

# Wastes in Lean Production Systems

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**Abstract:** In any production system, wastes is something which is not adding value to the system and these are basically the operations named as non-value added operations or activities. However, it has been observed that the most of the time, the communal always considers wastes as the typical scraps in any lean production system. Hence, the authors of this research study have conducted a literature review which explains about the typical wastes acting in any lean production systems which are seven in number and named as over production, over waiting, over transportation, over motion, over inventory, defects and over processing. Moreover, it has been observed that the underutilization of employees is also considered as the one of the wastes which was previously not in the list seven wastes and considered as the eight leading wastes. The input of this literature study is the explanation of eight wastes affecting the system which will be helpful for communal to understand and explain wastes affecting systems.

**Key words:** Lean manufacturing; Wastes in lean manufacturing, Literature Review, Wastes understanding

## I. INTRODUCTION

For fulfilling the need of reducing useless activities and to strive for steady up gradation, Lean manufacturing is the best tool which overcome this need Moyano-Fuentes and Sacristan-Diaz [1]. After World War II, The concept of lean was first discovered when the Japanese had faced financial crisis in manufacturing sector due to deficiency in demand of automobiles and supreme car manufacturers like Toyota bear great lose, when there were majority of unsold cars in inventory and market got seriously infected. Due to business slump their economy was in its worst time and seriously devastated then Japan first time introduced Lean Manufacturing to normalize there country's economy [2]. Market behavior and large inventories result in financial decline and limitation of space which further allowed the company to buy new equipment furnished with modern technologies and to produce new varieties of cars [3,4]. The main concern of lean manufacturing is to focuses on minimization of wastes, which increase desirability for customers by completely implementing all the functions that

**Revised Manuscript Received on June 05, 2019**

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adds worth to the finished product [6]. According to customer perception, the works that are not only fulfils the requirement as per quality standards but also increase customer satisfaction which allows the customer to pay for that, that are known as value added works [7]. In order to add different activities that are coupled with industrial companies, different researches had been done focusing on the key concepts of waste minimization [5,8-12] but Taiichi Ohno of Toyota has to be considered as a pioneer of Lean manufacturing whose idea first observe and described about the wastes [8].

Depending upon the type of manufacturing units; Waste types, that control the production system varies accordingly. Al though, in general Lean Guru Taiichi Ohno introduce seven most common waste that are to be studied in view, [6,8,13,14]. After identifying and working on these wastes, Liker [9] declared in their research work that the improper usage of employees, talent and efforts in the organizations which are commonly working on conventional manufacturing systems as a new waste, which would be named as underutilization of employees which become a basis of new term of knowledge that focuses many researchers do to further research on that topic [12,15,16]. Furthermore, one more waste has been investigated by Gibbons et al. 2012 that is analogous to and underuse of resources. Un-optimized procurement and un-necessary internal management are the two wastes that re linked with the procurement, has been analyzed by Deign (2016). Different wastes that may analogous to resources are, Over processing, Over motion, Over production, Over transportation, Over inventory, Over waiting, Waste of defective products, Underutilization of Resources, Underutilization of employees, Unnecessary internal management, Un-optimized Procurement. However, Sarkar [17] in their research work concluded that all sectors like manufacturing and services contains the aforementioned wastes. However, Underutilization of Resources, Un-optimized Procurement, Unnecessary internal management are linked with the procurement rather than manufacturing, so the author has desired to depicts the 8 most common wastes as mentioned below. Previous researches become basis of providing the detail study and the conclusions which are related to each of the eight waste. As explained below that the inadequacy of regularized flow among operations or in accurate layouts are responsible for Over transportation, Over motion and these problems have been overcome by using cell based manufacturing [7].

## II. METHODOLOGY

The methodology of this research is a literature review which first discusses about the basic concept of lean manufacturing and then further discusses about the



wastes affecting in any system. In order to perform this literature review, the authors of this study has utilized previous researches and portals Taylor & Francis, Emerald, Sage journals, Elsevier and may more. The common keywords that has been punched to search the right data are lean manufacturing, wastes in lean manufacturing and after wards each and every wastes has been searched individually to attain the right result. The results attained are as mentioned in Section 3.

### III. RESULTS

First of all, the definition of over transportation was first given by Karlsson and Ahlstrom [7] in their exploration work concluded that all the unnecessary transportations which are not beneficial for the system and also increasing production time like supplies and work in process comes under over transportation. Karlsson and Ahlstrom [7] moreover added that incomplete layouts in plants is the source of the unnecessary transportation. In order to minimize transportation, Askin and Goldberg [13] recommended that shipment areas and the site storage should be close to each other that lessens the transportation time as well as the cost. Furthermore, cell based layouts and grouped layout can be most effective to reduce transportation. Higher transportation issues rise due to designing of plants as per functional in spite of product basis noticed in most of the layouts, Slack, et al. [18]. On the basis of this, the researchers concluded that with an objective of less transportation of product; lean manufacturing is most effective tool that can control and regularized the flow of products between different workstations as possible by assembling product in lined with product families [19]. Moreover, over motion wastes and variance between resources can be minimized by managing over transportation wastes [20].

Askin and Goldberg [13] gave the definition of over motion in their research study as the type of motion that are not effective for the system but actually spending more time and energy without any outcome. Motion of people or movement of material different between work stations which is not effective and finding of tools for processes etc. are the most common examples of over motion, [15,21]. Precautionary measure have to be taken while modifying or installing work places, operational setups, operational procedures, and processes in order to minimize this waste. So, it has been noted that the from manual type assembly to the right selection of fixtures and machines, reduction of overall set up time for each machine, reducing the waste and to minimize the complete framework time for each machine or operation are helpful in minimizing over motion related wastes.

When the number of finish product become more than the production limit the remaining products will go to inventory adds the production cost and become a cause of waste known as over production, which is observed as one of the major waste among all the wastes and because it has a potential to grow all other wastes [22]. Previously, on the basis of production quantity which not only contains usage of resources but also crowded the production unit; from these views, the managers of any production plant were judge. Subsequently, it would be considered as one of the major waste and the manufacturing companies focusing to overcome

that waste by producing the products as per customer requirement [23]. Forecasting is the main cause for over production as observed and according to exact demand it is inappropriate to predict customer requirement, which is a source of over production [24]. Thus in order to get rid of this problem, manufacturing companies follows lean manufacturing concept through make to order production concept [25]. It take too much time to implement this waste management technique but can be executed by using some lean applying tools [19].

Keeping parts and products at warehouse which adds cost to the system become a source of over inventory [15]. If the product that are being manufactured took some time for their turn to move to next process is commonly comes under inventory and, different studies have been done to optimized this situation, [23]. Although, it is suggested to first find out the basis of over inventory and then minimize it up to as much as it is possible [7] for that purpose, struggle should be made. The main objective of Lean manufacturing is to decrease inventory as it is favorable for minimizing issues related to over production and manages unnecessary variations in plant [18]. Work in process and part storages are common type of over inventory and irrespective of location of the production line, these types are considered as significant parameters leading to poor plant performance [18].

Over waiting wastes depicts the wastage of time that includes time taken by the material to arrive to the next work station, processing of materials, work performed by labor on machines, late delivery etc. [10,19]. It has been further investigated that over waiting also includes the waiting of products in stores, which need to be allocated in plant and become a source of leading problem among plant as well as, one of the major drawback of this waste is the waiting of information among the members working in supply chain department of the plant and which become a basis of serious retardation among supplies and dispatchment that must be resolved to achieve smooth lean implementation [26,27]

Extra consumption of resources and energy that add the production cost or increase production time lies under waste namely, over processing waste. The use of resources that will not take part in enhancing the quality of the product [28]. This type of waste is minimized by continuous assessment on plant operations and processes that are not adding value to finish product and need proper consideration from the management and experts, altering plant processes through practical arrangement, minimizing unnecessary limits, altering process layout, analyzing designing of product and detailed study on process plans [13,19,28]. The use of improper mechanism and extra usage of resources can be viewed as over processing [3,12,29]. Value stream mapping, which is the proper selection of processing steps need to be taken during the production process. That has been utilized for decreasing the over processing waste in operations [14,25,30].

Quality is the essence of a manufacturing company. Every manufacturing company striving towards continuous product quality. If the quality of the product will not meet with the design standards. That product will consider as a waste. The faulty products



are viewed to be a useless which does not add significant outcome to the network [7]. The faulty product shall be reprocessed in order to make it in working condition which require the consumption of resources during fabrication and that adds the cost of product. In literature of lean manufacturing, the best method to eliminate the waste of faulty products is to conduct the feasibility study which helps to identify the main symptom that is linked up with the quality issues [3]. Moreover, in production units, the whole lot have been replaced if one of product does not meet the quality standard, which become a big loss for the plant in term of resources, time to meet the demand, energy that must be determined and eliminated [29]. Underutilization of employees are the deficiencies of using the right skills of people, expertise, thinking and relatively fails to appreciate the people or employees capability [9,16]. Taiichi Ohno [8] does not introduce it as a waste among of his seven wastes, although, Liker [9] in his research inferred it as eight form of waste that is accepted worldwide and has become eighth form of waste [12,15,16,21]. Some other major parameters consist of inadequate transferring of information and bad management of people that results in poor control of material, equipment, and capital are assumed to be some of the essential cause of this waste [31, 32].

#### IV. DISCUSSION

The useless motion that leads to spending more time as well as energies is the main cause of over motion and it can be diminish through proper and careful choosing of fixtures, machines and assemblies. Furthermore, over production, that defines producing more than the demands is the most significant waste [23] and can be minimized through appropriate estimation and by implementing the concept of make order as recommended by Abdulmalek and Rajgopal [25] in their research work. Moreover, over inventory is due to excessive overproduction some time that has many adverse effects on manufacturing system according to Karlsson and Ahlstrom [7] through proper identification of the problem an important action should be taken to decrease that waste. After over production, waiting time also referred as over waiting of material is the main waste that effects the production system. By use of modern operations and latest technologies in lean practices the given waste can be minimized as described by Chen, et al. [33] in their research work. Over processing is also considered as a major waste which is more linked with the manufacturing process and can be lessen by employing real time practices like changing of process layout [13,19,28]. over defects wastes, which is more analogous to the quality is the next waste that may damage the production system J. P. Womack and D. T. Jones [3] concluded in their study that this waste can be lower by first determining and studying the parameters that can cause decrease in quality and then attempts should be carried out to overcome that waste. Bad management of people is result of underutilization of employees is the last waste which give rise to poor controlling of material, equipment, and capitals [31,32]. Thereafter, lean executing methods are employed to determine and turn down these wastes.

#### V. CONCLUSION

In common language wastes are scraps and extravagance in any system, however, in production systems wastes are non-value add activities and operations which are increasing the cost and not beneficial for internal and external customers. In order to understand these non-value added activities the experts of this field has segregated the wastes into eight different types named as over production, over waiting, over transportation, over motion, over inventory, defects, over processing and employees underutilization. This literature study has enlightened and explained these wastes in light of previous research available. The literature elaborates that over production is something excess in production which certainly results in over inventory. It is very important to understand that the inventory which is required in any system is not waste however, over inventory of any thing is actually the waste. Moreover, excess in operations in any system is over processing and unnecessary travel of goods in operations is over transportation. Unnecessary travel of employees in any system is over motion and all of these in combination results in over waiting commonly. Furthermore, it has been observed that it is always ideal to have production with zero defects but realistically it's not possible in any system. However, unnecessary defects certainly effects cost of any system and considered as wastes. Last but not the least is the underutilization of employees in any system is considered as wastes as it is a lack of management which is not capable to utilize his employees and the system is paying for that. Summarily, wastes in production are different from normal wastes and are not acceptable in any plant.

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