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IMPACTS OF LEAN EXECUTION ON COMPREHENSIVE PERFORMANCE OF GLOBAL SUPPLY CHAIN

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Abstract

The complexity of products, frequently changing customer demands, and the augmented competition for new concepts all require significant changes to traditional supply chains. Lean Execution, which increases the effectiveness of the supply chain, brings about the necessary transformation. Lean Execution focuses on locating and eliminating waste throughout the supply chain. This paper is focused on lean Execution in traditional supply chains, which leads to in-depth knowledge of lean systems (LS), as well as barriers and pressing issues faced in the Execution of lean systems in the supply chain. The articles published in refereed journals from 1985 to 2022 are taken into consideration, and a big pool of articles is subject to structured content analysis in order to actualize the study objectives. Starting with the introduction, the paper is divided into six sections. In the second section, a theoretical framework is covered. The third section then discusses methodology. The fourth section presents a descriptive analysis of publications, which is followed by a conclusion in the fifth section. and finally the sixth section discusses the future scope.

Keywords: Lean Barriers, TPS, Lean Supply Chain, NVAs, Lean Systems, Lean Practices.

1. INTRODUCTION

To improve performance in the manufacturing sector lean is a renowned concept. A Lean System is defined as a group of techniques that work together to generate a high-quality, efficient system that produces finished goods that meet customer demand with little or no waste [1]. The supply chain (SC) is widely understood to be the integration of key business activities across industries. When Lean System is fused throughout the SC it transforms into a lean supply chain. Structured content analysis is used in the article which includes material collection, descriptive analysis, category selection, and material evaluation. The paper's major findings present the researcher's progression, limitations, conclusions, and scope for further research in this area.

2. THEORETICAL BACKGROUND

1. Supply Chain: The principle of SC is to obtain input from the organization's suppliers, add value, then deliver value-added output to customers [2]. Dynamic capabilities in SC make the organization easily go through market turbulences [3]. Downstream complexity, internal complexity, and upstream complexity decrease the performance of SC [4]. Innovation, collaboration, supply networks, and evolving leadership impact SC effectiveness [5]. Effective implementation of SC practices places a strong emphasis on the training and retraining of the employees [6]. An SC is a network of activities of product development, procurement of materials, manufacturing, and distribution of goods to customers. Scopes of SC include suppliers, manufacturers, distributors, and end customers [7]. Industry 4.0 (I4.0) technologies are now used for the sustainability of supply chains [8].

2. Lean System: Lean Manufacturing often referred to as Lean system (LS), comes from the Toyota Production System (TPS) [9]. The LS achieves the target through continuous improvement and waste elimination by sorting out Value Added activities (VA) from NVA [10]. The push system is driven by predetermined schedules, while the pull system is driven by customer requirements [11]. Major wastes considered in Lean System are Overproduction, Waiting, Transportation, Processing, Inventory, Motion and Defects [13].

Table 1. Principles of Lean System [12]

Principles	Objective of Principles
Standardization	To improve quality and efficiency.
Simplification & Specification	To reduce production lead time.
Teaching and Learning	Supervisors and managers act as a mentor insolving problems.
Socialization	An atmosphere of respect & common goals to improve efficiency.
Continuous Improvement	Done by the people to improve their own work systems.
Supplier-customer Relationship	To replenish the resources in the right quantity at right time to the customer.
Coordination & Communication	To smoothen the work process and increase efficiency.
Functional expertise & stability	To develop the set of skills work as ateam from different departments
Striving for Ideal goal	To make improvements to reach the ideal goal.
Seed organizational Knowledge	Faith of the organization that the knowledge generated will pay_Off later.

2.1 Key Tools of Lean System: Kaizen, 5-S, Simplification/ Standardization, Line Balancing, Statistical Process Control (SPC), Kanban (Pull), Group Technology, Single Minute Exchange of Dies (SMED), Visual Control, Focused Factories, Level Mixed Model (heijunka), Poka-Yoke and Total Productive Maintenance (TPM)[13].

2.2 Lean System practices: Cycle time reductions, JIT production, Process capability, TPM, Safety improvement programs, TQM, etc. [14]. Production Levelling [15]. Value stream mapping (VSM) [16]. One-Touch Exchange of Die (OTED) or Single Minute Exchange of Dies (SMED) [17]. One piece flow [18] are the Key lean practice followed in industries.

Table 2. Lean Techniques and Associated Practices, [19]

Lean Techniques	Lean Practices
Customer Involvement.	Gather information on customer requirement
Value Stream Mapping	Value chain analysis and end customer focus
JIT, TPM, small lot size, 5s, SMED	Waste reduction
JIT pull System, Kanaban	Production exact quantity and when needed
Suppliers Integration	Strong & effective Relationship
5-Whys, employee Involvement, VSM	Problem search
Employee participation, Training	Solving the related problems

2.3 Major Barriers of Lean Execution: Many companies adopted the LS by learning about the sustainable growth of Toyota and became very successful but other companies did not get that much success from lean Execution. Major barriers to implementing a LS are cultural issues and resistance to change which hinders continuous improvement [12, 20]. Companies implementing the LS have better flexibility and a good market share with waste minimization [22]. Application of lean elements as a group avoiding seven lean wastes instead of specific waste [23]. Tools and methods of LS are very significant in industries [24]. For Lean Production System (LPS) hybrid maturity model for assessment is more attractive than either lean or I4.0. [25]. Lean automation with human-machine interaction results in bio-mechatronic production systems [26]. The manufacturing sector has been consistently adding value to the global economy [27].

Table 3. Barriers to Lean Execution in industries [21]

Barriers in Lean Implementation	Small	Medium	Large
Investment Cost	Y		Y
Insufficient Senior Mgmt./ supervisory/Workforce skills for lean Execution	Y	Y	Y
Insufficient management time	Y	Y	Y
Employee attitudes/resistance to change	Y	Y	Y
Inadequate external funding	Y		
Social and Cultural issues		Y	Y

The scarce attention to Lean soft practices is the undermining cause of failures in Lean and CI Programs [28]. Lean principles with simulation improve the productivity and efficiency of off-site manufacturing (OSM) [29].

3. EXECUTION OF LEAN IN SUPPLY CHAIN

A case study at Ranbaxy suggests measures of how and at what level Quality improvement is achieved after lean implementation [30]. Five elements Pull System, lean Production, Continuous Flow, High Inventory Turnover, and Shorter Lead Time considered while deploying lean practices to suppliers [31]. Lamming states that between firms in the LSC, cost transparency must be maintained [32]. In manufacturing company application of LS transformed the SC into more productive and efficient chain [33]. The worldwide interest in the lean Execution in logistics identified the challenges are freight cost, customers' requirements, forecast accuracy, labor costs, quality, and planning process [34]. The automotive industries have a high level of lean Execution, followed by the electronics, information technology [35]. Approximate Time Frame for Lean transformation of an industry is five years [36]. A case study from the Ford Motor Company revealed that through Lean Execution in SC OEE, productivity, output quality was improved, cost fell, lowered inventory and its cost and lead times shortened [37].

Table 4. Comparison of LSC with CSC model [41]

Features	LSC Model	CSC Model
Number & structure	Fewer, clustered	Many; vertical
Procurement personnel	Limited	Large
Outsourcing	Strategic	Cost-based
Selection criteria	Performance	Lowest price
Contract length	Long term	Short-term
Pricing practices	Target costing	Competitive bids
Quality	Designed in	Inspection-intensive
Delivery	Smaller quantities –JIT	Large quantities
Inventory buffers	Minimized, eliminated	Large
Communication	Extensive, multi-level	Limited, task-related
Information flow	Collaborative, two-way	Directive, one-way
Role in development	Substantial	Limited

Production flexibility	High	Low
Technology sharing	Extensive	,Very limited
Dedicated investments	Substantial	Minimum required
Mutual commitment	High	Very limited
Governance	Self-governing	Market driven
Future expectations	Considerable	No guarantee

By Lean Execution in SC, Automotive Electronics Group could minimize lost man-days by 81%, slashed capital expenditures by 70 %, and time of raw materials movement reduced by 61%. Besides overall lead time (LT) reduced severely from 30 to 18 days which resulted in 12 days of value-added time [38]. Manufacturing firms in the Kingdom of Saudi Arabia (KSA) enhanced productivity through supplier and customer relationships, cost reduction, and waste elimination [39]. "Tesco" became the globe's second-biggest retailer and raised its profits above £1.4 billion by Execution of LS in SC [40]. A difference of almost 2:1 was found in productivity between car assembly plants in Europe and those in Japan because of the successful Lean Execution in SC [42]. The LS achieve quick response and reduced lead times within the existing SC of textiles and apparel industry [43]. A case study on an automotive SC suggests that lean tools like just-in-sequence production, use of reusable containers, and racks are the main factors that make SCs more efficient [44]. The next step in achieving superior performance is creating a lean enterprise by linking individual breakthroughs up and down the value chain [45]. The term "lean supply" was coined by combining lean production with supplier and customer collaboration. [46]. LSS can support DT in boosting value throughout supply chains and generating rise-wide benefits [47]. The incorporation of lean principles and practices into SCM has culminated in differentiated results along the SC [48].

Methodology

Distinguished research methods include conceptual, modelling, case study, and survey are used in industries [49]. Research methods can be sub-classified into theoretical, qualitative, empirical, and quantitative research. While considering LSC, the most widely used research method is a case study and it is followed by survey and conceptual approaches [50]. Content analysis for this paper is done by a four-step process model which includes Materials gathering, descriptive analysis, category identification, and material evaluation. To achieve this purpose, papers published from 1985 to 2022 that discussed lean Execution in the SC are taken into account and Emerald, Elsevier, Scopus, Springer link, Google Scholar, Taylor & Francis, and other refereed journals are searched for achieving the goal. keywords used for the search include SC, lean principles, lean tools, lean practices, Lean System, lean enterprise, lean Execution in SC, etc. The preliminary search using keywords resulted ensued more than 500 hits. The number of articles was considerably decreased after limiting the initial search to articles with research domains. The same process was reiterated for different databases and keywords. Scanning of abstracts, introductions, and body contents of the articles provided additional screening. A total no. of 56 articles were finally selected for the research study. The descriptive analysis includes the examination of basic descriptive characteristics of the selected articles. At the category identification stage, a Decision on categories and dimensions was taken to structure the gathered material. Category identification is followed by material evaluation, which involved the study and categorization of gathered material according to the selected structural categories and dimensions. The basic descriptive characteristics of the papers include the Publication year, Authors' Vision on Lean Execution in Supply Chain, distribution across journals, distribution across Research domains, distribution across time intervals, and distribution across industry types.

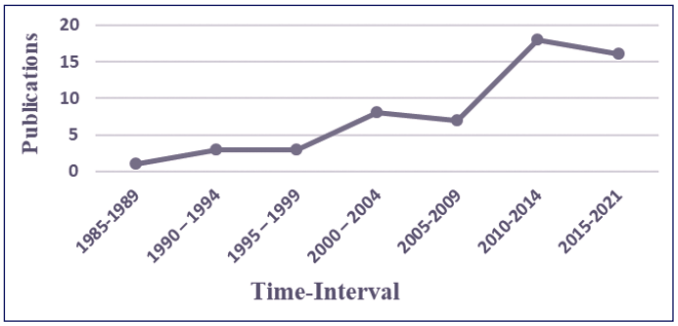
4. DESCRIPTIVE ANALYSIS

4.1. Authors' Vision on Lean Execution in Supply Chain: Authors of the reviewed articles perceived major lean principles for the successful Execution of LS in SC which are- Identify from the value end, Map value to expose and waste elimination, establish flow, Let the customer pull products, and Endeavor for perfection. They perceived Lean techniques include Customer Involvement, Value Stream Mapping, JIT, TPM, small lot size, SMED, cellular manufacturing, Supplier integration, pull System, Kanban, 5 Whys, employee Involvement, and Training [51]. The manufacturing line's reliability is increased by using a lean strategy of working with a small number of suppliers on a long-term contract, which lowers overall costs [52]. To reap the utmost benefit of lean implementation, the focal organization should focus on supplier's and distributor's activities also along with internal activities [53].**4.2. Dispersion of Articles Across Time Interval:** Published papers during the years 1985-2022 are considered for dispersion in terms of time. The contemporary Lean Digital Supply Chain (LDSC) is used to describe how Industry 4.0 technologies are used effectively to reduce waste at every level of the supply chain in order to accomplish lean goals [54].

Table 5. Dispersion of Articles Across Time Interval

S.No.	Time Interval	Publications
1	1985-1989	1
2	1990 – 1994	3
3	1995 – 1999	3
4	2000 – 2004	8
5	2005-2009	7
6	2010-2014	18
7	2015-2022	16

Figure 1. Dispersion of Articles Across Time Interval

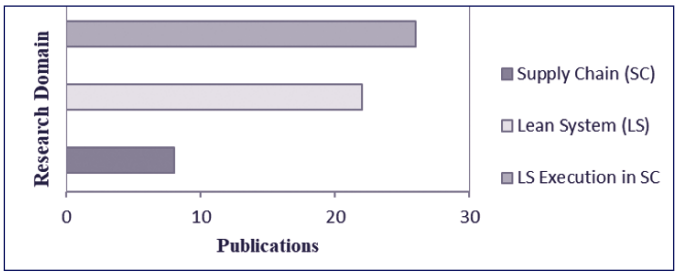


4.3. Dispersion of Articles across Research Domain: Articles selected for this study provide the in- depth know- how of lean Execution the SC. The articles selected for the study are majorly classified into three main categories and the table below is showing the no. of articles used for each stream.

Table 6. Dispersion of Articles Across Research Domains

S. No.	Research Domains	Publications
1	Supply chain (SC)	08
2	Lean System (LS)	22
3	LS Execution in SC	26

Figure 2. Dispersion of Articles Across Research Domains



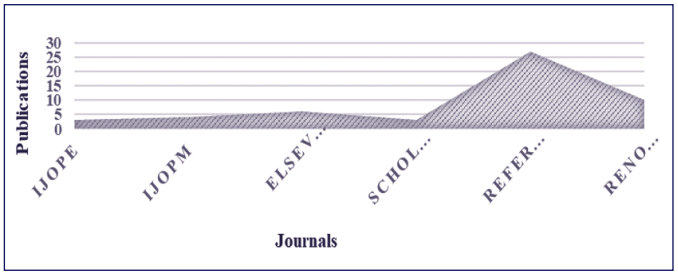
4.4. Dispersion of Articles Across Journals: The publications were found in diverse scholastic journals i.e. Three papers were published in the International Journal of Production Economics (IJOPE), Five papers were published in the International Journal of Operations & Production Management, seven articles were found in Elsevier, Procedia, three were found in the Journal of Operations Management (JOPM) and so on, Detailed distribution is given in Table 7.

Table 7. Dispersion of Articles Across Journals

S. No.	Name of Journal	Publications
1	International journal of production economics	3
2	International Journal of Operations & Production Mgmt.	4
3	Journal of Operations Management	1
4	Elsevier, Procedia	6
5	Journal of Cleaner production	1
6	International Journal of Production Research	2
7	Journal of Manufacturing Technology Management	1
8	Production Planning & Control	1
9	Supply Chain Management: An International Journal	1
10	Applied Science	2
11	South African Journal of Industrial Engineering	1
12	Conference and Renowned Proceedings	2
13	International Journal of Lean Six Sigma	1
14	International Journal of Benchmarking	1
15	Resources, Conservation & Recycling	1
16	Int. J. Services and Operations Management	1
17	European Journal of Purchasing & Supply Management	1
18	J. Advan. Manag. Res.	1
19	Computers & Operations Research	1
20	Automation in Construction	1
21	International Journal of Purchasing and Materials Management	1
22	Journal of Asia Business Studies	1
23	Environmental Science and Pollution Research	1
24	Int. Journal of Management Research & Business Strategy	1
25	Int. Journal of Management Science and Engineering Mgmt.	1
26	Journal of Lean Manufacturings	1
27	J. Bus. Logistics	1
28	International Journal of Managing Value and Supply Chains	1
29	Journal of Management Development	1
30	Management and Production Engineering Review	1

31	Polish Journal of Management Studies	1
32	Transfer inovácií	1
33	Production	1
34	Renowned Books, Articles, and Ph.D. Dissertations	10

Figure 3. Dispersion of Articles Across Journals



5. CONCLUSION

The study endeavored to present lean Execution in SC in an elite way from available resources in diverse industrial sectors. In addition, this study provides acumen of previous research is done, recent work, research approach, trends, and authors' perspectives on lean Execution in SC. The distribution of papers across different sectors evidenced that lean does not have any boundaries in terms of industry sectors [55]. The study suggests that lean implementation must stretch to suppliers and distributors along with internal activities of the focal organization to utilize the lean implementation to its full potential [56]. In the same direction, the study examines the barriers to lean adoption, because knowledge of barriers is extremely important to evade letdowns and maintain the lean transformation. Ideally, an SC would be lean with no waste of time and inventory. Lean Execution in SC leads to Continuous improvements which assure significant growth in ROI [40]. The literature indicates that the lean concept is widely accepted in India but when a question on implementation in SC comes, it is merely the beginning of a trip and a long journey is still ahead. As such this study on the evaluation of lean implementation in the SC shall be of great aid to researchers for further research in the same direction as well as industries for implementation of lean in existing supply chains.

6. FUTURE RESEARCH

Based on findings from the evaluation of research papers, it is suggested that future studies on the topic explore performing more realistic quantitative research, such as surveys and simulations. The research method will assist the implementation of lean techniques for the betterment of SC and will support assertions regarding the unstoppable advantages of LSC. In addition, case studies based on explicatory evidence and predictive research employing mathematical modeling will contribute to harvesting more benefits out of lean implementation in SC. It is required to stretch out the research to types of industries that are entirely untouched by the researchers. Further organizations should be encouraged to embrace the full implementation of lean in their SCs to reap full benefits by including other members of SC such as end customers and distributors. Finally, the analysis of case studies to compare the results of the evaluation along with industry practices will aid to streamline the research with the demands of industries.

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