroad also.

A recent study by Price Waterhouse Coopers found that 61% of CEOs said that innovation was a priority or primary focus of their business. Yet another study of Accenture found that only 38% of businesses have a well defined Innovation strategy and system. This is not be a luxury leading organizations can do it at their own pace. Unless an integrated pragmatic management plan and practices are taken for nurturing reverse innovation, the reverse innovation will remain as an individualistic stray effort and cascading chain reaction will not take place to yield economy the requisite momentum. This is needed for growth of the developing countries and survival for the developed countries.

At this moment India has reasonable good attempt in reverse innovation. But what is much needed is to create hub or base of innovation centre. The much needed eco system is the need of the day. Indian brain, mindset and attitude are quite suitable for Innovation and highly regarded all over the world. A grass root culture of innovation development and encouragement may probably take India a long way.

2. Research gap and research objectives

There is abundant literature available on Reverse Innovation. In fact, it is the most hot and popular topic, more preached and less practiced subject in management and economics. The more the literature, the more are the gaps and confusion. For example, at least fifteen types of traditional innovations are discussed in the literature, leave apart the reverse innovation and related innovation.. All these related innovations are closely related to reverse innovation, but are different from fifteen types of traditional innovation.

The objectives of the research are

- Conceptual development of Reverse innovation from traditional innovation
- To make a focus discussion on Reverse Innovation and other related Innovations in literature which are similar to reverse innovation
- To develop a framework for Reverse Innovation
- To devise a strategy for managing Reverse Innovation in India which is practical, sustainable and can boost Indian economy

3. Research Methodology

The research methodology in this study includes
- Literature review
- Case examples
- Case studies and

- Key informant interviews
-

The literature review includes published as well as unpublished sources of literature on Reverse Innovation in books, journals, websites of the organizations etc. A list of designated key words and phrases are used for investigation of related literature and case studies, like

- Innovation
- Reverse Innovation
- Reverse Innovation strategy
- Reverse Innovation in emerging economy
- Reverse Innovation in developing countries
- Reverse Innovation in developed countries
- Managing Reverse Innovation
- Issues in Reverse Innovation
- Why Reverse Innovation fails

In case example, studies have been focused mainly in the developing countries in India and China which have become the birth place of Reverse Innovation in recent past and how these reverse innovation have shaken the global leaders in business to think in the reverse innovation strategy in their growth model. These examples give an insight how reverse innovation is becoming important in growth strategy.

Informal telephonic discussions have been carried out with the key executives of the organizations in case of key informant interviews, who are actively engaged in the process of reverse innovation management. The organisatios include industry, university and research institutions The discussion is mainly based on the framework and strategy needs to be adopted for achieving success in managing reverse innovation in present age.

4. Literature Review On Reverse Innovation

In the study of organizations as well as economics, innovation has been one of the most discussed and happening topic. Researchers agree on the importance of innovation for economic growth (e.g. Brem, 2011, Christensen, 1997), and also for creating and sustaining competitive advantages (e.g. Freeman, 1995 and Landabaso, 1995 cited in Johannessen, Olaisen and Olsen, 2001). While most of the researches on innovation in the last fifty years is focused on Technological Innovation (Henderson, R. M., & Clark, K. B. 1990. , Utterback, J. M,1994) Process Innovation (Pisano, G. P. 1996), Service Innovation (Miles, I. 1993), Gallouj, F., & Weinstein, O., 1997), Product Innovation Herstatt, C., & von Hippel, E. 1992), Marketing Innovation (Bullinger, H.J. (1999),, Organizational Innovations (Anderson, N R & King, N (1993), Social innovation (Gerhuny, J, 1983), Financial Innovation (Allen, Franklin & Galle, Douglas, (1994)., Management Innovation (Beneveniste G., 1993) or Strategic Innovation (Hamel, G. 1998), the interest on of researches on Reverse innovation is relatively new development. But within a short span of seven to ten years, it has drawn an enormous attention of the researchers, Reverse innovation is a solution for many contemporary issues that

companies are facing and it is considered a new wave in the history of organizational strategy with bright future prospects. Followings are the reason why and how Reverse Innovation is coming at the centre stage as a strategy.

4.1 The Developing Countries are "Catching Up"

It was hard to believe few decades back that the developing countries can ever be able to catch up to the level of the developed countries or really surpass the developed economy. However (PWC, 2013) report predicts:

"China is projected to overtake the US as the largest economy by 2017 in purchasing power parity (PPP) terms and by 2027 in market exchange rate terms. India should become the third 'global economic giant' by 2050, a long way ahead of Brazil, which we expect to move up to 4th place ahead of Japan. Russia could overtake Germany to become the largest European economy before 2020 in PPP terms and by around 2035 at market exchange rates." Thus there is an indication of 'reverse' trend of economy.

4.2 The Emerging Economy - Fortune at the Bottom of the Pyramid Phenomenon

"A relatively recent revelation is the bottom-of-the-pyramid markets (i.e., consumers that earn less than $1 per day) are a viable consumer population" (Prahalad, 2010). "The traditional products are not viable when targeting the cost-sensitive population" (Tiwari & Herstatt, 2012). Thus it is critical to design and develop products or services specifically for emerging markets (Govindarajan, 2012). The products or services developed specifically for these emerging markets are often substantially different from those that exist in developed markets and, consequently, sometimes offer potential value even in developed markets also. Thus the concept of reverse innovation is becoming imminent (Immelt, Govindarajan, & Trimble, 2009). According to Lee "Reverse innovation shares some common underpinnings with the well- established concept of reverse knowledge transfer" (Ahreum Lee, 2013). This new immense potential market has opened a golden gate in favour of Reverse Technology Transfer and Reverse Innovation.

4.3 Definition of "Rest of the World" Changes

Fifteen years back, when companies were deciding about global strategy, they were thinking in terms of Europe, the US, Japan and the rest of the world. Today and in the coming future, they have to decide global strategy in terms of BRIC countries (Brazil, Russia, India, China), the Middle East, Africa and the rest of the world. Now, the "rest of the world" has become the US, Europe and Japan. This shift in mindset will enable all business leaders to think in line with what GE is doing right now.

4.4 Reverse Innovation is the Bare Necessity for Survival for Developed Countries

So long as the rich countries were growing at healthy rates, multinationals were happy. Post-2008 financial crisis, growth has significantly slowed down in developed countries. Multinationals are therefore forced to look for new avenues for sustained growth. At this

juncture, poor countries offer a significant opportunity. After all, over 5 billion lives in poor countries represent a huge customer base. Organisations must innovate since middle-class consumers in emerging markets are fundamentally different from the middle-class in the rich-world.

4.5 Developing Countries are Finding Places in Fortune 500 list

Only in the past decade, local firms from developing countries have started to become global rivals. "Emerging giants from India (Infosys, Tata, Mahindra & Mahindra), China (Haier, Lenovo, Huawei), Brazil (Embraer) and Mexico (Cemex) have global aspirations" (Vijay Govindarajan, 2011). "Therefore, ignoring emerging markets can cost multinationals more than a missed opportunity abroad. It can open the door for local firms from the developing world to inflict pain or even severe damage even in multinationals' well-established home markets. This possibility inevitably draws multinationals into the reverse innovation game". More and more emerging countries' MNCs are also part of the Fortune Global 500 and thus ranked according to the profits they made: in the 2010 ranking, 46 MNCs were Chinese, 8 were Indian, 7 were Brazilian, 6 were Russian, 2 were Mexican, etc. (http://money.cnn.com/magazines/fortune/global500/2010/index.html,)

4.6. Optimism is at its Peak in Emerging Countries

In sharp contrast to developed countries, majorities of people in China and India believe that current economic situation is good, expect conditions to improve further and think their children will be better off than now they are. This is a region that, to echo Churchill's phrase, "sees opportunities in every difficulty rather than difficulties in every opportunity". These emerging countries are not only optimistic, but taking away every opportunities from developed countries in their favour.

5. Conceptual development of Reverse innovation

"A reverse innovation is any innovation that is adopted first in the developing world." (Sinha, 2013). Grameen Bank started providing micro banking facilities in Bangladesh. The success of "micro credit" concept enabled the microfinance institution to establish a subsidiary in the United States- Grammen America to serve on low incomes. "In fact, there are at least five enormous gaps that separate needs in the rich world from those in the developing world: the performance gap, the infrastructure gap, the sustainability gap, the regulatory gap, and the preferences gap" (Chris Trimble, 2012). Reverse innovation attempts to address these gaps and finally the solution brings applications in developed worlds/

The term "reverse innovation" is no doubt recent, but an attempt to go insight down shows that the theoretical concept has evolved in phases from traditional innovation driven by the current needs with passage of time. Of course, it has certain similarities as well as differences with traditional innovation. The instinct of growth and survival and success has always driven both the developed and developing countries. Reverse

innovation can be thought of fourth stages of evolution of innovation starting from Traditional innovation, Globalization, Glocalization and finally Reverse innovation.

Traditional innovation have been refined in four stages and reached the level of reverse innovation, as follows:

1) Traditional Innovation: Innovation originated in developed countries but no infusion to developing countries.
2) Globalisation: Innovation transferred from developed countries to developing countries through subsidiaries as it is.
3) Glocalisation: Innovation transferred from developed countries attempting to meet local needs of developing countries
4) Reverse Innovation: Innovation originated in developing countries and flows to developed countries.

The same is explained in Table-1

Table 1: Stages of development in Reverse Innovation

Sl no.	Stages	Objectives	Remarks
1	Traditional Innovation	Innovation originated in developed countries but no infusion to developing countries.	First wave of innovation
2	Globalisation	Innovation transferred from developed countries to developing countries through subsidiaries as it is	Second wave of innovation
3	Glocalisation	Innovation transferred from developed countries attempting to meet local needs of developing countries	Third wave of innovation
4	Reverse Innovation	Innovation originated in developing countries and finally flows to developed countries	Fourth and recent wave of innovation

Finally, "Reverse innovation is developing products in countries like China or India and then distributing them globally" (Immelt et al., 2009). This implies the locations of R&D in emerging countries will continue to grow. Besides, it would no longer be limited to the downstream phases of R&D but the full creation of products in emerging countries. Those products would be address emerging countries but also to all the developed countries in the world.

6. Examples of Reverse Innovation

The examples of reverse innovation are tabulated in table 2**.**

Table 2: Example of Reverse Innovation

Innovation	Innovator	Description	Reference
Tata Nano	Tata Motor Ltd	World cheapest passenger car at $2000	Ray and Ray (2011)
Tata Swach	Tata Chemicals Ltd.	The world's cheapest water purification system for household.	Tiwari and Herstatt (2012)
Tractor	Mahindra	High-quality, low-horsepower, low-cost tractor,	Govindarajan,v.(2012)
Micro-finance	Grameen	Microloans	Bhatti and Ventresca (2012)
Cardiac surgery	Narayana Hrudayalaya Hospital Bangalore	Application of mass-production techniques for heart surgery	Bhatti and Ventresca (2012)
Artificial leg	A doctor in Thailand	Low cost artificial leg made of recycled plastic yogurt con-tainers	Govindarajan,2012
Portable ultrasound machine	GE	standard laptop for data processing and imaging unit, which support of local language, easy to use and portable,	Zeschky et al. (2011); Immelt et al. (2009)
Computer mouse etc.	Logitech	Simple functions, established technologies (e.g. USB dongle, wireless connection),	Zeschky et al. (2011)
Bedside patient monitoring system	Philips	Simple functions, robust design, high reliability, ease of use	Zeschky et al. (2011)
Computed tomography (CT) scanner	Siemens	Simple functions, designed for intensive use and fast workflow, high reliability, ease of use	Zeschky et al. (2011)
Zhongxing X-ray machine	Zhongxing Medical	At approximately 1/20th price of Western X-ray machines through designing out extraneous functionality	Sehgal et al. (2010)

Anemia screening device	Mumbai-based Myshkin Ingawal	Non-invasive test that offers non-medical staff the means to detect and tackle anemia	Currently in prototype, biosense.in
ChotuKool refrigerator	Godrej & Boyce	Small size, high-end insulation, battery-operated and portability designed for the local context	Tiwari and Herstatt (2012); Bhatti and Ventresca (2012)
Solar power as a service	SELCO	Distributing the solar lights every evening and collecting them the next morning	Bound and Thornton, 2012
Minute Maid's Pulpy	Coca Cola	An orange juice with pulp. Coca-Cola introduced it in other countries after first introduced in China.	http://adage.com/article/ global-news/p-g-levi-s-ge-innovate-thinking-reverse/228146/
Maintenance Management Practice	Bharat Forge	The maintenance management process focused on minimizing downtime during machine maintenance and has an advanced information system that predicts problems before they happen	http://www.casestudyinc .com/reverse-innovation-definition-and-examples
Magie	Nestle	Low-cost, low-fat dried noodles developed for rural India and Pakistan found market in Australia and New Zealand	http://www.casestudyinc .com/reverse-innovation-definition-and-examples
Vicks Honey Cough	Procter & Gamble	Honey-based cold remedy developed in Mexico found success in European and the United States market	http://www.casestudyinc .com/reverse-innovation-definition-and-examples
Gatorade,- the sports drink	pepsico	The drink used in treatment for dehydration in Bangladesh used as sports drink as re-hydration	Govindarajan,2012

Kurkure	PepsiCo	Successful in India and then in west also	Fareeda, Syed Abdul Samad (2010)

These all examples are mainly initiated by organization in business industry where normally organization involved are not too small and investment in the process of achieving the success of reverse innovation is considerable. There are other sides of reverse innovation where individual or institute is involved and research fund is a constraint or even if the research passes successfully through stages of concept development, prototype production, small scale production, but can not achieve the full potential benefit because of policy support, resource constraints and lack of business knowledge or market idea.

7. A Case Study on Reverse Innovation

Bangladesh's Grameen Bank – Nurturing Reverse Innovation.

Bangladesh's Grameen Bank is another case to Reverse Innovation. The bank's mission is to convert the poors into entrepreneurs. Muhammad Yunus started with a small loan of US$27 to a group of 42 families so that they could make items for sale, without the burdens of high interest under predatory lending. He believed such loans to a larger population could stimulate businesses and reduce the widespread rural poverty in Bangladesh. 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 were given to women, who against the conventional thinking and beliefs proved 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%. 97% of the borrowers were women. The success has inspired similar projects in more than 40 countries around the world, including a World Bank initiative to finance Grameen-type schemes.. If Grameen Bank can make millions of unsecured loans to individuals who have no banking history, this proves Reverse innovation is not a distamt possibility. (https://en.wikipedia.org/wiki/Grameen_Bank).

8. Reverse Innovation- A case apart from similar innovations

Reverse innovation is relatively new development. But within a short span of seven to ten years, it has draw an enormous attention of the researchers, Reverse innovation is proposed as a solution for many contemporary issues and problems that companies are facing and it is considered a new wave in the history of innovation and globalization with bright future prospects. This innovation are structurally different from each other with respect to their original motivation, value proposition, and value creation mechanisms. For example, while some solutions may emerge from the redesign of an existing product to make it drastically cheaper, others may be entirely new and create new markets, as well.

Table 3- Reverse and Allied Innovations

Type of innovation	Coined by	Central focus	Remarks
Frugal innovation	Carlos Ghosn	-Reducing the complexity and cost. -Removing nonessential features,	Achieving more with fewer resources
Disruptive innovation	Christensen	-Disrupting an existing market and value network	ZIP Drive replaces CDs
Sustainable innovation	Frans Berkhout	- not creating new markets but rather evolves with better value propositions,	Intelligent window glass- automatically regulates the temperature and light resulting in high energy-savings.
Resource constrained innovation	J.A. Starr and I.C. MacMillan	-"Necessity is the mother of invention,"	Human mind is most productive when restricted. limited or better focused
Jugad Innovation	Radjou, N., Prabhu, J., & Ahuja, S	-Adapt quickly to situations and circumstances,	improvised solution born from ingenuity and cleverness
Gandhian Innovation	Prahalad C.K., Mashelkar R.A	-Affordability and sustainability, -No compromise on quality, - minuscule research budgets,	low prices, and big ambitions
Humanitarian innovation	Alexander Betts and Louise Bloom	- coping capacities of crisis-affected people,	new forms of partnership, and the use of the ideas
User innovation	Herstatt, C., & von Hippel, E. 1992.	-Attempt first from users who develop improvised versions to serve their own needs	Based on used involvement
Indigenous innovation'	Chen Jin	-Home grown innovation,	origination from self , no help from developed countries,
Inclusive innovation	George et. al. (2012)	-Targeted directly at meeting the needs of the low-income	affordability is main key point

		population, delivering high performance products and services at ultra-low cost to the people whose needs are generally not addressed.	
Social innovation	Murray et al. 2010,	-Role of the customer changes from a passive to an active player, people focused innovation,'	Practised by the International Institute for Communication & Development (IICD)
BOP innovation	C. K. Prahalad and Stuart Hart.	-Challenge Core Beliefs and assumptions about Poor People and Markets,	Business Designs from the Bottom-Up, - Invest in a Business Ecosystem

9. Development of Conceptual Frame Work for Reverse Innovation

Mari Terrio 2014, in her thesis "Examining Reverse Innovation and Collaboration: A Case Study in the Context of Uganda", commented "existing literature did not provide a substantial framework for the process of reverse innovation", and attempted to collect the key elements of key literature to adopt into a framework to model the reverse innovation process.

Radojevic (2012) writes, "this concept still needs to be integrated with literature on locus, characteristics, and diffusion of innovation" and this is just one of the many areas where more research effort is required.

The effective steps involved to institutionalize the effort of reverse innovation can be described as:

- Need analysis: any innovation should start only when there is need - explicit or may be latent.
- Prioritizing of constraints: since reverse innovation is 'more for less', prioritizing of all the constraints are very important.
- Optimization analysis: At this stage, optimization of resources or resource allocation and appropriation is done.
- Design specification: Initial design is freezed.
- User feedback on specification optimization: Feedback is taken from all stakeholders on design finalization.
- Prototype design: Prototype is designed and set for field trial and comments are collected on suitability.
- Iteration based on feedback from all relevant angles: Final tuning of design and processes.

- Total value chain development: Developing total value chain including raw material, components, consumables at one end ad market and channel distribution at other.
- Production: Managing production and achieving economy of scale
- Customer delight: Add more value for money.

The same is explained in figure 1.

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              ┌──────────────────────┐
              │    Prioritizing of   │
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              │       analysis       │
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              │     User feedback     │
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              │    Prototype design   │
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              │      Value chain      │
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              │      Production       │
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              │    Customer delight   │
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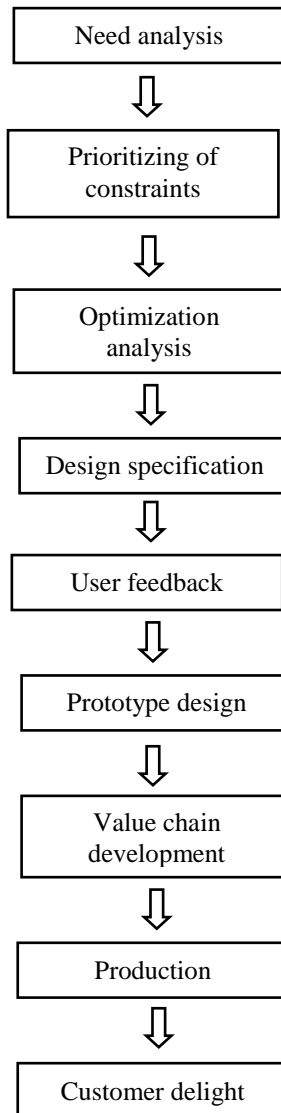
Figure 1: Various stages in Reverse Innovation

10. Strategy for Management of Reverse Innovation in India

Development of strategy for reverse innovation should not be in conventional way. It should be based on radical thinking and not incremental thinking. The strategy should

evolve in heart rather than in head. Head is the place for rational thinking and heart for intuitive thinking.

The product oriented strategy of reverse innovation can be based on focus of one or more of these factors and compromise on others, if it is bare necessity:

- Quality
- Affordable cost of the product and services
- Delivery/ time to market
- Mass production
- Features
- User involvement
- Human oriented
- Focus on under privileged
- Sustainability
- Mass customer base
- Focus on available resources
- Interdisciplinary approach.
- Inclusive approach
- Resource constrained approach
- More value for money

11. Managerial Implications

"Reverse innovation is about far more than reducing cost for the sake of poor consumers. It is about pushing the performance paradigm and offering more for less," Govindarajan explained. "As counterintuitive as it may seem, the quality demanded by poor people tends to be higher than the quality demanded by the rich" . As developed and emerging markets continue to converge over the next few decades, time is not very far to come true when innovation starts to flow more evenly in both the directions and it's more likely that the Reverse Innovation concept itself will become the most effective strategy for future.

12. Conclusion

Due to increased competition, Innovation has become the central theme of competitive edge in present age. Multinationals expect that about 70% of the world's growth in the next few years to come from emerging markets, with 40% coming from just two countries, China and India. They have also observed that China and to a lesser extent India have been pouring much resources into education over the past couple of decades. So innovation from developing countries i.e Reverse Innovation is the most natural choice as strategy for growth.

Unless an integrated pragmatic management plan and practices are taken for nurturing reverse innovation, the reverse innovation will remain as an individualistic stray effort and cascading chain reaction will not take place to yield economy the requisite momentum.

The best way now to go forward is to go in reverse way – in reverse innovation way.

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Digital Socialization – Fastening your social seat belt, socializing 30,000 feet up in the sky

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Abstract-

Human beings are social animals. The Social intent in human beings has transformed from one to one face interactions to intentions over call to pen friending and now to social media. But the entire social intent is lost when one is interacting with his/her social friend and ignoring the companion sitting next to him/her. The intent of this study is to combine the concept of social interaction and one to one interaction. Thereby using the digital means and social media to discover social acquaintances in the vicinity and then do a physical interaction with them

New media technologies are having a major impact on society as a whole. The incorporation of such technologies into social settings, such as the household, is having a major influence on social interaction between individuals. It is apparent from existing literature that new media technologies impact on the social interaction within households in many different ways. Social media technologies can help in increasing interaction amongst families by bringing generations and family members together. As a result, it can help bridge generational and digital gaps.

On the other hand, these new social media technologies in a household can also lead to a growing privatization within family life, with individuals increasingly using technology independently rather than collectively. The problem is important to bring back the concept of one to one physical interaction in the society and not just limit it to the social media interactions. The study will also enable me to measure the purchase intention of the customers using this application and reflect on it with respect to various industries/companies.

***Keywords**: Digital, Socialization, Airlines, social seating*

1. What is Digital Socilization?

With the rise of the Internet and smartphones, breaking news has become most accessible through a small device you slip into your pocket or a laptop that you carry around in a book bag. With a single click, students can be filled in on their weekend plans, results from elections and their class schedule for the day. With that kind of access to digital information, it is no surprise that smartphones, laptops and social networking prompt such compulsive use. The question remains if this is just a convenience or if technology in the digital age has taken away the ability of young teens and adults to communicate with people face to face.

So what is Digital Socialization? Digital socialization is the way people communicate using social media or internet. It is the custom and language unique to any culture. The internet involves millions of people across geography and background and has developed their own cultural quirks all on its own. Culture is shaped through communication and interactions with

each other and its continuously developing. Digital media is increasing so much that it is impacting on how we do things. Facebook has more than 1 billion active users in 2012. The micro-blogging platform Twitter has 150 million, while LinkedIn claims 75 million users. Internet socialization involves a huge number of people worldwide. Digital Socialization is the art of surviving online surpassing national borders, local cultures and societies and needs to be inclusive for equal participation. Nevertheless, this is not always possible due to local and individual limitations. In a country like Sweden, playing computer game is one of the most common practices for digital socialization among youth or you may say among digital youth, but not in schools or teachers.

Thus, there is limited established support taking obligation for the socialization process online of digital youth. Whereas, in a country like Sri Lanka, telecentres provide rounded community services with free access to computer hardware and sometimes also Internet to bridge an internal digital divide. Thus, it is necessary to understand how to design environments for digital socialization for youth online to achieve equal participation and keep societies together globally and locally. This chapter presents a brief background followed by problem statement and research objective. Furthermore, scope, significance and data analysis and discussions are presented.

2. Need of Study

The intent of this study is to combine the concept of social interaction and one to one interaction. Thereby using the digital means and social media to discover social acquaintances in the vicinity and then do a face to face interaction with them. This problem is relevant, as all digital age groups need to be socialized online by participating in practices in digital society, such as being present on social media and using the same in their day to day lives and also using it as a medium to make purchase.

The significance of digital socialization is from a social perspective to keep digital society together, and from an individual perspective to use it in their favor to take it as a medium to make a better and informed purchase decision. Solving the problem is a challenge due to different local requirements (e.g. privileged / underprivileged communities), the digital barriers across geographies and digital society. This study will have great impact in the contribution that it will make to the world of sociology. It is the study of sociology that makes us better understand and gives insight into today's society. Digital Socialization and the impact they are having on social interaction within the household is a topic that is evident and of great importance to the present world. It is through this study that the most important institutions of society; the home and the society will be looked at in greater detail and it is in this institution where society functions. My investigation will study the household and the role that new media technologies play in the development of social interactions.

3. Variable of the study
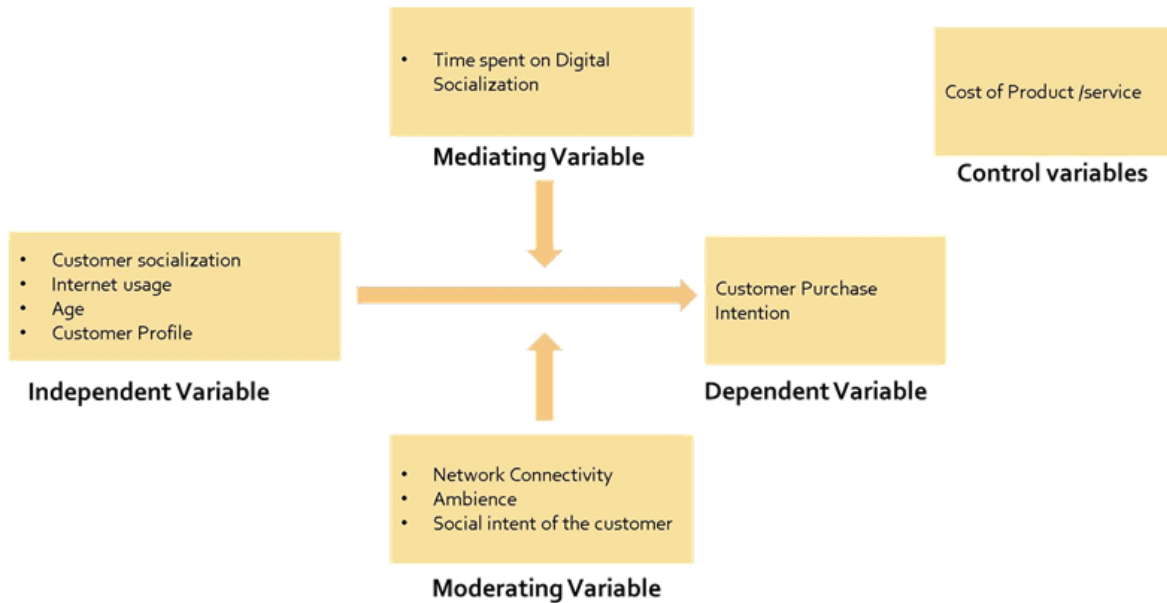
Fig. 1: Variables of the study

Variables of my study can be segregated into Mediating, Moderating, Independent, Dependent and Control.

Time spent on Digital Socialization:
The social media for digital interactions is the mediating variable which will help me evaluate the purchase intention of the customer. This can be measured using a tab on the devices a customer is using and the time spent on each device exclusively. The time spent on all the devices will then be added to finally come to the exhaustive time spent on all the devices and hence by the individual on digital socialization.

Customer Socialization
This variable will be measured as an independent variable by following an online profile of an individual and understanding how actively present he or she in on social media. This would be then judged relatively amongst the various responses received and would then be neutralized.

Internet Usage-
This would be an independent variable which would help me understand the time an individual spends on internet. This may need not necessarily be on social media. It would be the total amount of time an individual would spend on the internet, may be doing social interactions, or reading articles or checking mails, doing e-commerce transactions or even sharing information for that matter.

Age:
This variable would help me assess the different age groups and understand and evaluate the results of the study based on the age and generation brackets of the individual. This would assist me to plot the result of my study across the age groups and see the effect of the age on purchase intention of an individual.

Customer Profile:
This independent variable would help me in plotting a customer profile with respect to the gender, demographics e.g. geographic location, occupation, income group, travel frequency (in case of Airlines sector). The study of this variable would help me investigate the effect and variability of customer profile in examining the purchase intention and further assess what kind of customer would contribute to the top line of a company.

Network Connectivity:
This moderating variable would be measured by assessing the quality of network in a location and a geography. The study could be varied if we have varying network connectivity. For example, if the network connectivity in a location is not favorable then the consumer socialization may not be preferable. Which means to say the network connectivity in a developed country is better than that of the underdeveloped country and hence the result would vary from one geography to another.

Social Intent:
This moderating variable would help me understand the social intent of an individual i.e. measure how socially inclined an individual is. Whether he is social in nature or not. I can measure this by first following and assessing the individual's social media webpage and measuring his day to day social activities may be likes on a page or the number of friends or mutual friends or pokes by an individual. This would not only be restricted to an individual's online social presence but also his offline social inclination. Which would necessarily mean how socially pleasant and inclines is an individual towards others offline. This can be measure by conducting interviews with an individual and his close and near ones.

Ambience:
This variable again a moderating one would help me assess how an ambience of a particular place or location helps a customer decide on the purchase of a product or a service. For example if the ambience is favorable which would men pleasant and appealing to an individual or not. He may or may not decide to visit the place again in future. If he is in favor of the ambience, may be the climate, the menu (in case of restaurant), the in flight service (in case of an airlines) all should favor the customer's purchase intention and his future recurring visits to the same place.

Customer Purchase intention:
Customer's purchase intention is the final dependent variable which I intent to measure using all the above variables. This variable would be the primary key measure to investigate my study on how the above variable and their correlations help in the purchase intention of the customer. Which of the variables positively impact and which ones negatively impact and which ones have no impact on the customer purchase intention in an airlines or in a restaurant.

Cost of Product

The cost of product is the final Control variable which may be not be changed but would have an influence on the final dependent variable which is the purchase intention of an individual. It may be the fare in case of airlines or price of product or dish in case of restaurant industry or tariff of room in case of Hotel industry.

4. Significance of Study:

With the rise of the Internet and smartphones, breaking news has become most accessible through a small device you slip into your pocket or a laptop that you carry around in a book bag. With a single click, students can be filled in on their weekend plans, results from elections and their class schedule for the day. With that kind of access to digital information, it is no surprise that smartphones, laptops and social networking prompt such compulsive use. The question remains if this is just a convenience or if technology in the digital age has taken away the ability of young teens and adults to communicate with people face to face. By joining social strength of ties measures, our work builds on Leider et al. (2010) in its deployment of non-anonymous versions of what were traditionally anonymous games (Berg et al. 1995) to link social distance and trust in an online context. (Berg et al. 1995)

The value of my study is to notify society and individuals further on modern life and to assess the impact that social media interactions are having on today's society. My research will yield a greater insight into and the appreciation of the social interactions across various facets of society.

My study will have direct comportment on the initial efforts of social media technologies on the present world. It will underwrite towards finding solutions to the new social phenomenon that is digital socialization. My research will ultimately provide a greater understanding that will enable individuals to control the conditions of social life and therefore, help improve these conditions.

5. Literature Review:

An important first step in any marketing program is the determination of how many people are on the Internet and what they are doing there (Hoffman and Novak, 1994a). Digital Media is changing at an alarming rate and people are using this medium to interact and communicate with relatives, friends and colleagues on a local and global scale (Ryan, D. (2014). Digital technology includes customer relationship management software, sales force automation, wireless technology, marketing automation software, and decision support systems. (Urban, G. 2003).

Digital technology has opened newer means to buy and sell product. It has brought both the customer and buyer at same level giving equal power to both the parties. The world is changing at such a fast pace that by the time a perfect solution is developed, it is almost time for the next solution to be adaptive. Hence all the solutions need to be agile, flexible and scalable (Kierzkowski, A., Mcquade, S., Waitman, R., & Zeisser, M. 1996).

Interactive consumer marketing has shown incredible promise but companies are not yet certain

on how best to leverage its potential. An examination of Web sites revealed that most still use interactive media like traditional marketing channels (McQuade, S., Waitman, R., Zeisser, M., & Kierzkowski, A. 1996). Customerization is a strategy adopted by seller for buyer centric selling combining mass customization and customized marketing (Wind, J., & Rangaswamy, A. 2001) Companies have been able to target the right customer and deliver information to them in almost the perfect manner. Internet is the most popular modes of conducting digital information, where information is processed at a very minimal cost (Farrar, M. (2010).

Digital marketing has overtaken traditional marketing for shaping the consumer for tomorrow. Digital marketing will make the consumer more engaged and interactive. Traditional Marketing is one way interaction, results can be ambiguous, there is a short term impact, it is expensive and more time consuming, resistance to go viral. Whereas digital marketing involves 2 way interaction, results are easy to measure, they are long lasting and effective. (Yasmin, Afrina, Sadia Tasneem, and Kaniz Fatema, 2016)

This provides the basis for the rational formulation and implementation of branding strategies, applying internet-based tools to the tasks of marketing communication and customer relationship-building in particular (Geoffrey J. Simmons, (2007)

There is an enormous amount of strategic uncertainty when it comes to the evolution of digital technology in the digital world. (Wang, Y. S., & Tang, T. I. 2003).There is a great deal of concern regarding the security of financial information transmitted over the Internet and its impact on consumer willingness to buy or sell products (IITA 1994). Limitations impact consumer behavior on the Web: currently, the majority of consumers use the Web to browse or search much more than actually to purchase something (Booker, 1995, Wintrob, 1995).

The main trials for marketers are to attract visitors to the site and generate significant repeat visits (Williamson & Johnson, 1995). Mindfulness leads to trial or the initial site visit so that the trial problem depends on "Web Traffic Control." However, sites will only be successful in the long run if they produce repeat traffic, which is far more difficult to achieve than trial. The repeat visit problem is partly a function of Web site design (Saloman, 1995)

Internet usage continues to detonate across the world with digital becoming an increasingly important source of competitive advantage in both B2C and B2B marketing. A great deal of consideration has been focused on the tremendous opportunities digital marketing presents, with little attention on the real challenges companies are facing going digital (Leeflang, P. S., Verhoef, P. C., Dahlström, P., & Freundt, T. 2014). Customers process information through the stages of exposure, attention, comprehension and perception, yielding, acceptance and retention (Chaffey, D., Smith, P. R., & Smith, P. R. 2012)

Many companies are not sure which digital route is the right one for them. Particularly given the pace of change, they wonder where they should jump in. But to be successful in this environment, one will have to be ready to make a step-change; small experiments will no longer suffice. One must be ready to take a transformational view of marketing. This means making a shift to DigiMarketing (Wertime, K., & Fenwick, I. 2011)

Culture

Culture "is the system of meanings shared by groups of people as encoded in their language, music, arts, and other expressive and representational forms and systems" (Danesi and Rocci, 2009 p.137). In digital culture, people share values by communicating both face-to-face and through online medium. Socialization is "the process whereby an individual learns to adjust to a group (or society) and behave in a manner approved by the group (or society)" (Encyclopædia Britannica, n.d.). Socialization is necessary for all citizens in order to participate in society and keep society together.
Socialization can also be seen to restrain social responsivity (the willingness to respond socially), which in pure form is free of the norms and behaviors preferred in a group (Asplund, 1987).
Furthermore, social response and asocial non-response do exist simultaneously i.e they co-exist; as social response is directed toward something of interest it also implies being turned away from everything else around (Asplund, 1987).

Digital Socialization

Digital socialization is to socialize in digital world, i.e. to learn the ways of surviving in social online medium, across national borders, local cultures, societies and geographies. This is not only relevant and problematic for youth but people across generation and age groups, which can be illustrated by quoting Thomas Ziehe, preceding the wide Internet adoption of the 1990'ies:
"Rarely has a society raised the abstract myth of "youthfulness" to such an ideal, and at the same time underestimated or even ignored the new problems associated with young people's life situation" (Ziehe, 1989 p.48)

The problems Ziehe relate to are values of modernity, such as the termination of generational boundaries, traditions and cultures; there is a greater need of motivation to learn something extensively due to all available references i.e. to turn away from other things (Asplund, 1987).

Ziehe closes generational boundaries of youth by focusing on ability to handle communication alternatives and not age (Norgaard, 2000); in other words to be socialized in digital culture. For instance, in a study based on a seven-year long survey of problematic online behavior of adolescents in Korea, the authors conclude that "school-based digital socialization to prevent adolescents' online delinquency is inevitable" (Kim, 2015 p.650). However, this also requires digital literacy among adults (ibid.).

Children today are socializing in a manner which is very very different from their parents or grandparents (Prensky, 2012 p.76). "Socio-economic background still plays an important role in shaping young people's access to and use of the internet, and this tends to disadvantage those from poorer families more." (Lee, 2008 p.148).

Social Interaction

The family is a social organization that has "a collective identity", a "result of shared recollections of togetherness that are created as family members spend time together in shared

meals, games, and chatting" (Mesch 2006:123). Communication is "a symbolic, transactional process or the process of creating and sharing meanings" (Smith et al. 2009:79) and it plays an important role in the relationship between individuals for the functioning of a family or a household. Families that spend time together "in common activities enjoy a higher quality of communication" (Mesch 2006:124).

A lack of communication within a household can have a harmful impact on family contact, family unity and thus on the relationships within individuals within a household. For that reason, family communication is vital to any family and household as it "plays a significant role in the relationship between family freedom and family functioning" (Smith et al. 2009:80).

Modern society has led to an alteration in family dynamics which has resulted in the emergence of the household as a different entity from the family unit. This paper has also discussed the main changes between society and the geography and culture, along with the importance of communication and social interaction within this social setting.

Digital Generation Gap

A digital generation gap is "a generation gap between those who master and do not master digital technology" (Aarsand 2007:235). Essentially, this gap is "the difference between those who know and those who do not know how to act in a digital environment" (Aarsand 2007:236). It is assumed that children or youth as regular users of social media develop a wider and more substantial knowledge base in how to use them from their parents and grandparents (Aarsand 2007). On the other hand however, adults may use this divide as a way to interact with their children or their age mates and in order "to enter into social intercourse with children" (p. 252).

Thus, a divide of this nature is shaped and continued through social interaction and can help message social relations within a society, or it can interfere in communication and lead to individualization further. This concept is central to this research question. I am seeking to find out if social media interactions influence the purchase intention of the customer.

Social Media

Social media has become embedded within daily domestic routines and are now an "intrinsic part of contemporary life" (Church et al. 2010:264). The adaption of social media has impacted contemporary society in a number of different ways. One of the main revisions however, is the impact it has had on personal everyday relationships.
As Mesch (2006) delineates "the introduction of new technologies such as the Internet into the household can potentially change the quality of family relationships" (p. 119).
Hence digital and new media technologies such as "video games, computer games, the internet and email" (Aarsand 2007:235) are now an essential part of children's everyday lives in the western world, regardless of the fact whether they have access to it or not.

Technology has affected the life of a household many unique ways and has become "a basis for future social behaviour" (Venkatesh and Vitalari 1985:3). The usage social media into society has led to major social change which has meant that individuals, families and households have

had to adapt in a number of ways. Social change is defined by Venkatesh and Vitalari (1985) as "the process by which alteration occurs in the structure and function of a social system" (p. 4).
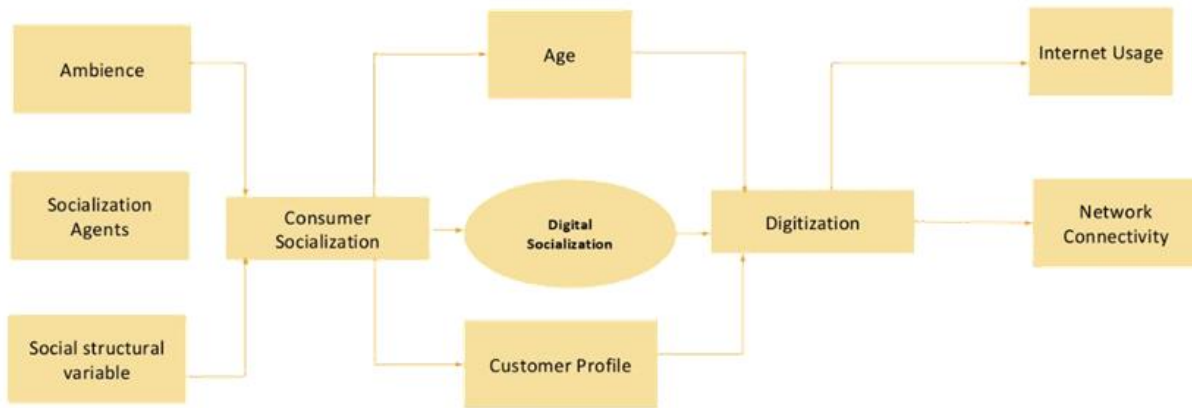
Concept Map

Fig. 2: Conceptual Map Design

The above illustration is how the different variables and factors lead to the concept of digital socialization.

Consumer socialization is determined by the variable like Ambience, Socialization Agents and Social Structural Variable. Ambience of a particular place or location helps a customer decide on the purchase of a product or a service. For example if the ambience is favorable which would men pleasant and appealing to an individual or not. Socialization agents like the mobile devices etc which lead to an individual opting for socialization and these also include the internet connection and the availability of the same. Social Structural variable which denotes the social nature or trait of an individual. All these factors lead to Consumer Socialization or which means the social readiness of the consumer to interact with other individuals in the vicinity.

Customer profile or the demographics of an individual with respect to the gender, income, geographic location, occupation, travel group, travel frequency (in case of Airlines sector). The study of this variable would help me investigate the effect and variability of customer profile in examining the purchase intention and further assess what kind of customer would contribute to the top line of a company.

Age along with the customer profile would help us in contributing to the parameter for digital Socialization.

Other factors include internet usage and network connectivity. Internet usage would be the total amount of time an individual would spend on the internet, may be doing social interactions, or reading articles or checking mails, doing e-commerce transactions or even sharing information for that matter. The study could be varied if we have varying network connectivity. For example,

if the network connectivity in a location is not favorable then the consumer socialization may not be preferable. Which means to say the network connectivity in a developed country is better than that of the underdeveloped country and hence the result would vary from one geography to another.

The concept of In-flight Socializing and its utility from customer's point of view can be best depicted by the 4 Use Cases as described below. The grey coloured plot denotes the Emotional Experience of activities across In flight Socializing and dotted line denotes the Complexity of those activities. As seen from the graphs below, it is observed that for all the use cases the emotional experience for the passengers is higher than the complexity of the activities

Use Case 1: Mark is a reputed Doctor in US. He has received an invite to attend a Doctor's conference to be held in Sweden. He is travelling to Sweden for the first time and hence is anxious about the travel. Let
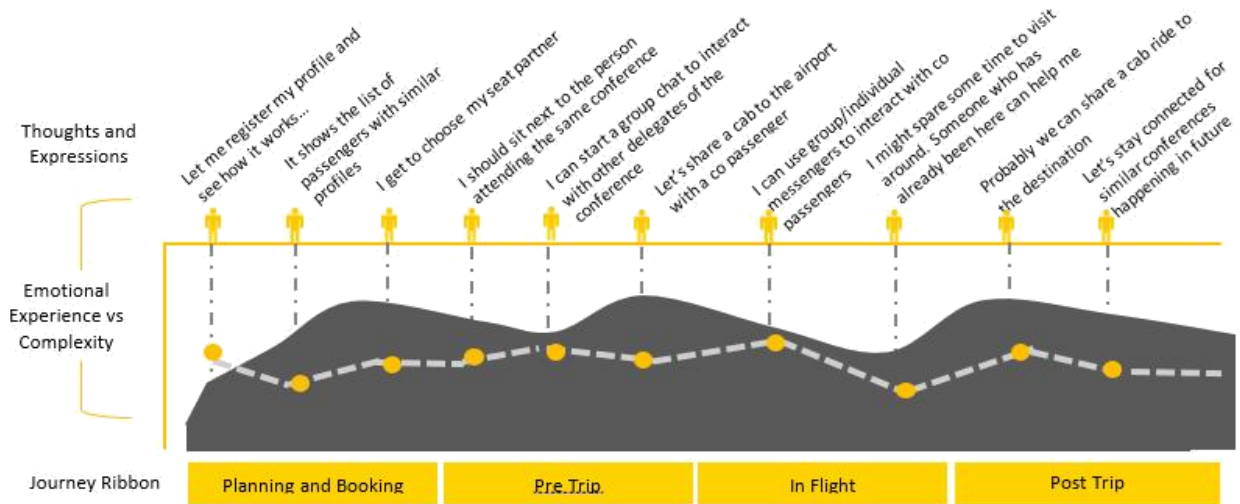
Use Case 2: David is travelling to China for a visit to one of his vendor companies. David has been to China before and realizes how language can be a communication barrier between him and the locals in the country. He wants to get all his queries answered by talking to a person from China who also knows English. The 'In Flight Socializing App has helped David get in touch with someone he needs to talk to.
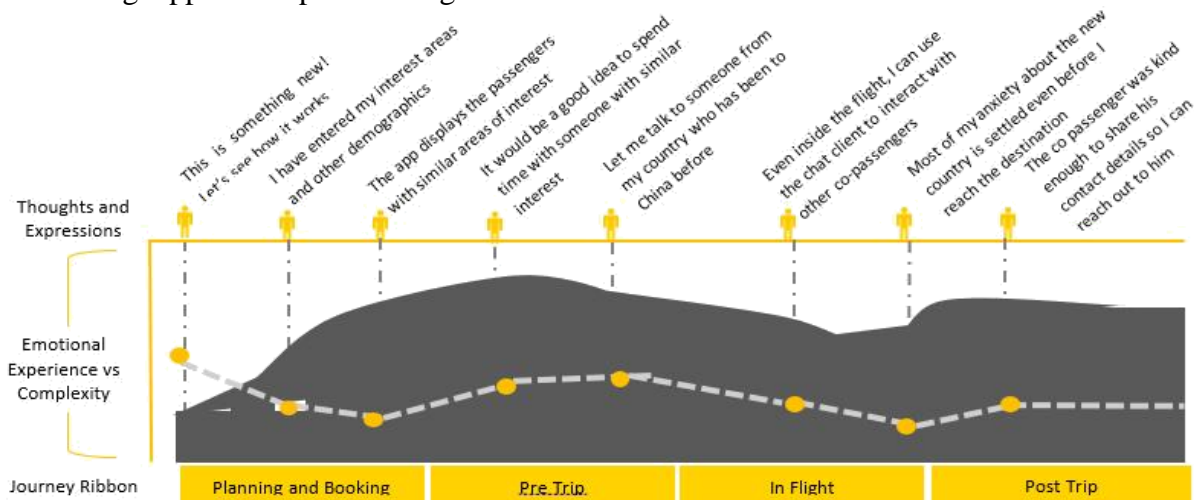
Use Case 3: Mary is travelling to Germany for admission in a University. This is the first time Mary is travelling to a foreign land and she is all by herself. Mary is excited about her new course, but is apprehensive about adapting to the new country. The "In Flight Socializing app" will surely reduce her apprehensions. Let's see how!
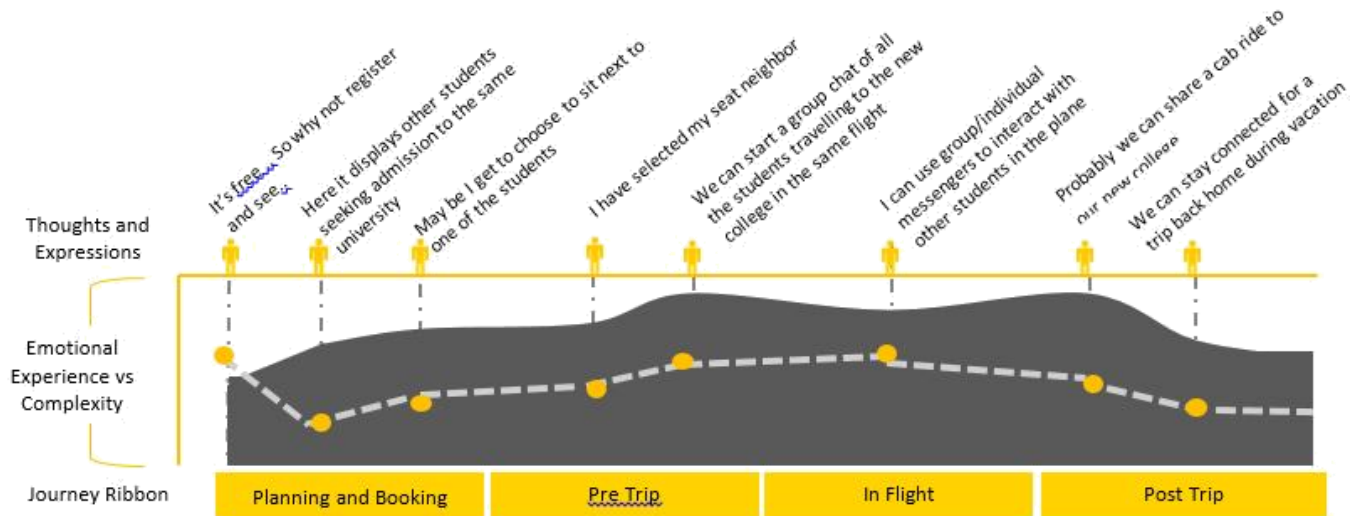
Use Case 4: Joe is taking his family for a long awaited vacation to South East Asia. He has his itinerary in place, but needs last minute advice on how to commute in the new country. Also, since he is travelling with his 2 kids, he would want to be prepared for any kind of emergency or medical help if required. The "In Flight Socializing App" has introduced him to someone who can help him ease his worries.
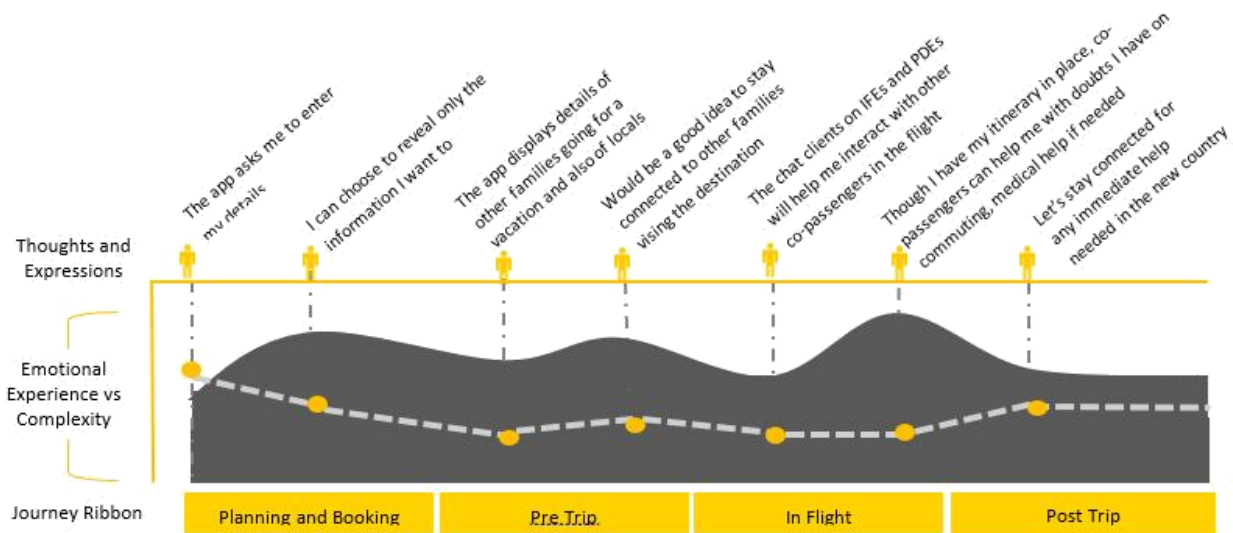
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SECTION – 4
SUSTAINABILITY

Agricultural Sustainability through Farmer Producers Company: A study on Challenges and Opportunity in rain fed region of Odisha

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Abstract-

Over the period, the low sectoral performances have a concern towards agricultural sustainability along with the livelihood of primary producers, whose part of share is less in consumer price. Farmer Producers Company (FPC) a new generation cooperative, stands as an institutional mechanism for marginal and small farmers to leverage the benefit of market liberalization through collective association. The FPC operationalizing in enterprises mode entitles the small producer to absorb the price risk.

The study determine the challenges and opportunity with the FPCs in Kalahandi district in Odisha, where small and marginal farmers constitute 86.8%, operate 61.07% and about 75% of the net shown area is under rainfed, who were found to migrate in earning their livelihood after the harvesting season. Further the study also tries to ascertain the sustainability factor among FPCs in the studied area through their multifaceted operations using Sustainable Business Model approach.

The study finds the initiative of linking farmers with formal value networks through institutional mechanism; entitle them with better economies of scale, better market facilitation with integration of backward and forward linkage leading to sustainability in agriculture. But the demand of professionalism to manage the institution seems to be ineffective for new entrant in a short run.

Keywords- Agricultural Sustainability, Farmer Producers Company, Rainfed, Institutional Mechanism, Sustainable Business Model

1. Introduction

A Globalised, Open economy with huge market competition, the nation is one among the fastest growing economy with projected GDP of 6.9 percent in 2019-20. Agriculture which is pre-dominant to Indian economy contributes 15.87 percent of the gross value added and Gross Capital Formation of 15.2 percent *(Central Statistical Office, MoSPI)*, which is passive to the total investment. The economy has undergone a major transformation since the Green Revolution, from gaining food aids to become self sufficient and net exporter of food produces. Agriculture is vital for India's economic development where 54 percent (*World Development Indicator, WBG, 2018*) of the total workforce, has dependency on agriculture & allied sector for their livelihood. The situation is at stake, when the decline in the share of Agricultural work force has been slower than the decline in the share of Agriculture in the GDP. The majority of the work force engaged in the primary sector relatively contributes insignificantly to the Gross Domestic Product. *Larson et al., 2000; Stephan et al., 2009 FAO, 2011; Bisaliah and Dev, 2012; Chand and Parappurathu, 2012* reflected that low public investment to Primary sector has neglected and sparked concern for economy. Accelerating Public investment with infusing human capital to be highly productive through

skilful jobs in the primary sector is an essential integration for economic development keeping pace to the growth of the agriculture and allied sector.

Report of, *World Bank Group, 2018* shows that the Agriculture sector exercise 61 percent of the total country's land and 90 percent of its water resources. *Agriculture Census, 2015-16* record an increase in operational land holding of 5.3 percent, in which the share of marginal & small farmers is 86.2 percent who holds 47.4 percent of the total area cultivated. Ironically, 4.3 percent of the large farmers hold 20 percent of the total area cultivated. The disparity in the land distribution, fragmented lands and composition of the farmers shows a peculiar scenario in the context of Indian Agriculture.

Purveying, to the rain fed Agriculture in India, *"NITI Aayog in a report in Revitalising Rainfed Agriculture in India"* water stressed in cropping and livestock impacting shortage of water for 7 to 10 months in the rainfed context. With early agricultural practices and exploiting the land resources by excessive use of chemical fertilizer with excessive run off irrigation deteriorate soil nutrient with leaching effect. But paradoxically, *Report on Rainfed Agriculture zone by NITI Aayog* reveals that the water stressed areas are maximum provider of protein and fat nutrient supplement in diet with relation to oilseeds, pulses, livestock produce and product and cotton. Concern to the development of irrigation and water resources, *Dev, Mahendra, S., 2012* posit that certain issues to irrigation needs to be address and major reforms *(Rao, 2005)* needed in irrigation reflecting public investment, raising profitability of ground water exploitation, rational pricing of irrigation water and electricity, involvement of farmers in the management of irrigation and making ground water equitable. An equitable distribution and allocation of water for irrigation addressed through water conservation technology and watershed programme at farm level to address water crises in rainfed zone by recommendation by *Parthasarathy Committee, 2009* under *National Rainfed Area Authority.*

Small and Marginal farmers could not creep the benefit of current technological advancement, policy & schemes, infrastructure in terms of communication, networking, cold storage, warehousing, insurance, food safety standard and laws, innovation at farm level with employment creation, value added products, Risk bearing capacity, diversification for income secureness due to lack of awareness, communication and unskilled growth, which influence negatively their income leading to farm distress and indebtedness *(Barham and Chitemi, 2009; Bienabe and Sautier, 2005; Mercoiret and Mfou'ou, 2006; Teshome et al, 2009)*.

CIPHET, Indian Government Harvest-Research body found that nearly about 67 million tons of food gets wasted every year, a quantity that is consumed by entire state of Bihar in a year. The reason behind such scenario is due to inappropriate supply chain management *(NDTV Profit, 2014)*, Post Harvest operation, warehousing, cold storage & lack of storage facility (*Planning Commission, 2007; The Hindu and Business Line, 2016*). Committee on studying the working of FCI states that, the Institution failed in achieving the objective of facilitating the farmers in delivering services *(Indian Express, 2015)*. *Survey by IIM Kolkata,* reveals that only 10 percent food get cold storage in India. Farm losses traps farmer in debt and face the risk of economic loss. Monopoly and inefficiency *(The Economist, 2015; The Tribune, 2015)* associated with regulated market *(APMC Act, 2003 reformed with APLM Act, 2017, E-National Agriculture Market)* due to high transaction cost, mediation charges, multiplicity of fees by commission agent, manipulative discovered price and cartelisation *(Nair, 2015)* makes the market counterproductive for the farmers as a result of the farmers share in consumer price is low.

With relation to problem of marketing, procurement and marketing intelligences, *NSSO, 2013* data reveals that only 24 percent of the total farmers have information about crop procurement, less than 10 percent of the total produce is sold to procurement agencies and only 1.6 percent of the total produce is sold at Minimum support Price *(Commission for Agricultural Costs and Price, 1965* to advice and set price on *Essential Commodity (Essential Commodity Act, 1955* and Other produce). The inefficiency of both the counter party can be brought out through creation of marginal and small farmers collective Organisation under *Institutional Mechanism (Joshi and Gulati, 2003)* by Enterprising farmers, collectively by adding value in the entire process of production and post harvest system and diversifying the farm activities, innovating in the present farm production process and bearing the risk of innovation and curving migration and unemployment can play an important role in bringing a significant change in farmers income, gain economies of scale and curving poverty. *Birthal and Negi, 2012; Brithal et al., 2015* found lower incidence of poverty among farmers who grow high value crop along other farm diversified activity (Allied Farm activities and Non-farm operation).

Collective Integration of Marginal and small farmers through Institutional Mechanism *(Joshi and Gulati, 2003; Barham and Chitemi, 2009)* are a decades old instrument under Economic growth policy to improve farmer income. Tracing the success cases from Cooperatives in India (Welfare approach) to evolution of New Generation Cooperative and Farmer Producers Companies (insertion of *Part IXA Section 581c* of *farmer Producers Company Act 2002* under *Companies Act, 1956*) on a commercial approach through institutional mechanism to double farmer income and its potential to alleviate poverty *(World Bank, 2007a)* has been a dynamic initiative.

The study determine the challenges and opportunity with the FPCs in Kalahandi district in Odisha, where small and marginal farmers constitute 86.8%, operate 61.07% and about 75% of the net shown area is under rainfed, who were found to migrate in earning their livelihood after the harvesting season. Further the study also tries to ascertain the sustainability factor among FPCs in the studied area through their multifaceted operations using Sustainable Business Model approach.

2. Literature Review

Sustainability as a concept is a complex and dynamic with various scholars and the existing body of knowledge expounding different definition and failing to reach consensus. Sustainability as an important construct, Stated as main principle of the declaration of the Rio-Earth Summit and Agenda 21, which was established in 1992 at the *United Nation Conference for Environment and Development (UNCED).*

"Agriculture Sustainability" gained its prominence since the publication of the *'Brundtland Report in 1987,* but the ideology of Agricultural Sustainability was noted first in 1798 by Thomas Malthus in his work on *'Principle of Population' in 1798*, where he drew attention on how the ever growing population could surpass the ability to produce the food. The technological development with constraint to economic growth carter to the changing needs of human by exploiting the land through productivity enhancement *(Feher and Beke, 2013).*

With the foot step of green revolution *(Kannan et al., 2005),* economic reform and policy reforms related to agriculture has brought a change in the global consumption of synthetic

pesticides and fertilizer, organic to inorganic consumption where livestock manure is substituted to synthetic chemicals and the decision making ability for input use has also reduced from farmers level to input suppliers. The impact of such creations makes difference with respect to economic, social and ecological dimension. Studies by (*Dale et al., 2013; Gomez –Limon and Sanchez, 2010*) *reflect* multidimensional character of sustainability which demands for profit operation at farmers level, equitable distribution of wealth at societal level and compatible eco-system and protection towards stewardship in environment.

The better agriculture development in terms of technology and input management, the human activities around the production system led to huge losses of soil through soil erosion, loss of organic matter, nutrient imbalances and leaching, *World Bank, 2011* reveals that it has an issue on the sustainability of agriculture which reduces the productivity, less rainfall damage rain fed agriculture and increased risk for farmers. Sustainability with an approach from Conventional practices (*Smith C.S and McDonald G.T, 1998; Obasanjo, 2013*) which led to capital intensive techniques, large scale, mechanized system with monoculture of crops, extensive use of synthetic fertilizers and pesticides at an alarming state make a move towards Sustainable agricultural practices. Sustainable agricultural practices make effort for use of alternative to conventional methods by using on-farm available resource; reduce use of synthetic fertilizer by natural and organic matters, crop rotation, and diversification of crops (*Hansen, 1996; Hill and Mac Rae, 1988; ZBNF, Economic Survey and Budget, 2019*).

Concern about Sustainability in agriculture, several indicators has been developed, which affect the environment as well as food productivity and profitability with relation to input used in practices, market access and decision making (*Pretty, 2008 and Muller et al., 2011; Nkambule and Dlamini, 2012; Lopez-Ridaura et al., 2002; Hani et., 2003; Swaminathan, 2006; Pretty, 2008; Guttenstein at al., 2010; Chan et al., 2013*). Further, (*Nkambule and Dlamini, 2012; Jayne et al., 2014*) empirically reflects that among small holders irrigation in sustainable agriculture, impact on agricultural productivity, production risk, natural resource conservation, societal growth, poverty reduction leading to economic growth. Whereas, to measure the sustainability (*Altieri, 1995; Lynam and Herdt, 1989; Beus and Dunlop, 1994; Webster, 1999; Gowda and Jayaramaiah, 1998; Rasul and Thapa, 2003; Zhen and Routray, 2003*) condition*,* indicator seeking to benefit from economic, social and environmental perspective have been listed out such as yield (*Van Pham and Smith, 2014*), security, input productivity, per capita food productivity, input self sufficiency, food security, integrated pest management, land productivity, water use efficiency, self sufficiency in information, farmers livelihood system, building indigenous knowledge, employment generation(*Herzog and Gotsch, 1998; Rasul and Thapa, 2003; King, 2016); (Zhen and Routray, 2003*)Benefit cost ratio of production, Net farm income, access to resources and support services, nitrate content of ground water and crop, awareness to resource conservation*;* Production cost (*Smith and Mc Donald, 1997);* Value Chain (*Pretty et al., 2008*); Economic efficiency (*Hani et al., 2006*);Market availability (*Van Cauwenbergh et al., 2007*); Crop diversification (*Senanayake, 1991; Saltiel et al., 1994; Ingels et al., 1997; Commer et al., 1999; Praneetvatakul et al., 2001; Nambiar et al., 2001; Horrigan et al., 2002; Rasul and Thapa, 2003*) .

Reviewing the existing body of knowledge on Agricultural sustainability, it reflects the condition is at stake. The Gap that could be established in existing body of literature i;e in Economic Indices "Enhancing production and productivity" has been given more focused with "Minimising cost of Production". But empirically and with practice over the time, it has been observed that despite of various moderate factors and measures, the income that is realised does not comes in par with the normal profit to cover the cost of production and does

not ensure protections towards environmental losses, Which breaches the standard for Agricultural Sustainability?

Acknowledging problems of sustainability in Agriculture and policy of *Doubling Farmers Income-2022 and National Mission for Sustainable Agriculture,12th Five year Plan, 2010* to retain farm practices effectively by meeting the high cost of production with/by increasing the income from farm output, emphasizing higher production and productivity at a given level ensuring safe guard to Social and environment factors, the Institutional Mechanism such as Farmer Producers Company *(Part IXA Section 581c* of *farmer Producers Company Act 2002* under *Companies Act, 1956; Budget, 2019)* with its potential provision like Innovation at Farm and regional level, bearing the price risk with diversifettion and innovation, Value addition across the supply chain, Employment creation among rural youth, land less labourers, women Producers entitles to break such strain of poverty by establishing Producers Company an 'Agricultural Enterprises *(Ahmad and Seymour, 2008)* and create an entrepreneurial culture*(Barham and Chitemi, 2009)* in rural communities*(Lundy et al, 2002; Markelova et al., 2009).*

Keeping a concern to the Agricultural sustainability to a rain fed context of Odisha, where small and marginal farmers are 86.2 percent and dominate the entire production system, but income is not increasing much significantly with respect to production of the crops taken in to practice. Farmers Producers Company*(Alagh.Y committee, 2002)* is one such choice which binds the producers in to a cluster by enterprising them while attributing value addition, innovation in the process and face value to bear risk, maintain economies of scale and lowering transaction costs*(Bernard and Spielman, 2009; Bienable and Sautier, 2005)* . *Suman et al., (2014)* advocates for an integrated agricultural extension services system in which all stake holders such as govt, Non govt organisation, Farmers Organisation, farmers club can actively participate and contributing to agricultural sustainability.

Business practices among the producers group and ensuring agricultural sustainability, *Wicks,1996; and Stubbs and Cocklin,2008* defines Sustainable Business Model is one where development plays an integral role in the shaping the core objective of the business and decision making that reflects a balance between triple bottom line with structural and cultural attributes. FPC has geared towards protecting the small and marginal farmers from the effect of liberalization and through a collective approach have able to face the market competition and bargain with the opponents, importers and traders.

Keeping align with different conceptual and theoretical definition of FPC with potential provisions such as innovation at farm and regional level, bearing risk by diversification in operation, value addition that provides opportunity to link market demand and creates employment within the association *(Farina, 2002; Anish K, 2007; Singh, 2008; Murray, 2008,2009; World Bank, 2008; ASA,2009; NRAA, 2009 Kantikar, 2016)* ensuring Agricultural sustainability *(FAO, 1991; Douglass, 1984;Bowers, 1995; Lopez-Ridaura et al., 2002; Hani et., 2003; Swaminathan, 2006; Pretty, 2008; Guttenstein at al., 2010; Chan et al., 2013)* entitles entrepreneurship among farmers is important for economic development in terms of capital formation, employment creation, increasing productivity, technological innovation *(Bach & Pinstrup Andersen, 2008; World Bank, 2008; Hall et al., 2010; Kelly et al., 2010; Wiklund et al., 2011; SADC, 2012; Ghiasy and Hosseini, 2012).* The potential provisions of Farmer Producers Company with a temporal perspective could meet the indicators of Agricultural Sustainability that relates to economic feasibility, social acceptability and protecting environmental stewardship & Agro-ecological sphere.

3. Context of the Study

Odisha, with a rich basket of agricultural, horticultural and marine produce has a geographical area of 1.55 lakhs sq. Km and divided in to 10 agro climatic zone. The total cultivable land of the state is 61.80 lakhs hectare out of which 54 percent is irrigated. With a dependence of over 60 percent of state population on agriculture and allied sector, it hold key to the economic development.

Kalahandi, district an agrarian economy with cultivated area of 378('000 ha) which is located in the south western part of Odisha falls under the undulating zone with annually 1375mm of rain fall. The district with rain fed area of 371.3 ('000ha) is the major producer of paddy and pulses with minor producer of maize around 11 percent and mango around 6 percent of Odisha total production.

The district holds a cropping intensity of 162% with net irrigated area of 135.57 ('000ha) where cannels on Indravati river gives a fate to the farmers to cultivate two crops a year but with a low catchment area in Rabi crop for only around 50.08('000ha). These results to migration, seeking to tillage the land in next kharif.

Dominated by small & marginal farmers who constitute 86.8 percent operate 61.07 percent of the total land holding. Literature and experts comments, During Bengal Famine kalahandi had sent alone 100000 tonnes of rice. The continuous poor rainfall from 1960s to 1980s made it a drought prone area. In 1980s Kalahandi became famous for drought, famine, child selling, mall nutrition, starvation death and Economist named it as "Kalahandi Syndromes".

In 1990 the central govt announced special project to KBK (Kalahandi, Bolangir, Koraput) undivided Kalahandi for development of the backward regions. "P.Sainath" in his book "Everybody loves a good drought" It mention about the human face of poverty of undivided Kalahandi. He mentions Kalahandi produces more food per person than both Odisha & India as a whole do. Its own inhabitants, though, consumes only 25percent of the food grains. The rest leaves through the channels of money lenders and merchants. Thus shows the scene of disparity among the people.

The major irrigation project in the Indravati River is a major boost for the agriculture development which gives the farmer two crops a year. Recent development and reports speaks Kalahandi has become the rice bowl in India, which has brought its paddy production yield from 82,000 tonnes during Post Indravati to 7lacs tonnes presently. But, despite it does not benefit the 86.8 percent of the small & marginal farmers, where the district marks poverty rate above 50 percent. Poverty is paradoxical to the context.

With response to the market integration the small and marginal yet could not able to gear the pace of agriculture as well as agribusiness system from back ward and forward integration. Seeking the importance of agriculture sector to the context and settling down towards lack of non-agriculture jobs in the district and adjoined district, the status of Agriculture enterprises are kept at a height where small and marginal farmers collectively could operationalize farm related business activity.

 Kurien et al.1979, revealed economic change reflects when there is interaction between three forms of basic economic element i;e ownership and control of resources, utilization of resources and processing and measuring the performance. Farmers Organisation, producers groups are one such deliverables which empowers and entitles farmers to creep the benefit across different verticals such as in production with quality inputs, post harvest management

with value addition, bargaining power in the market with accessibility, innovation with risk bearing. Nathen et al.1997 posit that a collective system can function well only if a system of monitoring and sanction for violating the common law is in place.

4. Objective of the Study

- To determine the challenges and opportunity with the Farmer Producers Company (FPCs) in the studied context.
- To ascertain the sustainability factor among FPCs in the studied context.

5. Methodology

The study considered Farmer Producers Company operating in Kalahandi with multifaceted business operations. The study categorised the FPCs in terms of nature of business they were involved with i;e production and input agency, procurement, marketing of agriculture and allied sector produces. The study use focus group discussion to access the data and information with response to the objectives. The study adopts Kruskal Wallis Test to measure H significance level. Further the in formations sets have been categories under the Sustainable Business model framework adopted from Stubbs and Cocklin(2008).

5.1 Hypotheses:

H_0: Institutional mechanism has significant relation to Agriculture sustainability.

H_1: Institutional mechanism has no significant relation to Agriculture sustainability.

6. Results and Discussion

- The sustainable business model components for the selected FPCs operations under the structural and cultural attributes, the studies tries to find whether there is insignificant relation towards sustainability in agriculture.

Table-1 Insignificant difference with the institutional mechanism towards s sustainability in agriculture			
Rank			
Dimensions	Operations	N	Mean Rank
Economic	Production and Input agency	6	9.5
	Procurement	6	8.17
	Marketing	6	10.83
	Total	18	
Environment	Production and Input agency	6	9.08
	Procurement	6	9.08
	Marketing	6	10.33
	Total	18	
Social	Production and Input agency	6	8.67
	Procurement	6	8.67

	Marketing	6	11.17
	Total	18	
Commercial	Production and Input agency	6	11.58
	Procurement	6	5.33
	Marketing	6	11.58
	Total	18	
Holistic	Production and Input agency	6	9.17
	Procurement	6	8.58
	Marketing	6	10.75
	Total	18	

Table-2	Test Statistics				
	Economic	Environment	Social	Commercial	Holistic
Chi-Square	0.943	0.289	1.417	6.708	0.592
Df	2	2	2	2	2
Asymp.sig.	0.624	0.865	0.492	0.035	0.744

The result of the analysis indicates that statistically the asymptotic significance level among the operation in three segments, the significance level is greater that 0.05 (standard significance), which rejects the alternative hypotheses. The study Reflect that institutional mechanism has significant relationship towards agricultural sustainability.

- As per objective 1, the study determines the challenges and opportunity from the FPCs.

    The most appropriate well being of farmers is to improve his farm income and income from secondary activity. Market linkage is an important element which changes the multidimensional poverty situation in to green income. The study through focus group discussion could determine certain challenges and opportunity that producers have to face. The study enlisted it as follows –

    Challenges and problem faced by the producers company, which was amended for a noble cause. The producers in the infancy stage face the problem to manage the institution. The institutional mechanism demands for professional management of the operation and legal virtues of the companies. So the FPCs have to face stumbling blocks in their teething state.

    Since, the concept is not widely extended among the public services and credit institutions, the FPCs fail to get recognition and support like working capital loans, incentives and schemes supports.

    The members extended their dissatisfaction towards group coordination and voluntary participation due to laggard behavioural tendency.

    Opportunity for the Producers, the marginal and small farmers tries to maintain economies of scale by adhering collective effort across the value chain in production and post harvest operations.

Due to collective approach, the producers amplify the political voice as a result they could bargain with the traders and deliver bulk quantity with qualitative demand.

The producers presently in this system could leverage quality and timely service related to their production like inputs, post harvest operation like ware housing, cold storage, low transaction cost, market linkages and integration of backward and forward linkages.

The institutional mechanism creates opportunity for the marginal and small producers to involve in value addition, innovation at farm level, creating employment among the rural youth by curving migration in terms of agency sale, credit facilitation, input distribution, procurement of raw produces and distributions.

Collective actions among the producers allow them to develop a new pattern of system and face market competition with their cultural practices.

The opportunity over challenges with the market situation provides producers to develop a multifaceted scenario which reduces the risk and uncertainties in the changing market trend. The institutional mechanism ruled a significant impact on the marginal and small producer economic and social sustainability with care for environmental stewardship.

- As per objective 2, the study tries to ascertain the sustainability factor among the FPCs through their multifaceted operations.

The study adopts the sustainable business model approach to critically examine the sustainability among the FPCs operation that led to agriculture sustainability purveying economic, social and environmental dimension through structural and cultural attributes. The operation have been categorised in to 3 segments i;e production and input agency, procurement and marketing.

Table 3	Sustainability in operation for Agricultural Sustainability			
	Economic	Environment	Social	Commercial and Holistic
Structural Attributes	The efficiency and growth is monitored by facilitating agency, the FPCs operate with concern towards triple bottom line	Balance use of synthetic chemicals, Regeneration of compost and farm manure, recharge ground water by watershed projects	Up gradation of skill set, training to youth for employment in similar operation contributes to physical development	Combination of cooperative and private ltd attribute regulates for strategic system and planning
	collective approach linking to government schemes, subsidies, market led extension, demand estimation	Develop produce and product with demand driven technology	physical extension regulates transparency in business operation	Review by stakeholder, facilitating agency using triple bottom line theory
	Capital support from producers as share holder, local agency,	Maintain Economic order quantity in stock management	Consultation and consortium of stake holder at different	Innovation at farm level, value addition with institutional

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	grant support from facilitating institution like NABARD, SFAC, Commercial bank on evaluation of bankable report	for inputs and efficiency in factors production	forum	ownership
		Protect agro-ecological sphere by balancing carbon and nitrate emission through adoption of modern techniques		Focus on demand driven and market led extension theory
Cultural Attributes	Profit is a mean not an end	Important stake holder	Coordination and Cooperation	Long term focus
	Investment towards a better livelihood	Balance investment towards environment depletions	structural change in present social status	Overall growth with quality, quantity and cost control mechanism
	Expectation towards short term return	Long term return	Long term return and sharing of resources among the community	Long term focus relation to economic dimension of the model

The structural and cultural attributes of sustainable business model in production, procurement and harvesting operation equates to sustainability dimensions which regulates in par with cost minimization, economies of scale, Economic order quantity, balancing environmental depletions, coordination and cooperation among the societies for a sustainable growth, stake holder management, technology and demand driven roles. The FPCs in the studied location have been rolling with more than 3 years of their operation. The above mention challenges in objective one have been faced out effectively with professional and stake holder management, which in long run results in sustainability of the companies. Mediating factors like climate, price policy, governance are considered important elements, which decide the sustainability of the companies.

7. Conclusion

The dimensions for agricultural sustainability in every farmer owned institution are intertwined with each other upon effective decision making. It decides the profitability at long term. The holistic approach towards sustainable situation entitles each stake holders to

adhere a transparency across the value chain. Institutional mechanism significantly contributes towards agricultural sustainability which amplifies the voice of marginal and small farmers and led them to face market competition. The producers companies voluntarily contribute to use environment friendly techniques subjected towards safeguard agro-ecological sphere. Farmers led institution where it lacks professional voice can secure stake holder and functional support of facilitating organisation to overcome uncertainties in teething stage. Attempting mutual understanding and seeking institutional and governance support can take Farmers producers Company at a new height, which aims to create integrated structure of services in a common platform.

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Sustainable Tourism Development And Leadership In Uttarakhand - A Himalayan State

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Abstract-

The Himalayan region in India remains a popular tourist destination as it attracts massive inflow of tourist round the year. The present study is focused on Uttarakhand as it provides both adventures and pilgrimage tourism along with tourism pertaining to Forest, Rivers, Hills and Ecology, which made it one of the most important regions of Himalaya in terms of tourism. The state of Uttarakhad is divided in to two divisions the North-Western division is known as Garhwal and South-Eastern division is known as Kumaon. It is a hill state with beautiful forest and snowcapped mountains and sacred pilgrimage spot, which attract tourists altogether. It is a developing state and tourism plays an important role for generating the employment opportunities, which provides source of living to local community. The tourism industry in the state creates environmental and socio economic consequences. The mountain tourism requires major concern as the massive infrastructural developmental activities are occurring for the promotion of tourism with even estimating the tourism carrying capacity.

Keywords: Sustainable Tourism, New Destination, Destination Discontinuity, Leadership, Employment and Growth

1. Introduction

The word sustainability is popular term in the present scenario which has become widely used globally. In the academic as well as industry segment sustainability is the prime word to be used in tourism, planning and development studies, especially for infrastructure development field. The definition of sustainability among the researches defer with little agreement on the basis of focus methodology. Sustainable tourism can be implemented in different context and it suffer from the same problem as eco tourism, where operationalizing as a concept poses numerous problem (Bottrill & Pearce, 1995).

The growing interest in sustainability as in approach to a statrategic planning as in area of concern has resulted in a new dimesions for the planning process and the result for tourism destination. This new interest on planning for tourism activities and development has also generated a new coffetable debate which tourism is being integrated with economic development. According to Dredg and Moore (1992). In an urban destination, tourism in not a corelvent in te process of planning, destipite its aprent economic significant. Therefore, it is clear that in the public sector the planning process must be acquired, sustaiable tourism for the overall development of the area. It is widely acknowledge that planning and management function are the main factor for influency, organizing, directing, coordinating reporting and budgeting of tourism with various effects on impact. (Heeley, 1981).

In the year 2012, the European Commission's Directorate-General for Development and Cooperation – EuropeAid established the project Enhancing capacities for sustainable tourism for development in developing countries. The project was undertaken in collaboration with the

World Tourism Organization (UNWTO); which was commissioned to prepare a Guidebook on Sustainable Tourism, as an engine for development, trade in services, job creation and poverty reduction.

The Guidebook is intended to enhance the understanding of tourism in all its dimensions, how it relates to the EU Agenda for Change so as to enable EU services in Brussels and the EU Delegations in 180 countries as well as other development institutions to include sustainable tourism development in their program cycles.

The main objective of UNWTO is minimize the negative impacts and maximize the positive contribution towards tourism. It also paying prime attention to the growth potential of developing countries to identifying and implementing interventions in sustainable tourism. UNWTO has open its parameter to invite different agencies and government as a partner. The main output of the effort of UNWTO can be seen in the country like Kenya, Vietnam, Senegal, Botsaana etc. The guide book published by UNWTO is launched with European Union on 27th June, 2013 in Brussels.

The sustainable tourism has very interesting data which impacts directly on economy –

Parameter	Unit
Direct Global GDP	5%
Jobs World wide	235 Million
International Tourist by 2030	108 Billion
World's Export of Services	30%
Economy Generated	$1.3 Trillion

Fig.1. Data from UN World Tourism Organization

Since last couple of decades, tourism industry has experienced seamless growth and diversification. It has been established the fastest growing economic sectors in the world. In terms of finance and employment the tourism industry today surpasses the parameters with business of oil export, automobiles, food products etc. Tourism industry attracts lot of youth and women around the world to become entrepreneur. For many developing countries tourism has become a major source of income and international trade.

2. Himalayan State Uttarakhand

The Uttarakhand state under the able leadership of Chief Minister Trivender Singh Rawat, Trying hard to transform the state as major tourist destination and working to establish as world tourist destination in coming years. The state Uttarakhand is located in the Himalayas which has many tourist spots, ancient temples forest reserves national parks, hill stations and mountain peaks. The state tourism is mainly categories in religious and pilgrimages, wellness, adventure, wildlife, historic and heritage.
As per the hindu mythology, Uttarakhand has been called "Land of Gods" as the state has many holiest science. The two most important river of the country Ganga & Yamuna originates in Uttarakhand named as Gangotri and Yamnotri respectively. The holiest temple name Badrinath (Dedicated to lord Vishnu) & Kedarnath (Dedicated to lord Shiva) is also situated here. These four main religious places together meets CharDham of the state. Uttarkhand state is situated in Himalayan regions which meets in a natural tourist destination- "The gateway of the God " is called Haridwar is a prime destination, which hosts the Kumbh Mela every 12 years, in which millions of pilgrims take parts from every corner of India and

the world. It has preeminent yoga center of the world situated at Rishikesh. Uttarakhand is a place of pilgrimages not only for Hindus; a holy place for muslims is Piran Kaliyar Shareef near Roorkee, Gurudwara hemkund Sahib, Gurudwara Nanakmatta Saheeb & Gurudwara Reetha Saheeb are pilgrimage center for Sikh. With the reconstruction of monastery the Tibetan and Buddishm has also meets its presence in Uttarakhand.

The wellknown hill station in Uttarakhand is Mussorrie, Nainital, Raniketh etc. Auli is a well known skiing resorts in the world. Uttarakhand state is captured with almost 80% of forest reserves and it has 12 National Parks and wild life sanctuaries. They are located in different altitudes. Varying from 800-5400mts. The world renowned and one of the oldest national parks in the Indian sub continents is Jim Corbett National Parks, which is a major tourist attraction. Similarly, Raja Ji National Park is known for its Elephants and other animals. The Utarakhand have valley of flowers and Nanda Devi national park in Chamoli district, the UNESCO has announced these two parks as World Heritage Site. This state is a destination for mountarian, tracking, white water rafting, skiing, camping, rock climbing, paragliding and recently a merged as best destination for film shooting.

The inflow data of tourist in Uttarakhand in last 10 years –

Sr. No.	Years	Auli	Mussoorie	Valley of Flowers	Tehri	Nainital	Corbett National Park
1	2009	41107	1102567	1775	887156	89079	184410
2	2010	40666	1104796	4456	914608	83609	190248
3	2011	42828	1120287	4525	933442	843815	136610
4	2012	32645	1205291	5392	980279	906331	212881
5	2013	29593	1075975	938	496369	744218	176802
6	2014	26402	1396702	181	571047	758123	252385
7	2015	26296	2769272	5253	1160335	815805	199848
8	2016	42981	2795124	11861	976834	873395	186719
9	2017	85134	2795973	13854	1462824	918652	254498
10	2018	151802	2872025	14792	2117431	933657	261280

Fig. 2 – Data shows the number of Tourists in Hill Station year wise

Sr. No.	Years	Rishikesh	Kedarnath	Badrinath	Hemkund Sahib	Gangotri	Yamunotri	Haridwar
1	2009	586419	403636	798204	332466	380157	322242	12069517
2	2010	1098712	400511	921526	309150	310561	309634	18866680
3	2011	1186529	570601	936172	424034	485137	448945	13481372
4	2012	809738	573052	1046619	291621	435552	413615	15258750
5	2013	374409	333774	476430	77861	210239	253110	12786261
6	2014	332988	40946	159575	37678	51694	38294	15477542
7	2015	437756	154435	366455	68073	160192	122926	19350640
8	2016	592227	309764	654355	108838	285459	155129	20508097
9	2017	678041	471235	920466	213401	408738	392208	21009098
10	2018	662118	731991	1048051	159103	447838	394445	21577583

Fig. 3 – Data shows the number of Pilgrims in Holy Places year wise

The data shows that the heavy cluster in Hill Station is at Mussoorie and Nainital and for spiritual places it is in Haridwar, Badrinath and Kedarnath. During the peek hour the famous destination like Nainital, Mussoorie, Raniketh, Chakrata and other places flosk with large number of tourist and it become discomfort for the administration to manage the crowd. Keeping this in mind, the Trivendra Singh Rawat Government has decided to establish and develop **"13 New Destinations in 13 Districts"** to ease the crowd.

The government has identified Munsiyari (Laser Tourism) in Pithoragarh district, Kausani (Tea tourism) in Bageshwar, Katarmal (Meditation Tourism) in Almora, Mukteshwar in Nainital, Lohaghat (Hill Station) in Champawat, Parag Farm (Amusement Park) in Udham Singh Nagar, Chopta (Ecotourism) in Rudraprayag, Tehri lake (Water Sports) in Tehri, Khirsu (Hill Station and Wildlife) of Pauri district, Chinyalisaur (Multi-purpose theme) of Uttarkashi, Gairsain-Auli (Winter Sports and Knowledge Town) of Chamoli, Chakrata (Heritage Tourism) in Dehradun, and Piran Kaliyar and Shaktipeeth (Religious Tourism) in Haridwar district for the project.

3. Five Key Pillars of Sustainable Tourism

Assessing the Current state of affairs with the pillars	Tourism Policy and Governance	Trade, Investment Data & Competitivenes	Employment and Capacity Building	Poverty Reduction & Social Inclusion	Sustainability of natural and cultural environment
Assessing the Capacities and skills at all level					
Uncovering Opportunities and challenges to be addressed					
Analyzing the needs and defining the most effective interventions					

Trivendra Singh Rawat said, "There are various locations for tourists to explore in Uttarakhand. We do not want them to visit just one or two areas but travel across the state." He pointed out that the project would not only boost the tourism sector but also provide holistic development in the entire state.

4. The Concept of Developing New Destination

In a study, it is the witness of a growing proliferation of new forms of tourism. The tourists wants to travel to the natural places to enjoy the eco-tourism, they study the different cultures "cultural tourism" they visit to the historical places "heritage tourism" they obtain desirable natural medical treatments and services (wellness tourism). Some of the countries like Japan & India officially recognize these forms of tourism to encourage more tourists. These new trends of tourism foster to drive environmental sustainability and wellbeing.

5. Sustainable Tourism

The World Tourism Organization declared in 1988 that Sustainable Tourism is: "Envisaged as leading to management of all resources in such a way that economic, social and aesthetic needs can be fulfilled while maintaining cultural integrity, essential ecological processes, biological diversity and life support systems."

There is evidence that the tourism industry has become an important activity around the globe. The sustainable tourism is required to be well planned to provide an opportunity to the tourists to experience the natural areas and local culture. It fulfill the objective of the tourism industry with phrase think global act local. Sustainable tourism activities is becoming income generation business for the local and the government.

The International Eco Tourism Society (2004) has portrayed sustainability in respects to tourism as follows:
- To maintain the environment with special term to fauna, water, greenery etc. this will make an advantage in a positive way.
- The Social and the cultural base of the area is intact and not harm the community.
- In the economic point of view the sustainable tourism is a quick kick for growth of the business and financial prosperity of the community.

Jointly, the above three points as "triple bottom line". This refer to the concept of "I am okay, you are okay". This means under the banner of sustainable tourism business it never destroy the natural resources but it appreciate the qualities and actuality of the place, people, culture.

Main features of Sustainable Tourism which may includes -
1. Indigenous oriented.
2. Focus on culture diversity.
3. Conservation of Flora & Fauna.
4. Understanding of local food and religious activities.
5. Impart new education experiences.

Objectives of Sustainable tourism
Broadly the sustainable tourism is based on economical, Environmental and Socio-Cultural aspects. The main objective of it can be study as follows:-

A. Economical aspects of sustainable tourism -
a) Benefits - This activity boost the local business and the locals get benefits.
b) Development of the Surroundings.
c) It generates the employment for the local people.
d) It integrates the social value of the area.

B. Environmental aspects of sustainable tourism
a) It controls the biological and visual pollution.
b) It ensures the environment and natural life, as well as minimizes the affect of tourism on the environment.
c) It reduces the uncommon and non-renewable resources.
d) It saves water and soil from contamination.

C. Socio-cultural aspects of sustainable tourism
a) It is the best source of building the social infrastructure, welfare of the people and

community.

b) The support to maintain and develop cultural heritage

c) It fosters to provide the safe and enjoyable tourist experience.

d) The local authority will engage in managing the tourists' inflow in a proper manne

6. Flow Chart of Sustainable Tourism

TRANSPORTATION   **ACCOMMODATION**   **PURPOSE OF TRAVEL**
- sightseeing
- business
- leisure/entertainment

SUSTAINABLE TOURISM

BOOST ECONOMY

- capital income

- higher employment in tourism sector and stakeholders (ex. Suppliers, local transportation companies etc.)
- development of infrastructure: roads, rail tracks etc.
leisure centers/activities
ECONOMIC DRAWBACKS
- unequal accumulation of resources between locals and guests

SOCIO-CULTURAL

- need for more qualified human resources
- local community develops, enriches when properly managed by responsible officials

- threat of cultural clush

ENVIRONMENT
- minimizing pollution cause by noise, waste disposal and congestion

- conservation of natural resources of destination

LOCAL TOURISM POLICY
RESPONSIBLE MANAGEMENT

Module 01. Example of functioning of tourism

7. The Triple-Bottom Line of Sustainable Tourism

There are three crucial factors that outline the base of the thought of sustainable tourism.

Global warming - Usually the circumstance whereby the soil is getting warm-up. The climate change situation decarbonizes the entire economy and similarly on soils and ecosystem. Most of the countries is facing such issues because of untrustworthy manhandle of the environment. And it surges the over all development of the area. This is one of the hinder for growth of tourism industry.

Social workers - Social worker is the exercises by human creatures to fulfill the financial needs of the society. This is a practice-based activity and in academic it promotes the social change and development. Individuals have gotten to be less supportive and more self-centered. The people have

misplaced the values that have been utilized to attract the tourists or visitors. It has shaped a ground for the individuals to connect these activities.

Resources – Many tourists travel to enjoy the natural resources available in the area. They attracts with natural recourses like forests, hill, river, sand, sea, birds, animals etc. For the vast development of the society many countries cut down the trees, which disturbed the natural resources drastically. This leads to the less foot-fall of the visitors in many areas. These slow down the tourism industries. Contrary to it the Uttarakhand State have many natural beauties available in terms of animals, forests, flowers, rivers hills etc. which attracts many tourists from around the world and create a good economy for the locals. This is the best example of sustainable tourism.

7. Limitation

The sustainability of tourism has some limitations too. And major limitation is it is expensive, as the tourists have to visit the untouched areas of the country the facilities for hospitality and eateries is costly. There is also a big barrier imposed by means of rigid government policies; the development of the area is very tough as the policies is not allowing to disturb the ecosystem of the concern area. The flora and fauna is required to be untouched. The other barrier towards the sustainability tourism is lack of knowledge, environmental awareness and future initiatives. Sustainability is required long term thinking towards the tourism industry.

8. Recommendations

It is recommended that more and more education towards sustainability approach is required to impose among the stake holders of tourism industry. Basically there are some areas which is required to reanalyze like Tourism planning, Operations and management, investment opportunities, tourism promotion and marketing, capacity building, consumption of the local resources, and monitoring with evaluations of the tourism business towards sustainability.

9. Conclusions

The sustainable tourism itself describes the long-term maintenance of the ecological system. It promotes the indigenous culture and ethnic society. Sustainable tourism works with locals to understand the tourism and the businesses in terms of the area concern like villages and town. There are certain ways to foster the sustainable tourism – home stay, tribal tourism, wildlife, ecotourism etc.

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Review Of Literature On Wind Energy Industry In India

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Abstract-

This paper is an attempt to bring together and give structure to the literature that is available related to the Wind Energy Sector in India by doing a Systematic Literature Review. A total of 7 databases and 55 Journals were explored and 70 articles were identified, which were then grouped into three major themes which are Sector Overview, Wind Economics /Finance and Policy. Of the 3 areas, Sector Overview has the most articles with 42 followed by Policy with 18, while Wind Economics and Finance has the least with 10. It can be concluded that majority of the literature has been written post 2010 and very limited literature is available prior to that.   Authors recommendations include need to study, compare and assess the effectiveness of the various policies in the growth of Wind Energy ,comparison of effectiveness of same policy in other Renewable Energy Sectors like Solar as well as with effectiveness in other countries, Comparison between Feed In Tariff Policy and Competitive Bidding or Auctions, efficacy of the National Off Shore Wind Energy Policy and study on the Strategy, Competitiveness as well as Business Models being followed by various Companies in the Wind Energy Sector in India.

Keywords: Wind Energy India, Renewable Energy, Wind Economics, Renewable Energy Finance, Wind Farms, Renewable Energy Policy, Policy Effectiveness

1.   Introduction

India is a growing economy with manufacturing sector becoming bigger part of it, incomes are rising and the country is becoming more urbanized**.** Sustaining and driving this growth further and to provide grid electricity and improving energy access to rural households poses a formidable challenge on the Energy systems in the Country. Peak electricity demand in India today is 140 GW and it is estimated that it   will double the levels of 2011-12 by 2021-22. Despite 275 GW of installed electricity generating capacity exceeding power demand but due to coal supply shortages, high level of transmission and distribution losses and poor financial health of utilities, some parts of the country still face acute power shortages (18th Electric Power Survey; Central Electricity Authority) (Niti Ayog, 2015). Due to continuous policy interventions, there has been a slow and steady progress. Number of people without access to electricity fell below 1 billion in 2017, electrification of all villages completed in 2018 and India aims achieve universal access to electricity by the early2020s. (IEA , 2019).As in other developing and developed   countries,   major commercial fuels like Coal and Petroleum products meet the Energy   requirements in India as well. Coal is a major contributor to pollution and petroleum products increase the import bill. (Singh & Parida, 2013). In all this mix of things,   to meet the energy demands in future as well as to address the challenges of pollution, depleting natural resources and increasing import bills development of Renewable Energy (RE) is key. (Kilinc-Ata, 2017)**.** The vast and largely untapped Renewable Energy (RE) resources that are available in India puts it in a very advantageous position in 21st century. India's estimated solar potential is greater than 750 GW and wind potential is 302 GW (Niti Ayog, 2015). Taking into account all these factors Govt. has put an ambitious target of achieving 175 GW of Renewable Energy target by 2022 with sub distribution as under (Niti Ayog, 2015).-

(a) Solar (utility-scale, distributed, off-grid/mini-grid – 100 GW)
(b) Wind (utility-scale – 60 GW)
(c) Small hydro (5 GW)
(d) Bioenergy (10 GW)

2.   Wind Sector in India- Background and Evolution

Wind Energy in India was used for the first time in 1950's to pump water for domestic and irrigation use. In 1952, Council for Scientific and Industrial Research (CSIR) established a Wind Power Sub-Committee, which was assigned the task of investigating the available resources that could be practically utilized, along with researching the economic possibilities of wind energy. In 1957, this subcommittee began to erect 20 wind velocity survey stations across India. CSIR established a Wind Power Division as part of the new National Aeronautical Laboratory (NAL) in Bangalore in 1960.   The NAL and other groups continued to carry out wind velocity surveys and develop improved estimates of India's wind energy capacity from 1960s to 1980s.   Government later introduced A National Water-Pumping Windmill Demonstration Programme in the 6th (1980-85) and 7th (1986-91) plan periods. Around 2800 units of the 12-PU-500 wind pumps for shallow well water pumping were installed around the country but unfortunately due to various technical and non-technical reasons, the project could not succeed except in some regions. (Jagadeesh, 2000).

The wind energy programme in India gained momentum when Commission for Additional Sources of Energy (CASE) was setup in 1981 and was later upgraded to Department of Non-Conventional Energy Sources (DNES) in 1982.A full-fledged Ministry of Non-Conventional Energy Sources (MNES) was established in 1992 which was renamed as Ministry of New and Renewable Energy (MNRE) in 2006. The Indian Renewable Energy Development Agency (IREDA) was established in 1987 as a financial arm of the Ministry to promote renewable energy technologies in the country (Purohit & Purohit, 2009). A Wind Resource Assessment Programme was taken up in 1985 comprising wind monitoring, wind mapping and complex terrain projects. The programme covered 25 states with over 600 stations. (Jagadeesh, 2000).

The first wind project in India was setup in 1985 in Veraval, Gujarat, in the form of a 40-kW Dutch machine (make Polenko) connected to the grid. Though the performance of this machine was quite poor, it established the technical viability of operating wind turbines in the grid-connected mode in India. The viability of grid connected wind farms in India was further established by 1988 with the successful operation of horizontal-axis wind turbines (HAWTs) in the rating range of 18.5- 100 kW at five locations in India (Sinha & Kandpal, 1990).

The sector was liberalized for private sector participation in 1992. The incentives that were made available to the sector included soft loans and tax benefits like Accelerated Depriciation, custom and excise duty reliefs. Wind-power plants grew from 41 MW in March 1992 to 968 MW by March, 1998. (Rajsekhar, et al., 1999). Post that also there was a steady growth of Wind Energy in India. Today with an installed capacity of 35.128 GW, India is the second largest market in Asia, and in solid fourth place in the global cumulative rankings. The sector is poised for major growth as government has seeks to its targets of **175 GW** of renewable capacity by 2022, with 60 GW of that coming from wind. The growth of Wind Power till 2018-19 is illustrated as under in **Table 1**:-

Table 1: State wise Growth of Wind power till 2018-19

STATE	AP	GUJARAT	KAR	KERALA	MP	MAH	RAJ	TN	OTHERS
Upto 31.03.2002	93.2	181.4	69.3	2	23.2	400.3	16.1	877	4.3
2002-03	0	6.2	55.6	0	0	2	44.6	133.6	0
2003-04	6.2	28.9	84.9	0	0	6.2	117.8	371.2	0
2004-05	21.8	51.5	201.5	0	6.3	48.8	106.3	675.5	0
2005-06	0.5	84.6	143.8	0	11.4	545.1	73.3	857.6	0
2006-07	0.8	284	266	0	16.4	485.3	111.8	577.9	0
2007-08	0	616.4	190.3	8.5	130.4	268.2	69	380.7	0
2008-09	0	313.6	316	16.5	25.1	183	199.6	431.1	0
2009-10	13.6	297.1	145.4	0.8	16.6	138.9	350	602.2	0
2010-11	55.4	312.8	254.1	7.4	46.5	239.1	436.7	997.4	0
2011-12	54.1	789.9	206.7	0	100.5	416.5	545.7	1083.5	0
2012-13	202.2	208.3	201.7	0	9.6	288.6	615.4	174.6	0
2013-14	298.5	279.8	183	0	37.4	1074.5	98.8	107.38	0
2014-15	166.3	126.9	230.5	0	143.9	273.45	267.7	124.45	0
2015-16	399.45	392.5	231.15	8.5	1261.1	209.15	684.95	158.86	77
2016-17	661.05	404	285.05	0	147.5	10.95	222.65	80.44	26
2017-18	1874.5	1,260.80	1355.25	9.4	230.4	118.2	81.05	502.78	2.1
2018-19	123.5	459.65	86.5	0	0	10.2	2	771.82	27.3
TOTAL(In MW)	3971.1	6098.35	4506.75	53.1	2206.3	4718.45	4043.45	8908.03	136.7

Sources :(Jethani, J. K. ,2016) (Jethani, J. K. ,2017),(MNRE,2014),(IWTMA,2019) (ET,2017)(GWEC,2016)

As is evident from Table 1 above that the growth in most of the states have picked up post 2010-11 and Tamil Nadu with total installations of 8908.03 MW leads in the country and is followed by Gujarat (6098.35 MW) , Maharashtra (4718.45 MW), Karnataka (4506.75 MW) and Rajasthan (4043.45 MW).

3.   Research in Wind Sector in India

As is evident from above, developments in Wind Energy Sector in India started back in 80s, however complimentary developments in research especially related to management, policy and economic aspects has not occurred at the same pace. This paper is an attempt to bring together and give structure to the literature that is available with reference to management, policy and economic aspects of Wind Energy Sector in India. Scientific Literature that relates to topics as aerodynamics, wind speed, metallurgy, applied physics ,tower and turbine design etc. have not been not covered here along with literature related to Environmental Impacts of Wind Farms . This paper tries to summarise the developments and research work done until date with the help of categorisation as themes and to provide direction in terms of important research questions for future researchers.

The Wind Energy Sector comes under the broad umbrella of Renewable Energy, which also includes Solar, Biomass etc. The available literature related to Renewable Energy in India covers overall status of all sectors including Wind Energy in general. Therefore, that literature has been excluded from the review. Only four papers primarily related to financing and economics of Renewable energy in India, which give significant insight on Wind Energy as well, have been included. The

review paper includes papers and reports published by International Renewable Energy Agency (IRENA) and Global Wind Energy Council (GWEC). In addition, policy papers issued and study reports carried out by Ministry of New and Renewable Energy related Wind Energy are included. Few related important articles published in Akshay Urja (Published by MNRE), Studies carried out by CRISIL, Mytrah/PwC and Conference papers have also been included.

4.   Research Methodology

The very first step in the review was to identify the databases and journals for searching the articles. The list along with the key words used to identify the same is reported in **Table 2** below. Articles were considered with in the domain of management, policy & its effectiveness and economic and financial aspects of Wind Energy Sector in India & associated topics like scientific and technology aspects, environmental impacts and broader area of Renewable Energy are not covered in the study. Subsequently after identifying and studying the articles, the citations and references were crosschecked and articles and papers balance have been added.

Table 2: List of Key Words used and Databases Explored

Key Words Used	Databases
1. Wind Energy India	1. Scopus
2. Renewable Energy	2. Taylor & Francis
3. Wind Economics	3. Elsevier
4. Wind Farms	4. Wiley
5. Wind Sector	5. Jstor
6. Renewable Energy Policy India	6. Springer
7. Wind Energy Policy India	7.Google Scholar
8. Energy Policy	8. Research gate
9. Wind Energy Management	
10. Energy Policy Effectiveness	
11. Renewable Energy Policy Effectiveness	
Key Words:7	**Databases :7**

Table 3: List of Journals Explored

Journals Explored	Nos
case-bharat.org	1
2016 International Conference on Electrical Power and Energy Systems (ICEPES)	1
Akshay Urja	2
American Journal of Engineering Research (AJER)	1
Carbon Balance and Management	1
Center for International Climate and Enviromental Research –Oslo , Working Paper-1999	1
Clean Technologies and Environmental Policy	1
Climate Policy	1
Climate Policy Initiative	1
Conferenc : National Conference on Advances & Research in Electrical Systems and Technology AREST-11 ,	1
Conference : Wind Power in India -2016	1
Conference: National Conference on Emerging Trends in Electrical & Electronics Engineering (ETEEE-2011)	1
CRISIL Insight	2
Current Sustainable/Renewable Energy Reports	1
Conference: 2018 National Power Engineering Conference (NPEC)	1
Energetica India	1
Energy Future	1
Energy Policy	3
Energy Sources Journal	2
Energy Strategy Reviews	1
Energy Sustainability Through Green Energy and Technology	1
Institute of Development Studies	1
GWEC	1
Journal of Renewable Energy	1
NRDC international: INDIA/india environment portal	1
CSTEP/WindForce	2
International Journal for Innovative Research in Science & Technology	1
Energy Security and Sustainability(Book)	1
Int. J. Global Energy Issues	1
International Journal of Advanced Engineering Technology	1
International Journal of Electrical and Electronics Engineers	1
International Journal of Engineering Research in Mechanical and Civil Engineering	1
International Journal of Renewable Energy Research	2
International Journal of Scientific and Research Publications	1
International Research Journal of Engineering and Technology	1
International Research Journal of Environment Sciences	2
IOSR Journal of Electrical and Electronics Engineering	1
IRENA	1
CICERO	1
ReFocus	1
Energy Policy	1

MNRE	3
Mytrah/PwC	1
Journal of Wind Engineering and Industrial Aerodynamics	1
Journal of Renewable Energy	1
Journal of Renewable and Sustainable Energy	1
Renewable and Sustainable Energy Reviews	7
Renewable Energy World	1
Renewable Energy	1
Globalization of Indian Industries, India Studies in Business and Economics(Book)	1
The International Institute for Sustainable Development	1
windpower.org	1
Wind Engineering	1
Summer Internship Report	1
Total Journals : 55	**70**

5. Research Analysis & Findings

Based on the researcher initial reading of the 70 articles, these articles were then grouped into three different categories based on major themes. These categories shall be treated only for categorisation purpose since no scientific coding method was deployed to arrive at it. It is wise to assume that these categories has been arrived at after reading those papers thoroughly and purpose of doing it is to organize the main body of work related to Wind Energy Sector in India literature which can be useful for future research. Thus, this categorisation cannot be treated as classification. **Table 4** provides a list of articles identified in various categories.

Table 4: Articles based on Categories

Theme	Topics Included	Articles
Sector overview	An Analysis of Wind power generation, Collective institutional entrepreneurship and contestations, India's Wind Power Potential, Wind Energy Scenario, Status and Review , Re-assessment of wind energy potential, Wind energy development, Potential of Wind Power Projects under Clean Development Mechanism in India, Indian wind energy programme, Importance of Wind Power in India, Wind Energy Market Developments in India, Barriers in Development of Wind Energy, Re-assessment of wind energy potential with new technology in India, OffShore Wind Energy, Future Trends of Wind Power	**42** **(60%)**
Wind Economics /Finance	Accelerated Depreciation ,Feed in Tariff, Generation Based Incentives, Foreign Direct Investment, Finance Mechanism, Competitive Bidding, Business Opportunities, Economics of Wind Farms, Techno Economic Analysis of Wind Generation, Financing Challenge to meet RE targets, Renewable Energy Financing	**10** **(14.28%)**
Policy	Policies to accelerate growth of Off shore Wind Energy, Role of Policy for Deployment of Wind Energy, India's Accelerated Depreciation Policy, Role of Policy in Deployment of Wind Energy, Project Allocation Mechanisms, Generation Based Incentives and Accelerated Depreciation Policies, Policies to accelerate growth of Off shore Wind Energy, Policy for Repowering Wind Projects, Strategic Plan for New And Renewable Energy Sector, National Offshore Wind Energy Policy ,Policy Effectiveness , Role of State Incentives in the Deployment of Wind Energy in India, technology diffusion analysis, 30 Years of Policies for Wind Energy	**18 (25.72%)**

Of the 3 areas, Sector Overview has the most articles with 42 followed by Policy with 18 While Wind Economics and Finance has the least with 10. Sector Overview being the dominant theme and articles under the same have touched upon all aspects related to Wind Energy i.e. Historical development and evolution of Wind Energy in India, various policies and enabling measures, Overall and State wise installation status and Barriers to the development of Wind Energy in India. As most of the articles are covering the theme on the similar line, it is difficult to further identify sub themes in the same. Policy Categorization has been further subdivided into Wind Energy Policies, Policy Effectiveness. Wind Economics and Finance has been further subdivided into Wind Farm Economics Analysis and Financing Mechanisms.

In order to further, understand the evolution of literature related to Wind Energy Sector in India, year wise analysis of literature has been carried out and described in **Table 5**. As is evident from above, that majority of the literature has been written post 2010 and very limited literature is available prior to that.

Table 5:   **Year Wise list of Articles**

Year	Articles
2019	01
2018	01
2017	06
2016	11
2015	17
2014	06
2013	08
2012	01
2011	06
2009	02
2007	01
2004	02
2001	02
2000	01
1999	03
1990	01
1988	01
Total	**70**

Table 6: Detailed Sub-distribution of articles related to Wind Energy Sector In India

Topic Area Study	Sub – Topic	Study
Sector Overview	Barriers and Challenges in growth of Wind Industry	(Kar & Sharma, 2015), (Rajsekhar, Van Hulle & Jansen,1999), (Jagadeesh, 2000), (Singh, S., Bhatti, T. S., & Kothari, 2004)(Arul,2015) (Mehra & Hossain,2015)(Jagadeesh, 1999) (Chaurasiya , Warudkar & Ahmed ,2019)

	Historical Developments, Background, current status and growth potential	(Singh & Parida, 2013), (Purohit & Purohit, 2009), (Kar, 2015), (Khare, Nema & Baredar, 2013), (Sangroya & Nayak, 2015), (Purohit & Michaelowa, 2007), (CSTEP, WFMS& SSEF, 2015), (Wind Denmark Report, 2013), (Hossain, Sharma, Mishra, Ansari, & Kishore, 2016), (Gunjker, Deshmukh & Jha, 2016), (Gambhir & Thakur, 2019), (PwC & Mytrah, 2015), (Hossain, Swamy, Mishra & Sharma, 2015)) (Ramachandra & Hegde,2017),(Kulkarni, Anil& Gowdar, 2016),(Jolly & Raven, 2015),(Singh Madhu and Singh Payal, 2014), (Sharma , Srivastava , Jha & Kumar , 2011), (GWEC, 2016), (Parihar & Purohit, 2017) (Kasisomayajula, 2013), (Chauhan, Agarwal & Suman, 2013), (Singh, Saini & Sood, 2016) (Kulkarni, Anil, & Gowdar, 2016), (Chakraborty, Sinha, Dutta & Biswas, 2011) (Bakhsh, Islam, Tabrez & Sharma, 2011) (Shukla, & Biswal, 2014) (Sitharthan, Swaminathan, Parthasarathy, 2018) (Maurya, Khare & Bajpai, 2015)
	Drivers of Wind Power	(Golait, Moharil, & Kulkarni, 2009)
	OffShore Wind Energy	(Kothari & Umashanker, 2015) (Arora, 2011)
Policy	Policies	(Bayer, 2013), (MNRE,2016), (MNRE, 2011), Niti Ayog (2015), (Jethani, 2016), (Chaudhary, Krishna & Sagar, 2014), (IRENA, 2012)
	Off Shore Wind Energy Policy	(Mani & Dhingra, 2013), (MNRE, 2015)
	Policy Effectiveness	(Kathuria,2016), (Sud, Sharma, & Kitson,2015), (Panse & Kathuria,2016), (Sangroya & Nayak, 2014), (Rao & Kishore, 2009) (Schmid, 2011), (CRISIL, 2016)
Wind Economics and Finance	Auctions	(Shrimali, Konda, Farooqee & David, 2015), (CRISIL, 2017)
	Wind Farm Economics	(Hossain, Thukral, & Kishore ,1988), (Sinha & Kandpal, 1990), (Purohit & Kandpal, 2004)
	Finance Mechanisms	(CEEW-NRDC., 2014), (Kar & Mishra, 2016), (Shrimali Nelson, Goel, Konda, Kumar, 2012) (Ravindran, 2013), (Kathuria, Ray & Bhangaonkar, 2015), (Spratt, Dong & Krishna, 2014)

6. Policy

All authors have touched upon the various incentives and schemes that were introduced by the Government to support the development of Wind Energy in India. Policies of Accelerated Depreciation(AD) and Generation Based Incentives(GBI) and Renewable Purchase Obligations(RPOs) find detailed mentions in nearly all the papers, Feed In Tariffs(FiT)(Kathuria, 2016) and other state level policies have been elaborated. In addition, recently introduced competitive bidding or auctions in Wind Energy have found mention in only one study paper by (CRISIL,2017),however (Shrimali, Konda, Farooqee and David, 2015), studied the Auction Mechanism for complete Renewable Energy domain in India. (Rajsekhar, et al., 1999) has highlighted that the most attractive financial incentive was the100% accelerated depreciation, which was later changed to 80% in 2002. (Sud, Shrama & Kitson, 2015) on wind-power equipment in the very first year of project commissioning in the 1990s.Accelerated Depreciation(AD) has been the single most beneficial facility which drove the investments in the Wind Energy Sector as it provided significant tax savings for the promotor. However, the same was misutilized as more often than not, wind-power plant investment decisions were taken to mostly to avail tax breaks and at a short notice resulting in hasty wind-power plant installations leading to compromise both in quality and performance. (Sud et al., 2015) have highlighted that quality suffered the most as developers has no interest in procuring new technology based higher capacity turbines as there was no incentive for them in increasing system efficiency and generate higher capacity. All this resulted in potential of sites not getting fully exploited as well as local wind turbine manufacturing companies not focusing on improving the performance of their turbines.

The AD scheme rewarded the development of capacity rather than generation from capacity, and as a result, there was no mechanism to monitor and penalize under-performance in terms of availability of capacity and associated power generation. The AD scheme resulted in investing in wind power plants as financial tax saving instrument for investors instead of the initial government aim of developing wind energy industry as it rewarded the development of capacity rather than generation of capacity with no mechanism to monitor and penalize under performance. There were even some cases where even projects were not developed but companies claimed tax benefits. All this resulted in first AD changing to 80% in 2002 and then its complete withdrawal on 01 April 2012.

Subsequently, The Ministry of Finance (MoF) (IREDA, 2014), announced the reintroduction of the scheme from 01.04.2014. The AD registration is presently available for all wind power projects who do not wish to avail benefit of Generation Based Incentive scheme of MNRE as both these schemes are mutually exclusive in manner. The Depreciation rates have further been reduced to 40% for projects commissioned after March 2017 (CRISIL, 2017).

According to (Bayer,2013)in his article in Renewable Energy World, in 2009 ,the central government adopted Generation Based Incentives (GBIs) of Rs. 0.50 per kilowatt-hour for a period of 4 to 10 years, with a cap of Rs. 100 lakhs per MW to increase the investor base, since the AD provision is not available to Foreign Direct Investment. From 2009–2011 annual installations more than doubled, but the withdrawal of the incentive in 2012 contributed to a 50% drop in capacity additions in fiscal year 2012, which probably led to the re-introduction of the scheme in April 2013. Subsequently GBI has been removed completely from 2017 (Bayer ,2013) also states that before the GBI and AD were removed in 2012-13 , the Indian wind sector had 'the best of both worlds i.e. the majority was a depreciation market with a lot of retail customers buying in, and large independent power producers (IPPs) were beginning to enter the market. After the incentive was removed the taxpayer side of the market exited, leaving a majority IPP market in which overall investment dropped significantly. An issue paper written by (CEEW-NRDC, 2014) has highlighted that the Electricity Act of 2003 enacted mandatory Renewable Purchase Obligations (RPOs) supporting wind, solar and other clean energy sources for states. RPOs require a percentage of all electricity to be sourced from renewables and are met through direct purchase via bilateral contracts and the Renewable Energy Certificate (REC) mechanism. According to (Kar, S. K., & Sharma, A. ,2015) in 2010, the Indian government launched the Renewable Energy Certificate, is a tradable certificate where one wind REC (non-solar) certificate is equal to 1 MWh of wind energy generated. Distribution companies, open access, and captive consumer to meet the RPO can purchase wind REC. However, according to (Bayar, 2013) in his article in Renewable Energy World has clearly stated, India's renewable energy purchase obligation policy has not been implemented in a significant way. No state government has enforced any penalties for not meeting the obligations, maximum they have done is to issue notices to the discoms. Therefore, effectively market has not kicked off.

At state-level, several key policies have been framed to influence investments in Wind Energy Sector like feed-in-tariff, wheeling charges, banking, third party sale and open access transmission. Of these, it is generally argued that feed-in-tariff (FiT) is the most important policy mechanism to accelerate investment in Wind Energy technologies. It achieves this by offering long-term contracts to Wind Energy producers, typically based on a pre-determined rate calculated on basis of tentative cost of generation by respective State Electricity Regulatory Commissions. (Kathuria, 2016) explored the possible relationship between State level wind energy policy as reflected in Feed-in-tariff and the FDI received in the sector by the State. The study tests the efficacy of FiT for eight Indian states having significant resource potential using panel data for the period 2004–05 to 2010–11. The results indicate that higher FiT has helped states in attracting FDI. (Kar & Sharma, 2015) highlights that several states have increased wind power tariffs by 2 to 15 percent to attract

investments which subsequently shifted wind power projects from resource rich states like Tamil Nadu and Gujarat to low-wind-density states like Rajasthan, Madhya Pradesh, and Maharashtra.

In addition, several other incentives at national and state level which are in place have been highlighted by (Kar et al., 2015) like reduction in Customs Duty and VAT of many products related to wind power generation, Banking and Wheeling, Soft Loans and Capital subsidy etc. For wind, wheeling charges i.e. charges paid to the distribution company to use transmission infrastructure to send power from off-site locations, for the different states fall in the range of 2 percent (Madhya Pradesh and Maharashtra) to 7.5 percent (West Bengal). The amount of energy to be banked and can be further accessed anytime during financial year also varies Tamil Nadu and Karnataka respectively allow 5 percent in Tamil Nadu to 2 percent in Karnatka of the total wind energy fed to the grid. Maharashtra has the provision for a capital subsidy of 11 percent for wind energy project development. Rajasthan provides soft loans equal to one-third of capital cost at low interest rates. The Maharashtra Development Agency (MEDA) has created a Green Cess (tax) fund which is partially used to create infrastructure for grid connectivity with proposed wind farms.

On 08th Dec 2017, Ministry of Power Issued guidelines for the Tariff based Competitive Bidding process for procurement of Power from Grid Connected Wind Power Projects. Not much literature is available related to the same in Indian context. (Shrimali et al., 2015), studied the Auction Mechanism for complete Renewable Energy domain in India and found that auctions are almost always cost effective and have led to fair project allocation in most cases. The authors have identified various auction design risks like Underbidding, Collusion, Completion risk, financial risk, Off-taker risk, Technology risk. They have also recommended certain changes in cost and deployment effectiveness ,which may help facilitate successful auctions .To improve Cost effectiveness, which is affected most by auction design risk, high competition to be ensured by setting the volume of capacity auctioned well within the market's ability to supply. To improve deployment effectiveness, which is most affected by completion and financial risks, support policies to improve transmission infrastructure and payment guarantees to reduce off-taker risk are required to be provided. Also for further improvement of deployment effectiveness, which is also affected by underbidding risk, include stringent penalties for delays in commissioning of projects. For the specific case of wind energy in India, they have recommended that start with auctions in a controlled environment, in which the project site is identified, transmission infrastructure is planned, and resource assessment studies are completed prior to bidding.

(CRISIL,2017) after studying the ongoing auctions has brought out that Competitive bidding will reduce OEM margins, FiTs will peter out and contracts for under-construction wind projects are likely to be renegotiated .Also ,with advent of competitive bidding, original equipment manufacturers (OEM) and developers would have to settle for lower returns. As FiTs and other incentives such as generation-based incentives and 80 % AD wane away, the market will consolidate towards independent power producers (IPPs).

There is a near total absence of literature in the field of Off Shore Wind Energy in India. Only one pure research paper in the field of Off Shore Wind Energy in India is available (Mani & Dhingra, 2013). In this pioneering study they developed a logistic regression model to calculate the log-odds of growth of offshore wind energy in India and identified a set of variables that are required to form the core components of offshore wind policy. They recommended that Policies on offshore wind energy for India needs to focus on the following legally enforceable payment policy, Establishment of Nodal Agency, Policy on Renewable Technology Park (RTP)/Renewable Economic Zone (REZ), Policy intent for long term (10 years or more), Specific Fiscal and Quota based policies for offshore wind energy. (Kar, 2016) has briefly described the National Offshore Wind Energy Policy (NOWEP) ,formulated by Government of India in Oct 2015 , as part of his Short Review of Wind Energy in India. (Kothari & Umashanker, 2015) looks at the difference between OnShore and OffShore wind projects and collate the initial steps being taken by India to develop Offshore Wind

Energy. (Arora, 2011) in his article has also given a brief overview of the prospects of off shore wind power in India and the related challenges.

(IRENA-GWEC,2012) in their paper 30 YEARS OF POLICIES FOR WIND ENERGY brought out the History and evolution of policy and regulatory framework for wind energy (1980-2011) in India and in the states of Gujarat, Tamil Nadu and Maharashtra. They divided the evolution in four phases , Phase 1 was Technology demonstration and R&D (1981-1990), Phase 2 is Economic liberalisation and institutionalisation (1991- 2000) , Phase 3 is Passing of Electricity Act, provision of tariffs by the states (2000-2008), lastly Phase 4 involving New incentives and reinforcement of tariff scheme (2009-2012). The paper identifies issues of grid integration, modernisation of transmission networks, forecasting and scheduling as well dual mandate of state and central government in policy and regulatory framework as major challenges towards development of Wind Power in the India. Some of the factors identified by (IRENA-GWEC, 2012) for the success and growth of wind energy in India are the early tax-based incentives, passing of the Electricity Act in 2003 and the subsequent stipulation of state-wise Renewable Purchase Obligations supported by the development of a national Renewable Energy Certificate scheme, initial support from international development banks, and migration to generation based incentives.

7.   Policy Effectiveness

Very few Scholars has attempted to asses effectiveness of the various National and State Level, Wind and other Renewable Energy Promotion (REP) Policies in Indian context. (Schimd, 2011) has empirically tested the effect of the introduction of the Electricity Act 2003 and the Tariff Policy 2006, as well as the implementation of feed-in tariffs and minimum quotas on clean electricity sourcing, on the development of grid-connected renewable energy power in nine Indian States over the period 2001-2009. His results state that the introduction of quotas (RPOs) has had a positive and significant impact on the development of REP and investment from the private sector is driving the development of REP. (Schimd, 2011) further states that there is no significant positive correlation between the development of REP and the introduction of preferential feed-in tariffs.

 (Benecke ,2011), studied TN and Kerala by applying a stakeholder network analysis and state that the current RnE position in these States has been the nature of the Government policies and power position in these States .The article identifies that Kerala enjoys energy security and therefore has less incentive to promote RnE technology and vice versa. (Rao & Kishore, 2009) used theory of diffusion of innovation to study the growth of wind power technology in TN, AP, Maharashtra and Gujarat. They calculated a composite policy index based on diffusion parameters such as land availability, preferential tariffs, wheeling and banking, Third Party Sales (TPS) and state specific incentives and found that there is a correlation between the ranking of diffusion parameters and the composite policy index. (Jagadeesh ,2000) used case study method and attempted to trace the reasons for the boom and the factors s that contributed to the slump in windfarm activity in the states of Tamil Nadu and Andhra Pradesh in 1990s. The case study reveals that incentives like depreciation, tax holiday, customs and excise duty reliefs should continue for some more years until the wind projects sustain on their own. In addition, creation of Wind Fund, establishment of co-operative windfarms, setting up of wind estates, linking generation to incentives for optimum production, promotion of reliable water pumping windmills and wind battery chargers for small-scale applications have also been suggested for rapid growth of wind energy.

 (Rajsekhar et al.,1999) studied using case study approach why Indian wind-power policies had a large impact as well as major undercurrents in terms of policy, institutional and technical factors are analysed which led to the slowdown of the new installations have been identified. The author's find that the capital incentives have provided a push to wind energy generation and development

especially in the initial phase. (Kathuria,2015) explored the possible relationship using correlation and pooled OLS data between State level wind energy policy as reflected in Feed-in-tariff and the FDI received in the sector by the State and suggested that higher is the Feed-in-tariff (FiT), more would be the FDI in the state.(Panse & Kathuria, 2016) studied the possible influence of state level wind power polices like Wheeling Charges (% of Energy), Banking Facility(Months), FIT(Rs/kWh), Renewable Purchase Obligations(RPO- % of total procurement of power from a utility) on the installed capacity of the state using annual data of installed capacity for 19 years of wind power in 7 states. A Fixed Effect Model was used with Market Size, Demand for Power and Geographical Potential as Control Variables. Based on results, authors concluded that favourable policy facilitates deployment of wind energy. (Panse et al., 2016) have effectively summarized the papers assessing the effectiveness of various government policies related to Wind Energy, that summary along with other papers has been is highlighted as under in Table-**7** :-

Table 7: Summary of Literature Assessing the Effectiveness of State Policies in Development of Wind Energy in India

Author	Year	Indicator for Investment	Proposed method/Model	Country (Time Period)	Significant Variables
Kathuria et al. (Paper 15)	2016	Installed Capacity	Panel Data Techniques -Fixed Effect and Random Effect Models	India (7 States)(1993- 2012)(19 years)	State Policies like Wheeling Charges, Banking Facility FIT ,RPOs
Kathuria et al (Paper 6 &43)	2015	FDI in Wind	Random Effects Covariance Decomposition	India (Eight States) (2004-2011)	State Policies
Schimd(Paper-71)	2011	Installed Capacity	OLS	India(Nine States) (2001-2009)	Tariff Policy, RPO
Rao and Kishore(Paper-96)	2009	Installed capacity	Theory of diffusion of innovation, mixed influence diffusion model (Bass model)	TN, AP, Maharashtra and Gujarat	Land availability, preferential tariffs, wheeling and banking, Third Party Sales (TPS) and state specific incentives
Benecke(Paper-95)	2008	Installed Capacity	Case Study	India(TN & Kerela) (upto 2008)	Pro activeness of govt, Industry Culture, Power Shortage
Jagadeesh(Paper-21)	2000	Installed Capacity	Case Study	India (TN & AP) (Till 1999)	Adequate Regional Power Stations , Production Based Incentives

Only three studies of the two major Central level polices Accelerated Depreciation (AD) and Generation Based Incentive (GBI) are available. (CRISIL, 2016) study ordered by MNRE had concluded that the GBI scheme has had a positive impact on the wind power sector and has changed the nature of projects from investment linked incentive to outcome linked objective.
The percentage of GBI based projects in the overall wind projects has increased from 3% in 2010-11 to 30% in 2015-16. As per the study, the biggest challenge facing the wind sector is reluctance of discoms to procure wind power due to their weak financial health. The study recommends that discoms should be incentivized to comply with RPO targets, suitable procurement based incentives may be introduced to encourage them to procure wind power, make timely payments and also to prevent forced backing down of wind power.
The Case Study of AD by (IISD, 2015) had brought out that scheme incentive was linked to the initial capital cost of the project with no provision monitor and penalize for under-performance. The other drawback of the policy was that the tax depreciation benefit could not be availed by large independent power producers and foreign investors. It suggested the need to link incentives to

performance and the importance of monitoring, the need for policy to appeal to all investors and the importance of further investments in the grid infrastructure to enable support to new capacity additions.

(Shrimali G, Pusarla S &Trivedi S, 2017) in their study analysed the relative differential effect of two different federal policies for wind – AD and GBI - on the generation efficiency of wind power plants using OLS regression technique on a sample of approximately 40 wind plants. The results show a consistent effect of policies on the PLF of wind power plants and the average PLF of the wind power plants set up under the GBI scheme is at least 3 percentage points higher than that setup under AD Scheme. The study also recommended that use GBI instead of AD and if AD continues as a policy. It needs to be modified in way that it ensures accountability of project developers towards operational efficiency and modify the AD policy in such a way that it takes care of the performance of the power plant and/or ensures the accountability of renewable energy project developers in terms of operational efficiency of the plant.

8.   Wind Economics and Finance

The literature related to Wind Energy Economics and Finance Mechanisms is even more limited. It can be divided into two distinct sub themes i.e. Wind Farm Economics, Financing Mechanisms. Most of the financing mechanisms are related to government incentives and schemes; therefore, there is a considerable overlap in this literature about the policy mechanisms.

One of the earliest research work in the Wind Farm Economics has been done in 1988 by (Hossain , Thukral & Kishore , 1988) wherein they have stated minimizing costs involved in developing the site , reducing the down time of the machine and identifying the most cost effective rating of Wind Electric Converters as the main factors for accomplishing the Wind Energy Generation in most cost effective manner .(Sinha & Kandpal, 1990) in 1990 established empirically a Cost Estimate Scaling Function for horizontal axis wind turbines (HAWT) and used it to compute the cost of wind generated electricity from the wind farms in India ,subsequently compared the results with that cost of generation reported from the wind farms at Tuticorin, Mandvi, Okha, Puri and Deogarh. (Purohit & Kandpal, 2004) developed a simple framework for techno-economic evaluation of windmills for irrigation water pumping.

In Financing Mechanisms, (CEEW-NRDC., 2014) analyses the growth of India's wind market with a focus on financing mechanisms. It has described key financial mechanisms like Non-Recourse Financing, Private Equity Funding, Green Bonds, IPOs, Mezzannine Finance, Debt Repayment by Pooling Wind Farm Assets etc. and policies for Wind energy like AD, GBI, RPOs, Clean Development Mechanisms and Carbon Credits etc. in India. Paper finds that India's wind market responds to incentives such as AD and GB. Poor enforcement of Renewable Purchase Obligations (RPOs) and uncertainty about the future of Renewable Energy Certificates (RECs) has reduced lender confidence and the relatively high cost and low availability of debt in India has significantly increased the cost of renewable energy projects. A Report by (Shrimali, et al., 2012) has studied the Financing Challenges to India's complete Renewable Energy Sector including Wind. The main conclusions of the report are that the high cost of debt, due to high interest rates, is the most pressing problem facing renewable energy financing in India and has significant impact on the levelized cost of electricity, also State-level policies — including the financial weakness of the state electricity boards — increase project risk. (Kar & Mishra, 2016) has given an overview of the various Renewable Energy Financing Models in India like Equity Financing, Debt Financing, Government Financing /Subsidy. He has further stated high risk and moderate returns, under developed bond market, lack of awareness about technology and potential of Financial Institutions, lack of

consistency in Policy and poor financial conditions of State Discoms as major impediments to financing of Renewable Energy.

9.   Sector Overview

The Sector Overview as research work has been covered most by the various researchers. All the works have generally followed standard structure, initially describing the historical background of development of Wind Energy in the Country, followed by briefly describing the leading wind markets in the world and India's position in the same. Some researchers have given state wise potential and installation status. The various policy measures like AD, GBI, RPOs, FiT etc have been briefly defined and the barriers in the development of Wind Energy in the country have been elaborated.

As per (Purohit & Purohit , 2009)the original impetus to develop wind energy in India came in the early 1980s from the government, when the Commission for Additional Sources of Energy (CASE) had been set up in 1981 and was upgraded to the Department of Non-Conventional Energy Sources (DNES) in 1982. A Wind Resource Assessment Programme was taken up in 1985 comprising wind monitoring, wind mapping and complex terrain projects. The programme covered 25 states with over 600 stations. (Jagadeesh, 2000). The Indian Renewable Energy Development Agency IREDA was established in 1987 as a financial arm of the Ministry to promote renewable energy technologies in the country (Purohit et al., 2009). This was followed in 1992 by the establishment of a full-fledged Ministry of Non-Conventional Energy Sources (MNES), renamed as Ministry of New and Renewable Energy (MNRE) in 2006.

Currently, China leads in wind power installation, followed by the US, Germany, Spain, India, UK, Italy, France, Canada, and Denmark. On the other hand, the US leads in wind consumption followed by China, Germany, Spain, India, France, Italy, Portugal, and Canada. (Kar & Sharma, 2015) India has an estimated wind potential of about 302 GW. There are 19 manufacturers of wind turbines, making about 45 models in India. About 11 of them have international collaborations with foreign manufacturers. India has an annual wind turbine production capacity of around 4000 MW. India is exporting wind mills, turbine/engines to countries like, US, Australia, Brazil, China, Europe, etc (Kar et al. , 2015) .

 (Jolly & Raven, 2015) using a qualitative case study approach carried out a research focused on wind power development in India from 1985 to 2014. The paper emphasized the role of individuals and organizations involved and the complexities faced by them in the development of wind energy in India by using the concept of collective institutional entrepreneurship. They divided the entire development period in three phases 1985 to 1995, 1995 to 2003 and 2003 to 2014. Major issues faced and identified solutions taken by various actors have been described. Authors have suggested that future wind energy development requires withdrawal of support mechanisms only when sufficient capability levels have been attained as it can have an adverse impact and even promote rent-seeking activities by interest groups.

10.   <u>Challenges and Barriers to development of Wind Energy in India</u>

 Most of the papers have highlighted the **challenges or barriers** in the development of the Wind Energy Sector in the Country.(Rajsekhar et al., 1999) has highlighted various market barriers in1990s like Low performance of Wind Power Plants with both the State and national level annual averages of wind-power plants CUF well below 20% which is due to the existing structure with tax credits granted as a proportion of capital cost (capital based tax credits) and there are no qualifying

performance benchmarks by any agency. Poor installation practices by misusing Accelerated Depreciation Policy is also one of the major factors for poor operational performance of wind farms. Wind-power plant investment decisions were taken at a short notice around the time of the financial-year closing to avail the tax breaks. Consequently, wind turbine manufacturers were forced into hasty wind-power plant installations, compromising on both quality and performance. There had been sharp increase in capital cost in the 1990s and the phenomenon of 'goldplating', arising due to 100% depreciation facility, has been the main cause behind the same.

(Singh & Parida, 2013) has highlighted technical and infrastructural challenges in the mid-1990s wherein wind turbine designs led to voltage fluctuations thus reducing overall power quality. These fluctuations also gave a negative feedback on wind turbines themselves as well. He has also highlighted the lack of service and maintenance experts to handle wind farm upkeep. (Amin, 1997) has studied the Institutional barriers to commercialisation of wind power in India with a case of Gujarat. According to him ,poor wind power performances and low operating capacity factors, Poor transmission and distribution of power ,inadequate wind mapping, Lack of skills for operation and maintenance, installation of inferior second-hand turbines which could not operate in Indian conditions, complicated and time consuming process of obtaining clearances and finance were the major hurdles .

(Khare , Nema & Baredar, 2013) has brought about various obstacles towards the growth of Wind Energy in the country like number of agencies for coordination and approval, No single comprehensive policy statement and challenges in financing the project especially as these projects carry a disproportionately heavy initial burden of capital cost that must be financed over the life of the project. Also the R&D investments by private sector and GOI backed research projects are minimal.

(Arul, 2015) states that main challenge is the high interest rates, limited availability of debt financing and poor financial health of state owned utilities. Grid integration issues and the development of wind turbines to cater to the lower wind speed wind regimes in large parts of India are the technical challenges (CEEW-NRDC, 2014). Has brought out that Uncertainty around long-term policies and incentives, such as AD and GBI, has been the primary reason for declining investments in india's wind energy market. Poor enforcement of RPOS and uncertainty about the future of Renewable Energy Certificates (REC) after 2017 has reduced lender confidence in the REC mechanism. The relatively high cost and low availability of debt in India significantly increase the cost of renewable energy projects, presenting a major barrier to expanding the wind energy market. Internationally, mechanisms such as green bonds, clean energy development banks, and tax credits have been effective in growing wind energy, which have are required to be implemented in the country.

(Kar et al., 2015) have highlighted that Wind power in India faces challenges grid infrastructure, lower capacity utilization and high cost of evacuation. (Kar et al., 2015) has also brought out that higher level of regulatory intervention is needed in terms of timely tariff revision, RPO Fixation and monitoring for penetration of Wind Energy .Challenges remain in development of transmission infrastructure for evacuating grid power as well as land availability.

According to (Chaurasiya , Warudkar & Ahmed ,2019) some of the key challenges in the development of wind energy in India are the lack of adequate evacuation and transmission infrastructure , which has led to many attractive potential wind sites remaining less tapped,. The dual withdrawal of both AD and GBI as well as frequent changes in policies on open access, cross subsidy surcharge , banking and wheeling , group captive , wide divergence in Feed-In Tariffs etc. at state level ,the land availability and the conversion of land from agricultural to non-agricultural and receiving clearance (for protected area) from authorities.

11.   Discussion

Literature on Wind Energy Policy brings out the evolution of policy and regulatory framework for wind energy in India. Initially Accelerated Depreciation policy had been the most important & attractive financial incentive, unfortunately the scheme rewarded the development of capacity rather than generation from capacity. It turned out to be more of a financial instrument for Investors for availing tax benefits as there was no subsequent monitoring of projects and there was no motive to increase system efficiency and generate higher power. Thus initially it was 100% accelerated depreciation on investment on capital equipment in the first year of installation, later it was reduced to 80% and then in 2016 to 40%), Generation Based Incentives (GBIs) of Rs 0.50 per kilowatt-hour for a period of 4 to 10 year to increase the investor base for Foreign Direct Investment since its introduction in 2009 had boosted growth of the Wind Energy Sector in India, however the policy has been discontinued since 2017. Renewable Purchase Obligations (RPOs) supporting wind, solar and other clean energy sources for states were mandated by Electricity Act of 2003 and in 2010, the Indian government launched the Renewable Energy Certificate but India's renewable energy purchase obligation policy has not been implemented and market has not effectively kicked off as no state government has imposed penalties on discoms. States also have different policies with respect to Wheeling, Banking, Inter State Transmission Charges as well as Third Party Sales. Special Additional Duty (SAD).Though with considerable variation across states, Feed in Tariffs Policy was in vogue till 2017 when Government introduced competitive bidding or auctions.

Only limited studies have been carried out to assess the effectiveness of various Wind Energy Policies. Studies by (Rajsekhar et al. ,1999) and (Jagadeesh ,2000) conclude that capital incentives like depreciation, tax holidays, customs and excise duty exemptions have provided the necessary thrust to the Wind Energy development in the country in the initial phase in 1990s. (Panse & Kathuria, 2016) concluded that state level wind power polices like Wheeling Charges (% of Energy), Banking Facility (Months), FIT (Rs/kWh), Renewable Purchase Obligations (RPO- % of total procurement of power from a utility) have an influence on the installed capacity of the wind power in the state. Also higher is the Feed-in-tariff (FiT), more would be the FDI in the state. In addition, (Benecke, 2011) concluded that states having higher energy security are not promoting Wind Energy.
The Case Study of AD by (IISD, 2015) had brought out that scheme has helped in growth of Wind Energy in India but was lacking in focus on long-term generation efficiencies and its limitation for large independent power producers and foreign investors. The study has highlighted the importance of the need to link incentives to performance and that of monitoring the project performance. (CRISIL, 2016) study ordered by MNRE had concluded that the GBI scheme has had a positive impact on the wind power sector and It has rightly set a transition from investment-linked incentive to outcome/ generation-linked objective, and has resulted in improvement of wind CUF levels. The study also states that the utilities are required to be incentivized to comply with RPO targets, and a suitable procurement-based incentive (PBI) is required to structure to help reduce the purchase cost of wind power for states. Thus overall it can be said that all the policies and incentives have had a positive impact on the growth of Wind Energy in the country. (Shrimali, Pusarla &Trivedi, 2017) had concluded that the average PLF of the wind power plants set up under the GBI scheme is higher than that setup under AD Scheme and have recommended a blended policy as a combination of AD and GBI.

The limited literature on Wind Farm Economics and Financial Mechanisms brings out the necessity of empirically establishing Cost Function to compute the cost of Wind generated electricity and comparing it with price achieved through auctions, thus determining the sustainability of the Industry. Also the in depth study and implications of various financial mechanisms like Non-

Recourse Financing, Private Equity Funding, Green Bonds, IPOs, Mezzannine Finance , Debt Repayment by Pooling Wind Farm Assets etc. in vogue in India is required.

In addition through Sector Overview, various challenges or barriers to the development of the Wind Energy Sector in the Country have got highlighted. In 1990s, poor installation practices or the phenomenon of 'goldplating', by misusing Accelerated Depreciation Policy had been the major barrier for development of Wind Energy. In addition, wind turbine technology was also evolving, poor transmission and distribution of power network, inadequate wind mapping, lack of service and maintenance experts, complicated and time consuming process of obtaining clearances and finance were other major hurdles. Today Wind power in India faces challenges of lower capacity utilization, high cost of evacuation, inadequate grid infrastructure and grid integration issues, high interest rates, limited availability of debt financing and poor financial health of state owned utilities. The land availability and the conversion of land (if available) from agricultural to non-agricultural and receiving clearance (for protected area) from authorities is time-taking process and difficult task. Also due to uneven spread of wind resources, wind production and consumption have been restricted to wind resource rich states and the development of wind turbines to cater to the lower wind speed wind regimes is a big technical challenge. In terms of policy, uncertainty around long-term policies, frequent changes in the incentives and poor implementation of RPOs remain a big challenge.

12.   Research Gaps and Directions for Future Study

Most of the studies have focused on Sector Overview, covering broadly the historical developments, policies /incentives introduced by Govt. And challenges/ barriers in the growth of wind energy in India. The sector has been marked by the introduction of large incentives and sudden withdrawals and subsequent reintroduction, still only limited studies have been carried out assessing the effectiveness of the same and the reason of these changes. Only State specific policies have been tested, Panel Data Techniques and Case Study Approach. No study is available of the period 2012 to 2018 as well as only one study each for the effectiveness of two major pan India policies Accelerated Depreciation and Generation Based Incentive are available.

In one of the most significant changes in Wind Energy development history in India, wind project allocation moved to competitive bidding or auction mechanism from Feed in Tariff (FiT) in 2017. However no study is available on the suitability of the auction mechanism in Indian scenario as well as on the exact impact of the several tranches of auctions which have been held till now. Also comparison with earlier implemented Feed in Tariff Policy and impact on earlier negotiated PPAs as well as under construction Wind Projects is yet to be studied and analysed. Also the impact of competitive bidding on the profitability of original equipment manufacturers (OEM) and developers is required to be studied. The future scope of existing incentives especially in case   of most of the incentives waning away slowly requires further analysis and study.

13.   Limitations

In spite of our best effort to carry out review and analysis of literature by categorising it in various themes, this review still have several limitations to mention. First, literature of related Wind Energy Sector in India has been taken however as Wind Energy comes under the broad area of Renewable Energy, therefore there is a possibility of some quality research work related to Wind Energy published under the same or part of the renewable Energy Study may have been left out. In addition, majority of the work i.e. 58% of contribution is related to Sector Overview following a standard structure, which is more of presentation of facts and background with no research question or objective, clearly brings out the lack of overall work done in this sector and a skewed representation.

There is a very limited research work with respect to auction or competitive bidding mechanism, which has started since 2017 in the Indian Wind Energy Sector.

14.   Conclusion

The present literature in the field of Wind Energy Industry in India is quite limited and has been primarily focussed on the overview and status of the Industry and only few researchers have tried to focus their research on the challenges and problems facing the industry and to empirically test the effectiveness of the various policies introduced in the sector. Present literature review has been categorized in only three themes due to the limited work done in this field. With the emphasis on Renewable Energy across the world and especially in India, there is a requirement to do further study in the various facets of the Industry. There is a need to study, compare and assess the effectiveness of the various Policies in the growth of Wind Energy. The comparison of effectiveness of same policy in other Renewable Energy Sectors like Solar as well as with effectiveness in other countries is also one of the key areas to work on. Comparison between Feed in Tariff Policy and Competitive Bidding or Auctions is also required to be studied. Off Shore Wind Energy is totally neglected area. Sector overview and status as well as efficacy of the National off Shore Wind Energy Policy are recommended areas to be worked upon. In addition, there is no literature on the Strategy, Competitiveness as well as Business Models being followed by various Companies in the Sector, thus providing niche area to work on.

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Understanding the concept of Industrial Ecology: An approach towards sustainable operations in industrial development

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Abstract-

The road to industrialisation with its ethos of expansion has been antithetical to the contemporary idea of sustainability. Several blueprints for sustainable development worldwide have identified sustainable industrial development as a high-priority area. The United Nations has listed Sustainable Industrialisation as one of the seventeen Sustainable Development Goals as well. It has a crucial role to play in achieving sustainability, because it is the driving mechanism for development of a country's economy and instrumental to several environmental and social problems. For the past few decades, Industrial Ecology has been playing a vital role in providing innovative solutions to complicated environmental problems in industrial operations and management. It is a relatively younger science and has demonstrated several successful models of sustainable industrial development, globally. This paper intends to understand the concept of Industrial Ecology and its role towards sustainable operations in industrial development. It will include the history, evolution and application of Industrial Ecology with the help of literature review and case discussions from developed countries and India as well.

Keywords: Industrial Development; Sustainable Operations; Environmental Management; Industrial Ecology

1. Introduction

With the advent of industrialisation, the ever-expanding nature of it has been a contradiction to the contemporary idea of sustainability. The initial approach towards industrial development gave rise to the economy but neglected the environment and ecology (Abhishek & Biswas, 2017). Now the rising concerns about sustainability in industrial development have led to innovation in industrial operations. (Jakhar, 2014; Mangla, Kumar, & Barua, 2014)

The concept of Industrial Ecology (IE) has demonstrated a number of successful models in sustainable industrial development, globally. Industrial ecology could be defined as a "systems-based, multidisciplinary discourse that seeks to understand emergent behavior of complex integrated human/natural systems" (B. Allenby, 2006). This relatively younger field deals with the issues of sustainability by investigating problems from multiple perspectives, which caters aspects of the environment, economy, sociology and technology. The possible analogy between the natural systems and the industrial systems is the central idea behind the derivation of the term itself. (Frosch & Gallopoulos, 1989) (B. R. Allenby, 1999)

2. Research Objectives

The research paper intends to achieve the following objectives-

- To present concise information about the concept of Industrial Ecology.
- To understand the role of Industrial Ecology towards sustainable operations in industrial development.
- To present and discuss the applications with the help of case discussions from industrially developed nations and India.

3. Research Methodology

The research methodology of this paper included literature review of relevant articles, international reports, blueprints for sustainable development to understand the evolution, concept and process of Industrial Ecology. The successful models of sustainable industrial systems were studied through secondary data sources and has been included for discussion.

4. Birth and Evolution of Industrial Ecology

During the late 80s, the term "Industrial Ecology" was majorly endorsed through an article discussing the industrial ecosystems, written by Frosch and Gallopoulos, which was published in a 1989 special issue of Scientific American (Frosch & Gallopoulos, 1989) but the fundamental concepts of the field surfaced much earlier. Industrial Ecology has evolved from numerous ideas and experiments from the past, few of them also go back to the 19th century. The aforementioned article came up with an intent to further foster the research and development of the concept. It triggered the appearance of Industrial Ecology as a solution to several issues of sustainability and as a field of scientific research.

In the 1940s, two terms namely, "Industrial Ecology" and "Industrial Symbiosis" was being used concurrently. According to an article published in 1947, the eminent geographer George T. Renner has mentioned "The General Principle of Industrial Location" as a "Law of Industrial Ecology". (Renner, 1947) The field of economic geography is one of the first subjects to use and discuss the two terms.

Figure 1 is an infographic flowchart to narrate the historical events that led to the evolution of Industrial Ecology as a concept and as a field of scientific research.

Figure 1 Evolution of Industrial Ecology

Before 1960s
1947, American Geographer George T. Renner refers to "The General Principle of Industrial Location" as a "Law of Industrial Ecology". The term "Industrial Symbiosis" is also used alongside

1970s
Industrial Ecology has been research subject of the Japan Industrial Policy Research Institute since 1971

1980s
During the 80s the emergence of another related term, "industrial metabolism", is observed. The term is used as a metaphor for the organization and functioning of industrial activity

1989
The term "Industrial Ecology" gains mainstream attention in the english speaking nations (1989) through a "Scientific American" article named "Strategies for Manufacturing" by *R.Frosch and N.Gallopoulos*

2000s
The Journal of Industrial Ecology, the International Society for Industrial Ecology (since 2001), and the journal Progress in Industrial Ecology (since 2004)

5. Industrial Ecology Process

The process of Industrial Ecology is based on the central idea of performing industrial operations inspired from the process in natural system. Figure 2 explains the suggestive broad process of Industrial Ecology in which the relationship between resource extraction, production, consumption and waste generation could be more sustainable.

Figure 2 Industrial Ecology Process
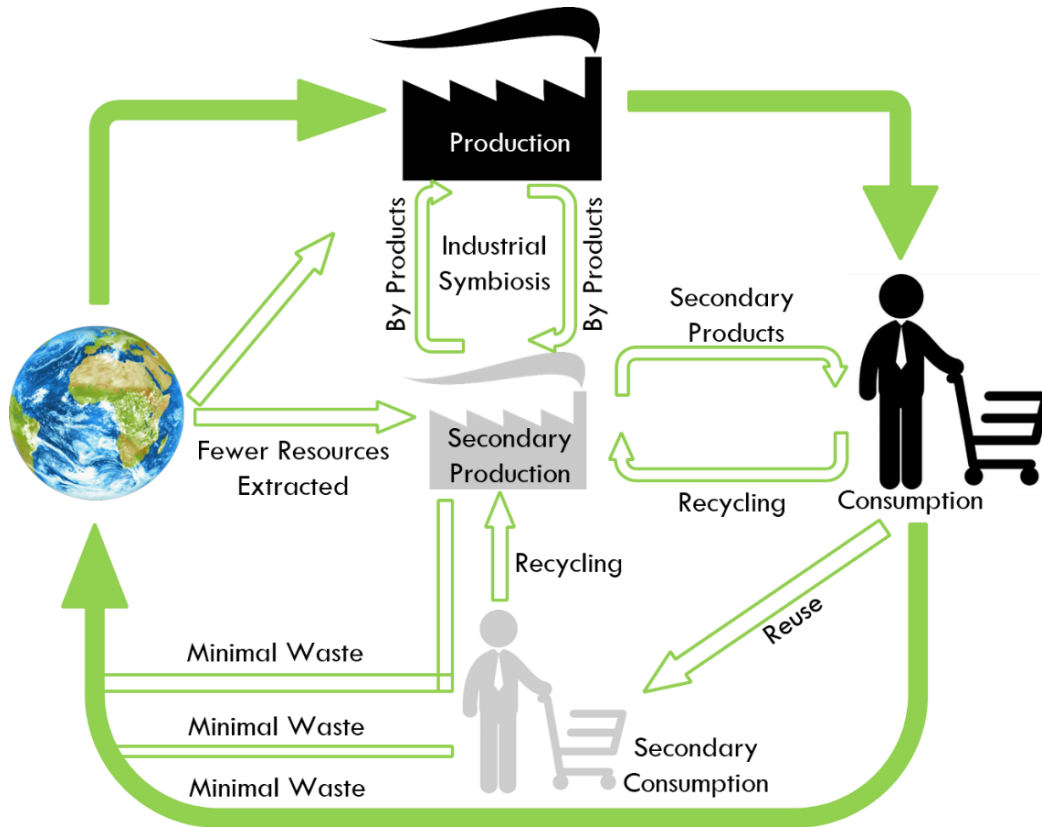
6. Case Studies

This section discusses two case examples to present the application of Industrial Ecology concept. The first example is of an Eco-Industrial park from Kalundborg (Denmark) and It is followed by an Industrial Estate in Naroda, Gujarat (India).

6.1 Kalundborg Eco-Industrial Park

It is an Eco-Industrial park with successful industrial symbiosis network located in Kalundborg, Denmark. The industrial operations in the region involve collaboration between the companies for utilization of the produced by-products in between the companies and otherwise sharing of infrastructure, resources etc. In the year 1961, It all started with a plan to make use of surface water from the Lake Tissø for a new oil refinery in order to cope up with the limited water supply for production (Chertow, 1999). The administrative body of the Kalundborg city assumed the charge for the pipeline construction to draw water, with funding from the refinery enterprise.

This was the advent of a progressive collaboration, it grew further with numerous collaborative projects and by the late 1980s, it was found that the voluntarily organized industrial collaboration has evolved into one of the stellar exemplars of Industrial Symbiosis followed under Industrial Ecology.(Boons & Baas, 1997)

Figure 3 Industrial Symbiosis Network at Kalundborg
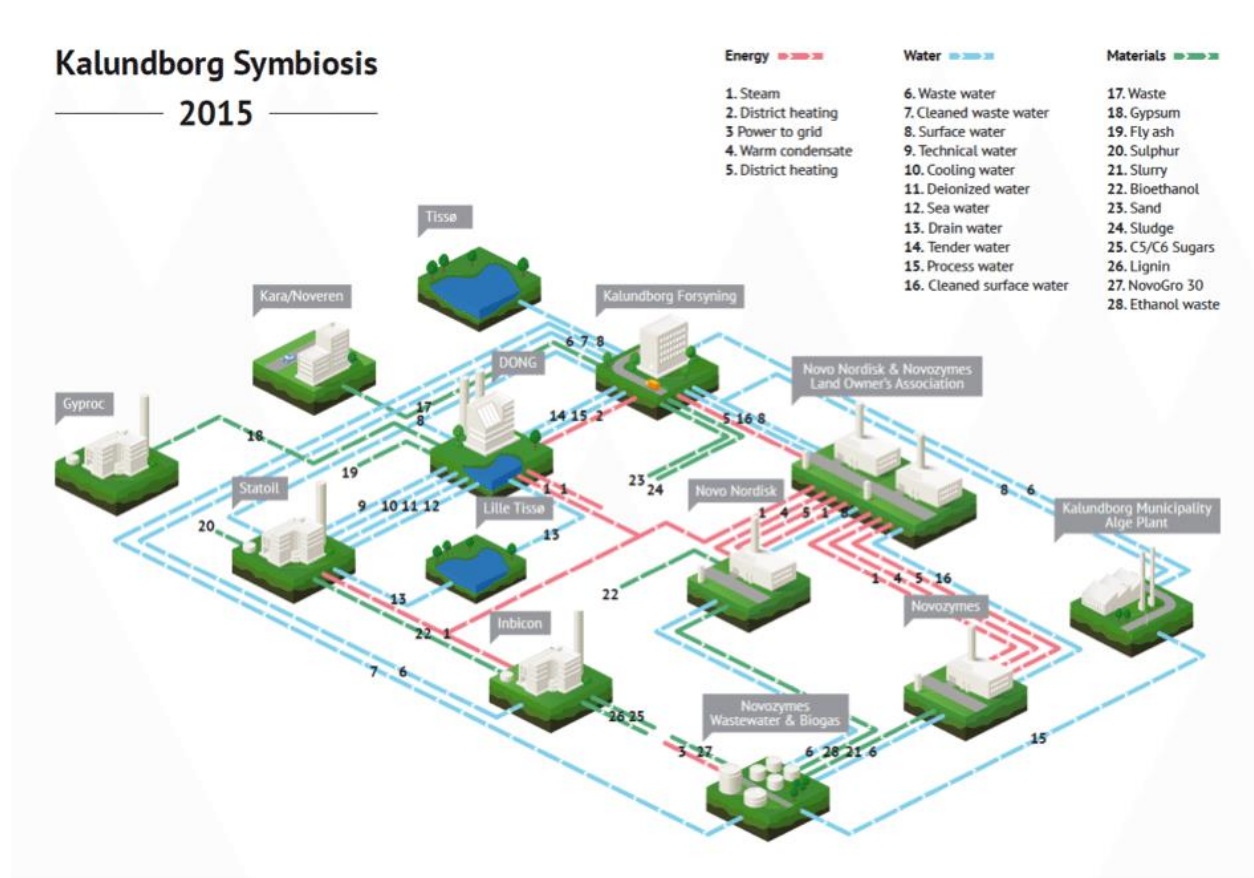
6.2 Naroda Industrial Estate, Gujarat

Naroda Industrial Estate (NIE) was established in 1964 by Gujarat Industrial Development Corporation(GIDC). During the late 1990s, the city succumbed to problems caused by heavy industrial pollution, therefore, an initiative of eco-industrial networking with research support from German researchers took place. The typology of industries involved chemical, pharmaceutical, dyes and dye intermediates, engineering, textile, and food production. (Haggar, 2007) (Yap & Vaidyanathan, 2015)

The initiative at Naroda Industrial Estate is an example of one of the largest industrial ecology networking project which occurred between companies with the direction from IE researchers to reduce pollution and achieve sustainability.(Abhishek & Biswas, 2018)

Figure 4 Symbiosis Network at Naroda
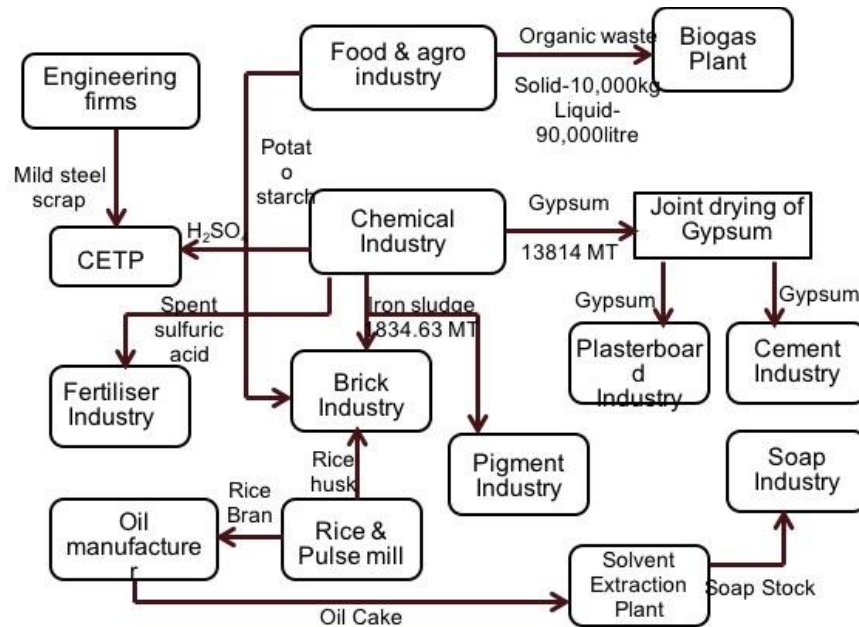
7. Discussion

Industrial Ecology is a relatively younger field of science with the core idea of following the natural ecosystem to solve problems of man-made systems. The two cases discussed above are major examples of eco-industrial networking under the gamut of Industrial Ecology from the perspective of developed and developing nations. In both the cases, the innovation in industrial operations were needed because of rising industrial pollution, lack of resources and infrastructure for production at regional level. But the fact remains that, it was beneficial for both, the economy and the environment. The sustainable practices in industrial operations supported resource efficiency, waste reduction, reduction in production costs, cleaner technology etc.

8. Conclusion

Industrial Ecology seems to be a promising solution to several environmental and social problems caused by industrial operations. It is instrumental to economy, environment and society at the same time. The practices of IE should be adapted before establishing an industrial project within a region for maximum benefit. Not only for the developed countries but it serves as a blueprint for sustainable industrial development in the developing countries.

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Effectiveness of crowdfunding for financing sustainably oriented enterprises in India: A study

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Abstract-

Entrepreneurial sustainability is the much-needed solution to the current world problems of social inequality and environmental concerns. Sustainable enterprises with social and environmental orientation often face difficulty in arranging funds from traditional sources of financing. Crowdfunding can help in collecting funds for projects with social and environmental orientation. Crowdfunding is a way of collecting money from different individuals who are willing to support a specific cause. Various individuals and enterprises have used crowdfunding either for their personal or social good. The primary objective of this study is to understand the effectiveness of crowdfunding in financing ventures with sustainable orientation. For the purpose of this study, enterprises with social and environmental orientation are considered as sustainable enterprises. The study is exploratory in nature. A sample of 458 campaigns belonging to different categories currently running on a crowdfunding platform – Ketto has been selected. Ketto exhibits different fundraising campaigns under different categories on its platform. The study aims to find out whether the campaigns having a social or environmental orientation are able to attract more supporters and thus are able to achieve their target level of funds. In other words, the study is meant to explore the effect of different categories on the outcome of the crowdfunding campaigns. The findings of the study suggested that the environmental orientation of a campaign cannot significantly predict the outcome of the campaign whereas social orientation has a negative effect on the campaign.

Keywords: Crowdfunding, Sustainable, Social, Environment, Ketto

1. Introduction

Entrepreneurship is an act of the undertaking risk to earn profits leading to economic development. It is an economic activity, but with increase in awareness on social injustice and environmental issues, entrepreneurship has extended itself to the social and environmental development along with economic development. Sustainable development comprises of environmental development as well as economic development. Social entrepreneurship is about undertaking entrepreneurial activities for the purpose of promoting social justice. It is the process which initiates the social changes to fulfil social needs. Socially oriented ventures are those where social good is of more importance than profits in terms of money. In other words, socially-oriented ventures focus more on social values than creating economic values (Mair & Marti, 2006). Innovation is generally considered as an effective way of creating social values (Peredo & McLean, 2006). Socially oriented ventures aim at satisfying the human needs which might be neglected in the process of economic

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development. They are often directed towards the fulfilment of sustainable development goals (SDGs) and Millennium Development Goals (MDGs) which tends to protect the needs of the future generations (Seelos & Mair, 2005). Environmental entrepreneurship involves focus on ecological and economic benefits. It aims to reduce environmental degradation in turn improving the health of the planet (Thompson, Kiefer, & York, 2011).

In recent times, sustainable enterprises are no longer limited to taking care of the future needs but have inclined towards sustainable growth and development. This growth and development include economic, environmental, social and ethical requirements of the society. The sustainable enterprises attempt to serve the social and environmental needs in the light of ethical and economic considerations through innovation and governance (Markman, Russo, Lumpkin, Jennings, & Mair, 2016). Sustainable entrepreneurship focuses on 'triple bottom line' which is related to the 3 Ps – 'people, planet and profit' (Thompson et al., 2011).

Crowdfunding is a mode of financing wherein an entrepreneur is allowed to collect funds from a large number of people (Frydrych, Bock, Kinder & Koeck, 2014), who may or may not have any investor experience, in a small amount (Mollick, 2014). The people acting as investors are called backers, funders or investors. Crowdfunding has been in existence for many decades but the emergence of web 2.0 has led to an upsurge of online crowdfunding platforms (Rossi, 2014). The concept of online crowdfunding was first launched in USA and UK and then was adopted by the developing nations like India. The online crowdfunding platforms host a plethora of campaigns or fundraisers belonging to different categories. These categories hold projects with different orientations such as social, environmental, cultural or commercial.

The whole process of accumulation of funds in crowdfunding depends upon the prudence of the funders (Bruton, Khavul, Siegel & Wright, 2015). Online crowdfunding platforms are a form of a network of funders who decides whether to invest in a certain project based on their intellect and emotions. Social media plays an important role in influencing the decision of funders (Frydrych et al., 2014). Funders often rely on other funders while making decisions. Funder's intellect is also influenced by the impact of a project which it is able to create on society.

There are four main models of crowdfunding depending upon the return they provide to the funders in exchange for their investments in the projects. They are Reward, Donation, Debt and Equity. Reward-based crowdfunding provides the funder with rewards in exchange for their contribution. The rewards can be in the form of a coupon, merchandise or product samples (Mollick & Kuppuswamy, 2014; Frydrych et al., 2014). Donation-based crowdfunding allows funders to contribute for non-profit projects and is a form of philanthropic activity wherein no returns are given to the funders (Flanigan, 2016). Debt-based crowdfunding is a form of loan wherein the funders are offered interest for their contribution. Equity-based crowdfunding provides funders with stakes in the project in exchange for their investment (Mollick & Kupuswamy, 2014). Crowdfunding has been done by many individuals and organisations for several purposes. Many social entrepreneurs are using it to financing their projects or ventures. Work in the field of crowdfunding and sustainability has been continuously increasing in the previous years (Martínez-Climent, Costa-Climent, & Oghazi, 2019).

2. Literature Review

Various studies have been conducted in the past establishing the link between crowdfunding with social, environmental or sustainable projects. Arrangement of funds for sustainable ventures, based on SDGs, is often difficult thus creating room for new infrastructures which can provide such ventures with funds (Scataglini & Ventresca, 2019). Crowdfunding can be an alternate way of financing ventures which primarily undertakes social and environmental goals and focus on economic goals on a secondary basis. Internet enables financial alternatives can empower the individuals to work for the achievement of SDGs (Abrahamsson, 2007).

Though many individuals are using crowdfunding for collecting funds for their business but it is still in its nascent phase. Bergamini, Navarro, & Hilliard (2017) in their study highlights that that social entrepreneurs are not highly aware of crowdfunding as a mode of financing due to its novelty and difficult access. Though social entrepreneurs have agreed on using crowdfunding in absence of other sources of financing. Therefore, creating awareness about crowdfunding can prove to be helpful in fulfilment of sustainability goals. Moreover, large-scale sustainable ventures which are growth and market-oriented are unable to secure funds via crowdfunding. The share of such large scale ventures utilizing crowdfunding as a source of finance is relatively low though activists with sustainably-oriented intentions are successful in securing funds through crowdfunding. (Hörisch, 2018).

Different models of crowdfunding serve a different purpose in the matter of arranging funds for ventures. Scataglini & Ventresca (2019) in his work suggested that donation-based crowdfunding can support the sustainably oriented ventures financially on these crowdfunding platforms are least regulated and can be used globally with the limitations of country-wise restrictions. Moreover, crowdfunding platforms are technologically sufficient and provide funds for innovative solutions. Donation-based crowdfunding can be useful in promoting a particular venture among a community and thereby raising the required amount of funds. Deb- based crowdfunding is helpful for the projects possessing investment nature and risk (Bergamini, et al., 2017). Debt-based crowdfunding is suitable when the social and economic value ought to be generated by a project is high. Reward-based crowdfunding is suitable when the social and economic value to be generated is low. Equity-based crowdfunding is suitable in case of high economic value and low social value whereas donation-based crowdfunding is suitable in case of high social value and low economic value (Meyskens & Bird, 2015). Micro- crowdfunding is a new approach whereby the local community is motivated to participate in the social and environmental projects by pooling money in support of such issues. It helps in increasing awareness about social and environmental issues among the local communities (Sakamoto & Nakajima, 2013).

Crowdfunding projects for the purpose of safeguarding the environment tend to be successful when local people of the region are benefitted. Further, increase in environmental protection and social wellbeing is directly proportional to amount of funds raised through crowdfunding (Adhami, Giudici & Anh, 2019). Venture with sustainable orientation is able to be more

successful in accumulating funds through crowdfunding as compared to commercial projects. Creativity and third-party endorsements related to a project have a mediating effect on the positive relationship between crowdfunding success and sustainable orientation (Calic & Mosakowski, 2016). Rey-Martí, Mohedano-Suanes, & Simón-Moya (2019) highlighted that funders in crowdfunding invest their money in social or environmental projects on the basis of the impact which the project is able to create in the society. The crowdfunding platforms, in this scenario, act as the agent of change by promoting such socially or environmentally oriented projects over their platforms.

Different factors are also responsible for influencing the outcome of a crowdfunding campaign. Updates and number of rewards associated with a campaign have a positive effect on the success of the crowdfunding campaign. Successful experience of crowdfunding has a positive impact on the success of the campaign in case of large-scale campaign. Projects backed by some social movement are able to secure their target amount more easily (Hsieh, Hsieh, & Vu, 2019). The project description is another important factor for the success of a crowdfunding campaign. Social entrepreneurs are more likely to depend upon their project description in order to attract funders as they lack experience and legitimacy as compared to commercial entrepreneurs. Socially oriented campaigns with relatable and coherent project descriptions tend to attract more funders but no such requirement was observed in case of commercial ventures (Parhankangas & Renko, 2017). Video has no impact on success of sustainable crowdfunding campaign (Hörisch, 2018)

However, there are several studies which conclude that sustainable, social or environmental orientation of a project has no effect on the success or failure of the crowdfunding campaign. Hörisch (2015) concluded in his study that projects with environmental orientation have no positive impact on the success of crowdfunding campaign. In other words, success of a crowdfunding campaign is not dependent based on its category. The results indicate that environmental orientation might have a negative impact on the success of a campaign. Motylska-Kuzma (2018) also concluded that sustainable orientation of a venture has no role in the success or failure of its crowdfunding campaign. Though crowdfunding is capable of providing funds for ventures which indirectly aids the social growth however the funders are not sensitive to the sustainable orientation of the venture. Laurell, Sandström, & Suseno (2019) highlighted the role of social media between crowdfunding and sustainability. Socially or sustainably oriented projects were unable to create an impact about themselves on social media. A negligible amount i.e. 0.21% of all the discussions was made on crowdfunding projects with sustainable orientation. Social or sustainable entrepreneurs were unable to grab attention for their projects across various social media platforms.

Based on the previous studies it has been observed that most of the studies were conducted in the USA (Mollick, 2014; Agrawal, Catalini & Goldfarb, 2014; Frydrych et al., 2014; Hörisch, 2015) or European nations (Vismara 2016; Kraus, Richter, Brem, Cheng & Chang, 2016) while only a few were conducted in Asia (Motylska-Kuzma, 2018; Moon & Hwang, 2018; Cho & Kim, 2017). However, no such research has been conducted in India. The concept of online crowdfunding is decade old in India. Indian crowdfunding industry has seen tremendous growth in the past few years. Crowdfunding can be a substitute for traditional financing methods especially in case of sustainable ventures. Ventures or projects with sustainable orientation had to face certain obstacles when it comes to the process of collecting funds. Such ventures can use crowdfunding for funds. The objective of the study is

to find out whether the projects with social or environmental issues can be more successful in crowdfunding. Based on this the research question of the study is as follows:

Whether the social or environmental orientation of a project have an influence on the outcome of a crowdfunding campaign?

The study is an extension of the existing literature in the area of crowdfunding for sustainability as it attempts to explore crowdfunding as a source to finance sustainable development in India. This study helps in ascertaining the connection between the project categories and the success of crowdfunding campaign. The study would be useful in assessing the future prospects of crowdfunding for funding socially or environmentally oriented projects.

3. Methodology

The study is exploratory in nature as it aims at exploring the social and environmental category crowdfunding projects and their respective outcomes. The study is based on empirical data collected from a crowdfunding platform – Ketto. Ketto is an online crowdfunding platform which is based and operational in India. Ketto was launched in the year 2012 and has become one of the largest crowdfunding platforms in India. It is a donation-based crowdfunding platform and hosts campaigns across different categories like food and hunger, design and technology, women, environment, medical, healthcare, community development and sports. It is based on 'Keep-what-you-have-raised' approach under which the entrepreneurs i.e. the fund- seekers are allowed to keep the entire amount which they have raised during their campaigns irrespective of the target. The dataset consists of all the campaigns listed on Ketto.org for the period starting from 27th July 2019 to 18th August 2019. The initial sample dataset includes 465 crowdfunding campaigns. However, 2 campaigns were deleted from the initial dataset has they were withdrawn and 5 campaigns were found to be outliers. Therefore, the final dataset consists of 458 campaigns which were completed, either successful or failed. The campaigns belong to different categories as shown in Fig. 1.
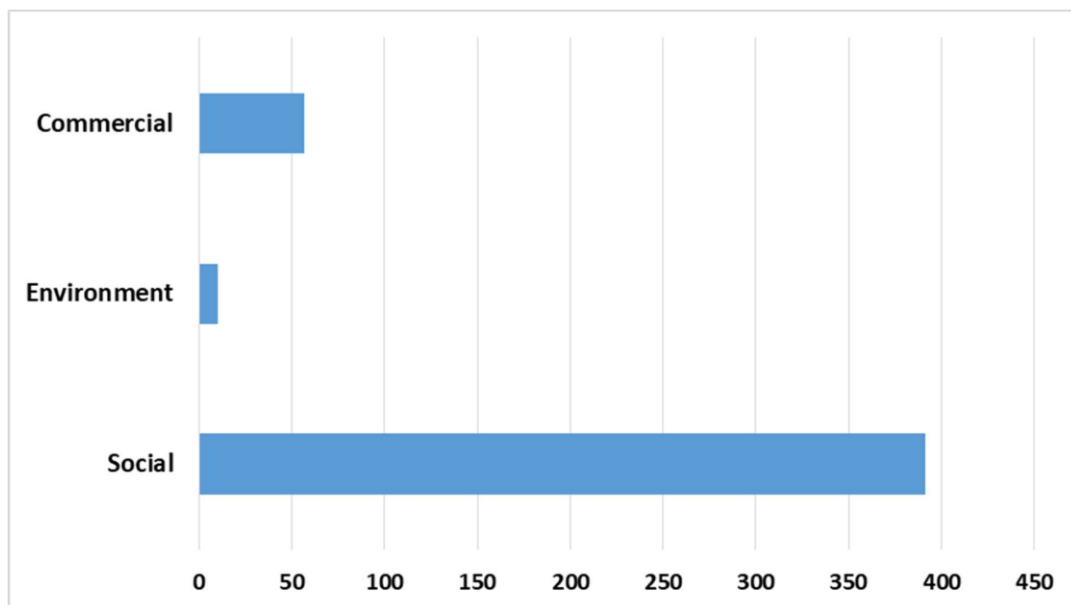
Fig. 1: Number of campaigns under different categories

The crowdfunding platforms can adopt two approaches - 'All-or-Nothing' or 'Keep-what-you- have raised' (Flanigan, 2016). In the case of 'all-or-nothing' campaigns, campaigners will receive the funds only if their target goals are achieved. In the case of 'Keep-whatever-you- have-raised' campaigns, campaigners are allowed to take whatever amount they have raised. Earlier researchers have based the dependent variable on the success or failure of the crowdfunding campaign. A campaign is considered to be successful when it reaches or exceed the set target goal (Mollick, 2014). Majority of the literature have used 'all-or-nothing' approach to define success.

This study takes the campaign which follows the approach of 'Keep-whatever-you-have-raised'. Therefore, for this study, the campaign success has been defined as the 80% of the target goal which implies that the campaign will be considered successful if it is able to rise 80% or more of its goal amount. The dependent variable is taken as a dichotomous or binary variable which has only two values i.e. either 1 or 0 where success is depicted by the value 1 and failure is depicted by the value 0 (Mollick, 2014; Frydrych et al, 2014; Hörisch, 2015; Sauermann, Franzoni, & Shafi, 2019).

Campaign or project category is the first independent variable (Mollick, 2014; Agrawal et al., 2014). For the purpose of this research, the different categories available on the platform are grouped into three main categories namely Social, environmental and commercial to study the effect of social and environmental orientation of the campaign on the success or failure of the campaign. Different categories have been clubbed into three main categories on the basis of the Sustainable Development Goals (SDGs) framed by the United Nations (Motylska-Kuzma, 2018). The social category includes campaigns related to medical, disability & healthcare, food and hunger, children, women and girls, community development, disaster relief and education. The project under environment category is retained as a single category and the rest other categories were classified as commercial category as such campaigns have no prominent sustainable motive. Three different models were analysed for the three different categories. The campaigns belonging to a particular category were coded as 1 against all other categories which were coded as 0. For example, if the campaign has social orientation then it will be coded as 1 for the purpose of analysing the effect of social orientation on the outcome of crowdfunding whereas all other campaigns were coded as 0.

The other variables included in this study are Average Fund and Supporters. Supporters are the people who put their money into the campaigns (Kraus et al., 2016). The number of supporters can influence the outcome of the campaign. A large number of initial supporters can lead to more number of funders (Burtch, Ghose & Wattal, 2012; Kuppuswamy & Bayus, 2012). Crowdfunding is the concept of receiving funds from a large number of people in small amount. Therefore, number of supporters can potentially decide the outcome of the campaign. Average fund is defined as the amount of fund per supporter. The success of the campaign also depends upon the amount of fund raised by a campaign which is dependent upon how much a supporter has contributed. It has been observed that a campaign can be successful if a few supporters contribute large sum of money. The variable average fund was used to normalise by taking the natural log. Table 1 shows the classification of the variables.

Table 1: Operationalisation of the variables

Variable	Type	Operational Definition
DEPENDENT VARIABLE		
Outcome	Dichotomous	A campaign is considered to be successful if it has achieved 80% of its target. Success = 1; Failure = 0
INDEPENDENT VARIABLE		
Category (Social)	Categorical	Social campaign = 1; Other campaigns =0
Category (Environment)	Categorical	Environmental campaign = 1; Other campaigns = 0
Category (Commercial)	Categorical	Commercial campaign = 1; Other campaigns = 0
LnAvgFund	Continuous	The total amount of fund raised divided by the no. of supporters of a campaign
Supporters	Continuous	No. of people who have contributed to a campaign

4. Data Analysis and Interpretation

Data extracted from the online crowdfunding platform Ketto.org has been analysed using SPSS. Table 2 shows the descriptive statistics.

Table 2: Descriptive Statistics

Variables	N	Mean	S.D	Minimum	Maximum
Outcome	458	0.08	0.27	0.00	1.00
Category (Social)	458	0.85	0.36	0.00	1.00
Category (Environment)	458	0.02	0.15	0.00	1.00
Category (Commercial)	458	0.13	0.33	0.00	1.00
LnAvgFund	458	7.19	1.07	1.61	10.53
Supporters	458	104.74	199.98	1.00	1224.00

The total number of observations analysed are 458 campaigns as shown in table 2. The number of successful campaigns is relatively less as compared to the campaigns who were not able to achieve 80% of their respective targets. Another observation is that the majority of the campaigns analysed have social orientation whereas only few campaign are

environmentally oriented. Variation in the number of supporters is quite evident from table 2.

Binary logistic regression is used to determine the effect of the project category along with the other variables which may influence the outcome of the crowdfunding campaign. Three different regression models are formulated for each of the three project category – Social, environmental and commercial.

The results for socially-oriented crowdfunding campaigns are given in table 3. The regression model for socially-oriented crowdfunding campaigns indicates that social category, average fund and supporters are significant predictors of success or failure of the crowdfunding campaign. The dependent variable for the analysis is Outcome which is a dichotomous or binary variable having only two values – success or failure. The number of supporters and the amount of average fund is found to be highly significant ($p<0.01$) in predicting the outcome of the crowdfunding campaign whereas the social category of the project is significant at 95% of confidence interval ($p<0.05$). However, the model indicates that a campaign belonging to the social category can have a negative effect on the outcome of the campaign (B = -0.973). The same can be ascertained by the odd ratio for the variable category (i.e. 0.378). The other two variables in the equation show a positive effect on the outcome of the campaign. The model is found to be statistically significant ($p<0.01$) with X^2 = 55.990. The Nagelkerke R^2 for the model is 0.276 which implies that the predictor or the independent variables explain for the 27.6% variation in the dependent variable. In other words, predictors Category, Supporters and Average fund can bring about 27.6% of variance in the outcome of a crowdfunding campaign. The model fulfils the assumption of no multicollinearity as the variance inflation factor (VIF) is low (VIF=1.032).

Table 3: Binary logistic regression for social crowdfunding campaigns

Model Summary	Values
Nagelkerke R^2	0.276
Chi^2	55.990***
VIF	1.032
-2 Log likelihood	191.271
Independent Variable	
B coefficient	
Category (Social)	-0.973**
Supporters	0.004***
LnAvgFund	1.385***
Constant	-12.607***
Odds Ratio	
Category (Social)	0.378**

Supporters	1.004***
LnAvgFund	3.820***
Constant	0.000***

Note: Hosmer-Lemeshow test is significant at p>0.05

The results for environmentally-oriented crowdfunding campaigns are given in table 4. The regression model for environmentally-oriented crowdfunding campaigns indicates that average fund and supporters are significant predictors of success or failure of the crowdfunding campaign. The dependent variable for the analysis is Outcome which is a dichotomous or binary variable having only two values – success or failure. The number of supporters and the amount of average fund is found to be highly significant ($p<0.01$) in predicting the outcome of the crowdfunding campaign. The model indicates that a campaign belonging to the environmental category positive has Beta coefficient (B = 0.833) but it is not statistically significant. Therefore, the environmental category of a project does not significantly predict the outcome of the crowdfunding campaign. The same can be ascertained by the odd ratio for the variable category (i.e. 2.299). The other two variables in the equation show a positive effect on the outcome of the campaign. The model is found to be statistically significant ($p<0.01$) with $X^2 = 52.802$. The Nagelkerke R^2 for the model is 0.261 which implies that the predictor or the independent variables explain for the 26.1% variation in the dependent variable. In other words, predictors Category, Supporters and Average fund can bring about 26.1% of variance in the outcome of a crowdfunding campaign. The model fulfils the assumption of no multicollinearity as the variance inflation factor (VIF) is low (VIF=1.013).

Table 4: Binary logistic regression for commercial crowdfunding campaigns

Model Summary	Values
Nagelkerke R^2	0.261
Chi^2	52.802***
VIF	1.013
-2 Log likelihood	194.459
Independent Variable	
B coefficient	
Category (Environment)	0.833
Supporters	0.003***
LnAvgFund	1.385***
Constant	-13.706***

Odd Ratio	
Category (Environment)	2.299
Supporters	1.003***
LnAvgFund	3.993***
Constant	0.000***

Note: Hosmer-Lemeshow test is significant at p>0.05

The results for commercially-oriented crowdfunding campaigns are given in table 5. The regression model for commercially-oriented crowdfunding campaigns indicates that average fund and supporters are significant predictors of success or failure of the crowdfunding campaign. The dependent variable for the analysis is Outcome which is a dichotomous or binary variable having only two values – success or failure. The number of supporters and the amount of average fund is found to be highly significant ($p < 0.01$) in predicting the outcome of the crowdfunding campaign. The model indicates that a campaign belonging to the commercial category has a positive beta coefficient (B = 0.918) but it is not statistically significant. Therefore, the commercial category of a project does not significantly predict the outcome of the crowdfunding campaign. The same can be ascertained by the odd ratio for the variable category (i.e. 2.503). The other two variables in the equation show a positive effect on the outcome of the campaign. The model is found to be statistically significant ($p < 0.01$) with $X^2 = 55.311$. The Nagelkerke R^2 for the model is 0.273 which implies that the predictor or the independent variables explain for the 27.3% variation in the dependent variable. In other words, predictors Category, Supporters and Average fund can bring about 27.3% of variance in the outcome of a crowdfunding campaign. The model fulfils the assumption of no multicollinearity as the variance inflation factor (VIF) is low (VIF=1.029).

Table 5: Binary logistic regression for commercial crowdfunding campaigns

Model Summary	Values
Nagelkerke R^2	0.273
Chi^2	55.311***
VIF	1.029
-2 Log likelihood	191.950
Independent Variable	
B coefficient	
Category (Commercial)	0.918
Supporters	0.004***
LnAvgFund	1.341***

Constant	-13.537***
Odd Ratio	
Category (Commercial)	2.503
Supporters	1.004***
LnAvgFund	3.882***
Constant	0.000***

Note: Hosmer-Lemeshow test is significant at p>0.5

5. Conclusion and Discussion

This study coincides with Hörisch (2015) that environmental orientation of a crowdfunding campaign has no significant impact on the success or the failure of the crowdfunding campaign. However, the study has been able to substantiate that socially-oriented crowdfunding campaigns can influence the outcome of crowdfunding campaign. This adds to the existing work of Parhankangas & Renko (2017), Hsieh et al. (2019), Calic & Mosakowski (2016) and Rey-Martí et al. (2019). It should be noted that the relationship between social orientation and crowdfunding success is inversely proportional. Therefore, it can be concluded that category or orientation of a campaign cannot predict its success or failure. In other words, category of a campaign may have a slight impact on its outcome as compared to other factors. This supports the work of Laurell et al. (2019) and Motylska-Kuzma (2018). The success or failure of a campaign can be influenced by other factors as well. The number of supporters and the amount contributed by them has a significant impact on the outcome of the campaigns. Increment in the number of supporters of a particular campaign and the amount of fund contributed by each one of them will increase the chances of success. It should also be noted that the change in average fund will create a greater impact on the outcome of the campaign as compared to the number of supporters.

The findings of this study stand in contradiction with the proposed theoretical work which assumes that non-profit nature of a campaign will create a positive impact on its success. The main reason for such results that donation-based crowdfunding is only seen as a medium for philanthropy activities (Flanigan, 2016). People putting their money in crowdfunding campaign assume it as an act of charity and in order to prompt people to contribute the campaign and its creator should generate quality and trust (Gerber & Hui, 2014; Zhao, Chen, Wang & Chen, 2016). Another, reason for such a contradiction could be that the number of campaigns with environmental orientation was far less (Hörisch, 2015) as compared to socially-oriented campaigns.

The study has certain limitations as well. Firstly, the findings are based on donation-based campaigns only. The factors which may affect the commercial crowdfunding campaign can be better analysed reward-based campaigns. Secondly, the number of campaigns belonging to different categories was unequal with more than half the campaigns belonging to the social category. Besides catering to these limitations, further research can be done to explore the reasons as to why some socially oriented campaigns are successful as compared to others. They

can further dwell into the ways in which the campaigners and platforms can invoke trust and communicate quality to the supporters. Crowdfunding industry in India has latent potential. The tool of crowdfunding can be power for many individuals, entrepreneurs, organisations especially small-medium enterprises and start-ups focusing on sustainability. It has been observed that crowdfunding has gained momentum in the past few years. More and more individual online platforms have emerged in the recent past which are category-specific. Crowdfunding can be used as a mode to boost sustainable development as well as equal distribution of funds amongst business entities. The government should promote crowdfunding for sustainable development and entrepreneurship. All crowdfunding platforms across the country should adopt similar practices and regulation along with practicing transparency which may, in turn, creates a positivity about crowdfunding among the supporters.

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SECTION – 5
ANALYTICS

Ergonomic Evaluation through Digital Human Modelling: A Review

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Abstract-

With global frequency of musculoskeletal disorders as high as 42%, ergonomic redesign is of relevance to modern day work organisations and work systems. Advancements in computer technology can be attributed to rise in popularity of Ergonomic analysis and evaluation through Digital Human Modelling (DHM) promising astute ways of product or system designs in early stages and assessment of disorders or impairments and conduction of therapies or surgeries while highlighting comfort assessment. DHM serves as a bridge between computer-aided human-machine system designs and Human Factors Engineering (HFE). This paper reviews the latest advancements in DHM in interactive ergonomics while integrating anthropometric and cognitive models while emphasising on methods to conduct evaluations in a digitised domain and discusses the generation of these models. The paper includes the applications of DHM in various fields through dynamic simulation and ergonomic evaluation for design of accessory devices and space movements to predict a work task outcome. The review also discusses the potential to imbibe valid postures, motion prediction models, biomechanics and psychophysical features in DHM, improving overall analysis and evaluation procedure. This paper brings out a framework on evaluation of tasks using Digital Human Modelling.

Keywords: Digital Human Modelling (DHM), Human Factors Engineering (HFE), Ergonomic Analysis, Computer Aided-Human Machine, Anthropometry, Cognitive Models

1. Introduction

Ergonomics is a field with the requisites needed to analyse and evaluate occupational activities and performance with quantitative and qualitative measures on tools, machines, tasks, workers to design and engineer a product or workstation that offers a degree of comfort admissible by all parties. Musculoskeletal disorders cause almost one-third of the sick leaves (European Agency for Safety and Health at Work: ZintaPodniece, 2008). Under such circumstances, while making decisions related to maintainability and reliability, human factors should also be considered and analysed through tools and techniques which seek to optimise performance of products or services. This can be done by evaluating a virtual environment represented with ergonomic data [1][2]. A significant reduction of awkward working postures can be achieved through virtual ergonomics evaluation of the workspace and such designs can steer towards improved existing as well as future designs of workstations [3]. Once evaluation is carried out the next step is ergonomic innovations; however, a number of barriers are faced by potential adopters, such as, ease of use and costs incurred [4].

After years of engineering work and developmental research to attain optimum fulfilment of products requirement, ergonomics and human factors engineering is gaining immense

recognition in global markets with the rise in need to establish product differentiation [5]. Incorporation of ergonomics in a conventional product design is especially a challenge as product development is based on transformation of material, energy or signals and ergonomic requirements does not fall within this domain as it is not directly correlated with transformation [6][7]. On account of changing situations, product developments have moved to a user-centric design which considers the association of product, user and environment holistically through the life cycle of the product, owing to adoption of a more relation-aligned approach than the classical functionally aligned approach [8]. To facilitate the shift, ergonomic evaluation is carried out through user interviews, prototype testing and most importantly, observations [9]. After many repetitions of development and testing, procured results are considered to optimise designs to suit appropriate ergonomic specifications subject to the situation [5].

To achieve an ergonomic future, evaluation is the first milestone which is enabled by Digital Human Modelling techniques which allows evaluation of the workspace design, accessibility of assembly design, risk of musculoskeletal disorders (MSD's) while reducing the production cost. By integrating robust CAD tools, today's technology provides analysis tools for experimental and interactive human modelling and task analysis [10]. DHM bridges the gap between computer aided engineering design, human factors engineering and risk assessments. On-going research includes risk assessment of workplaces, hand-object association, tracking eye movement and assessing degree of comfort. Utilisation of digital human model favours benefits like shorter design time, lower development cost, enhanced quality and productivity while being a useful tool for organisations giving them acompetitive edge through incorporation of the human element into their product design [11]. Using DHM allows engineers to accommodate ergonomic requirements in pre-production planning rendering the production of real prototypes out-dated in today's scenario reducing the need for physical testing [12].

DHMs represent the human being in a virtual form as a part of a software system, containing complete or partial human characteristics and abilities. DHM has found application in cognitions, medical sciences, biometric amongst others to define work places, allowable stress or work environment. Popularly used DHMs like Human Builder, JACK, V5 HUMAN and RAMSIS (Realistic Anthropological Mathematical System for Interior comfort Simulation) prove to be useful inputs to planning and development process in digital factories by integrating CAD, anthropometric data and replicating of body postures and inspection of ergonomic issues [13].

A digital human, in general meaning is to reproduce human in form and function on a software application thereby reducing the iteration in a design process. Typically, the designer can assess a product in a virtual setting with the human model providing feedback such as reachability, maintainability, reliability etc. while making sure the simulation model is validated by using motion capture equipment tools [13]. This paper further highlights building models, and reviews the various applications of DHM.

2. Literature review

In this section, work of various researchers in the field of virtual ergonomics is discussed in detail.

Bertilsson. E et al.,studied the simulation methodology in the Swedish automotive industry and realised the difficulties, opportunities and clarification with respect to human diversity.

They also differentiated between the existing user focus of product development while production development did not factor the human element into its process, rather focused on lean management [14].

Nitesh Bhatia, Anand V. Pathak and team developed natural simulations using vision as estimation factor for human postural simulations, limited to hand reach. They illustrated vision based feedback without using inverse kinematics and considers formerly developed vision and hand modules to describe an integration technique to provide feedback and feed-forward mechanisms. Spatial data is generated by a module that behaves almost identically to human eyes such that the workspace object and model of DHM hand projected over the grid. The implementation is restricted to hand reach simulations, monocular vision and two dimensional hand movement which can be used for planning of workstation to improve task productivity [15].

Latest work by Michael A. Rizzuto, Michael W.L. Sonne and group examined the practicability of a head mounted display with a motion capture system to simulate real life occupational tasks. Subjects were required to perform a task under real environment, virtual environment with auditory inputs and virtual environment with visual inputs. It was observed that peak pointing speed was slower and movement time was longer during virtual conditions using simulations like Oculus Rift and Siemens [16].

GregorHarih and BojanDol_sak conducted studies to account the shape of the hand during optimal power grasp posture while determining the structure of tool handles which can lead to cumulative trauma disorders (CTDs). They developed an anatomically accurate static digital human-hand model which allows direct modelling of tool handle without repeated designing that was based on anthropometric data of ten subjects. It was noticed that tool handles generated from these designs had a higher overall rating with respect to comfort as compared to conventional cylindrical handles lowering the risks of CTDs. This was achieved by outer hand moulds on pre-cylindrical handles for variable finger diameters which increased the area of surface contact thus increasing user performance [17].

3. Methodology

Based on the thorough literature review, creation of the virtual human is discussed in this section along with their numerous applications. This section proposes a framework for evaluation of tasks using Digital Human Modelling.

By consolidating work of many researchers, we propose a broad framework for evaluation of performed tasks using digital human modelling. As in Fig 1., the preliminary step is to empathise with the operators and understand the task and its requirements in two levels, i.e., the task level (1.1 as in Fig 1.) and environmental level (1.2 as in Fig 1). Comprehending the task includes tools, utilities, functions, movement etc. Environmental level is concerned with the surroundings like hazardous materials, moving or stationary objects, lighting, and ventilation. Step 2 (2 as in Fig1.) is concerned with collection of all related anthropometric data for the task, by addressing the target population dimensions. The evaluation is accurate only if the task fits the population utilising the product or workspace. Analysis and evaluation of tasks using Digital Human Modelling (as shown in Fig1.) is step 3. This includes the modules building models (3.1), modelling of shape and movement (3.2), and evaluation of task (3.3). In this paper, we discuss building of models and modelling shape and movement in detail in the subsequent sections. Step 4 in the framework is to assess the compatibility of the Digital Human Model with respect to the anthropometric data used. In the next step (5 as in Fig 1), ergonomic specialists must carefully judge the results of the evaluation and suggest

improvements. The improvements should be documented in a systematic manner for clear implementation and in cases for future.
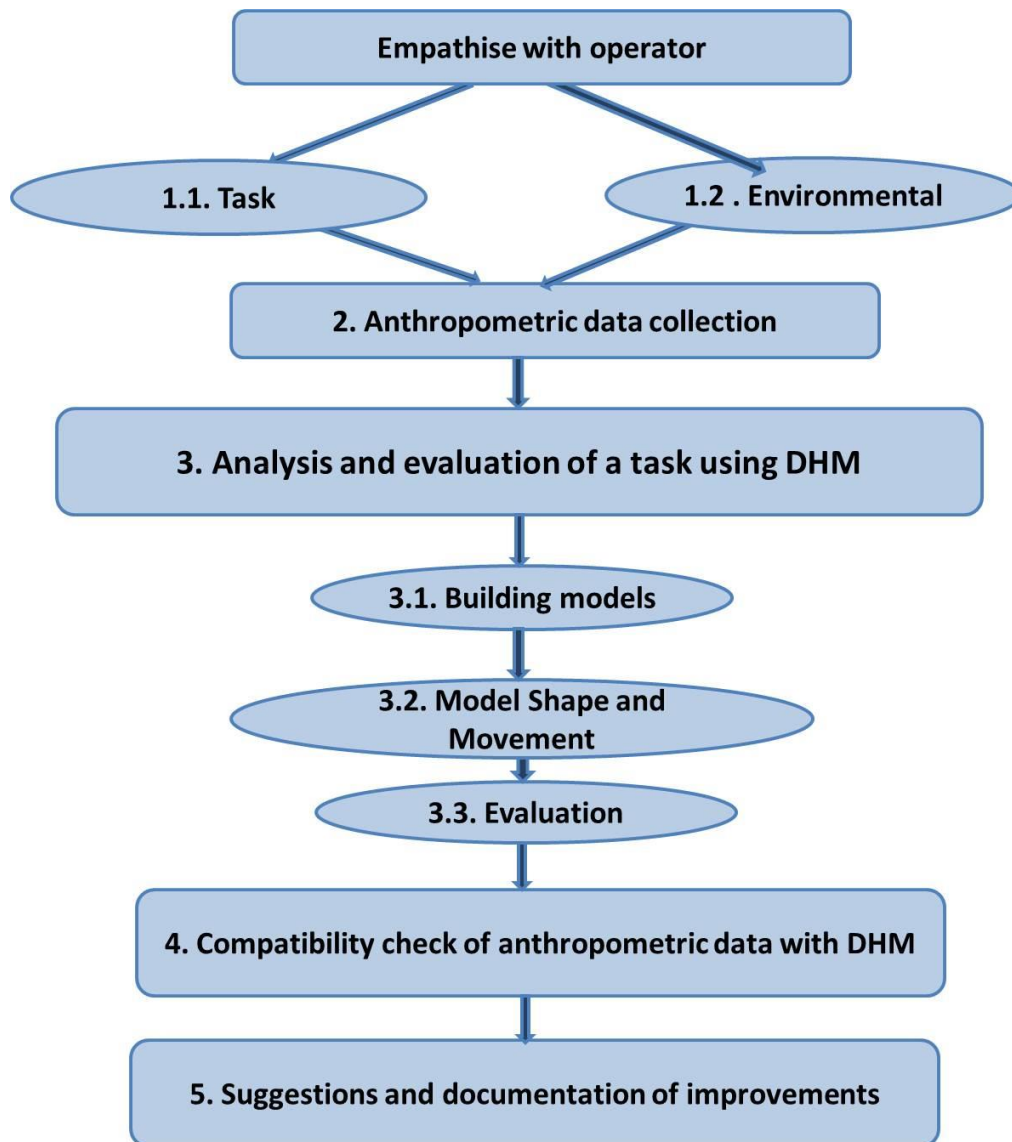

Fig 1. Broad Framework of evaluation of tasks using Digital Human Modelling

Further insight into Step 3, i.e., Analysis and Evaluation of task using DHM is provided in the following sections.

Step 3.1 Building Digital Human Models

DHM models are essentially based on an abstract skeleton model that pairs bones with joints. Reproduction of body postures can be facilitated through joints which have zero to three degrees of freedom. For production design, the three dimensional body has skin or clothes and moves along the way of the coupled segment. Recent technologies include deformable skin and clothing and models can be positions with kinematics. Forward kinematics, inverse kinematics and posture databases are the essential functions used.Fig 2 describes a digital human working posture in the different degrees of freedom [18].

Functional database of DHMs as shown in Fig 3, mainly includes [18]:
1. Manipulation functions
2. Analysing functions
3. Output functions
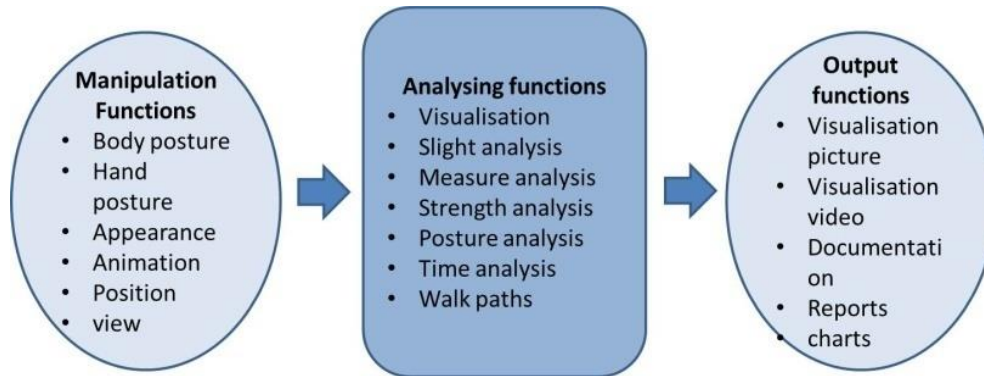
Fig 3. Functional database of DHMs

DHM is used to picture a population's reach and clearance dimensions including the effects resulting from different equipment like gloves, helmets and also personal clothing. In some instances, its most principle characteristic is simulations and the related graphics which enables engineers to understand underlying difficulties that a population subgroup might encounter while working with a particular design. It also finds applications in determining of allowable stresses, strength and endurance while performing labour intensive tasks and complying with government regulations [19].

While using DHM, some criteria need to be considered. Simulation models must be based on real human motion data and should represent that are not already in the existing system. It should have an exploratory approach with fast run time and novel methods for prediction of situations specified by the engineer [19].

Despite the advantages of Digital Human Modelling approach to ergonomic evaluation, it is still far from being utilised and implemented as a tool. This may be on account of several reasons, some of which may be [10]:

- Methodological: a shortcoming in incorporating the new tools with conventional ones along product life cycle.
- Psychological: difficulty in adapting to the change from already familiar routine tools to new and innovative and experimental tools even if they provide better results.
- Organisational: lack of understanding of the benefits of DHM tools, possibly because of cost.

Virtual Humans

Virtual Human was realised as research environment combined with biochemical and biophysical systems and advanced computational algorithms integrated with digital, solid-body model of the anatomy. Oak Ridge National Laboratory (ORNL) commenced the development of Virtual Human, a human simulation tool which includes a problem solving environment (PSE) to accomplish the incorporation of physiological models using different

programming languages and associating with anatomy.The Virtual Human PSE provides the foundation to institute the Virtual Human Concept. In its early stages of development, Virtual Human was used to analyse radiation doses to workers and medical patients by modelling the body and organs in the form of spheres, ellipses, etc. This was done through mathematical phantoms which were controlled by simple mathematical expressions [20].

Virtual Human was developed with a goal to simulate human response to any physical stimulus, thus the integration of PSE. Computational resources like hardware, software, instruments, database and people are assembled in a computational grid to account to the modern way of structuring of scientific work. The problem solving environment comprises of all such computational devices in the environment. Along with the PSE, anatomy needs to be used which can either be a simple compartment like an organ /sub-organ level or a more complicated model of multiple organs and external body. Physiology is modelled with circuit models which are initiated with a description of the original system state. Virtual human was used to analyse many bio-modelling projects like simple cardiac functions, production of lung sounds and response to inhalation exposure [20].

To utilise DHM, knowledge natural forms of human body and method to convert it into software application needs to be known. Natural form of human joint structure is analysed with medical imaging and 3D modelling which finds applications is variegated fields such as art, archaeology, and palaeontology. The commonality of all these fields with the medical industry is the need to perform inner and outer structure analysis and reconstruction of natural forms. This requires complicated modelling, as natural forms are free-form based rather than parametric shapes, as used in Computer Aided Drawing. Thus integrating natural form and parametric design gives rise to new challenges and to counter this, natural forms need to be simplified and Douglas D. Robertson and Gulshan B. Sharma have carried out research for the same by analysing natural form of living or extinct creatures (antiques and fossils) [21].

Percentile and custom-built techniques are the two approaches to building a virtual human. The custom-built models are based on anthropometric data previously defined and other measurements and proportions are determined by regression analysis. The percentile technique works on an already existing anthropometric data system of a particular age, gender of nationality from which the human model is generated [16].

Use of DHM and integration with Product Lifecycle Management (PLM) software has significant advantages in terms of cost and time. CIMdata's research conclude that lead times are reduced by 30% in the market, the number of design changes by 65% and time spent in process planning by 40% bringing a total increase of 15% of output and cost cuts by 13%. Sophisticated product development strategies involve a high degree of human-machine interaction and ergonomic comfort. Use of DHM tools can boost the quality by adding the human element, reducing unessential designs and betterment of safety aspects of a product. Motion capture is used an input to DHM and acts as an aid that allows manufacturers to predict underlying risks even before production begins [22] The ergonomic evaluation is characterised by discover, design, develop and deploy stages to accentuate.

Step 3.2 Modelling shape and movement

Hundreds of thousands of grid points are applied in 3D scans of human bodies.Some databases have up-to hundred fifty thousand grid points. For evaluation and conversion to Digital Modelling, human bodies necessitate compact shape rendition. AfzalGodil developed two such representations of the human body shape [24]:

- A descriptor vector d, based on lengths between large single bones, therefore forming a 3D description vector of fifteen distances including wrists, elbow, shoulders, hip and knees.
- Rendering the human body from front, side and top to create three silhouettes, that are encoded as Fourier descriptors for later similarity based retrieval.

The author also rendered the human head shape in two approaches [24]:

- Applying Principal Component Analysis (PCA) on the 3D facial surface
- Using a 3D triangular grid which is transformed into a spherical co-ordinate system.

This was carried out by the CAESAR anthropometric database which contains data of approximately 5000 human subjects and a similarity based retrieval system from CAESAR was used [24]. Cluster analysis is a method for extricating patterns or relations by grouping shape descriptors [25].

Virtual Human, developed out of the necessity to provide astute geometry and understanding of human physiology, has been developing. Recent advancements like high-computing, computer graphic modelling and simulation, and numerical analysis can provide insight into virtual human modelling and biomechanical simulations. Commercial softwares like SIMM (Motion analysis Inc.), Madymo (TNO Automotive Inc.) and Lifemod (Biomechanics Research inc.) can be used for numerical analysis of human musculoskeletal model. Yoon Hyuk Kim researched the development of a virtual Korean musculoskeletal model and its application to the biomechanical field [26].

Strength exerted in movement of a human can be suggestive of movement performance at or close to maximum level. Kang Li and Xudong Zhang proposed a framework for human movement modelling and simulation that imbibes the strength factor for physical tasks. In their research, the authors conducted two studies; in the first study they observed the effects of individual's dynamic strength and their knowledge of strength based on their selection of load-pace balancing strategy and in the second study they examined the effect of dynamic strength on how people move. The two studies put forward that both high-level decision making and low-level motor control during an objective-oriented task performance highly depends on the strength factor. Integrating these findings into virtual humans is an essential step for evaluation and analysis. For digital models represented at lower geometrical physical levels, the only personal attributes considered are anthropometry and gender [27].

There are two approaches to modelling virtual humans, static and dynamic. Static modelling generates a model to describe posture a given point in time and is concerned with shape description, registration, hole filling, shape variation characterisation and shape reconstruction. Dynamic shape modelling is concerned with changes in posture over time, identification, skeleton modelling and shape deformation. Various graphical elements can be used to describe human shape, like for example; Allen et al. [28] and Anguelov et al. [29] dealt with vertices or polygons of a scanned surface. These methods guarantee reconstruction but are not quite accurate for shape identification, searching and discrimination [30].

Applications of DHM

This section highlights applications of DHM in industries cognitive modelling, human modelling in transport, health and rehabilitation and industries.

Cognitive modelling

Several attempts have been made to integrate cognitive architecture into digital human modelling to predict human performance There is no straight forward method to predict what happens in the head; the mind "leaks" onto the world, and hence cognition cannot be regarded without its context from the body. Feyen, in 2007 suggested an approach to view human as whole than segregating into "neck up" and "neck down" and Barsalou et al., discussed social embodiment, both of which favoured the viewing of human body holistically where both mind and body are essential for cognition [27-29].Hannaman et.al.[30] discussedthe Human Cognitive Reliability (HCR) model to quantitatively measure human cognition by dividing the behaviour of human into skill, rule and knowledge in a man-machine interface. Since skill, rule and knowledge depend upon human perception, modelling can be tough. The model however considered only permitting and executing time while ignoring absolute time impact human error probability [35].

Two approaches of integrating cognitive models into DHM can be recognised, mathematical model and a low tech physical body system. The mathematical model considers all credible factors like mental tasks, predict error rates, and effect of noise in the environment which are assimilated with cognitive behaviour. The second approach considers the human body in an environment with features and working of a physical body where the mental demands are functions, feedback and compatibility [20].

Computational models of human performance can deliver an advantageous source ofinformation when used suitably. Models are interactive and mimic users yielding statistics that are useful for quantitative comparisonof different designs. Small improvements can prove to be a financial benefit to the organisation. Along with evaluating human performance, it provides in-depth information of potential human computer interaction [36].

Cognitive workload can be identified through tracking of eyes, which is done by NES (Network Evaluation System), a network of co-ordinated eye-tracking systems that keeps track of decision makers within an environment. Inputs from NES, i.e., the location of each eye in terms of horizontal and vertical grid and size of pupil, are used in digital human modelling accounting to the cognitive aspect of ergonomics [37].

Human Modelling in Transport

Every vehicle interior is designed to accommodate the human element. The main motto behind every designis "if we design like this we could include more user groups as well, rather than excluding them" [38].

Digital human models are used in areas such as motion capture and simulation, used for the measure of performance of the system, to check the reach capability and visibility. It can also be used in the CAD environment where the DHM'S help the designers understand the human-product interaction, the human friendliness of the product and thereby make suitable design changes or modifications required in the early design stages. DHM'S are usually combined with CAD systems to enable designers to carry out ergonomic evaluations of the vehicle interactions and understand the effects occupants have on various changes in the vehicle design parameters[39].

DHM'S are utilised for design of car seats and assessment of driver reach and ingress/egress. Primary qualitative design targets to avoid restriction of mobility and postural fixity. The H-point or the hip point is a key area used during the design. As most of the seats are full foam,

it is primarily dependent on the nonlinear and visoelastic, quasistaticbehaviour of foam. Interfacial forces, including friction forces and tangential shear forces between the seat and the occupant help in determining static settling point in the system and thus the H-point [40].

Health and Rehabilitation

Respiratory protection gears requires accurate fit to an individual's face to avoid hazards likeleakage and inhalation of various contaminants and other gases that cause discomfort to the user when used for a prolonged period of time. Finite element method is the most widely used computational technique where a complex geometry is divided into a mesh that consistsof elements represented by nodes at the corners[41].

The digital human modelling tool delmia V5 human was primarily used for conducting all the customizations suggested for an optimal fit in the health care industry. DHM is primarily used for checking anthropometric data, observing the range of motion, posture prediction and physical manikin properties [42].

Human modelling is also used capture the biomechanics data which otherwise is difficult for all the older adults to perform and therefore the bio-mechanists will have a better insight into all the causes of mobility problems observed in all the elderly persons, it can be done by observing the stresses observed in the joints and how it changes during the tasks performed[43].

The use of computer tomography plays a vital role in three understanding of the human anatomy and the pathology. It is the done with the use of 3D visualizations and novel user interfaces along with the existing radiological and diagnostic imaging. It can be designed for the visual human explorer wherein it allows the sliders that animate the cross section of the body and also navigate between the coronal sectional overviews and the axial image previews[44].

DHM'S are also being used to design custom fir product for instance prosthesis socket. In such a case a lot of things of the human body needs to be considered, for eg stump morphology acquisition, also a virtual body needs to be generated which needs to consider both the external shape i.e. theskin and also the internal shape like the shape of the muscles and the bones and also the mechanical characterisation of the stump to be able to simulate correctly the socket-stump interaction[45].

Industrial and Ergonomic applications

Poor ergonomic design will not only result in physical injuries to the personnel but the companies will also have to bear huge financial and reputational losses. Therefore computer aided tools are used to reduce excessive physical prototyping in order to reduce the design and manufacturing costs and time[46].

Head injuries and facial injuries are a major cause health hazards and physical disabilities. Under such circumstances, the companies must invest heavily in the safety of these headgears. Digital head models are used to observe the anthropometric data and design suitable headgears and other facial equipment. Design of the head-forms isdone using the AUTOCAD computer aided design package. Around 48 linear head dimensions were used to locate the 26 facial landmarks using the head-form wireframe[47].

Ford motor co. had integrated the UGS Tecnomatix Jack human simulation solution to study workspace ergonomics and worker safety in the installing of a new satellite digital antenna

radio system. The analysis of this was done at an early stage and hence helped reduce the late design modifications and aided in assessing the performance. UGS Tecnomatix is a product life-cycle management tool which has been used to reduce the deficiencies in the human factor and ergonomic related areas[48].

A few of the software simulation using digital human models have been commercialized and are being used in the design of automobiles and airlines [49].Some of the digital human models are also being integrated into workplace designs to improve performance. They have been increasingly used in areas with respect to production[50].

Ergonomic design has become a key issue in a warship as it can improve the safety and reliability of the warship and also enhance and simplify its maintenance and operation. It is also important for the safe navigation and accident precautions of the warship. Therefore for the evaluation of the design, various DHM's are used as real human body experiment is costly and sometimes perilous. A visualizing human is used in CAD systems for product design of these warships[51].

Conclusion:

The considerable problem encountered by most organisations is the omission of the human element in product or workstation development leading to compromises on cost, time, quality and safety. Therefore, imbibing Digital Human Modelling into evaluation process has become essential to account for the ergonomic setbacks and provide a competitive edge for organisations. DHM is gaining momentum and researchers have shifted their focus to more user-centric technologies. The applications of DHM in numerous fields such as cognitive modelling, transport, medical and health, and industrial ergonomics is discussed elaborately in the paper. Although DHM has been progressing, it has potential in futuristic technologies which include complete co-ordination between mind and body. Advancements in Artificial Intelligence and Machine Learning can be key to overcoming these limitations. Various fields are experimenting with virtual humans and with progressing exploration; DHM can be a widely used tool in the future.To observe the pattern of innovation, the framework proposed in the paper on evaluation of tasks using Digital Human Modelling can be executed. Future scope includes implementation of thisconsolidated framework in a real time case study to observe improvement in performance.

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Leveraging Social Media Analytics in influencing Organizational Culture

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Abstract-

This study attempts to predict the effects of Social Media Site Usage at workplace on Organizational Culture and other work-related outcomes. It is huge challenge for organizations to develop an alignment between Social Media Usage and Organizational Culture. This study empirically tests the direct and mediating effects of Workplace Behaviour by studying 3 sub-variables like Communication, Interpersonal Relations, Absenteeism; Job Performance through Job Involvement, Organizational Commitment, Innovative Behaviour; and Job Satisfaction through Employee Engagement, Turnover Intention, and Perceived Organizational Support on the relationship between Social Media analytics and Organizational Culture. 460 IT-Employees from 37 Public Limited IT-companies listed under Software Technology Park of India (STPI), Pune is the sample-size determined using Mean Method. The results of the Cochran's Q-test show that the purpose of use of Social Media Sites significantly differs in frequencies. The Pillai's Trace test shows that the Quality of Work-life depends upon usage of Social Media Sites. To examine the impact of Social Media on Organisation Culture, a 2-group between subjects One-way MANOVA has been performed on aforementioned 9 Dependent Variables. The result shows that Organizational Culture depends upon usage of Social Media Sites. SEM is used to examine the predictive relationship between usage of Social Media and Organizational Culture as well as Organizational Performance.
This study advocates that the Decision makers and the Management of organisations should frame policies which allow standardized use of Social media that is beneficial for organizations and employees both for efficient information sharing and operations.

Keywords: Social Media Analytics, Social Media Sites, IT employees, Organisational Culture, Quality of Work Life

1. Introduction

Like several emerging technologies, Social Media Sites, and their use in the workplace, have been a provocative issue. Some argue that the use of Social Media Sites in the workplace leads to better culture and employee productivity through effects on intermediate variables, such as higher morale (AT&T, 2008; Bennett, Owers, Pitt, & Tucker, 2010). Others argue that the biggest concern about the use of Social Media Sites in the workplace is the loss of labor productivity due to time wasted at work (Shepherd, 2011; Accountemps, 2010; Nucleus, 2009; O'Murchu et. al., 2004). Similarly, Facebook use is found to decrease productivity by 1.5 percent (Nucleus Research, 2009); which may negatively affect workplace culture. However, another study by AT&T (2008) testified that majority of employees considered that using Social Media Sites increased productivity levels, resulting in positive work environment. Various

studies also seem to assert that Social Media Sites use make employees happier and highly productive (Li et. al., 2008; AT&T, 2008; Bennett et. al., 2010; Leidner et. al., 2010; Patel & Jasani, 2010) resulting in better organizational culture.

There is considerable research that demonstrates that IT employees are no exception to using Social Media at work and they highly value its usage in their daily lives including their work-life (Shami, Nichols, and Chen, 2014). It can't be unseen that the use of social media has become a part of organizations and organizational culture affecting its various dimensions. Based on the review, it is observed that the studies that claim positive or negative impact of Social Media Sites in organizations, failed to empirically examine and measure its positive or negative effects on Organizational Culture and other work-related outcomes. Hence, in this study the researcher sincerely attempts to empirically test the impact of Social Media Site Usage on Organizational Culture through Workplace Behaviour, Job Performance and Job Satisfaction amongst IT employees.

2. Research Methodology

Descriptive Research Design is applied to conduct this research. 460 sample IT employees from 37 Public Limited IT companies were selected from 230 IT Companies listed on STPI, Pune. Mean Method is adopted to arrive at the sample size. The Variables in this study are measured by using five-point measurement scale; hence the Mean Method is adopted. Following is the Formula used to determine the sample size:

$$N = \frac{z^2 * s^2}{e^2}$$

Where, 'z' is the standard score associated with confidence level (95% in the current case). Hence standard scores equals to 1.96 (borrowed from normal table)

'S' is the variability in the data set, computed as a ratio of range / 6. Range is equal to 5-1 = 4 (the difference between minimum and maximum value in the 5 point scale). 6 refer to ±3 standard deviation values on the X axis of the standard normal curve, which takes in all the data set in study.

Hence S = 4/6 = 0.66

E is the tolerable error = 6% (in the current study).

Sample size n = $\frac{1.96^2 * 0.66^2}{0.06^2}$ = 464

Hence, the final size of sample is freezed at 460 IT employees.

In this study, one key objective is to examine predictive relationship between usage of Social Media Sites and Organizational Culture as well as Organizational Performance. Since Usage of Social Media Sites, Organizational Culture and Organizational Performance are latent constructs; Structural Equation Modelling is used to confirm Dependence Relationship between these constructs.

'SEM' is an advanced Statistical technique used for concurrently studying the Interdependence and Dependence relationship between several constructs. Structural Model involves 6 Latent constructs: Social Media Sites Usage, Social Media Behaviour, Workplace Behaviour, Job Performance, Job Satisfaction, and Organizational Performance. Following Research questions have been answered using SEM:
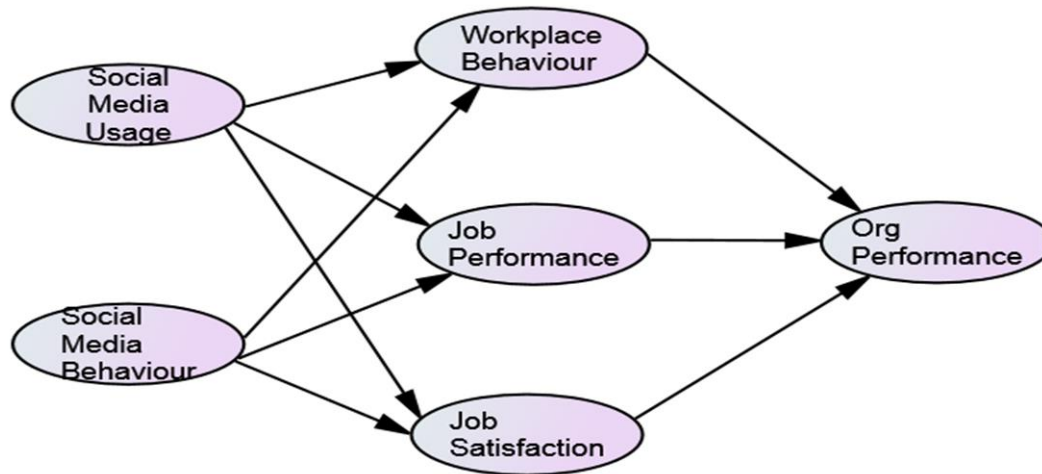
Hypothetical Model

Fig. 1: Hypothetical Model

The proposed Hypothetical Model consists of 6 latent constructs (Social Media Sites Usage, Social Media Behaviour, Workplace Behaviour, Job Satisfaction and Job Performance, Organizational Performance). SEM is used to confirm the following Hypothetical paths in the model.

3. Research Question and Objectives
1. To study the Pattern of Social Media Sites Usage by IT Employees.
2. To study the influence of Social Media Sites Usage on Workplace Behaviour, Job Performance and Job Satisfaction
3. To analyze the impact of Social Media Sites Usage on Organizational Culture.
4. To examine the predictive relationship between usage of Social Media and Organizational Culture and Organizational Performance.
5. Social Media Sites Usage does not influence the relationship between Organizational Culture and Organizational Performance

4. Literature Review
Several studies have been conducted on influence of social media use on society, youth, adolescents and adults in various countries. Studies have also been undertaken on influence of social media use on behavioural, social and economic aspects considering various dimensions. **Romina Cachia, (2008)** explored and identified the social and economic implications of social networking sites in Europe. The study concluded with relevant social and economic impacts of social networking sites in Europe and their implications for policy. **A. Ferreira T. du Plessis, (2009)** specifically investigated the effect of online social networking on employee productivity and consequences of unrestricted access of social networking sites to the employees. **James Bennett, Mark Owers, Michael Pitt, Matthew Tucker, (2010), Emily Oxenford, (2011) Fakhar Shahzad, Rana Adeel Luqman, Ayesha Rashid Khan, Lalarukh Shabbir (2012)** investigated workplace impact of social networking and examined the link between social networking and organizational culture. **Gigi G. S., Dr. P. Umarani, (2013)** found that empowering employees to be active in social channels can actually improve employee

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engagement, which is the key to improving employee morale, job satisfaction, and productivity. **Robert E. Ployhart, (2014)** addressed how Social media is revolutionizing the way people connect and share information, it affects the entire organization.

Most existing studies have shown the positive and negative influence of Social Media Sites Usage at workplace on Organisational Culture. This study, however, considered IT employees to measure the impact of Social Media Sites Use in workplace on Organisational Culture through selected variables.

5. Result and discussion

Results show the demographic profile of the respondents where 57.6% are men, 42.4% are women. Majority of respondents of the study are between the Age group 31 to 40 years. Out of 460 respondents, 23.7% are Lower-level, 66.7 are Middle-level and 9.6 are Higher-level IT employees showing majority percentage of respondents are Middle level IT employees. The study also shows that 23.5% have 0 to 3 years of total work experience, 36.1% have 3.1 to 6 years, 18.7% have 6.1 to 9 years, 14.6% have 9.1 to 12 years, 7.2% have 12.1 years and above of total work experience.

It is found that majority i.e. 69.8% of the respondents is using Social Media Sites since 4 to 9 years and has 1 to 10 accounts on different Social Media Sites which they access for 1 to 3 hours daily who preferred Facebook, Whatsapp, LinkedIn, Skype and Instagram as the top 5 Social Media Sites for creating Personal profile. Also, 32.8% respondents daily spend less than 1 hour for using Social Media Sites and 53.7% spend 1 to 3 hours per day.

5.1 Purpose for using Social Media Sites do not differ in frequency

To measure the pattern of Social Media Sites Usage at workplace, Cochran's Q test is applied to test the difference between the purposes and frequencies of usage. The results show that the Cochran's Q test is significant ($p < 0.05$) that shows Null Hypothesis is rejected. Hence, the purpose for usage of Social Media Sites significantly differs in frequencies.

5.2 Quality of Work-life is independent of Social Media Sites Usage

The employees whose Social Media Sites Usage is high achieve better work life as compared to those whose Social Media Sites Usage is low. A 2-group between subjects ONE-WAY MANOVA was conducted on 12 Dependent Variables (Workplace Communication, Information and Knowledge Transfer, Inter-Personal Relationship, Work Satisfaction, Engaged at Work, Trusted and Supported, Open Work Environment, Creative and Innovative, Long-Term Work Relationship, Motivated, Job Performance, Enriched Overall Working Experience). The result show the Bartlett's Test of Sphericity is statistically significant: p-value is less than 0.001 indicating sufficient co-relation between dependent variable to proceed with the analysis. Results indicate that observed Covariance matrices of the Dependent Variable were unequal across Independent Variable groups. Hence, Pillai's Trace was employed to evaluate all Multivariate effects. The Pillai's Trace was significant at 5% Level of Significance.

Since p-value is less than 0.05, the null hypothesis is rejected. Hence, it can be concluded that Quality of Work-life depends upon usage of Social Media Sites.

5.3 Social Media Sites Usage has no influence on the organizational Culture

To measure the influence of Social Media Sites Usage on the Organizational Culture, A 2-group between subjects ONE-WAY MANOVA was conducted on 9 Dependent Variables (Workplace Communication, Interpersonal Relations, Absenteeism, Job Involvement, Organizational

Commitment, Innovative Behavior, Employee Engagement, Perceived Organizational Support, and Turnover Intention). The results show the Bartlett's Test of Sphericity is statistically significant: p-value is less than 0.001 indicating sufficient co-relation between dependent variable to proceed with the analysis.

It indicates that observed Covariance matrices of the Dependent Variable were unequal across Independent Variable groups. Hence, Pillai's Trace was employed to evaluate all Multivariate effects. The Pillai's Trace was significant at 5% Level of Significance. Since p-value is less than 0.05, the null hypothesis is rejected. Hence, it can be established that Organizational Culture depends upon usage of Social Media Sites.

5.4 Structural Equation Modelling:
(i) Social Media Sites Usage is not a positive predictor Workplace Behaviour
(ii) Social Media Sites Usage is not a positive predictor Job Performance
(iii) Social Media Sites Usage is not a positive predictor Job Satisfaction
(iv) Social Media Behaviour is not a positive predictor of Workplace Behaviour
(v) Social Media Behaviour is not a positive predictor Job Performance
(vi) Social Media Behaviour is not a positive predictor Job Satisfaction
(vii) Workplace Behaviour is not a positive predictor of Organizational Performance
(viii) Job Performance is not a positive predictor of Organizational Performance
(ix) Job Satisfaction is not a positive predictor of Organizational Performance

Construction Measurement: A list of Latent Constructs and the corresponding measured indicators are as in the tables below:

Table 1: Latent Constructs

SMSU1	Surfing my social media accounts are a part of my everyday activity
SMSU2	I do not hesitate to tell colleagues or boss that I'm on Social Media Sites
SMSU3	I feel out of touch when I haven't logged onto Social Media Sites
SMSU4	I am a part of the social media office community
SMSU5	I actively share views, opinions, suggestions, happenings etc. on social media work group
SMB1	Time to be dedicated to SMS use at workplace
SMB4	Reaction-time to check SMS notification
SMB5	Reply to every SMS message
SMB6	Change in Views/ Opinions/Approach due to SMS information
SMB7	Influence on Behaviour due to SMS use
SMB8	Pass on Messages without cross verification
SMB9	Decrease in Stress-Level
SMB10	Disturbance at Workplace
SMB11	Rejuvenated/ Refreshed
WB1	Communication
WB2	Interpersonal Relations
WB3	Absenteeism
JP1	Job Involvement
JP2	Organizational Commitment
JP3	Innovative Behaviour

JS1	Employee Engagement
JS2	Perceived Organizational Support
JS3	Turnover Intention
OP1	Individual performance is high
OP2	Team performance is high
OP3	Employees are satisfied
OP4	Proportion of Absenteeism is lesser
OP5	Organizational goals are efficiently achieved

'SEM' is a two-step process. In the first step, the measurement model is validated using Confirmatory Factor Analysis and in the second step, Structural Model is validated using SEM. The researcher's hypothesized model included 6 Latent constructs (Social Media Sites Usage, Social Media Behaviour, Workplace Behaviour, Job Satisfaction and Job Performance, Organizational Performance).
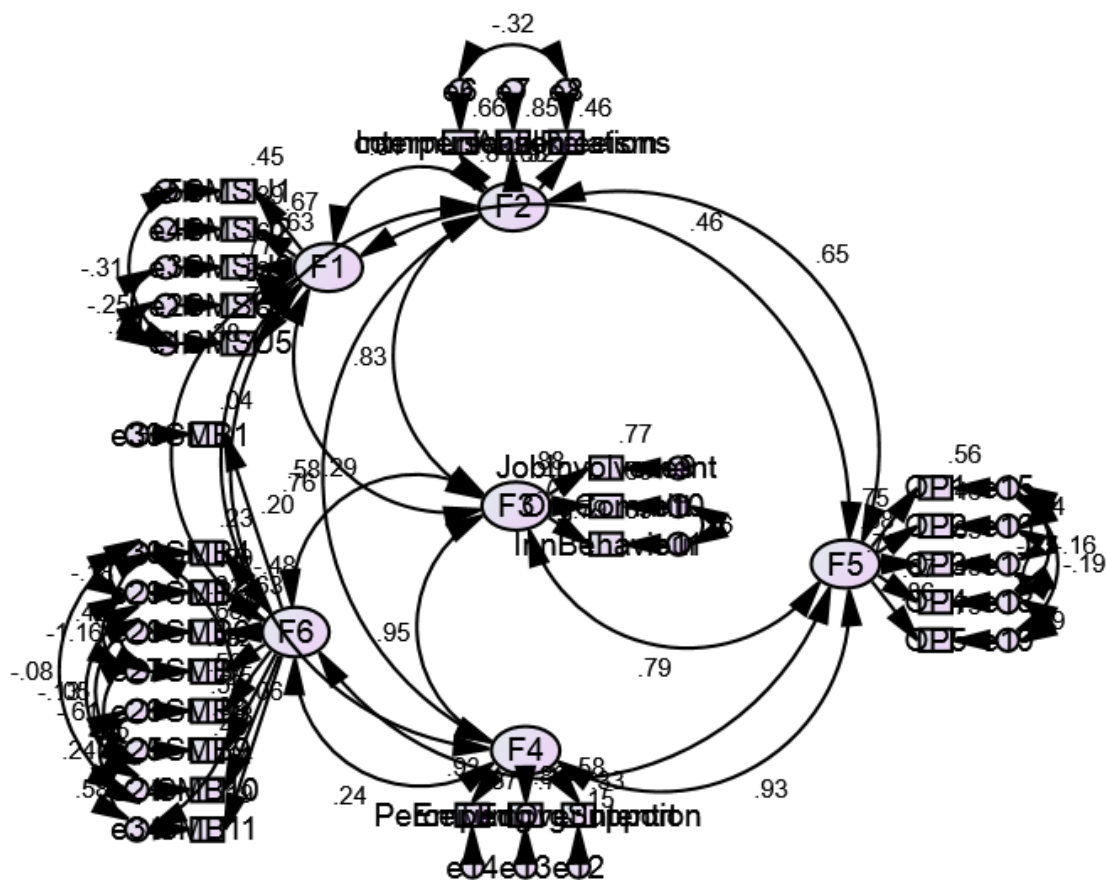
Fig. 2: Assessing the Model Fit of Measurement Model

Table 2:5 Fit Indices have been used to assess the Model Fit

Fit indices	Observed	Criteria for acceptable	Result

		fit	
CMIN/DF (Minimum discrepancy as indexed chi-square)	5.3	Less than 5	Marginally Missed
CFI (Comparative fit index)	0.83	More than 0.9 for good fit, between 0.9 to 0.8 for borderline fit	Acceptable fit
RMR (Root Mean Residual)	0.057	Less than 0.08 for adequate fit, between 0.08 and less than 0.1 for borderline fit	Borderline fit
PNFI (Parsimonious Normal fit)	0.66	More than 0.5	Acceptable fit
RMSEA (Root Mean Square error of approximation)	0.097	Less than 0.08 for adequate fit, between 0.08 and less than 0.1 for borderline fit	Acceptable fit

All the Fit Indices suggest a good fit between the Hypothetical Model and sample data except for CMIN/DF which has a Marginal missed.

Construct Reliability and Validity:
Reliability is the ability of scale to produce consistent results. For a Latent construct, it is internal consistency amongst items of the construct. Cronbach Alpha (α) is used to assess Reliability for constructs under the study. Alpha scores above 0.7 (α > 0.7) indicate Reliability. All the constructs haveα-score above 0.7 and hence Reliability is supported.

Validity is the ability of the scale to produce accurate results. For Latent constructs Validity is the extent to which items of a construct unite together to measure the underlying construct. Factor Loadings and Average Variance Extracted (AVE) are used to examine Validity. Factor Loadings that are significant with values above 0.5 indicates Validity. Similarly, Average Variance Extracted (AVE) above 0.5 indicates Validity.

Table 3: Factor Loadings

Measured Indicators		Construct	Loadings
SMSU5	<---	F1	0.788
SMSU4	<---	F1	0.537
SMSU3	<---	F1	0.773
SMSU2	<---	F1	0.626
SMSU1	<---	F1	0.672
Communication	<---	F2	0.811
InterpersonalRelations	<---	F2	0.922
Absenteeism	<---	F2	0.675
JobInvolvement	<---	F3	0.877
OrgCommitt	<---	F3	0.775
InnBehaviour	<---	F3	0.793

TurnoverIntention	<---	F4	0.578
PerceivedOrgSupport	<---	F4	0.835
EmpEng	<---	F4	0.93
OP1	<---	F5	0.748
OP2	<---	F5	0.679
OP3	<---	F5	0.792
OP4	<---	F5	0.67
OP5	<---	F5	0.865
SMB10	<---	F6	0.38
SMB9	<---	F6	0.526
SMB8	<---	F6	0.499
SMB7	<---	F6	0.958
SMB6	<---	F6	0.682
SMB5	<---	F6	0.628
SMB4	<---	F6	-0.476
SMB1	<---	F6	0.203
SMB11	<---	F6	0.43

All items have Loadings above 0.5 except for SMB1, SMB4 and SMB11 which have marginally missed the threshold point. Hence, Validity is supported.

Table 4: Construct Reliability

Construct	Number of Items	Cronbach-α Value
SMSU	5	0.798
SMB	3	0.814
WB	3	0.86
JP	3	0.816
JS	9	0.72
OP	5	0.68

All Constructs have α-score above 0.7. Hence, Reliability is supported.

All the Fit Indices suggests a good fit between the Hypothetical Model and Sample data. Factor Loadings and Average Variance Extracted (AVE) have supported Validity and Cronbach-α has supported Reliability. Since the Measurement model is valid, we proceed to the Structural Model (SM). Structural Model has been assessed using 5 Fit Indices.

All the fit indices suggest a good Fit between the Sample data and Hypothetical model assessing the significance of the path except CMIN/DF which has Marginally Missed the threshold point.
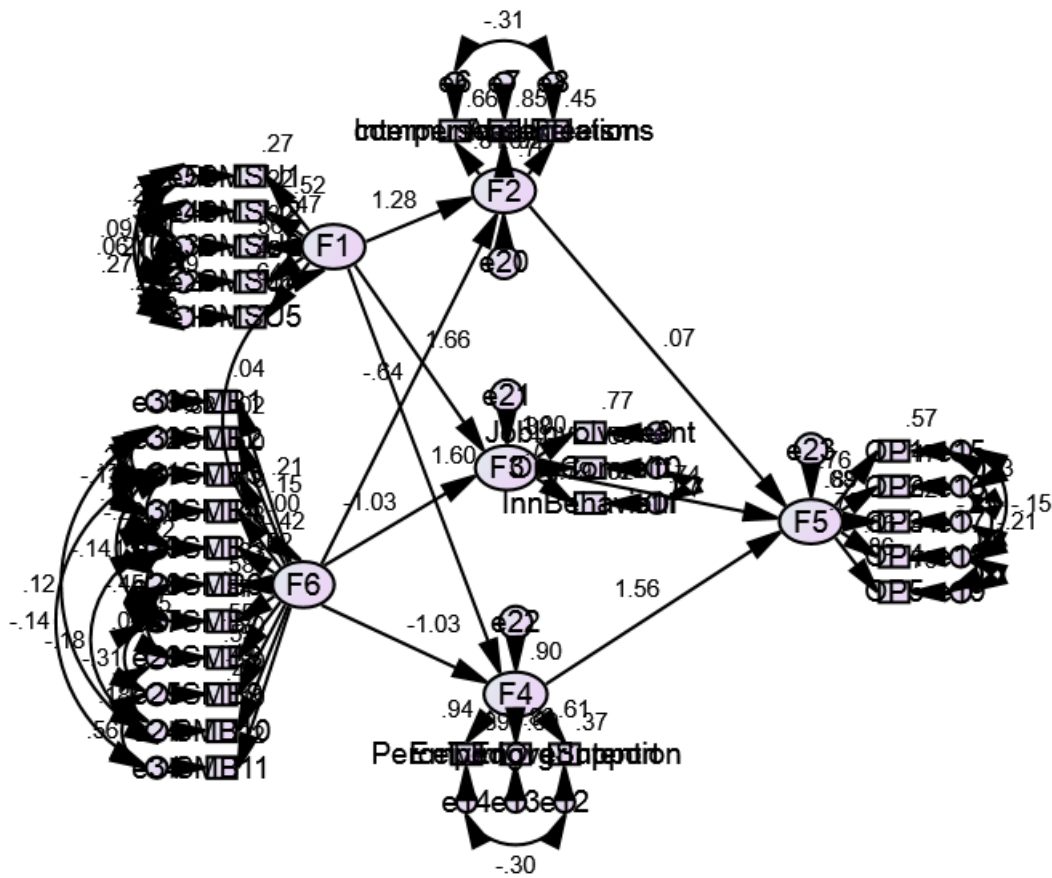
Fig. 3: Structural Model

Strengths and significance of the paths were assessed using standardized Regression weights and P-values. Following table shows the results for relationship between exogenous and endogenous variables:

Table 5: Relationship between exogenous and endogenous variables

Construct		Construct	Estimate
WB	<---	SMSU	1.24***
JP	<---	SMSU	1.61***
JS	<---	SMSU	1.55***
WB	<---	SMB	-0.59***
JP	<---	SMB	-0.98***
JS	<---	SMB	-0.99***
OP	<---	WB	0.065[ns]
OP	<---	JP	0.76**
OP	<---	JS	1.58**

'***' significant at 0.1% level of significance, '**' significant at 1% level of significance, 'ns' is not significant

SMSU → WB (B=1.24, P<0.001)
SMSU → JP (B=1.61, P<0.001)
SMSU → JS (B=1.55, P<0.001)
SMB → WB (B= -0.59, P<0.001)
SMB → JP (B= -0.98, P<0.001)
SMB → JS (B= -0.99, P<0.001)
WB → OP (B=0.065)
JP → OP (B=0.76, P<0.01)
JS → OP (B=1.58, P<0.01)

Social Media Sites Usage is the positive predictor of Workplace Behaviour
Social Media Sites Usage is the positive predictor of Job Performance
Social Media Sites Usage is the positive predictor of Job Satisfaction
Social Media Behaviour is the negative predictor of Workplace Behaviour
Social Media Behaviour is the negative predictor of Job Performance
Social Media Behaviour is the negative predictor of Job Satisfaction
Workplace Behaviour is the positive predictor of Organizational Performance
Job Performance is the positive predictor of Organizational Performance
Job Satisfaction is the positive predictor of Organizational Performance

6. Research implication

The use of Social Media Sites at workplace helps the employees to rejuvenate and it helped them to concentrate of their job. The use of Social Media Sites positively influenced the employee's work life and improved the Organisational Culture. The study focused on the Organisational Culture; nonetheless, it has been extended to study the effect of Social Media Sites use on the Organisation Performance which provides a scope for further research in various other sectors considering similar and extending it to different work-related outcomes. This study can be of great relevance to the Management and HR Managers for developing Social media related policies and HR Practices.

7. Theoretical & Managerial Implication

Social Media Sites Use at workplace creates an open work environment which builds and improves inter-personal relationship amongst IT employees strengthening workplace communication. Social Media Sites Use increases information and knowledge transfer between employees improving their creativity and innovation at work. Employees feel well-engaged at work, trusted, supported and highly motivated to perform which improves their work satisfaction leading to better job performance. Liberal use of Social Media enriches the overall work experience increasing their inclination towards long-term work relationship with the company.

From the study it is concluded that Social Media Sites Usage positively influences organizational culture as high Social Media Sites Usage leads to better quality of Work-Life, stronger workplace communication, healthier inter-personal relationships, higher employee engagement, improved creativity, higher rate of information and knowledge transfer, more innovativeness, higher work satisfaction and better job performance compared to those whose Social Media Sites Usage is low.

The Decision makers and the Management of the organisation should allow employees to use standardized Social media as per the uniform Social Media Policies so that it can be optimally utilized for the benefit of the organization and employee. The management must incorporate

standardized Social media policy in organization to help regulate the workplace behaviour, enhance employee performance as well as organizational performance by its optimal utilization. Due to the ease of Internet connections and access of SM in the workplace, organizations can enhance organizational operations and employee communications by having their own intra-office and inter-branch social media platforms which can enrich knowledge bank and develop collaborations. The management can use Social Media Platforms as a training tool which allows flexibility of time and location to the employees. A provision for Social media break can also be incorporated (which can refresh employees, improve efficiency and productivity).

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Application of SAP Leonardo in Paint Industry

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Abstract-

The Paint manufacturing industry is a ceaseless stream type with exceptionally unique and focused in nature which makes it basic for such organizations to have an incorporated arrangement that can improve productivity, lessen costs, increment deals and benefit. Above all, it empowers the association to make exact, refreshed and vital choices at the right time. An endeavor asset arranging framework could be the response to meet all these fundamental necessities. ERP innovation coordinates every one of the parts of business (assets, activities, observing, announcing, deals, bookkeeping and account, and so on.) and engages organizations to work easily by keeping up a solitary database. SAP Leonardo is the most recent sort in the SAP condition, as more programming proficient discussions about it, however the vast majority not yet comprehended what it can do. In this paper we talk about how SAP Leonardo innovation incorporates all parts of business and engages organizations to work easily by keeping up a solitary database for an assembling industry.
Keywords: ERP implementation, SAP Leonardo, SAP Cloud platform, SAP Edge, IoT, Paint Industry

1. Introduction

Colouring has captivated culture since forever, every age and each district has created colours and colour contingent upon the accessible assets. Various hues have been with us for over 20,000 years. The confirmations could be found in the cavern works of art in India. The tradition of subcontinent paintings evolved and increased extra time, creating a bumpy produced and best style, fusing the district and religion's way of life and trust. Indian Paint Industry's historical background is traditional with the Indians ' historical context. Indian paints consistently grasp rich hues and clear imagery, utilizing explicit iconography to make religious figures plainly unmistakable.

The Indian paint industry has 100 years of assembly as of late. Indian paint assembly started around 1902. In the inclinations of individuals from traditional whitewash to higher-quality paints such as emulsions and lacquer paints, the Indian paint industry has seen a continuous change. Developing popularity of new variations offering improved completion and textures, increasing individuals ' per capita salaries and making efforts to offer improved forms such as eco-friendly, scent-free, residue and water-safe paints has guided the production of paint ads in India. Endeavour with regard to the manufacturers making innovative innovations in the paint industry has prompted a sought-after production of paints in India.

Indian lodging divisions are blasting and furthermore expanding towards urbanization has made simple accessibility of lodging credits. This has been come about into a move from semi-lasting to perpetual lodging structures. Development in the enriching paints fragment represents almost 65-70% of the Indian paint industry. Seasons are additionally engaged with the interest for ornamental paints, where utilization tops around with bubbly time. In the course of recent years, the Indian Paint market has generously developed and grabbed the eye of numerous global

players. The development in the market is driven by rise of the white-collar class in India, developing framework, increment in the inclination to spend and developing youthful populace slanted towards rich way of life.

1.1 Challenges Faced By The Indian Paint Industry

➢ In the previous, a basic test in the paint business was the challenge from the disorderly players; who were not at risk for extract just as different duties. Decrease of extract obligations in the course of the recent couple of years, from 40 percent to the present degree of 12 percent, has made a level playing field between the sloppy and sorted out fragments. As the chaotic area loses its focused edge, it is likewise losing piece of the overall industry to the sorted-out segment players. The clients also are requesting quality items from entrenched brands.

➢ The expanded buying power in India is prompting an expansion in post painting movement. The Indian shopper has moved from low quality to high-quality paints. This fragment is not overly sporadic, and repainting accounts for 60 percent of value in existing paints. Rising yearnings, redevelopment and repair of homes drives this market to develop reliably. It is a move in the impression of paints, having a defensive feature that has lessened the effect of regularity given the brightening one. Paint units have consistently been a commonly recognized name for premium quality paints so minimal effort or venture quality paints are never again a test.

➢ Due to globalization, enormous quantities of tasks are overseen by universal specialists who prescribe "paint determinations" of various sorts meeting prerequisites of explicit undertakings. Paint industry includes items inside a few fragments, for example, zero-VOC waterproof concrete paints, premium low-VOC outside emulsions: with sunlight based intelligent properties, with quartz totals or with silicone which address the need of various surfaces and undertaking determinations.

➢ Boom in the Indian Housing Sector - The expanding accessibility and simple money for houses, driven by quicker development in the livelihoods of center and higher-salary classes, expanding urbanization, and a move from semi-perpetual to changeless lodging structures, have been driving development in the outside paints fragment.

➢ The retail portion has a significant influence in the outside paints business. Paint industry has a settled national dissemination chain with different merchants, sellers and retailers dish India. A considerable lot of these sellers are third era. To manufacture such a circulation system would consistently be a test for new participants and has been a key aggressive quality for paint industry.

➢ Distribution reach is significant for development and further all the more adjusting them reliably and on time will further assistance accelerate the infiltration levels. At present it principle is just auspicious overhauling is the greatest test.

New paint industry developments will spur better execution, cost reduction, and broader use of paints in India. The Indian Paint Industry is just a fragment of the Indian material industry that over the last five years has experienced a steady double-digit growth rate. The development levels reported over the last couple of years have been amazingly experienced in paint demand and use with upward trends. Four teams, unique Asian Paints, Nerolac Paints, Berger Paint, and Dulux India Paints, are ruling the huge scale segment. The little scale part comprises of more than 5000 players. This growth was strongly linked to today's India's market and technological

advancement. Paint assembling is a tremendous industry. About each industry and segment of the market from land, to assembling uses paint in its creation components. For new developments, paint has turned into the basic parts of the advancement arrange. The developing car industry makes an immense interest for the modern paint in market. Paint industry is currently adopting proactive strategy for receiving ERP framework to streamline and scale their procedures. Increasingly more paint ventures are understanding the advantages of an ERP for Paint Manufacturing Industry and executing it for development and better versatility.

In the form of SAP IoT based contracts, SAP Leonardo started to be marketed as ready to use packages. Leonardo causes associations to quickly plan, model and convey industry explicit IoT arrangements on the SAP Cloud Platform. It is a software technology platform that allows customers to easily rely on the SAP Cloud Platform to make new innovative applications. Moving from System of Records to System of Intelligence, SAP Leonardo will gradually make SAP applications smart and enable new applications to make business types more efficient and also to make new action plans. SAP Leonardo comprises of a few, for the most part in SAP Cloud Platform based, segments which help clients to advance effectively dependent available variations. The sections are Edge, Base, Server (Cloud & Amp; HANA), Applications (Products, Resources, Fleet, Markets & People) and Bridge. In addition, SAP Leonardo includes the quickening agents required for wholesale, buyer products, separate assembly, and sports and entertainment — with packages for services and bus travel and transportation.

2. Literature Review

Madhan Kumar et al. [2018] Inspected well-ordered procedure for updating the ERP system within the shop floor and also aims to improve business processes and operations through a broad structure for business correspondence. In a vehicle assembling shop floor, this document aims to implement an ERP system Implementation of a The execution of broad ERP implementations was understood to be considerably more problematic than the further implementation of a PC system supporting a single business work arranging unit by visual basic programming language.

Farshad Salimi [2016] measured the three-fold ERP implementation of large ERP packages in an aeronautical business on a contracting market. The company took ERP's successful use as the main upper hand against its competitors around the world. The organization pursued consistency through the use of three packages of ERP; SAP R2, BaaN IV, and Pentagon in an ongoing process of development. They distinguished the administration association, venture the executives, the board control and proprietorship, acknowledgment of taking a stab at the hierarchical fit, key IT incorporation, and staff devotion as key basic achievement factors (KCSFs) with specifically faculty commitment and their profitable commitments to changes.

SamwelMatende and Patrick Ogao [2013] Explored reading on the use of ERP with the framework point a case to include clients in this execution. Of example, introducing a software system in an organization, the Enterprise Resource Planning (ERP) process brings with it improvements in how customers function. An ERP system cuts over an association's distinctive utilitarian units and thus, if not properly supervised during its implementation, can cause consumer opposition. Most of the study spikes on ERP systems were on choice of ERP, assessment of achievement, and CSFs. In the fruitful value of ERP systems, there is a lack of focus on consumer interest and customer commitment.

AndrejsTambovcevs [2012] exhibited a contextual investigation of ERP frameworks execution in worldwide development materials acquirement and obtaining organization in Latvia and quickly depicted the business procedures engaged with the assembling and development organization and showed how ERP frameworks could be actualized and the effectiveness of the executive's framework thusly upgraded. They further argued that ERP systems are an inexorably significant source of authoritative progress with real implications for the organization and the job executives. Over the last couple of years, the ERP technology business sector has evolved at a rapid pace and is expected to continue to grow steadily over the long haul. Using standard shared data and information flows, ERP systems can implement flawless hierarchical procedures. Organizations as of late must usually upgrade their current venture software structures such as the ERP platform in order to gain their upper hands and improve their business performance, yet the skills learned from this new implementation are not exactly clear and hard to identify.

AndrejsTambovcevs and Yuri Merkuryev [2009] examined to recognize, research, break down and rationalize the components, it can impact conception and working of the ERP framework in an organization and make philosophy of ERP framework usage. Compelling work requires incorporated frameworks that can share access to a typical informational index. Coordinated work environment associations in the development organization are requiring undertaking asset arranging ERP- type frameworks that, thusly, integrate all significant strategic, offices, human asset, monetary and venture information into a solitary, shared database. Tragically, numerous ERP frameworks make things progressively complex for development business. Actually, few ERP frameworks are vertically incorporated for use in development, and the majority of them are very muddle and at last hard to actualize. Likewise, providers of ERP frameworks, for instance iScala, SAP, Oracle and so on., must work with experts and integrators to give ordinary frameworks work after execution. ERP framework modules for development endeavor were assessed, advantages and dangers of ERP framework were outlined.

Ben Dankbaar et al. [2006] Exhibited a survey of ebb and flow literary works on key core achievement factors (KCSFs) and their inescapable relative ties to ERP advantages, hazard (key) goals and ERP objectives; this writing audit scans for the accessible KCSFs in two divisions: assembling and administration industry in the initial segment. The second piece of paper explores the open writing of contrasts in the field of assembly and administration. We deduce from these differences that there are similarities between assembly and administration in the execution of ERP.

3. Implementation Of ERP

3.1 ERP SCOPE

The introduction of an ERP system would require enormous changes in staffing and job rehearsals. The consultants are responsible for the underlying stages, planning the analysis of the work process of the leader, tweaking applications, shooting nuisance and dealing with ERP problems. Since there are so many developments that impact almost everyone in the organization, it is important to include them in the task of making and using the ERP system as a victory. There are four noteworthy explanations behind executing ERP framework in shop floor, they are as per the following

- ➤ To coordinate budgetary information.
- ➤ To institutionalize assembling forms.

➢ To improve organization development.

➢ To make representative employments simpler.

3.2 BASIC ERP MODULES

The development in the infrastructure of IT is the basis of the use of ERP application in any assembly industry. The companies that upgrade ERP systems may have separate office and control are acknowledged. From now on, electronic data is transferred through departments where advance mobilization is used to facilitate transfers, such as Workgroup, Workflow, Groupware, Electronic Data Interchange (EDI), Web, Intranet, and Data Warehousing. The ERP software consists of various product packages for the individual assembly units to be chosen based on both financial and technical practicality.

➢ The arrangement module for ERP generation aims to improve the use of assembly boundaries, parts, segments and product resources using authentic production data and deals.

➢ The ERP procurement module streamlines the acquisition of the appropriate raw materials by mechanizing the way to recognize possible suppliers, manage prices, send requests to suppliers and related charging forms.

➢ ERP stock control system facilitates processing in the distribution center by separating stock requirements, setting goals, maintenance methods and alternatives, monitoring usage, welcoming stock changes and reporting stock status.

➢ The main capacities in ERP deals are administrative structures, scheduling demands, transportation and invoicing. This is important because the associations ' live blood is revenue from contracts.

➢ ERP's budgetary module is the core module for ERP's programming systems, collecting money-related information from different departments and generating documents such as accounting statements, general records, provisional equalization and quarterly fiscal summaries.

➢ The ERP (HR) unit regularly maintains a full representative data base to integrate contact information, payment subtleties, engagement, performance evaluation and progression of all aspects. It's key to improving all things considered using the aptitude.

3.3 ERP Implementation Steps

a) Planning

Project group: Assign staff to a task group to deal with, client management, bookkeeping, procurement, operations, and senior management. Every colleague must focus on achieving the undertaking and be responsible for specific undertakings such as setting up a timetable, deciding destinations, preparing a training plan.

➢ Examine current business forms: Examine which business processes must be changed for the team to perform. Assemble duplicates of main documents, such as queries, bunch tickets and test filling bill. The colleagues should also guide meetings with key staff to identify additional areas of improvement that are required.

➢ Set goals: The destinations should be clearly defined prior to the implementation of the ERP

> ➢ Develop a task plan: The team will create an organizational plan that integrates recently defined priorities and objectives, activities programs, curriculum planning, as well as individual group responsibilities. The venture plan's final product should be a schedule for each colleague of the undertaking.

b) Procedure Review

For every part of the business, establish SOP. These approaches should be published. Ensure that the record updates automatically whenever the specifics of the SOPs change.

c) Data Collection

Convert information: We accept 100% of the information that can be modified as the system can contain outdated data. Through thorough examination of current information, it is important to decide that details should be turned over.

Collect new information: Define the latest information that needs to be obtained. Recognize the information's source documents. Create spreadsheets to collect information and break it into coherent tables.

Review all information contribution: After the shift in the physically collected information has been transferred to the ERP server, it must be checked for consistency and fulfilment at that point. Data drives the company, so the data is accurate is important.

Data tidy up: The unneeded data must be properly recorded of consumers who have not purchased for some time or are no longer in the industry.

d) Training and Testing

In the test server, the task group must rehearse to ensure that all data are correct and function correctly. Use a whole seven-day stretch of genuine information exchange to move the yield authorization process. Run real situations to check for reliability of data. The results obtained during the research should ensure that each critical interface is designed and that mixture problems are defined to ensure that the product works with different frameworks.

e) Evaluation

Create a structured appraisal plan that ties back to the priorities and goals set in the process of arrangement. Moreover, a post-use analysis should be carried out after the process has been introduced for the main week for the purposes of negotiation and the advantages of the industry are established.

3.4 Before And After ERP

The correspondence between the offices will be well organized before ERP, and after ERP correspondence with a data set will be natural. Fig 1 Displays the data stream between ERP offices and Fig 2 after ERP.
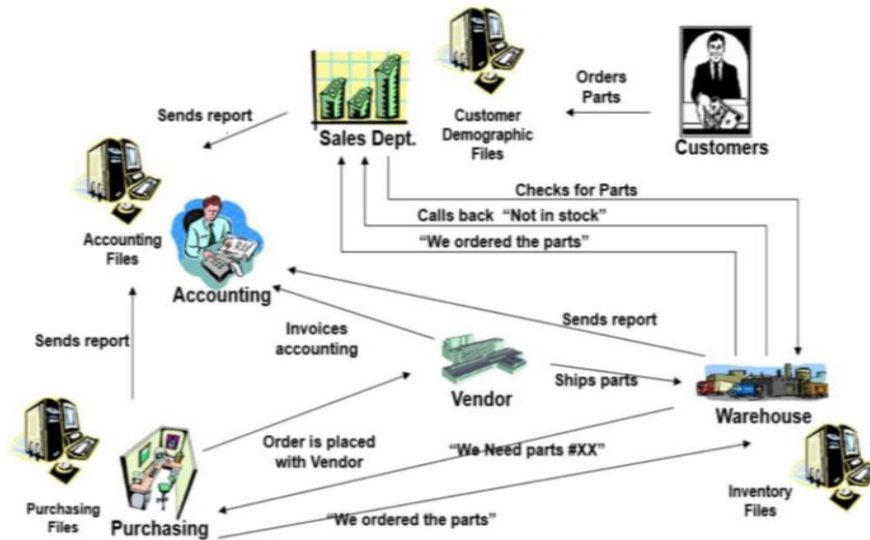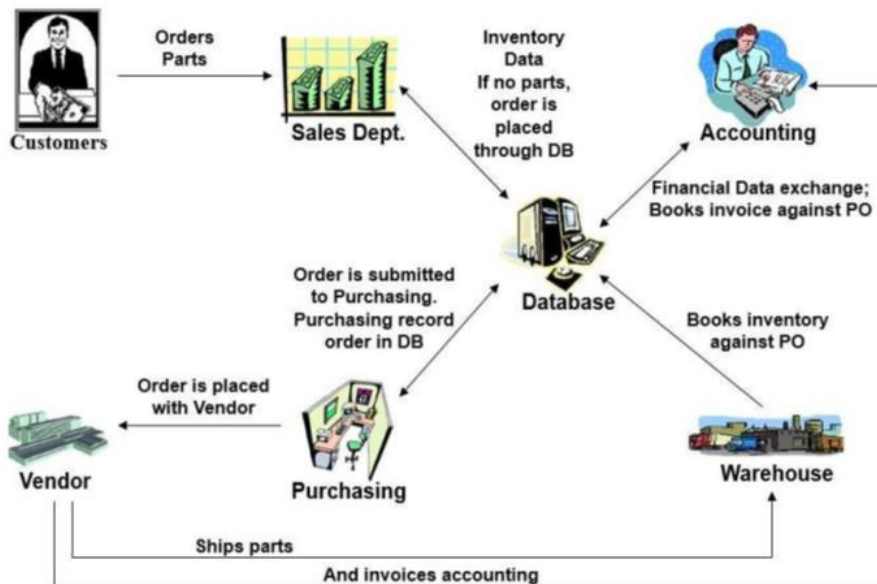
Fig 1: Before ERP

Fig 2: After ERP

4. SAP

4.1 Digital Transformation

On the planet, Seventy-two percent of CEOs worldwide agree that the next three years will be more fundamental for their business than the last 50 years. Source: Forbes Insights, 2016 Global CEO Outlook Companies with half or more sales from computerized biological systems achieve 32% higher revenue growth and 27% higher net revenues. Source: MIT Sloan Management Review, thriving in an increasingly virtual environment Just 5% of associations think that they have behaved informatically to the point of separation from the competitors. The advantages of a carefully changed business are clear – 85% piece of the pie increment, 80% gainfulness increment, 31% representative commitment increment. The advantages and dangers of not acting currently are perfectly clear particularly with 75% of Fortune 500 organizations expected to carefully change by 2027. None of the normal ways to deal with computerized advancement are

perfect: 1. Wager huge on an intense, multi-year, venture wide activity; regularly having various objectives with a low conviction of achievement 2. Strategically execute tasks utilizing point arrangements; frequently neglecting to propel a more extensive authoritative methodology 3. Hatch autonomous skunk works ventures; regularly with no reasonable method to coordinate into tasks 4. Advance current activities while observing advancement of others; regularly giving up first mover advantage.

4.2 SAP Cloud Platform

SAP Cloud Platform is an open-stage administration that offers in-memory features, central-stage management, and one-of - a-kind micro services for structuring and extending clever, compact, driven cloud applications. The stage is intended to quicken advanced change by helping you rapidly, effectively, and financially build up the careful application you need – without putting resources into on-premise framework. In view of open gauges, SAP Cloud Platform offers total adaptability and authority over your selection of mists, structures, and applications.

4.3 SAP Analytic Cloud

SAP perceives that validity as a cloud item and specialist organization relies upon accomplishing more than moving existing on-premise arrangements into the cloud. With SAP Analytics Cloud, we made plans to carry crisp deduction to the table and build up an absolutely new cloud arrangement. Rather than concentrating on innovation first, we manufactured this item starting from the earliest stage to reflect what clients need and need. We brought UI originators into the advancement procedure from the very beginning, so client experience is at the center of the arrangement as opposed to painted on as a reconsideration. This methodology gives the arrangement the drawing in look and feel of a buyer application – for each sort of client. Capacities for which the run of the mill venture relies upon examination include:

> Backward-confronting money related close, budgetary compromise, revelation the executives, administrative recording, interior administration and board announcing, and fluctuation examination.

> Present-situated administration of key execution pointers, procedure score checking, hazard investigation, client maintenance, activity following, and examination of income stream execution.

> Forward-looking planning, cooperative income determining, long-go vital arranging, workforce and capital arranging, prescient arranging, and imagine a scenario where arranging.

> With the new SAP Analytics Cloud arrangement, every one of these capacities can stretch out over your lines of business. You set aside cash and time – and dispose of the danger of mistake that emerges when you coordinate numerous items for prescient investigation, business knowledge (BI), and venture execution the board (EPM). You decline the all-out expense of proprietorship by preparing all leaders and business experts with the equivalent amazing examination devices. You help the speed and exactness of partner reaction with investigation installed with regards to everyday errands and envisioned in dashboards customized by job and individual inclination. Streamlined work processes convey understanding to the point of choice, and you can team up on dialogs pretty much all information – of all shapes and sizes – with any number of clients, whenever.

4.4 SAP Edge Services

Processing models have developed: from the unified centralized computer model of the 1960s and 1970s, to the dispersed customer server model of the 1980s and 1990s, to the post-2000 brought together portable cloud model that is universal today. Be that as it may, what's straightaway? Furthermore, more significantly, why? These answers are best clarified by analyzing the ascent of appropriated knowledge, otherwise called the Internet of Things (IoT). The IoT is the system of associated insightful articles. Models incorporate vehicles, shipping holders, machines underway plants, development apparatuses, wearable gadgets, and considerably more. These "things" are associated with the Internet, sense the earth, trade information, and at last collaborate with business frameworks to make business results. The center of an IoT arrangement is regularly a focal IT framework for putting away, preparing, and investigating IoT information. Furthermore, quite a bit of this IoT information can be situated in the cloud, away from the center. Be that as it may, IoT endpoints (that is, gadgets with sensors) frequently don't have the correspondence abilities expected to transmit all their sensor information in a safe, dependable, and cost-productive way profoundly. Here are a couple of the most widely recognized deterrents:

➢ Sensors may just help low vitality conventions to preserve battery control
➢ Mobile gadgets utilizing cell correspondence need inclusion in specific areas
➢ Mobile correspondence connections are regularly transfer speed obliged or costly
➢ Wide zone associations can present a lot of inactivity for constant basic leadership

Besides, certain neighbourhood frameworks – for instance self-driving vehicles – should self-ruling settle on choices continuously and can't hang tight for directions sent from the cloud. Edge handling can address these difficulties. An edge preparing unit is a physical gadget, regularly alluded to as an IoT portal, likewise called a haze hub. It interfaces with gadgets that are away from the center (frequently alluded to as gadgets "at the edge") through correspondence conventions, for example, Bluetooth Low-Energy or ZigBee. Simultaneously, it additionally associates with the center straightforwardly utilizing fast Internet. Also, passages give security and lifecycle the executives at the edge, with the end goal that the edge is a reasonable and sensible process unit. The equipment utilized for such portals ranges from powerful, rack-mounted servers to littler gadgets with inserted ARM processors and anything in the middle. IoT edge figuring portrays the capacity of handling, putting away, and breaking down sensor information just as basic leadership at IoT portals. Examiners, including the market knowledge organization IDC, show that 40% of IoT-made information will be liable to IoT edge registering and that this proportion of edge-to-center information and handling is developing yearly.

5. SAP Leonardo

The name SAP Leonardo was enlivened by Renaissance painter, stone carver, modeler, architect, and thinker Leonardo da Vinci. With an expected IQ of more than 220, this widespread and productive virtuoso had the innovative capacity to make spearheading creations in a wide scope of orders. The point of SAP Leonardo's comprehensive methodology is to help organizations and open division associations in each part of their advanced development techniques.

In the more extensive setting of computerized advancement, it rapidly turns out to be evident that points like the Internet of Things, AI, blockchain, investigation, man-made consciousness, and Big Data regularly should be seen in blend: This is the way to making a system for bridling the

most recent computerized achievements. Just as advances, administrations, and applications, the SAP Leonardo portfolio incorporates configuration thinking strategies, information knowledge devices, benchmarking, and that's only the tip of the iceberg. Furthermore, to accelerate time to an incentive for clients, SAP offers "SAP Leonardo quickening agent bundles" that are custom fitted to explicit enterprises and center capacities, for example, IoT.

At present, quickening agents are accessible for retail, buyer items, discrete assembling, and sports and stimulation – with bundles for utilities and travel and transportation in transit. SAP additionally offers quickening agents for IoT center capacities, for example, SAP Leonardo IoT for SAP Connected Goods and SAP Leonardo IoT for SAP Global Track and Trace. Contingent upon their industry, required capacities, and use case, clients purchase a fixed-cost, custom-made quickening agent bundle that contains configuration thinking systems, the imperative cloud licenses, and improvement and configuration administrations right the route through from the underlying model to the last arrangement. Thusly, the SAP Leonardo computerized advancement framework speaks to the portal to computerized change in the endeavor.

There is a refinement here between instant applications fuelled by SAP Leonardo (like SAP Service Ticketing), and the microservices and APIs (like the SAP Streaming Analytics microservice) that keep running on SAP Cloud Platform to support clients and accomplices incorporate SAP Leonardo capacities into their own applications. The SAP Streaming Analytics microservice investigations approaching information streams and reacts separately to them. SAP Service Ticketing fuelled by SAP Leonardo, utilizes AI abilities to investigate approaching administration tickets by substance and to advance them to the right preparing specialist consequently.

The SAP Leonardo Centres' structure a worldwide system of interconnected areas intended to fill in as purposes of contact for set up organizations and new businesses looking for motivation for digitalization ventures and synergistic development. Starting models and pilots can be made here as a feature of the SAP Leonardo quickening agents. SAP Leonardo Centres' are as of now working in New York and Paris; further focuses in São Leopoldo, Brazil, and Bangalore, India is at the arranging stage

SAP Leonardo is a methodical way to deal with carefully change organizations, concentrated on repeatable answers for surely knew business issues crosswise over numerous ventures. SAP Leonardo quickens and de-dangers computerized change utilizing demonstrated philosophies and pre-incorporated programming segments. It unites grant winning plan benefits, an industry-driving cloud stage and applications, profound ability in business forms, and the most creative new advancements, for example, investigation, Big Data, blockchain, information knowledge, AI, and IoT.

➢ Innovate – With demonstrated SAP Design Thinking system and Industry Value Network specialists, it can concentrate on understanding your business needs, procedures, and individuals and after that it attempts to fabricate a business case, model, and outline that address your most prominent chance or top test first. There's no innovation first methodology nor huge scale ventures without an obviously attainable command.

➢ Integrate – It executes the task with cutting edge advances including investigation, Big Data, blockchain, information knowledge, AI, and IoT that implant exponential change into your everyday activities. These advancements are based upon and coordinated into the computerized center of your business utilizing SAP Cloud Platform.

➢ Scale – SAP Leonardo empowers us to scale advanced change over your whole association in a stage insightful, orderly manner and can actualize strategic tasks realizing they expand upon a more extensive hierarchical system and an assembled, incorporated stage. We can start your adventure with applications enhanced for SAP Leonardo just as industry and IoT quickening agent bundles with a fixed cost or open advancement administrations.

5.1 SAP Leonardo Innovation Services

SAP Leonardo carries versatile advancement to your business by joining leap forward innovations with end-client centered structure forms. SAP Leonardo Innovation Services unites partners and end clients with structure and innovation specialists to open advancement in your association's plans of action and procedures.

a) Objectives
   ➢ Guide you through your computerized change
   ➢ Discover imaginative answers for your business issues and difficulties
   ➢ Combine a plan drove process with cutting edge advancements in a solitary stage to scale development and boost esteem
b) Solutions
   ➢ Digital change along various tracks, contingent upon your individual needs: Express, Open Innovation or Enterprise Edition
   ➢ SAP specialists effectively work with us through the whole development lifecycle, keeping up an emphasis on client sympathy to improve the reasonability of the arrangement
c) Benefits
   ➢ Get access to quick advancement apparatuses, top tier venture structure innovation, and a demonstrated plan drove improvement process
   ➢ Collaborate with SAP creators and venture programming specialists who offer their experience and bits of knowledge on the most proficient method to best apply
   ➢ SAP answers for computerized change Scale achievement development by finishing a creation prepared model

5.2 SAP Leonardo Analytics

SAP Leonardo Analytics brings you in all cases examination abilities that work together to investigate information from all sources, for undertakings all things considered and over each industry. SAP arrangements help you catch an all-encompassing comprehension of your business, plan and foresee future chances, and change your endeavor to Run Simple in the computerized age.

a) Objectives
   ➢ Uncover questions over your business scene and foresee future open doors for advancement
   ➢ Empower everybody to settle on better choices by giving exceptional access to big business wide information
   ➢ Drive bits of knowledge without hesitation
b) Solutions

- SAP Leonardo Analytics half and half arrangements: an exhaustive, coordinated arrangement that gives a stage crossing endeavor and cloud information
- SAP Analytics Cloud: a solitary, reason constructed arrangement that consolidates powerful examination forms
- SAP Digital Boardroom: a continuous, carefully associated venture experience that breathes life into gatherings of numerous kinds

c) Benefits
- Deliver get through execution, so you can improve without limitations
- Tap into shrouded experiences to comprehend and adjust to market moves before they occur
- Gain constant knowledge from live information to act unhesitatingly

5.3 SAP Leonardo Big Data

The SAP Leonardo Big Data arrangements give cutting edge answers to the present Big Data challenges. With the use of SAP programming, can incorporate various information types from all sources, including undertaking and Big Data systems. This empower clients for association to effective use to make, screen and oversee incredible information pipelines, see each scene personally, and enormously scale as indicated by need.

a) Objectives
- Store and procedure enormous volumes of information monetarily and dependably in the cloud
- Process various, crude information proficiently utilizing progressed conveyed preparing motors
- Monitor and administer venture information adequately crosswise over on-reason and cloud conditions

b) Solutions
- Integration and ingestion of all information types
- Elastic stockpiling and industriousness, incorporating into the cloud
- Distributed figuring and preparing with cutting edge in-memory registering motors
- Unified organization, administration and observing

c) Benefits
- Discovery of information crosswise over information lakes, distribution centres, information lakes and databases on reason and in the cloud
- Massive versatility and petabyte ability to help developing information volumes
- Faster systematic preparing in the cloud at a lower TCO
- Ability to make propelled information calculation pipelines over an assortment of information types
- Straightforward organization of complex information forms from a focal UI

5.4 SAP Leonardo Blockchain

SAP Leonardo Blockchain gives an approach to individuals, organizations, machines, and calculations to execute and speak with each other in a frictionless manner by empowering genuine information sharing, accelerating multi-party exchanges and bringing down expenses, while guaranteeing all gatherings are ensured. SAP is utilizing its skill over all ventures to effectively investigate blockchain innovation, incorporate it into the SAP scene, and help to make use of its potential.

a) Objectives
   - ➢ Build blockchain augmentations for existing applications crosswise over enterprises and lines of business
   - ➢ Use open gauges to make new consortia-based and private blockchain models and systems
   - ➢ Explore blockchain use-cases to perceive how it can profit your business
   - ➢ Prototype, test, and fabricate redid blockchain applications utilizing keen contracts

b) Solutions
   - ➢ SAP Cloud Platform blockchain administration gives a simple, okay portal to appropriated record innovation in the cloud
   - ➢ Integration with built up SAP arrangements makes cooperative energies, particularly in multi-party forms
   - ➢ Allows joining with other cutting-edge advances in SAP Leonardo

c) Benefits
   - ➢ Reduce the requirement for certain kinds of outsider delegates
   - ➢ Allow for quicker, increasingly secure multi-party exchanges that aren't restricted by available time
   - ➢ Create slenderer, progressively productive, and increasingly beneficial procedures
   - ➢ Automatically trigger activities, occasions, and instalments once conditions are met

5.5 SAP Leonardo IOT

SAP Leonardo IoT benefits as much as possible from the shrewd resources by enabling to gather and break down sensor information, for operational improvement, yet additionally to change key business procedures and models. Through SAP Leonardo IoT, currently have a phenomenal chance to join individuals, things, and information to expand and advance the center business forms.

a) Objectives
   - ➢ Know where opportunity lies over the various Internet-empowered things in our business biological system
   - ➢ Transform business procedures and make the correct move at the time
   - ➢ Create new plans of action and wellsprings of significant worth, and build up new upper hands

b) Solutions
   - ➢ Delivers a stage for enhancing business tasks utilizing an assortment of information sources
   - ➢ Offers space explicit IoT arrangements and full coordination with business applications
   - ➢ Let's us expand client applications on SAP Cloud Platform with IoT application administrations

c)Benefits

   - ➢ Create verifiable, ongoing, and prescient knowledge inside and past existing procedures

- ➢ Improve gainfulness through operational magnificence
- ➢ Gain steady income from new plans of action and increasingly responsive contributions

5.6 SAP Leonardo Machine Learning

SAP Leonardo Machine Learning brings exceptional experiences and robotization of information work over the endeavor by empowering business clients, examiners, information researchers, and designers to exploit AI. The organization can construct, broaden, convey, oversee, and mix AI bits of knowledge and exploit canny applications and augmentations for its endeavour.

a) Objectives

- ➢ Automate start to finish AI forms
- ➢ Develop, fabricate, and broaden AI applications
- ➢ Remove human mistake and inclinations via mechanizing learning work
- ➢ Gain AI bits of knowledge where individuals communicate
- ➢ Deliver understanding in close constant with Big Data and IoT

c) Solutions

- ➢ Automation of information readiness, model structure, organization, scoring, and retraining
- ➢ Natively procedure and investigate organized and unstructured information with full network to SAP HANA and outsider information sources
- ➢ Develop, manufacture, and broaden AI applications both in the cloud and on reason
- ➢ Automate the information work with industry and line-of-business-explicit shrewd applications and expansions

d) Benefits

- ➢ Quickly access AI that is completely implanted in SAP applications and stages
- ➢ Find designs in Big Data already unthinkable for people to find without anyone else
- ➢ Deliver phenomenal bits of knowledge, venture wide, progressively
- ➢ Automate routine errands and spotlight staff on higher-esteem work
- ➢ Foster exact forecasts in business capacities

5.7 SAP S/4HANA And SAP Leonardo

SAP S/4HANA coordinates with SAP Leonardo to convey ground-breaking new conceivable outcomes for upgrading the business forms with a first influx of wise applications. From mechanized receipt coordinating to prescient misrepresentation discovery, SAP Leonardo administrations collaborate with organisation association's advanced centre to improve, quicken or robotize key business forms.

a) Objectives

- ➢ Capitalize on ongoing data to quickly move from bits of knowledge to activity
- ➢ Boost effectiveness and scale your common administration abilities
- ➢ Improve chance distinguishing proof and aversion and react quicker to dangers
- ➢ Proactively oversee contracts and improve your agreement exchange viability
- ➢ Achieve increasingly dependable arranging and planning

b) Solutions

➢ Intelligent applications associate SAP S/4HANA with amazing administrations in SAP Leonardo
➢ Machine learning application robotizes receipt coordinating
➢ Predictive investigation distinguishes and anticipates misrepresentation cases
➢ Machine learning administration predicts contract utilization
➢ Smart bits of knowledge figure conveyance time of stock in travel

c) Benefits
➢ Enable ongoing key choices
➢ Reduce manual exertion to save time for key undertakings
➢ Minimize disturbances to basic business forms
➢ Empower focused contract renegotiation
➢ Stay in front of shipment and conveyance barriers

5.8 SAP Leonardo Technology Overview

The technology overview of the SAP Leonardo is shown in fig. 3
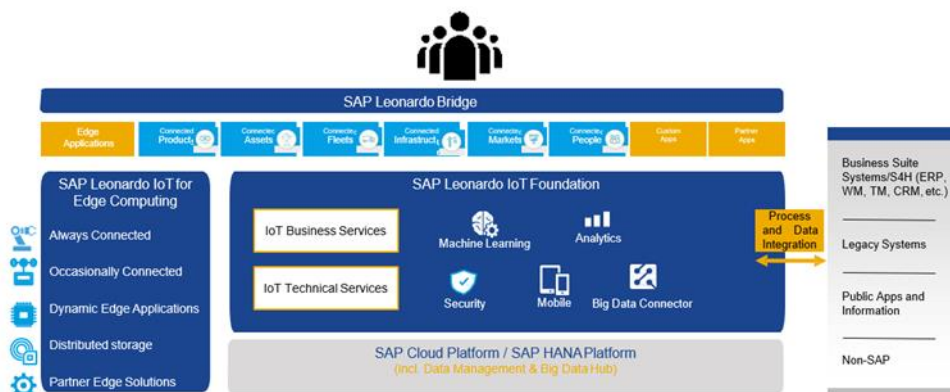
Fig 3: SAP Leonardo Technology Overview

6. Need For Sap Leonardo In Paint Industry

Both paints and coating industries are now elevating and gathering knowledge about acquisition and adoption of ERP. Now a day's paint manufactures realize the advantages of ERP to incorporate it to their businesses. By implementing the suitable ERP to the industry, cost and time have enormously increased. In the meantime, this technology fit to the industry. Suggestions made on overall industry is about:

➢ Intensively raw material-based industry: A huge amount of ingredients, mainly petroleum-based products (imported) has 50% involves in total ingredients. Some others are like TiO_2, phthalic anhydride etc., this ingredient make the 50% of total cost.
➢ Highly regulated industry: Paints have effects on environment and this results in industrial emission. When the sunlight is exposed in paints, the ozone's lower atmosphere is intensively damaged.
➢ Need of Mixed mode: Both process & manufacturing is on the industrial side and on the other side, retails has products of OTC. A huge amount of variety of variations of packaging are needed both in massive as well as tiny packets.

It is a tortuous and dynamic industry with an onliest share of requirements and characteristics which are listed below.

Formulation: In this industry, to survive, have to progressively innovate to satisfy and arise for customer's expectations, requirements, demands and advanced technologies. In the past, catalogue is used to present the paint colours. But present condition is customer expecting the unexpected different variants of paints at every time. It resulting in,

- ➢ Colour formulations are unlimited
- ➢ Ingredients are eco-friend
- ➢ To meet customer needs by R & D
- ➢ Continuous attainment of meeting low Voice of Customer.
- ➢ Packing the multiple forms

Some of the ERP's have Intensive Formula Management Module (FFM). Thousands of formulations and their combinations are created, regularized, retrieved and archived. The ability of ERP is to perform an in-depth physical and analysis that emerges an innovation. Also, ERP can manage multiple Bill of Materials, a single formula supports multiple packaging.

Batch processing for paint industry: Some common batch processing methods are followed by various paints manufacturers. Here the complexity is material switching/ substitute and batch sizing to meet the various customer's demands. ERP have the ability to endow various forms of batch processing to simplify the operations in production unit and also it is helpful in optimizing the plant capacity.

Multiple units of Measurements using paints industry: The different units such as weight, volumes etc.., The final products are generally kept in huge weight or volumes (usually expressed in Quintals) in cans. This export quantity are tons and kg's only. Here packaging has separate division with labelling. ERP have the ability to maintain different number of units and selection for paint industry.

Poly plants: Generally, the paint industries have different types of plants in different locations for both wholesale and retail selling. They centralize their plants to get the proper information and distribution of stocks and to get inventory information's. ERP have the ability to analyse warehouse stock information and the movement of goods at anytime and anywhere.

Fracture Management: Wherever the production occurs, the defects and failures also occur. It may be containers problem, composition of the product, its adhesiveness etc.., ERP have the ability to maintains the rework and scrap can ease the work. The function that assure the improvement of proper reuse, rework and reduce in cut-down losses.

7. CONCLUSION

In today's organization, ERP is an essential technology to realize their mission and vision with various strategies. The implementation of ERP is one of the difficult process in relation with cost active and time consuming process. Here also the customization and integration with existing system is long range process. But it essentially promotes manufacturing industry. This study presents the overview of SAP Leonardo ERP package and ERP implementation project for a paint manufacturing industry. Conclusion is about studies made

of ERP implementation on paint industry encourage the projects, to the similar nature of companies the way to implement ERP is in best practices.

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Forecasting Of Time Series Data Using Fuzzy Based Multi-Granular Model

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Abstract-

Data Mining is the process of finding or extracting interesting useful information from the hidden databases. The data that has been collected over a particular period of interval is termed as time-series database or temporal database. The analysis and prediction of time series data is one among the data mining techniques. It is used to forecast the future values and its trends using the historical information. Previously, the prediction of trend analysis has done using conventional forecasting techniques such as moving average, exponential smoothing, naive forecast, transfer function models and Markov Process model. The main disadvantages of these techniques are increased memory requirements, computational complexity and in some cases, it leads to the local optimum solution. Hence to overcome these drawbacks, the fuzzy time series based forecasting approach is used along with particle swarm optimization method to forecast the time series data. The proposed forecasting approach makes use of multiple granular spaces to predict the future trend and values. The proposed method is tested using the Australian Electricity Market and stock exchange dataset composed from the National Stock Exchange (NSE) website. The performance of the proposed work are evaluated using evaluation metrics such as Mean Absolute Percentage Error (MAPE), Root Mean Square Error (RMSE), and Mean Absolute Error (MAE) to prove that the proposed method is more accurate compared to other methods.

Keywords*: Forecasting, Time Series, Fuzzy, Multi Granular Model, Metrics*

1. Introduction

1.1 Data Mining

Data mining is also known as information hiding or knowledge discovery in databases (KDD) or data archaeology, information harvesting and information discovery. It is the process of analyzing data from special perspectives and shortening it into functional information. It permits users to inspect data from many different dimensions or angles. The task of data mining includes data pre-processing, frequent pattern generation, association rule generation, classification, clustering and anomaly detection.

1.2 Challenges in Data Mining

There are many issues emerging and have been solved by data mining experts, among which Qiang Yang [13] proposed 10 challenges in data mining. They are i) Mining complex data ii) Speckled data mining and mining multi-agent data iii) Sequence data and time series data mining

iv) Mining techniques for high dimensional data and high speed data streams v) Designing and developing a unifying theory of data mining vi) Knowledge extraction in a network setting vii) Mining for biological and ecological problems viii) Process-related problems with respect to data mining ix) Trading with non-static, unbalanced and cost-sensitive data x) Privacy, Security and data integrity.

Among various challenging problem in data analysis research, one of the interesting and challenging problem is mining sequential data and time series data. Despite other problems, to proficiently classify, group and forecast the trends of the time series data is still an imperative unlock research. This work focuses on forecasting of time series data.

1.3 Temporal Data Mining

Temporal data mining compacts with the yielding of useful information from time series or temporal database. Temporal database or time series database is a database which contains time related information like year, month, week, day, minute and second etc. The database contains the sequence of real numbers, each number representing value of an attribute of importance, observed at various point of time. Typical examples include the volume of product sales, medical history of the patient, stock prices, currency exchange rates, weather data, biomedical measurements, etc., collected over monotonically rising time.

The present work focuses on temporal data mining which is based on temporal data. The types of temporal data include static data, sequences data, time stamped, time series and fully temporal data. Time series data is a unique case of the time stamped data. In temporal or time series data, events have uniform distance on the time scale. The temporal data mining task includes temporal pattern generation, association, temporal classification, temporal clustering, temporal searching and retrieval, prediction, sequential pattern and trend analysis.

Temporal pattern generation is the finding of frequent patterns from the temporal database. Temporal categorization or classification is the process of organizing data into groups for professional use. The aim of classification is to analyze input data and develop a classier by using a set of classes and attributes. Temporal clustering groups the data that are having similar behaviors or patterns. Temporal association is data mining technique, which uses categorical values for marketing decision. It is widely used to find the items that are purchased together by the customer. Searching and retrieval are concerned with efficiently locating sub sequences or sub series in large databases of sequences or time series. Forecasting is the process of making decision about measures, whose original outcomes have not yet been obtained. Many industries like the stock market, textile industries, and prediction of climatic change, which solemnly depends on forecasting results. Such industries use historical data to predict future trends. A good prediction should be more accurate. This work focuses the task of forecasting the time series data.

The remaining section of the paper is planned as follows: Section 2 talks about related work, Section 3 discusses the proposed work, Section 4 deals the result, Section 5 covers the metrics used for parameter evaluation, and Section 6 focuses conclusions and future work.

2. Literature Survey

In earlier days, the forecasting of pattern analysis were done using conventional forecasting techniques that make use of mathematical notations, formula and techniques. These conventional techniques can be enhanced further using various developments in automation methods. Apart from these, the other enhanced forecasting models have been developed that make use of more stochastic techniques such as Support Vector Machines, Auto-regression, Support Vector Regression, etc. These methods can also be combined with optimization techniques to provide better prediction accuracy. The techniques like fuzzy approach and Soft computing techniques such as Genetic Algorithm, Neural Networks, Rough Set theory and Particle Swarm Optimization, Ant Colony Optimization etc. have been used for developing forecasting models for specific purposes.

2.1 Traditional Forecasting Techniques

2.1.1 Regression Model

The regression model is broadly used forecasting method and it is easy to execute. This method is mostly implemented in a model that has different types of associations between the data to be predicted and the other aspects that it depends on. The regression method depends on the illustration of the various settings that are used for predicting the future data and a method should be implemented to determine these factors using the existing historical data. The regression types may be simple linear regression, multiple regression, polynomial regression, ridge and multivariate regression etc. These models need one or more independent variables. Some of the regression algorithms use the weighted least-squares estimation for prediction. The performance of the regression can be estimated by error estimation formula.

2.1.2 Exponential Smoothing

Exponential smoothing is one of the traditional methods used in existing forecasting applications. Here, the data to be predicted is modeled based on the previously existing data and then this model is used to predict the future data. It can be combined with other methods such as the moving average, autoregressive models and spectrum analysis. The theory behind this hybrid model is that averaging and smoothing models means that the time series is locally stationary with a gradually varying mean. The complexity of the model increases since it relies on lots of computational factors. The intricacy on the factors can be adjusted by the degree of smoothing. This may lead to strike some kind of optimal balance between the performances.

2.1.3 Stochastic Forecasting Techniques

The exclusive patterns of the demand and load of the electricity forecasting and other applications are complicated to forecast using normal time series techniques. These types of applications use stochastic methods and some of them are explained below:

Xing Yan et al. [17] explained the application of Support Vector Machine (SVM) and Least Squares Support Vector Machine (LSSVM) for mid-term electricity forecasting. SVM is used to avoid data over fitting problem, where as it may be occurred in Artificial Neural Networks (ANN). SVM is a supervised learning method and it is simpler and easier to build the classification or prediction model. SVM uses a quadratic equation during the training process, whereas the LSSVM uses a linear equation. SVM selects only those data with static coefficient as support vectors and the LSSVM selects training data as support vectors.

Later, Xing Yan et al. [18] proposed various SVM models for electricity market clearing price forecasting. Instead of using single SVM, the author used hybrid SVM and multiple LSSVM models to improve the performance. The price zones are categorized as Low, Medium, High and Peak. To improve the accuracy of the algorithm, the author used the data pre-processing tasks. Preprocessing of data needs to be done before developing the model. The outcome showed that Multiple SVM and LSSVM yield better accuracy than conventional SVM model.

2.1.4 Soft Computing Forecasting Techniques

Now a day's, most of the latest researchers are using popular learning method called Neural Networks (NN) or the Artificial Neural Networks (ANN). It is used for the analysis and prediction of the trends and the seasonal time series data. Peter Zhang et al. [12] provided an investigation on how to effectively model the time series prediction using various types of neural networks. For short term prediction of time series data, the author used Neural Network algorithm. Hamzacebi also proposed a new type of NN model called Hybrid NN Model [5] for improving the performance of seasonal time series prediction. Hybrid NN models are also used for seasonal time series prediction was given by Taskaya-Temizel et al. [16]. Other than NN model, many random search algorithms and gradient search algorithms are also used for forecasting the time series data.

To analyze the dynamic time series data, various coefficients models have been used in recent days. The Radial Bias Function network based Autoregressive model (RBF-AR) is one of the widely used coefficients modeling. It is a linear model that is derived from a set of RBF networks. Radial function can be used for resembling the coefficients. Min Gan et al.[10] proposed and executed the RBF-AR model to forecast the trend and seasonal time series. RBF-AR model is based on the type of input variables, the selection of a suitable state vector representation and the estimation of other parameters. The parameters include the number of nodes, center values and weight values.

To model the RBF-AR model, Min Gan et al. used the hybrid Genetic Optimization and a Gradient based Optimization [11]. In this method, the input parameters and the nodes of the RBF network are evolved and optimized using the Genetic Algorithm (GA). In this model, the nodes are optimized using a gradient-based optimization function. The optimization method employed in this method was the Structured Nonlinear Parameter Optimization Method (SNPOM) [9]. The employment of the hybrid RBF network with GA is experimented by nonlinear time series data such as Box-Jenkins time series and other real time applications.

2.1.5 Fuzzy Forecasting Techniques

Latest studies have mainly focused on fuzzy time series since they do not require any assumptions and is applied to solve the prediction problem of various fields, such as enrollment, electricity price, temperature, demand, stocks, and weather etc. Fuzzy time series was first proposed by song and chissom [15] in 1993. The ladder of the fuzzy time series includes defining the universe of discourse, partitioning the universe and applying the model. Huarng [9] proposed two heuristic methods to partition the isometric universe. Cagdas et al. [2] enhanced the ratio based method proposed by Huarng [9] by using the optimization function.

Erol Egrioglu [5] used Fuzzy C-Means (FCM) clustering method in the fuzzification phase. Apart from the hierarchical clustering such as agglomerative and divisive, the algorithms like

Gustafson-Kessel fuzzy clustering [4] are also used. It is more preferable in cases of non-linear and non-stationary data. IF-THEN based fuzzy logic rules was proposed by Mrinalini Shah. It is used for fuzzy based time series forecasting and trend prediction.

A novel hybrid approach by combining the Fuzzy c-means (FCM) and the Artificial Neural network (ANN) for forecasting fuzzy time series was introduced by Erol Egrioglu et al. [6]. Later on, Fuzzy C-Means (FCM) clustering along with Particle swarm optimization (PSO) was implemented by ErolEgrioglu [5]. Bas et al.[1] proposed a modified Genetic Algorithm (GA) approach for forecasting fuzzy time series.. GA improves the performance of the forecasting by using the optimization techniques such as the selection, crossover, fitness calculation, mutation, etc.

3. Proposed work

3.1. Proposed Method

A multi granular based fuzzy forecasting model [14] is proposed that makes use of the Particle Swarm Optimization (PSO) algorithm in establishing a fuzzy relationship. The change in time series data happens randomly for the passage of time, so it is not possible to learn those changes in pattern using normal means and by considering only the last available value in the dataset. The value in a time series data set changes with respect to time, this change has a specific and random pattern for various data sets. These datasets are based on the characteristics of the attribute values. Existing pattern of the data can be used as the training factors, to predict the future value of the data. For this purpose the PSO algorithm is more suitable. This is because the PSO algorithm takes the position and velocity of each of the particles associated with each of the values in the dataset. The change in position a teach iteration determines the amount of change in the data overtime and the velocity indicates how fast the data changes.

In the proposed approach, relationship values of annotations are employed when fuzzy relations are denied. It prevents the information loss. This algorithm converges faster than other learning algorithms and guarantees to the global optimum solution.

3.2. Contribution

- Forecasting the time series data using multi-granularity model for National Stock Exchange (NSE) and the Australian Electricity Market dataset. These dataset takes into consideration of all attributes when performing the prediction.

- Forecasting the future trend/pattern using fuzzy trend logical relationship groups such as down trend, Uptrend and Equal trend.

3.3. Design Methodology

In this work, the time series stock data are collected from the National Stock Exchange website [18] and Australian Electricity Market dataset was collected from www.aemo.com.au. The collected data is then processed and this preprocessed data is taken as the input data to the proposed model. This work proposes a multi-granular based fuzzy model for forecasting of stock

data. The proposed model predicts the future value by considering various factors of the stock dataset such as date, open, close, low, high and stock sales.

3.3.1. Automatic Clustering

The input dataset is first preprocessed to handle missing values and unknown values. Then the automatic clustering algorithm is implemented to calculate the various intervals for each of the factors of the dataset. Here, the attribute 'open' is the main factor and the other factors are taken as the secondary factors. For any given factor k, the intervals are determined as $u_{k,i}$, $u_{k,2}$.....$u_{k,pk}$ where pk is the number of intervals of the corresponding factor k. The steps followed in automatic clustering algorithm are discussed as follows:

1. The input data d_1, d_2,......,d_N of size N is sorted in ascending order.

2. The average difference Diff_{avg} and average standard deviation Std_{avg} between each adjacent data [14] can be calculated using Eq. (1) and Eq. (2):

$$\text{Diff}_{avg} = \sum_{i=1}^{N} \frac{d_{i+1} - d_i}{N + 1} \tag{1}$$

$$\text{Avg} = \sqrt{\frac{\sum_{i=1}^{N}(d_{i+1} - d_i - \text{Diff}_{avg})^2}{N - 2}} \tag{2}$$

3. Calculate maximum distance Distmax by using the standard deviation and a constant c using the equation given in Eq. (3):

$$\text{Dist}_{max} = \left[c * \text{Std}_{avg}\right] \tag{3}$$

4. Create an initial empty cluster and place the first data from the sorted values into the initial cluster. Mark this cluster as current cluster.
5. For each sorted data, if $d_{i+1} - d_i \leq \text{Dist}_{max}$ then place d_{i+1} into current cluster, else create new cluster and place d_{i+1} to the new cluster created and this cluster will be updated as the current cluster.
6. Repeat step 5 till all sorted data is clustered. For each cluster an interval is generated based on certain rules. For the first cluster the lower bound is given as in Eq. (4) and for the last cluster the upper bound is given as in Eq. (5). In all other cases the lower bound and upper bounds are given as in Eq. (6) and Eq. (7) respectively.

$$\text{LOW}_i = \left[d_{11} - \text{Dist}_{max}\right] \tag{4}$$

$$\text{UP}_{p_i} = \left[d_{p_iz} + \text{Dist}_{max}\right] \tag{5}$$

$$\text{LOW}_k = \left[\text{UP}_{k-1}\right] \tag{6}$$

$$\text{UP}_k = \left[\frac{d_k + d_{k+1}}{2}\right] \tag{7}$$

The automatic clustering algorithm is implemented for each of the factors separately.

3.3.2. Generating Fuzzy Domain and Fuzzy Relationships

 In the next step after generating the intervals for each of the factors (open, close, low, high and stock) the fuzzy sets should be developed for each interval. The fuzzy sets for any given factor k is represented as $A_{k,1}$, $A_{k,2}$.....$A_{k, pk}$ and the fuzzy set value Ak, l for factor j where l = 1,2. . . , p_k is generated using the equation as given below in Eq. (8):

$$A_{k,l} = \frac{a_{l1}}{u_1} + \frac{a_{l2}}{u_2} + \cdots + \frac{a_{lp_k}}{u_k} \tag{8}$$

After identifying the fuzzy sets, the next step is to fuzzify the input data values from the dataset. For each input value of factor j in the dataset, if the value is available within the interval $u_{i,l}$ where l = 1,2.. . . , p_k then this value is fuzzified as $A_{k,l}$. This is done for all the data values in the input dataset.

In the final step, the second order Fuzzy Logic Relationships (FLR) is generated using the fuzzified data values. The fuzzified data value of the time series data in factor j at time t is given as $A_{i,m}$ then the fuzzified data in the previous times t-1 and t-2 are represented as $A_{i,i1}$ and $A_{i,i2}$ respectively. Then FLR between these can be represented as $A_{i,i2}$, $A_{i,i1}$ → $A_{i,m}$. Similarly the FLR is generated for all the fuzzy sets. The fuzzy domains can also be generated for each of the factors by using the triangular membership functions. Let the maximum and minimum values of the data for a given factor j be max_i and min_i respectively. If the number of domains for a given factor be $2O_k+1$, where O_k is the domain order for factor k.

3.3.3. Forecast Trend using Trend matrix and Trend Groups

This phase focuses on forecasting the fuzzy trend by establishing the trend. The trend can be generated from each of the FLR which was produced in the previous step. Then, the Fuzzy Trend Logic Relationship Group (FTLRG) shows to which group the given FLR belongs. Three types of groups are considered such as UP, EQUAL and DOWN. For a given FLR of the factor k determined as $A_{k2}, A_{k,i1}$ → $A_{k,m}$ the group is determined based on three conditions as follows: If k_2 is less than k_1 than the FLR belong to DOWN group. If k_2 is equal to k_1 than, the FLR belong to EQUAL group. If k_2 is greater than k_1, then the FLR belong to UP group. Based on these rules the FTLRG is generated for all the FLR corresponding to each of the factors. Using this FTLRG the fuzzy trend matrices are formed. A 3x6 trend matrix is generated for each factor where 3 corresponds to number of groups and 6 corresponds to the total counts of each group and sum of data values in each group [14].

$$[S_D^1 N_D^1 \ S_E^1 \ N_E^1 \ S_U^1 \ N_U^1$$
$$S_D^2 N_D^2 \ S_E^2 \ N_E^2 \ S_U^2 \ N_U^2$$
$$S_D^3 N_D^3 \ S_E^3 \ N_E^3 \ S_U^3 \ N_U^3]$$

The matrix is represented as given above where S_T^G represents the sum of trend T of all the FLR in group, G and N_T^G represents the count of trend T of all the FLR in group G. The trends are represented as DOWN (D), UP (U) and EQUAL (E) and the groups are represented as 1, 2, and 3 as given in the matrix. After the matrix is defined it should be updated using the FLR and FTLRG based on certain rules. For any given FLR $A_{k,i2}, A_{k,i1}$ → $k_{j,m}$ of factor k in group G the

following rules are verified to updates values in trend matrix of factor j: If i1 is greater than m then increase S_D^G by $mid_m - mid_{i1}$ and increase N_D^G by 1. If i1 is equal to m set S_E^G to zero and increase N_E^G by 1. If i1 is less than m then increase S_U^G by $mid_m - mid_{i1}$ and increase N_U^G by 1. Here, the middle value represents the mid-point between the upper bound and the lower bound values of the respective intervals. Repeat these steps for each of the FLR in that factor and the trend matrix is generated. The trend value for factor k is calculated as given below in Eq. (9):

$$\Delta_{trnd}^k = \frac{S_D^G}{N_D^G} * \frac{N_D^G}{N_D^G + N_E^G + N_U^G} + \frac{S_U^G}{N_U^G} * \frac{N_U^G}{N_D^G + N_U^G + N_U^G} \tag{9}$$

3.3.4. Forecasting Trend and Value using Granular Spaces

Initially, the global data is split into many spaces. Then, the fuzzy trends and the values are forecasted in each of these spaces. This can be done by considering different patterns of factors. The open values are forecasted using combination of other factors in different granular spaces. A total of n+ 1 granular space have been taken where the value of n can be taken as the number of secondary factors leaving the stock sales factor and the main factor that is to be forecasted. So the value of n=3 by considering the factors close, low and high that will give a total of 4 granular spaces. In space 1, the attribute 'open' is used to predict the future value and trends. In spaces 2, 3 and 4 together with open values, the other combination of factors are also taken for forecasting the open value and trend. The main factor is represented as Ma and the other factors are represented as Sey where y=1, 2. . . , n are the secondary factors within the same space as Ma. In a given granular space r from all the granular spaces where r=1,2. . . ,n + 1.. The current state of the main factor belongs to group G1. The granular space can be obtained as given below in Eq. (10) and Eq. (11) respectively [14]:

$$\Delta_r = F_{ma} * \Delta_{trend}^{ma} + \sum_{y=1}^{n} F_{Se_y} * \Delta_{trend}^{Se_y} \tag{10}$$

$$R_{r(t)} = R(t-1) + \Delta_r \tag{11}$$

The values of F_{Ma} and F_{sey} are the main factors and secondary factors weighting values. The values can be calculated from the correlation vectors between the main factor and the secondary factors using the fuzzy trend matrices. The corresponding equation is given in Eq. (12) and Eq. (13).

$$F_{Ma} = \frac{1}{1} + \sum_{y=1}^{n} V_{ec_y} \tag{12}$$

$$F_{Se_y} = \frac{V_{ec_y}}{1} + \sum_{y=1}^{n} V_{ec_y} \tag{13}$$

Where, Vecy is the correlation coefficient between the trend variation vectors of main factor.

3.3.5. Generating Fuzzy Rules and Trend Rules

In the final stage, the fuzzy rules and the trend rules are generated by using the fuzzy domains and the FLR generated in previous stages. The steps to generate the fuzzy rules are described below:

1. Split fuzzy domains for each of the factor with the order $2O_{j+1}$ where O_j is the order for factor j.

2. Build the fuzzy domains for each factor. The fuzzy domains consist of intervals for each region within the domain. Example, consider the domain for "open". This domain contains 3 regions such as cheap, moderate and costly. Each of these regions has their own intervals denied using triangular function.

3. For each row in the input dataset, identify the region to which the values of open, low, high, close and stock belongs to using the interval.

4. Calculate the membership degree for the regions to which each factor belongs using the triangular membership function. If a value occurs between two regions, take the one that as high membership degree value. Finally using these regions form the fuzzy rule. The rule weight is the sum of membership degrees of open, low, high, close and stock. If duplicate rules occur then increments the support count by 1.

The fuzzy rules are used to identify to which range or domain the stock sales of future will belong to. And the trend rules are used to identify the change of trend in the stock sales with respect to previous day. The steps used to generate the trend rules are explained in detail below.

1. Obtain the first FLR for all factors such as open, low, high, close and stock.

2. Using the trend of all the factors the trend rule is generated.

3. If duplicate rules occur then increment the value of support by 1, after generating all rules, only take the rules that contain the trend of final forecasted "Type equation here.open" value.

4. Evaluation Parameter

The accuracy of the time series data can be evaluated by the performance metrics. The evaluation metrics include Mean Absolute Error (MAE), Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE).

Root Mean Square Error (RMSE)

$$\text{RMSE} = \sqrt{\frac{1}{D_{size}} \sum_{t=1}^{D_{size}} \left(y_t - y_t'\right)^2} \tag{14}$$

Mean Absolute Percentage Error (MAPE)

$$\text{MAPE} = \frac{1}{D_{size}} \sum_{t=1}^{D_{size}} \left|\frac{y_t - y_t'}{y_t}\right| \tag{15}$$

Mean Absolute Error (MAE)

$$MAE = \frac{1}{D_{size}} \sum_{t=1}^{D_{size}} |y_t - y_t'| \tag{16}$$

Where D_{size} is the number of observations, y_t and y_t' are the actual and predicted values. The minimum the value indicates the least error of the algorithm i.e the algorithm works well for the given application.

5. Result and Discussions

The proposed multi granular based fuzzy forecasting model is applied to an existing dataset and the future value is predicted. The Stock Exchange data collected from National Stock Exchange (NSE) website and Australian Electricity (AE) dataset are used for the experimentation purpose. The NSE time series data has 4156 observations. The sequence chart of observed value and original value of NSE is shown in Figure 1.
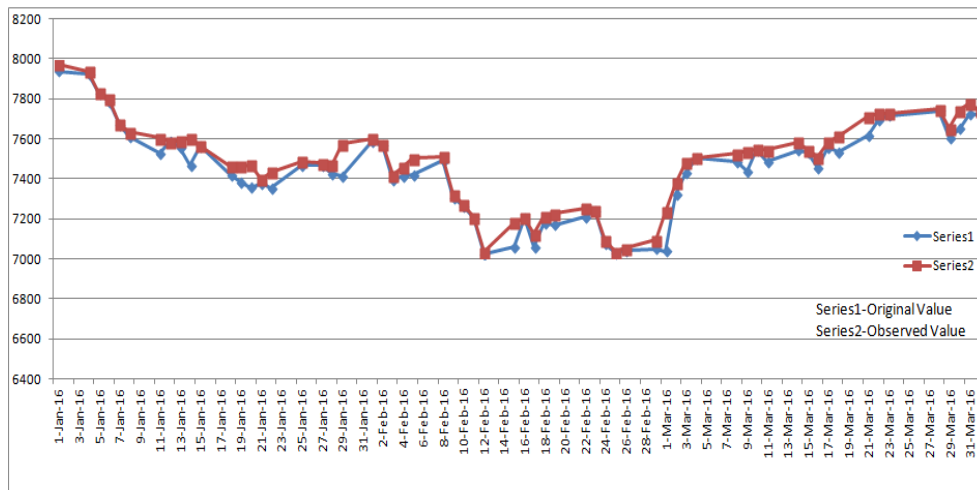

Fig. 1: Sequence Chart

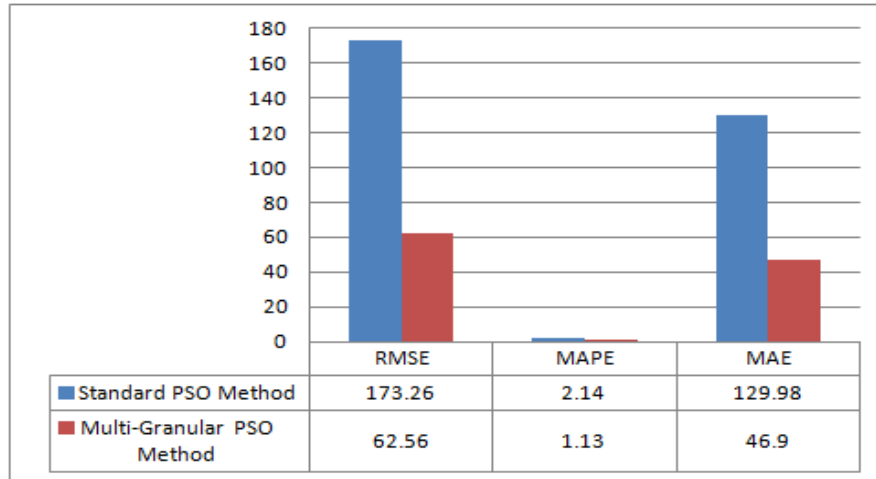To make a comparison an existing method is considered that makes use of the standard PSO algorithm for forecasting.

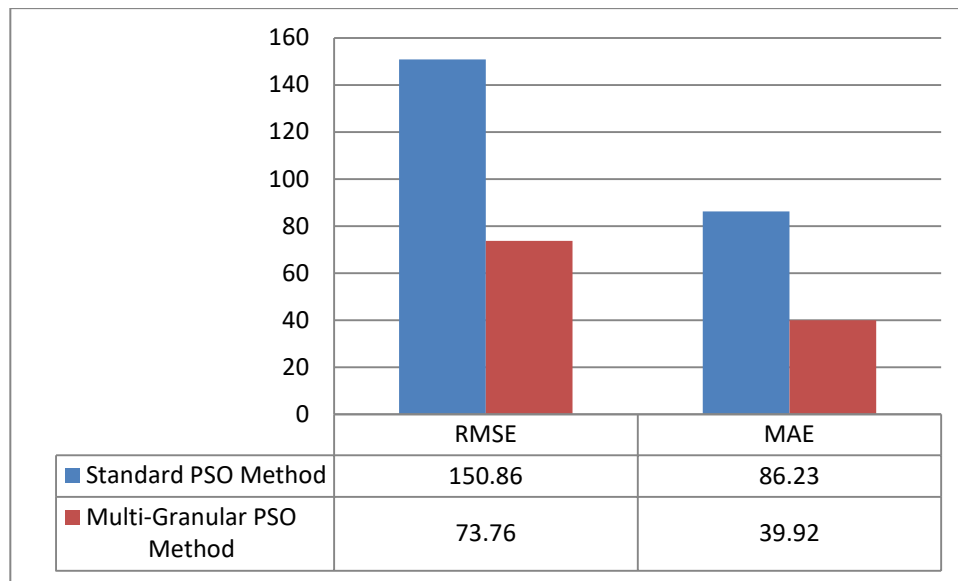**Fig. 2: RMSE, MAPE, MAE comparison between Standard PSO Method and Multi-Granular PSO Method – NSE Dataset**

	RMSE	MAPE	MAE
Standard PSO Method	173.26	2.14	129.98
Multi-Granular PSO Method	62.56	1.13	46.9

Fig. 3: RMSE and MAE comparison between Standard PSO Method and Multi-Granular PSO Method – AE Dataset

	RMSE	MAE
Standard PSO Method	150.86	86.23
Multi-Granular PSO Method	73.76	39.92

In this work, the Fuzzy C-Means (FCM) clustering algorithm is used to obtain the membership degrees using which the fuzzy sets are formed. Then, using the PSO algorithm the fuzzy relationship matrix is generated and based on this the final forecast is obtained. The comparison of performance evaluation parameters between the Standard PSO method and the proposed method known as Multi-granular PSO method is shown in Figure 2 and 3.

6. Conclusion and Future Work

Now a day's, forecasting of time series data faces many issues which depend on the number of instances, number of attributes and types of data. Accuracy or error rate is the main concern in predicting the time series data. The error rate is less in the proposed method "multiple granular spaces based forecasting method" compared to the existing methods. In this algorithm, membership values of annotations are employed when fuzzy relations are defined. It is used to prevent the information loss. This method is efficient to forecast future values for short-term period. This can be addressed in the future for long-term period by using enhanced techniques combined with the proposed method.

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