IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 08, Issue 5 (May. 2018), ||V (IV) || PP 35-42

Effectiveness of Lean Tools and Technique in Automobile Industries

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Abstract: Lean Manufacturing is also Known as Toyota Production System and it consist of plethora various tools and technique which are applied to eliminate various non-value asses activities from the production and operational processes. Value added activity according to lean manufacturing are those for which the end customer is willing to pay and non-value added activities are those which are not appreciated by end customers. Through this study an attempt has been made to identify various tools and techniques of lean manufacturing from the published literature. Further identified tools and techniques of lean are prioritized using fuzzy and technique order preference by similarity to ideal solution (TOPSIS).This study will be very helpful for the managers and executives working on lean implementation. This study provides them an insight about which tool and technique of lean manufacturing is important.

Keywords: Lean Manufacturing, Value added activity, Non-value added activity and Fuzzy TOPSIS.

Date of Submission: 27-05-2018 Date of acceptance: 10-06-2018

I. INTRODUCTION

The lean manufacturing (LM) or Toyota Production System (TPS), pioneered by a Japanese automotive company, Toyota, has been implemented by nearly all countries across the word due to its global superiority in cost, quality, flexibility and quick respond. Lean is a production practice that aims to minimize waste with entire value streams creating more value for customers.[1]

It is purely a customer based strategy which focuses on optimization of lean techniques. The principles of lean manufacturing states the use of resources that does not deliver consumer value is a target for change or elimination. It is practiced across lands in order to improve firm's efficiency and production. [1]

The lean practice explains seven types of wastes namely as overproduction, waiting, over processing, unnecessary part movement, excess inventory and defects. The waste in any industry can be effectively eliminated using strategies such as one piece workflow, Takt time and Pull system. There are various tools and techniques which are used by different firms to implement lean concepts. The core lean methods frequently used are Kaizen Rapid Improvement Process; 5S; Total Productive Maintenance (TPM); Six Sigma; Cellular Manufacturing / One piece Flow Production Systems; Just-in-time Production / Kanban; Pre-Production Planning (3P) and Lean Enterprise Supplier Networks. [1]

In Today's Industrial Environment enormous misfortunes/wastage happen in the assembling shop floor. This waste is because of administrators, upkeep issue, tooling issues and non-accessibility of segments in time, non-value added action in assembling and so forth. Different types of waste incorporates sit still machines, work non-appearance, separate machine, rejected parts and so on are on the whole cases of waste. The characteristics identified with waste are of noteworthy significance with regards to the organization as far as time, material and the reputation of the organization in the market. [2]

There are different techniques of waste reduction and performance enhancement like Just in Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), Kaizen etc. JIT is a strategy for manage the inventory in which raw materials and components are conveyed from the supplier immediately before they are required in the manufacturing plant. Kaizen is Japanese technique for improvement for the better refers to philosophy or practices that focus upon continuous enhancement of processes in manufacturing, engineering and business management. [2]

There are problems in automobile firms in terms of production, such as waste, cost, productivity, and maintenance. The research study intend to utilized relevant literature to solve lean tools techniques, and also prioritized the s in order of its application in the Indian Automobile Industry.

II. REVIEW OF RELEVANT STUDY

Many studies have been conducted by various researchers on reduction of waste and productivity in various industries, specifically automobile industry.

Padhi et al. [3] examined distinguishes five imperative SSCPs, for example, practical outline and improvement, vital sourcing and proficient innovation and reasonable item returns and reusing. This investigation acquaints an approach with upgrade manageability of store network that can be stretched out crosswise over enterprises through a procedure perspective of supply chain, in developing economies like India.

Singh et al. [4] examined different late economical fabricating thoughts connected in the unmistakable segments with an in tend to either re-cycle/re-utilize the disposed of one's or to create a crisp part in eco-accommodating conduct. Unique consideration is paid to the current patterns in machining and a short contextual analysis of economical assembling of aviation industry has additionally been examined. The results of the contextual investigation unequivocally pushed the dry machining as the best practice among the others. It is additionally featured that, the machining group, particularly the scholarly analysts and field engineers, should step up with regards to the ZW machining not exclusively to particular portion of machining industry yet overall.

Garre et al. [5] identified the bottlenecks in the production line of a Aerospace Manufacturing Industry, in order to provide a background on lean manufacturing and presented an overview of manufacturing waste, such as, remove the scrap and other waste, and Layout configuration reduced the transport time with introduction of 5s and reported the increase in productivity of full welding process and child parts assembly station along with decreases in its total operating cycle.

Gupta et al. [6] used a system dynamics model to eliminating the wastes in a Radial tyre manufacturing, analysis the varying the level of employee skill, man power availability and machine availability is conducted. It represented the overall performance of the Radial tyre manufacturing through the implementation of Lean thinking and system dynamic modeling, reported an increase in machine availability, lean waste reduced through a high degree of maintenance and overhauling, the machine downtime reduced, it improved the standard of hardware deployed to attain higher greened level by reducing volatile organic compound and hazardous air pollution wastes.

Panwar et al. [7] investigated the impact of lean practices on performance improvement of process industries in India, this study consequence of 121 Indian process businesses demonstrates that reception of lean practices comes about in a positive effect on stock control, squander end, cost diminishment, efficiency, and quality change in process enterprises. In the Indian process industries surveyed in this study, there was no significant difference in level of performance between lean adopters and non-adopters with respect to lot size reduction and space utilization.

Jasti and Kurra [8] examined at the legitimacy and unwavering quality of the existing lean production network administration lean supply chain management systems (LSCM) in Indian assembling industry Utilizing a poll study experimental information were gathered from 180 best and center level administration staff in the Indian assembling industry. Factor investigation was performed to check uni-dimentionality of the exact information on LSCM systems. Cronbach alpha estimation of each chose LSCM structure was computed to test unwavering quality. At long last, recurrence circulation investigation was performed on the chosen structure to recognize and uncover basic builds of LSCM. It was concluded that there is a need for a new LSCM framework to fulfill the requirements of Indian manufacturing industry.

Botti et al. [9] used modeling which leads to an impressive arrangement of both manual and automated works, this arranges a hybrid environment to maximize the uses and profits and minimize the waste of resources. Both assembly lines solutions ensured the low risk and high-quality outcomes. However, working in parallel with automated system was itself a hazardous and risky situation if precautions were not properly implemented. The equations in hybrids assembly lines were best fitted for the production and should be improved for the manual workers too by focusing the risk levels and assembly of the design, as a lean manufacturing such as a talk cycle.

Bhanot et al. [10] investigated intends to propose thorough maintainability system for assembling area to reinforce the empowering agents and alleviate obstructions in view of the reactions of specialists, and industry experts. Basic leadership Trial and Evaluation Laboratory approach has been connected to recognize most powerful factors among ten distinguished empowering agents and boundaries in both the gatherings. Further, a logical approach, Maximum Mean De-Entropy calculation has been used to coordinate the got comes about with Interpretive Structural Modeling in light of edge an incentive to build up a progressive structure of the mind boggling framework. At long last, the investigation has been factually approved for empowering agents and obstructions by utilizing auxiliary condition displaying in view of the reactions of both the gatherings, and expected to highlight the underlying divergences in their opinions which can be jointly worked upon to minimize this gap towards sustainability implementation.

Omogbai et al. [11] developed a systematic dynamic based Lean Assessment tool and by using system dynamic (SD) modeling approach, Validate the proposed Lean Improvements and Analyzes the inter-relationship between Lean variables, further the model was used to minimize lead time in a packaging manufacturing Industry.

Helleno et al. [12] introduced new manufacturing techniques leads to the Lean Manufacturing methods; this by keeping the various environmental factors in mind like working conditions, keeping a good eye on resources as well as production. Lean Manufacturing and Value Stream Mapping (VSM) target the production without waste for standard outcomes. Somehow the tools in VSM were not measured according environmental, social and economic factors. It's indicated the sustainability in production and development scenarios and further leads to continuous improvement to develop sustainable manufacturing processes.

Kumar and Choudhary [13] investigated expect to speak to Kaizen usage in a machine bad habit producing organization. Kaizen has indicated enormous effects on the creation systems and lead times. An extensive number of little scale enterprises have demonstrated their reality in India. It has been troublesome for little enterprises to make due because of extreme rivalry among them. All are confronting issues like low creation also, low quality items. Fishbone diagrams have been used to represent cause and effects and result has been shown as savings in terms of money and time.

Sharma et al. [14] explored the effect of lean creation hones on execution measures in machine instrument industry and decides the lean criteria that can have huge positive effect on execution and introduced a mix of hypothetical structure furthermore, useful applications. Surviving writing was explored and to accomplish the exploration targets, an exploratory overview was done in machine instrument supply chains situated in the national capital area of India. Dependability test, factor examination and stepwise various relapse investigated draw out a few lean criteria that can influence key execution measures.

Shah et al. [15] represented of different tools and techniques which provided basis for continuous improvement, and used Kaizen, 5s, TPM and collective application of these discussed tool help Industry to achieve better position in competitive market where main focus is on reduction of lead time and improving quality. There were number of factors affecting the productivity, improper workflow and improper material handling, and reported to eliminate these factors industry needs to sustain in financial crisis then continuous improvement is only key to survive.

Leite et al. [16] used of the lean philosophy in services proved to be effective and quite worthwhile. Service companies shown significant gains and confirmed an increasing and promising future for "thinking lean". Variables were Lean service; Service performance improvement; Waste elimination; Lean philosophy and reported that each business service sector to where lean has been applied such as health, government, logistics, offices, teaching, retail and others minimize lead time and maximizing operational performance.

Khanchanapong et al. [17] recorded that both manufacturing technologies and lean practices have unique effects on arrange of operational performance dimensions, including quality, lead-time, flexibility, and cost and reported that various variables explained theoretical and practical insights which support the importance of building a strong manufacturing technology and lean practices that maximize operational performance.

Jhadav et al. [18] were to considered the UNIDO– ACMA Model and in addition ISM Model of Lean usage what's more, approve the ISM Mode by contrasting and UNIDO– ACMA Model. It additionally goes for introducing a guide for Lean execution in Indian car part industry depended on auxiliary information which incorporates the exploration articles, web articles, doctoral theory, review reports and books on car industry in the field of Lean, JIT and ISM. ISM Model for Lean hone groups was produced by creators in interview with Lean professionals. The UNIDO– ACMA Model has six phases while ISM Model has eight stages for Lean usage. The ISM-based Lean usage show is approved through high level of closeness with UNIDO– ACMA Model, proposed ISM Model for feasible Lean usage. The ISM-based Lean execution system presents more prominent understanding of execution process at more micro level when contrasted with UNIDO– ACMA Model. To implement Lean successfully, sustenance of Lean Practices and perfection at each phase are absolutely essential. ISM-based Lean model advocates implementation eight Lean practice bundles in sequential order and application of ISM-based Lean implementation frame offers clearer picture.

Arunagiri et al. [19] mainly focused on ranking of lean tools, its positive impact towards the automobile industries, analysis the flexibility of lean tools can be effectively utilized for the increase in the production rate of the manufacturing industries. The variable were taken such as Lean systems; Impact lean tools; weighted average and by using these variables the five tools such as 5S, Overall Equipment Effectiveness, 8 Step Problem Solving Methodology, Pareto analysis, reported the elimination of waste have a positive impact towards the productivity of the automobile industries

Vimal and Vinodh [20] reported a contextual investigation in which manufactured neural system (ANN) has been utilized for performing fluffy rationale based leanness evaluation. Leanness is the measure of lean assembling practice. Fluffy rationale has been utilized for the figuring of leanness. To enhance the

adequacy of calculation, ANN instrument has been utilized as a part of this investigation. The system has been demonstrated, prepared and reenacted utilizing the MATLAB programming and conducted in an Indian transformer manufacturing organisation. Hence, the results derived from the study are validated in a real time manufacturing environment and implemented in the improvement proposals, lean performance measures were measured to quantify the improvements.

Kumar and Abuthakur [21] used Single Minute Exchanger of Die techniques and 5s lean tools to set up time reduction in a Fagor press. It is noted that a rapid and efficient way of converting a manufacturing process from running the current product to running the next product, and total time taken to perform the set up reduced 28 min and production rate has been increased from 92200-98080 i.e. 5800 pieces.

III. RESEARCH METHODOLOGY

The research methodology used in this research is a case study methodology. The case study method allows researchers to retain the holistic and meaningful characteristics of the real-life events [22]. A case study was performed in one of the automotive components manufacturer in India. This company selected was based on its achievement as a Toyota Production System (TPS) Model Company awarded by India and Japan government. Interview was conducted at the case study Honda Company with two executives; Manager of Safety Environment & Quality Management, and Assistant Manager of Toyota Production System & Skill Development. Both of them are from Total Quality Management Department and very familiar with the LEAN TOOLS AND TECHNIQUES implementation projects. Interview was conducted through prepared semi-structured and open-ended questionnaires. The semi-structured interview and open ended questions were used where interviewees were encouraged to explain why the line operated in a certain way. The semi-structured and open-ended questionnaires were utilized to gain insights regarding the status of LEAN TOOLS AND TECHNIQUES implementation approach in this case Study Company. For this case study company, the semi-structured and open ended questionnaire consists of three sections;

(a).The company's background information (year of establishment, start of production, ownership, number of employees, products, customers, and achievements)

(b).The understanding of lean manufacturing

(c).The implementation of lean manufacturing.

In order to find out the approach of LEAN TOOLS AND TECHNIQUES implementation from this company, a number of questions were tailored to enable the extraction of ideas that give a true reflection on the interviewee's practices. Therefore, set a number of questions in this case study that embodied the companies' understanding of LEAN TOOLS AND TECHNIQUES and LEAN TOOLS AND TECHNIQUES implementation. For example, the key questions in section (b) and (c) of the semi structured and open-ended questionnaires were as follows:

- Since when did your company started to implement LEAN TOOLS AND TECHNIQUES?
- What is your understanding about LEAN TOOLS AND TECHNIQUES?
- Who has motivated your company to implement LEAN TOOLS AND TECHNIQUES?
- How long it takes to complete the first implementation project of LEAN TOOLS AND TECHNIQUES in your company?
- Do you think it is necessary to hire consultant to assist the implementation of LEAN TOOLS AND TECHNIQUES?
- How about your company's practice?
- Who is the person responsible to lead the implementation of LEAN TOOLS AND TECHNIQUES in your company?
- Where has LEAN TOOLS AND TECHNIQUES been implemented in your company?
- What were the criterions for choosing that specific area?
- How many people involved in the project?
- What kind of waste does LEAN TOOLS AND TECHNIQUES eliminated in the project?

During the interview, it was tape recorded with the permission from the interviewees to avoid any missing points of information given by them. Finally, the overall information obtained from the interview was summarized and verified with the interviewees. Findings from the interview were analyzed and discuss in the findings and discussion section.

3.1 Background of the Company

From the section (a) of the semi-structured and open ended questionnaires, the company's background information was gained and illustrated in Table 1.

Honda Cars India Ltd (HCIL) is a subsidiary of Honda of Japan for the production, marketing and export of passenger cars in India. Formerly known as Honda Siel Cars India Ltd, it began operations in 1995 as a joint venture between Honda Motor Company and Usha International of Siddharth Shriram Group. In August, 2012,

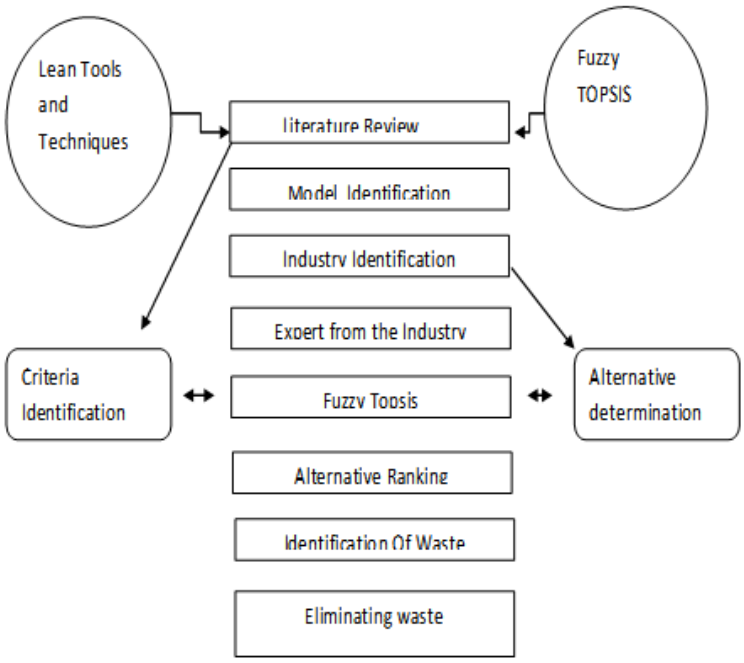
Honda bought out Usha International's entire 3.16 percent stake for 1.8 billion in the joint venture. The company officially changed its name to Honda Cars India Ltd (HCIL) and became a 100% subsidiary of Honda.
HCIL's first manufacturing unit at Greater Noida began operations in 1997. Set up at an initial investment of over 4.5 billion, the plant is spread over 150 acres (0.61 km^2). The initial capacity of the plant was 30,000 cars per year, which was thereafter increased to 50,000 cars on a two-shift basis. The capacity has further been enhanced to 100,000 units annually as of 2008. This expansion led to an increase in the covered area in the plant from 107,000 square meters (1,150,000 sq ft) to over 130,000 m^2 (1,400,000 sq ft).
HCIL has 331 dealership outlets across 121 cities in 20 states and 3 Union Territories of India. It sold 189,062 units during the period between April 2014 and March 2015 as against 1, 34,399 units during the same period a year ago, recording an increase of over 44%. Honda, the Japanese carmaker, launched a new compact SUV on the Jazz platform called WRV in March 2017. 2017March ended revenue touches 16,870crore, First profit 360crore profit after 6 years losses.

Table1. Company's Profile (HONDA)[23]

Type	Subsidiary
Industry	Automotive
Founded	1995,23 year ago
Headquarters	Greater Noida, Uttar Pradesh
No. of locations	2
Key people	Gaku Nakanishi (President and CEO) Mr. Gaku Nakanishi is President and CEO of Honda cars in India Ltd. With effect from 1st April, 2018. Mr. Nakanishi has served as Manager director and CEO of Honda Thailand in his last Assignment.
Product	Automobiles
Achievements	**2005-** • CNBC Auto-car Car of the year 2004 • ICICI Overdrive SUV of the Year 2004 - Honda CR-V • ICICI Overdrive Car of the Year 2004 - Honda City • Business Standard Motoring Car of the Year 2004 - Honda City **2006-** • Best Indian Company (unlisted) by Business Standard Group • Manufacturer of the Year by NDTV Profit-Car India • Manufacturer of the Year by CNBC-TV 18 Auto car India • No 1 Mid Size Car (Honda City); No 1 Entry Luxury Car (Honda Accord) and No 1 Premium SUV (Honda CR-V) by TNS • Best Mid-size Car in Initial Quality (Honda City) and Most Appealing Mid-size car (Honda City) by JD Power **2014-** • corporate - Engine of the year - Honda eco technology(HET) 1000cc engine Sedan Of The Year - Honda City

IV. FINDINGS AND DISCUSSIONS

Lean manufacturing implementation in this company was started in 1996. At that time, the concept of lean manufacturing is still new and the knowledge in this company is still at a very low level. In 2002, the president of the company from headquarter in Japan came and asked to start lean manufacturing activities where one team was formed with five full-time members. At the early stage of lean manufacturing implementation in this company, the project based approach was used. The project based is a small scale project where the focus of LEAN TOOLS AND TECHNIQUES implementation in this company is to solve the problem at the small area. From the interview, the authors have formulated the lean manufacturing implementation approach by this company as shown in Figure 1



Figurel. Flow chart of the research work

First, this company forms a small team with five fulltime members to run the lean manufacturing implementation project. A few Indian experts from headquarter in Greater-Noida came to teach and shared their knowledge of lean manufacturing implementation with the team members.
Second, Fuzzy TOPSIS (technique for orderly preference through similarity of ideal solution) was applied in order to prioritize the lean manufacturing implementation study of research. The selection of the model line was based on the following characteristics; waste, cost, maintenance and productivity.
Finally, at the project base approach by this company, the focus of lean manufacturing implementation is reducing the level of inventory. For this company, inventory is the mother of other wastes. Reference [24], the father of Toyota Production System identified seven types of waste:

- Waste of over production
- Waste of unnecessary transportation
- Waste of waiting times
- Waste of unnecessary processing
- Waste of unnecessary motion
- Waste of defected product

Table2. Closeness Coefficient C*

S.no	Lean Tools/Managers	C*	Rank
C1	Work reduction	0.4	2
C2	process Improvement	0.27843	6
C3	Quality Improvement	0.45143	1
C4	Market Oriented	0.36571	5
C5	Shop floor improvement tools	0.377	3
C6	Supplier Development	0.08929	7
C7	Human resources	0.37586	4

The table 2 above is the analysis conducted using Fuzzy Topsis in order to rank, and the graphical representation shown in figure 2. The graph is a variation of ranking in Lean tools with coefficient of closeness.

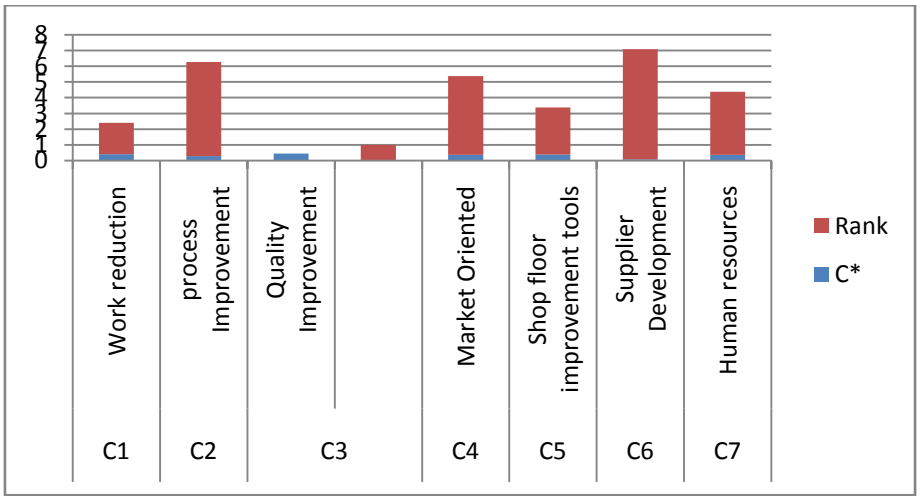


Figure 2 *Variation of ranking in Lean tools with coefficient of closeness*

V. CONCLUSION

The purpose of this paper was to investigate how to implement and what approach to be used in order to implement in Indian automotive industry manufacturer. The findings from the interview session with semi-structured and open-ended questionnaire shows that the case study company used the project based approach in implementing lean manufacturing. They form a team with five full-time members, and applied fuzzy Topsis, and did the continuous improvements effort until the ranking order found. In their LEAN TOOLS AND TECHNIQUES implementation project, they focus on reducing the level of inventory as the mother of the other wastes. After they reduce the inventory level, the other wastes has been highlighted and continuously reduce. The other wastes are over production, waiting times, excessive transportation, excessive processing, excessive motion, and defected products. In order to conduct the lean manufacturing projects, they have full support and clear direction from top management level especially from their president of the company. They have proper planning through their LEAN TOOLS AND TECHNIQUES approach and implemented by the five full-time members that produce the full-time results. They follow the same approach in another area after having completed the first LEAN TOOLS AND TECHNIQUES implementation project. As a result of LEAN TOOLS AND TECHNIQUES implementation effort by this case study company, in year 2014 this company has been awarded as corporate - Engine of the year - Honda eco technology (HET) 1000cc engine Sedan of The Year - Honda City. As a lean production system model company, this company has become a reference and role model in implementing lean manufacturing for other manufacturing companies in India. Future work will involve presenting the next stage of LEAN TOOLS AND TECHNIQUES implementation approach by this company towards sustaining lean manufacturing implementation.

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Manish Tiwari "Effectiveness of Lean Tools and Technique in Automobile Industries."IOSR Journal of Engineering (IOSRJEN), vol. 08, no. 5, 2018, pp. 35-42.