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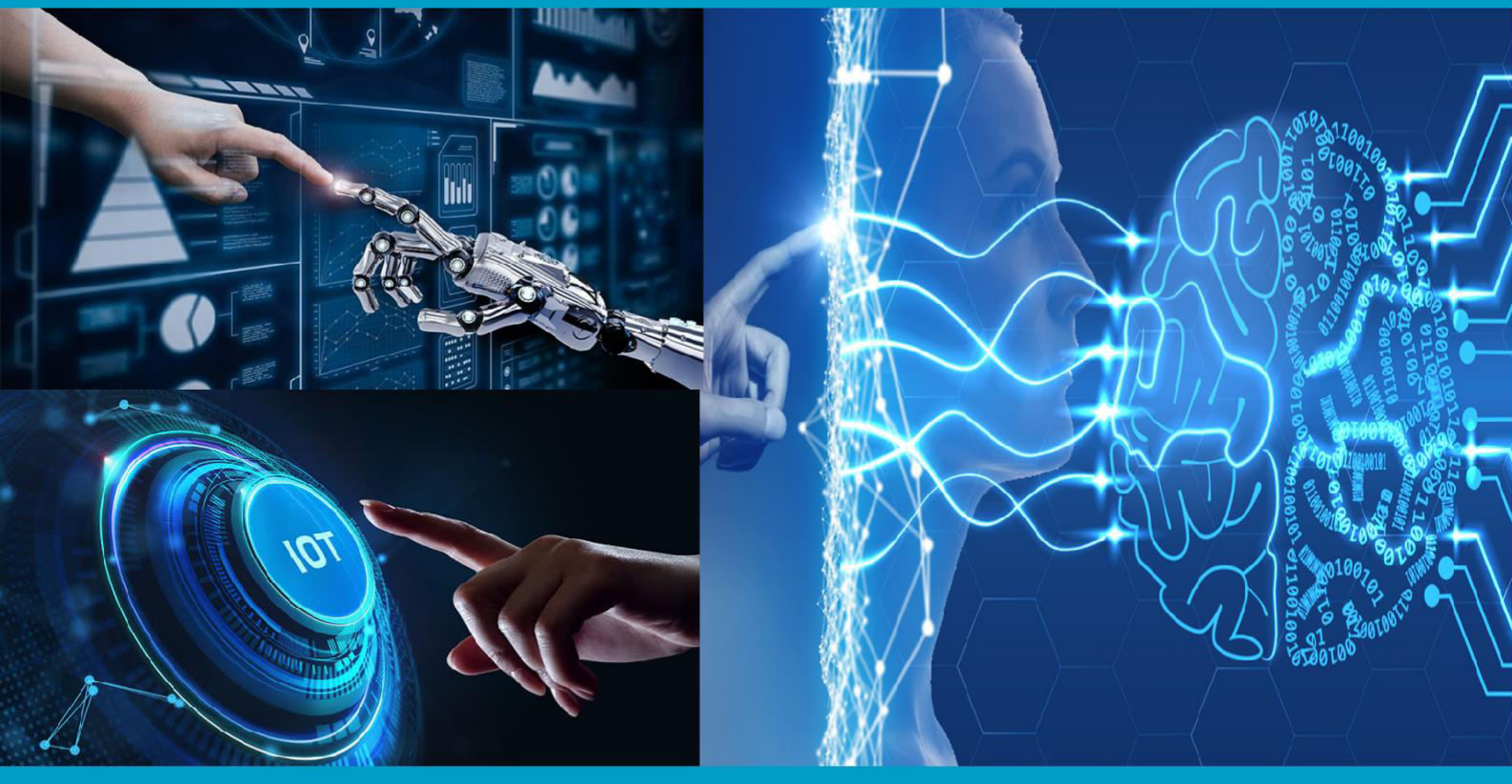

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Lean Manufacturing: A Comprehensive Research

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ABSTRACT: Today, automotive suppliers are concerned with improving quality and delivery while lowering costs, which leads to increased system productivity. To remain competitive, waste from the value stream must be identified and eliminated in order to run the system as efficiently as possible.A production is to order, and a large number of different products, each in relatively small volume, are produced. A production shop is made up of a number of machine centers, each with a distinct activity. Machine shop issues include late deliveries, long lines, and high work in process inventories, and also in the improper utilization. These issues raise the overall cost of production. Demand for the customized products/parts with shorter lead times, for the requirement for global competitiveness, necessitates the production of products/parts in small batch sizes as specified by the customer.Processing in small batch sizes necessitates a change in the flow of production through various processes based on their processing speeds. Furthermore, close monitoring of processes is required to reduce process variability (defect free production), efficient planned maintenance of all machines (for increased availability), and reduction in non-value-added activities such as setup times, material movement between work processes, and additional material processing.The efficient use of machines while producing in small batches reduces WIP inventories, throughput times, and lead times, resulting in competitive manufacturing. The machine shop manufacturing system must adopt a lean environment.In this industry, we focus on the VSM tool to improve productivity by identifying waste and then eliminating it through the application of lean principles. This processallows a company for takeout and eliminate waste, streamlining work processes, reducing lead times, lowering costs, and increasing quality and thus productivity. VSM's goal is to identify, demonstrate, and reduce waste in the process, highlighting new ideas to improve that will have the greatest impact on the overall production system. In this study, lean concepts are introduced in the processes using VSM.

KEYWORDS: VSM's,Lean Manufacturing, Productivity,

I. INTRODUCTION

After the world war had stop many problems comes all over the area also to the Japan manufactures due to have less material, money, and workers. The problems are everywhere after the World war all around the world but the problems in front the Japan manufactures are not similar to other countries. These situations solution comes in form of “Lean” that is the concept of manufacturing. A company named as Toyota motor, directed by head of the company and got that the manufactures in the America of the 100 years makes the same parts like a competition to Japanese parts. In the between 1939-1940, western makers are leading in the counterparts that the Japan was making. In view to resolve the problems that the Japan manufactures are facing Japan executives like as Asmoko Sinikawa, Yoshide muoga, Amitio Mocho, revised a good, well-planned processed system, that is called now a days as “Toyota Production System,” or “Lean Manufacturing”. Taichi Ohno, to whom a work was given to gain the efficiency of Toyota is all around the universe as a drive mechanism at the other side of the system Konho took it from other countries, similarly from the Tom Ford’s Novel “Now and Then”. Toyota manufacturing system was done on another industry of regularly used material. Toyota manufacturing system came in world and started in the middle of 1944 and 1972 following many trials, so that was quite get larger now a days far and wide. The elementary proposal on the side of organization is to make smaller the utilization of assets that fill none according to the part that is manufactured.

Now a days when we compete with fast growing market, US manufacturers have realised that the concept we had followed since many years must be adapted to new lean manufacturing ideas. A study conducted at the Sant Kabir Institute of Technology and Management on the transition production of huge or massive to lean manufacturing, as described in the book "The technology that change the world" by Stomacho and Ronacco (1996), jolted US manufacturers awake. The study highlighted Toyota's great success at SESP (Stimulated Engines Specifications Programme) and highlighted the huge gap that is remained from many years between Western countries and the other countries. Because the companies of Japangrowing, manufactured, or allocated products with half or less labour expense, investment of money, area of floor, equipments, raw material, time, and all other expense, the ideas were transformed in the United States.

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Principles of Lean Manufacturing

The manufacturing of Lean focuses on minimizing waste during providing good dimension products at the cheapest possible value to both the manufacturer and the consumer. Lean techniques almost always come in significant environmental advantages. Lean manufacturing is a managed philosophy that aim on decreasingthe seven wastes in newly prepared products (overproduction, waiting time, transportation, over-processing, inventory, speed, and bad material). Quality of a product increase, production time is reduced, and costs are reduced by eliminating waste. Lean "tools" include continuous process analysis (kaizen), "pull" production (via kanban), and mistake-proofing (poke yoke).

One critical realization is that the group of costs are analyzed when a product is designed. An engineer will normally specify familiar, safe materials and processes over inexpensive, efficient ones. This reduces overall risk of the project, i.e. the engineer's cost, while increasing money risks and decreasing profits. To research older designs of the product, good industries search and review checklists. Burton and Border (2003) suggested the following five lean manufacturing principles:

1. Specific values from the customer's point of view for both products and services.
2. Determine the value stream for products and services and eliminate non-value-added waste along the value chain.
3. First clearly make sure that the product and services flow uninterrupted through all the process of the value chain.
4. Authorize the production of products and services based on customer demand.
5. Strive for perfection by constantly removing waste later.

Thus, lean is essentially about getting the required steps to the right place, at the right time, in the right quantity, while minimizing waste and remaining flexible and adaptable.

World competition and Lean Manufacturing

Manufacturing is undergoing radical transformations as a result of universalcompetition and customer needs. As a result, companies around the world that recognize the value of being a member of the universe market are looking for operational methods to boost its power of competition throghout the use of inventive manufacturing systems. Traditional manufacturing paradigms are under attack, and newly manufacturing rules are emerging. Lean manufacturing, world-class manufacturing, and agile manufacturing are terms that have emerged. Firms have placed a greater emphasis on delivering products that customers' needs quicker than their competitors and meeting or exceeding "best-in-class" quality standards.

As we also know that the many manufactures have many competitors all over the world and have a competition between them, competition from lower grade countries, and faltering home economies, many have turned to the lean philosophy to reap the benefits of eliminating non-value-added waste through the value chain, which positively impacts profitability and create value for customers, leading to a competitive advantage.

The majority of organizations are either in the process of making lean thinking or are considering doing also. What is it about this obsession with lean thinking that has such a strong impact on organizations? In short, the advantages of cancelling non-value-added waste throughout the value chain are significant because it improves profitability and creates good value for customers, which leads to a competitive advantage. An organization's financial performance can be influenced from both a cost and a growth standpoint. Now a days economy, mostly organizations have demonstrated the ability to generate double-digit sales growth. As a result, the focus has shifted to increasing gross margins through cost reduction. There is a huge amount of untapped cost savings that is able to be generated by cancelling waste across value streams. We know that it is separate than others to find value added content ratios that are varies from 5 to 30% in value stream components. That means we have a chance to eliminate 70 to 95% of the not required material in value chain. There are some benefits of lean as stated by Burton and Border (2003):

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Table 1 Lean Benefits

Elements	Benefits
Capacity	10 to 20% gains in capacity by optimizing bottlenecks
Inventory	Reduction of 30 to 40 % in inventory
Cycle time	Throughput time reduced by 50 to 75%
Lead time	Reduction of 40%in order fulfillment
Product development time	Reduction of 25 to 30% in development time
Space	25 to 30% gain space reduction
First-pass yield	5 to 15% increase in first-pass yield
Service	Delivery performance of 89%

Lean Manufacturing Trick and Equipment's

In the below figure we shown some lean tools and methods about which we talk in this file with diagram carefully. These lean tools are:

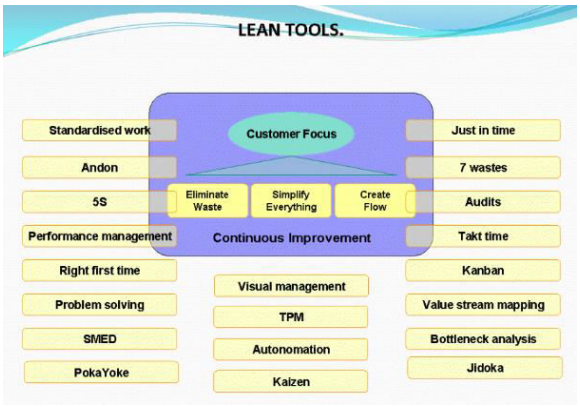

Figure 1: Lean tools

Total Productive Maintenance

Total Productive Maintenance is an industrial process that was founded by the Japanese Engineer Seiichi Nakajima in around 1970. It is normally a way for increases the no of products production in an industry and the good skill of a worker good making process, to the well maintained and continuously planting its eight main steps of a support. The main goal of this process to give well situations for a process that is capable to control in a systematic path and with no more errors. It is mainly use for decrease the failures and errors and advertise total productive maintenance. Also, it also includes that the equipment is also in a good condition because if the equipment works properly than the error does not come and quality of pieces that are made is also perfect and ensure "no failures", "no defects", "no breaks". Also, this process works for making beneficiary contact among worker, product and machine to lessen failures in a process. This is possible only when the employee works with honesty and concentration during working on a machine because if the worker works with hos full concentration, then there will be a less chance of error on a product. The TPM is called as a philosophy which is used for making a perfect production in an industry. By this capital of an industry increases and the efficiency and perfection of a worker is also increases.

Kaizen

Kaizen also we named it as fastest improvement process also known as the foundation of mostly methods that are used in manufacturing of lean. The main work or we can say ambition of these process for reduce or decrease less the time

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which is wasted in an industry during making process of the product. How can we reduce a time in a production and make production easy to process and making a production easier than earlier for futuristic work. The small changes that are normally done and comes in a good result with good improvements. This is like a process that brings all employees at working area in industry to resolve a problem and make a process efficient. The employees of the industry that analyze the techniques called to mapping to stream to the value to with high acceleration that classify possibility of waste elimination in a distinct process. Employees who are working company works quickly to implement selected changed with a bettermainly focuses on methods that has not need or want huge outline of the money. The holy grail of periodic look into events want to make perfect that the kaizen blitz refinement is encourage due to the worktime. Generally, we used this technology to contrivance the majority different from normal used methods.

In 5s phenomenon for reducing bad or we can say the material that we do not need and increasing the efficiency of the industry by keeping the workplace clean are the SS pillars that organize, clean, develop, and sustain an environment which is known a productive. The discipline that remains an industry or organization and lines of the orders are very difficult to the planeand the involved all techniques used in a company's daily work. This method about which we are talking in this thesis motivates employees to improve their working conditions and supports their efforts to overcome shrink in time, the time which is not planned before, and the processing inventory. SS lays the all history of the method that are used in manufacturing of lean known as maintenance of total productive, grounded technology, just-in-time production, and Sigma of the Six.

For Production Smoothing

In order to decrease the unused material in a lean manufacturing department, that was very critical to shift to the higher process of control. Production smoothing is another tool for accomplishing this. Ashinjuka is called as a fact that is used in manufacturing of Toyota system, which translates to "production smoothing," refers to manufacturers' efforts to keep production levels as consistent possibility to complete it in everyday,Ashinjuka is called as a fact that is used in which it is mandatory that we should not make more cars and also, we need not to make the part of that cars for lessen the production costs. To support this, the timing of the production must be smooth in a way to make more products than the required quantity of products while utilizing manpower efficiently.

Just in time Production Kanban/Process

The manufacturing of cellular and just in the time processes are inextricably linked, a layout of the production of cellular is usually required to achieve the production at a time that is seemed to be done. JIT takes advantage of layout of the manufacturing that is cellular to drastically lessen the discovery and work-in-process (WIP). JIT suggest to the industry for making a product according to the demand of its customers and the quality what the customer want, and in the quantities they desire. JIT techniques level production by spreading it thoroughly according to time and promote a regular and continuous rate to the process. Changing the product that are mixed because they made on the same machine, also known as kasha-biald production, is an efficient way to achieve the desired production mix. Physical clues which are founded currently and are frequently used in JIT process says that the new raw material in an industry put in advance to reduce the waste of time due to shortage of material. Kanban is frequently used with a limited number of the containers that are used twice, ensuring that only what is required is produced. In most of the companies the process of manufacturing of lean used that also need the product supplier that supply the material to the industry on-demand. The company alerts its suppliers, either through computers or after showing that the boxes are empty, and industry needs more material for making a specific component when it is required. As the last the result comes that waste is diminished to the unnecessary inventory, WIP, and overproduction is typically reduced significantly.

JIT has several advantages, including:

- It eliminates unnecessary work-in-process, resulting in lower inventory costs.
- Because the commodity is made when it is required or demanded by the customers, quality failures can be founded early.
- Because inventory is reduced, storage space is saved.
- Preventing excess production can reveal hidden problems.

Single piece flow systems

In this work, units are arranged in a sequence that allows raw goods and different parts of the machine to flow easily during the manufacturing of a product for avoiding a increasing in time due to delay. Whether we can not move many product respect to other product to the same machine to make less process time (as in batch-and-queue or large-high productivity) a process by which single piece is used in manufacturing in which the product we shift from one place to another, at a sequence that is assumed by the needs of the customer. This type of process of manufacturing businesses

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the freedom to change product types or the advantages that are given to the line at which the process are doing changing customer demands. For making a separate or distinct design a company must frequently replace large, machine that has high efficiency to low efficiency machines, flexible, "right-sized" machines that fit well within the process "cell." Using a technique known as automation, equipment is frequently designed according to the work hard or normal. Worker should work on more than one machine after applying this process. While plant-floor employees may be required to load and unload the parts at the start or at the end of the process according to the timing and need of the work.

Other waste decreasing techniques

Zero defects, setup reduction, and line balancing are another techniques that used in waste reduction tools. The main aim of none defects is to make permanent that products are fault-free because of the process of making the line through continuous improvement. Humans will almost always make mistakes. When errors occur and are not detected, defective parts appear when the process was going to finish. However, if errors can be avoided before they occur, defective parts can be avoided. Poka-yoke is the famous tools used by the zero-defect principle. Shingo's Poka-yoke is an autonomous defect control system that is installed on a machine and inspects all parts to ensure that there are no defects. Poka-goal yoke's is to observe defective parts at the source, identify the source of the defect, and avoid moving the defective part to the next workstation. SMED was invented by the man named as Ohonomo in the company Toyota in 1950. Ohno's want to make a concept in which the time which is used to fix the dies in machine they took less time and fixed more quickly. At the end of the year in 1950s, Ohno had reduced the time that is five minutes less than the previous time that is wasted to fix the die. Generally, the main aim behind the process SMED to lessen the machine setup time. The configurations in the SMED we know that are of two types: internal and external.Internal process is called as the process that we do when the machine is at its rest position or the machine is switch off, whereas the activity named as external is done when we are working on a machine or we can say when the machine is in moving position. This entire process is done to change many and many processes from within to without. Following the identification of all activities, the next step is to attempt to simplify these activities (e.g., standardize setup, use fewer bolts). Many advantages can be realized by reducing setup time. First and foremost, die-change specialists are not required. Production with the less quantity reduces inventory while allowing for a larger types of pieces mix. Line balancing is regarded as a powerful weapon against waste, particularly worker waste. The goal is for each workstation to produce the appropriate amount of work that is continuously transmitted to upstream workstations. By this we can say each workstationoperates in synchrony, neither faster nor slower than other workstations.

Work Standardization

When we start standardize the actions that the worker are using is a critical waste elimination principle. Main job about which we are talking believes people that each job that was organized and completed with no objection also by good route the job is done. The quantity which we expect is fulfilled by regardless of the person who is working in an industry. Every employee at Toyota doing the match set of procedures all mean and minds. By this the time that is required for finishing a process, the sequence that following the procedure to take for each job, whereas the pieces are made. By this we manage the process known as line balancing is good, unnecessary inspection or checking that are done in process by which work is completed, and non-value-added activities are reduced The term "takt" timing gone by which it is calculated to do a product in sequence. Takt time shows the process how frequently the parts are made by conducting a survey in public according to their demands that are made by the customers. The company's thinks it make the products that is no faster than that time about which we are talking about (Mid-America Institute of the Technology Manufacturer release, 2000).

Six Sigma

At the earlier times nearest to 1990, Motorola developed it like a system and pair of statistical techniques for observing the processes in the way by which we can stop any up and down in process variation. Sigma is a Greekish word that show us the change in the process. The level of the term Sigma indicates the likelihood of failures coming out during the process. Quality if the term Six Sigma is defined as 3.4 failures respect to the thousands, representing better finishing and low disturbance in the process. Some businesses that are implemented in these types of areas are leveraging Six Sigma's equipment thatwe use to control this process also the ways to drive further productivity and the changes that are made to make great change in quality. Considering a thing in mind that not all companies use lean manufacturing systems or some of other lean methods.

Value Stream Processing

It is known as a visualization tool based on Toyota's company. It assists in understanding and streamlining work processes by utilizing tools and methods from Lean Manufacturing. VSM is done by finding a clear process,

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demonstrating, and reducing waste. The term "waste" refers by which there is no benefit to the final product and is frequently for showing and reduce "waste" in the whole process by which a product is manufactured. So we can say the term VSM can be taken for helping all of the suppliers of the industry, management of company, customers of company in identifying and determining main problem of waste. We use this process because it is simple in use and give less waste in the process. VSM can provide an answer to the question, "How can we improve our process regularly to reduce waste in a easy manner?". It is use because it identifies the current state of the process also future state while manufacturing. By this the position of the users is known by them and which wasteful actions should be avoided. The outcome, VSM serves earliest or we can say Earl step in putting lean thinking into practice by providing a "map" by which we plan a process in order to apply all rules of the lean during the manufacturing. The user then employs al the techniques that are written in lean manufacturing achieve the desired result. This tool will bethoroughlyexamined in the following chapter. ideal situation.

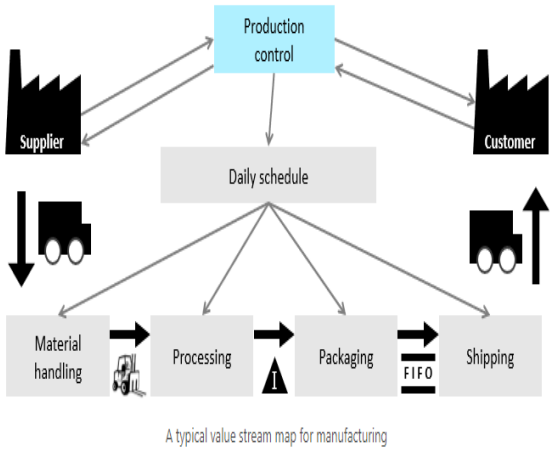

Fig. 2: VSM Process

II. BACKGROUND

Hines discuss the significant evolution of lean since the pioneering work on the machine that brought about many changes in the world.2006).They discovered the difference between tactical lean production and strategic lean thinking. It is essential to comprehend lean as a whole in order to apply the appropriate methods. strategies and tools for adding value to customers. It is generally agreed that being lean is more beneficial. The LM's limitations have been highlighted by some researchers. Batch production has long-term value in terms of work design and manufacturing process, according to Cooney (2004).Bhanu and Bhander (2006) identified the root causes of low rates of successful lean initiatives and discovered that the adaptation is still difficult.

Holweg etal. (1979) The term lean manufacturing increases the value to Toyota system that is a production system by giving the term called as enterprise-wide by which we manage the customers, by which the development process of the product we manage and we also manage the supplier by this.

Hallgren and Olhager et al. (1980) It is known as a programme aimed primarily at increasing operational efficiency.
Taj and Morosan et al. (1981) A multi-dimensional strategy that improves all the operations that are used in manufacturing process by which the quality of the product becomes good and cost in manufacturing the product become less with a minimum waste during the process.

Alves and colleagues et al. (1984) This type of production is demonstrated as like as model in which individuals assume the main work of its assumptions and its participation promotes the continuous improvement and provides businesses with probability that about they require need to deal with demand of customers and environmental changes both at present and in future.
Ward and Shah et al. (1985) Lean process is known as the process which manages the industry that focuses on finding the problem in process and solution of that problem throughout the allover pieces that are made, that are not passing through the organization and not only passing about the organization.

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Power and Simpson et al. (1987) This is a system in which the main moto is that to make a system un which all processes are organized and by which the production will increase. In this system wee improve ourselves regularly to stop the waste in the manufacturing.

Naylor and colleagues et al. (1989) Leanness entails creating a process known as stream of value to diminish unwanted material, consumption of time, maintain a consistent schedule.
Krafcik et al. (1990) In comparison to mass production, in this labor cost is half compared to that, and the area required for manufacturing is also very less, investment in the tools is less compared to that, and the manufacturing time is also less while making a new piece in half the time. It also necessitates to have divide by two than that of the required inspection to the hand, shows good outcome in far some of the problems, output is wider and ever-expanding range of products.

Jones and Womack et al. (1996) Defines as the process which defines a systematic way that uses fewer inputs overall to produce the required result as a system which we are using from many of the decades providing more variety to consumer.
Jones and Womack et al. (1999) Production made by lean manufacturing method is different from all methods that combines distinct tools, methods, and ideas that are for managing for the improvement of the piece, management of the suppliersand the management in which the operations are observed in cohesive whole.

Cooper et al. (1999) Lean process is showed in most of the industries like aim to competes on other industries in which the new techniques are used to lessen the waste rather than avoiding competition, confronts it head-on.

Pisano and Hayes et al. (2000) In a nutshell, we call this process as a lean because in this process the cost is very low during the operations and in this we use least quantity of everything that needs to make a piece by this method and provide a service.

Dankbaar et al. (2001) This process makes the best use of workers' skills by assigning them multiple tasks, by giving them easy and difficult work, and motivate them regularly. Hence, compared to oldest mass production, this may produce a wider range of products in the minimum cost other than and in a superior quality with fewer inputs: minimum number of workers required, space for fitting the machine and doing operations is also less required, and less material.

Mathaisel and Comm et al. (2001) It is known as philosophy whose motive is to make less costs and cycle time of the process in the whole value map by improving the working of the product. Many of the links are used to make this value chain. In the industries and in the government they are exist at the both.

Ward and Shah et.al (2003) In the industries a great method that is known as lean provides maximum value to customers after clearing the waste that comes out from process. This method has evolved into a system that is a compressed system comprised of highly interconnected elements and a wide range of management practices such as systems in which quality is concerned, and so on.

III. VALUE STREAM MAPPING

From about 1890 to about 1920, early industrial engineers began mapping work processes. Frederick Taylor created standardized work and time studies during this time period. Gilberth invented the first process mapping system, which was originally known as "process charting." Gilberth saw all work as a process and created the symbols and also conventions we had used since decades widely used, as described by Lee and Snyder (2006).

Ralph M. Barnes codified the principles and method of time study and motion economy in the 1930s and 1940s. During the same time period, Allan H. Mogensen incorporated much of this early work into his "Work Simplification" system. Work simplification promoted the use of Gilberth's charting technique and popularized it.

Mike had long sought path that was created by himself to connect lean concepts also the tricks those are seemed more disparate than they should be as he worked on many plant floor implementation efforts in the 1990s. He recognized that mapping had far-reaching potential, formalized the tool, and created an extremely successful training method around it. John, a Toyota employee, has been known tool for over ten years. Mike and John both created and popularized the amazing technique known as mapping of the value stream with their book "learning to see."

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VSM is now used in offices, hospitals, construction, the aerospace industry, and as an environmental tool kit.
During the 1950s and 1960s, Toyota realized that they are truly refine production methods, it was necessary to respect its workforce's knowledge and expertise and use these skills to help develop and refine the end-to-end process for making a vehicle that the average person could afford while also being reliable. Shigeo Shingo used these techniques at the production system known as Toyota which began migrating to the west around 1980 and became known as "Lean Manufacturing" after James P. Womack and Daniel T. Jones published their magazine “World changing machine."

Activities involved in Value Stream Mapping

It is necessary to define Value and Value Stream before delving into the definition of VSM. Focus on the value that the customer/end-user is willing to pay for. To carry out this activity, the company must first understand the customer's requirements for features and performance, as well as how much they are willing to pay for the product. This activity provides a clear picture of what products the customer requires. These requirements may not be immediately feasible, but they accurately represent customer demand. The value stream includes the entire product development process. The value chain starts with the concept and ends with customer delivery. Every stage of the product's life cycle should add value to it, but this is not always the case. Mapping the value stream aids in the identification of value-added and non-value-added (i.e. waste) activities; examples are provided below.

The value stream encompasses both value-added and non-value-added activities that are required to take a product from raw material to customer delivery. In other words, VSM is a diagram of the manufacturing life cycle of a product that identifies each step of the manufacturing process. VSM is the only tool that can effectively outline and distinguish the true value of a product.

The utility and simplicity of value-stream mapping are what make it so appealing. VSM helps to answer the question, "How do we continuously improve in a capable, sustainable manner?" VSM is a map that depicts a manufacturing system's current and future state, allowing users to see where they are and what wasteful acts need to be eliminated. VSM method is a visualization tool based on Toyota's Lean Manufacturing methodology (Toyota Production System). It facilitates the understanding and streamlining of work processes by utilizing Lean Manufacturing tools and techniques. Main motive of the vsm is to find, demonstrate, and reduce waste throughout the process. . Waste is defined as any activity that have no benefits to the final product and is frequently used in manufacturing systems to demonstrate and reduce the amount of 'waste.' Hence, VSM requires to assist management, engineers, production associates, schedulers, suppliers, and customers in identifying waste and determining its causes. The current state of the value stream map is drawn to clearly visualize all types of waste in the value stream; waste throughout the stream must be identified and eliminated to reduce lead time and increase value-added percentage - in other words, to shift the production system from batch and push to one-piece flow and pull. Understanding the seven non-value-added elements identified by Hines and Rich (1996) is the only way to identify waste: overproduction, inventory, transportation, waiting, motion, inappropriate processing, and correction (re-work).

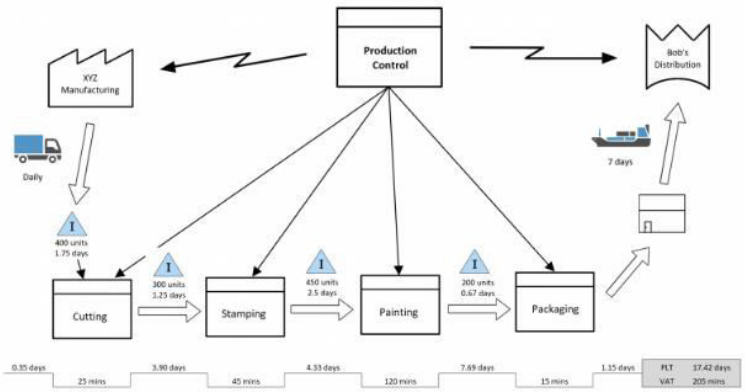

Fig. 3: Production Control

On the current-state map, all seven elements can be identified (if they exist). A list of these, as well as a discussion of them, is provided below:

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Overproduction
Overproduction is considered the most serious waste because it prevents the smooth flow of goods or services and is likely to impair quality and productivity. Overproduction also tends to result in long lead and storage times. As a result, defects may not be detected early, products may degrade, and artificial work rate pressures may be generated. Furthermore, overproduction results in excessive work-in-progress stocks, which causes physical dislocation of operations and, as a result, poorer communication. This is frequently encouraged by bonus systems that encourage the sale of unwanted goods. Toyota solved this problem by implementing the pull or kanban system.

Unnecessary inventory
Unnecessary inventory tends to lengthen lead times, preventing rapid identification of problems and expanding space, discouraging communication. As a result, inventory conceals problems. These issues must first be identified in order to be addressed. This can only be accomplished by reducing inventory. Furthermore, unnecessary inventories incur significant storage costs, lowering the competitiveness of the organisation or value stream in which they exist.

Waiting
In the industry while during the process there is wastage of time in a wrong way that results in waiting period. This waste occurs in a factory setting when the material are in a rest position or in working condition. This waste impacts both goods and workers, who both waste time waiting. The ideal state would have no waiting time and a faster flow of goods. Waiting for workers can be used for training, maintenance, or kaizen activities, but it should not lead to overproduction.

Inappropriate Processing
It occurs when overly complex solutions to simple procedures are discovered, such as using a large inflexible machine instead of several small flexible ones. Overcomplexity discourages ownership and encourages employees to overproduce in order to recoup the large investment in the complex machines. Such an approach promotes poor layout, which leads to excessive transportation and poor communication. The ideal situation is to have the smallest machine possible, capable of producing the required quality, and located close to preceding and following operations. Inappropriate processing also occurs when machines are used without adequate safeguards, such as hoke-toke or jivorka devices, allowing poor quality goods to be produced.

Unnecessary Movements
It involve production ergonomics in which operators must stretch, bend, and pick up when these actions could be avoided Such waste is exhausting for employees and is likely to result in low productivity and, in some cases, poor quality.

Defects
Defects are the bottom-line waste because they are direct costs. According to philosophy that is used by Toyota, defects should be viewed as opportunities to improve rather than a trade-off against what is ultimately poor management. By doing this, defects are targeted for immediate kaizen action.

In summary, steps that are used in process of manufacturing of lean history are to manage the reduction of waste (highlighted by VSM) so the need of a variety of process improvement tools.

Transport
Transport involves the movement of goods. To put it another way, any movement in the factory could be considered waste, so transportation minimization rather than total removal is usually sought. Furthermore, double handling and excessive movement are likely to cause damage and deterioration, with space in this processes proportional to management time feedback poor quality reports and take corrective action.

IV. VALUE STREAM MAPPING METHODOLOGY

VSM Methodology
The selection of methodology is a very critical thing and needs in any research project. The methodology describes the research process and serves as an effective structure for carrying out the tasks outlined in the research design (Easterby-Smith, Thorpe and Jackson, 2012). The methodology must supplement the philosophical assumptions of the paradigm that underpins the research design (Creswell and Creswell2017). As a result, the choice of ontology and epistemology

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influences the methodology and methods employed in a research study. The literature describes a wide range of methodologies that are available to researchers. Following the Relativism and Constructionism paradigms, a 'case study' approach appears to be an appropriate methodology we used for doing this process. The main reason for using this process so that it allows the retention of the holistic and meaningful characteristics of real-life events (Yin, 2003). We had done this type of study whenever the lack of knowledge of theoretical and empirical linkages between lean tools and remanufacturing. With anecdotal reports and no quantitative data to test, the investigation required "real life" data from people working in remanufacturing. Interacting and communicating with participants is permitted using lean tools.

Because such "truths" differ from process to process, several perspectives were required to demonstrate that lean tools offer benefits in the remanufacturing context (Easterby-Smith et al, 2012). Following the case study methodology resulted in a methodology that offered flexibility and triangulation in data collection while supporting relativist and social constructionist approaches, allowing iteration of data collection and analysis, and revision of the researchquestion (Bryman, 2012; Silverman, 2005. The methodology of value stream mapping shows that how value stream mapping manages the whole process from start to the end of the process.There is no better tool than VSM to begin improving productivity by identifying waste and then removing it through the implementation of lean principles in the industry. The Value Stream Mapping (VSM) method is a visualisation tool based on Toyota's version of Lean Manufacturing (Toyota Production System). It aids in the understanding and streamlining of work processes through need of Lean Manufacturing tools and techniques. VSM's goal is to identify, demonstrate, and reduce waste in the process. Waste means if there is any activity by which there is no profit to final product and is frequently used to demonstrate and reduce the amount of 'waste' in a manufacturing system. As a result, VSM can serve as a blueprint for Lean Manufacturing. According to Rother and Shook (1996), VSM has four major steps:

1. Product
2. Current state of drawing
3. Creating a future state
4. Create a work plan for the future state's implementation.

Figure 3.1 below depicts all of the VSM steps.

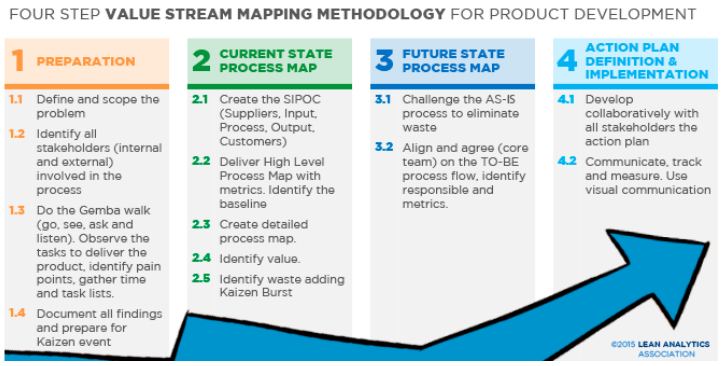

Fig. 4: Steps of VSM

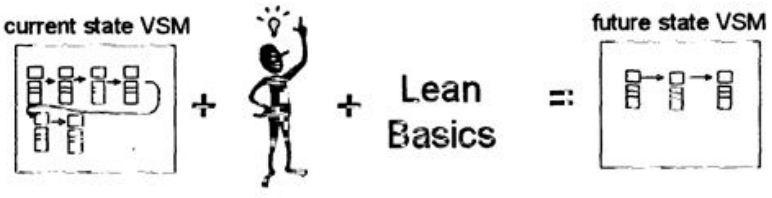

Fig 5: VSM Process

STEPS FOR DRAWING CURRENT STATE VSM:

To create the map, the user must draw a series of icons, each representing a different stage in the value chain. Appendix A shows three distinct icon types: material flow, information, and general icons.

Step 1:Always begin by mapping the value stream with customer demand. Begin by drawing a factory icon and a data box in the top right corner of the paper. (See Fig. above.)

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Step 2: Enter a list of demands that are required by the customers in data box.
A value-stream map's scope is much broader than just the factory. It encompasses whole process from basic metal to finished product shipment. As a result, the best place to begin is with the customer, because we all know that the peoples are or customer the only person who can determine the true value of the commodity at hand. (The customer icon on the map is shaped like a castle, indicating that the customer is king.)
Step 3: The following step is to outline the basic supplier production process. To represent suppliers, use a process box on the left side of the map. Because all suppliers cannot usually be listed, the rule of thumb is to choose the supplier of the most critical components or the company that supplies the most components in terms of dollars.
Step 4: After drawing the suppliers, enter the purchasing information from the suppliers into a data box. This data should be easily accessiblefrom the purchasing department.
Step 5: The next step in creating a current state map is to create a production control icon and then connect all of the icons with information flow icons. Depending on the type of information flow, draw the appropriate icon. Figure above depicts electronic information flow, which is denoted by lines that resemble lightning bolts. Other types of flow employ various types of lines. Draw a description box below each information icon and fill in the frequency of information flow.
Step 6: At this point, halt all mapping activity and have all team members get out of their chairs to observe production from the floor.
Do not take anything for granted; always double-check. The Assembly department is the best place to start. The team should divide into small groups and document the process backwards. Working backwards provides a better understanding of a product's flow and construction. All machines, processes, WIP, inventory (raw and finished), and cycle times within each process must be obtained from the production floor.
Step 7: Once the information has been gathered, the team will reconvene and draw the appropriate icons on the map's bottom.
Step 8: Begin with the Assembly department and work your way backward. When processes are disconnected and the flow stops, draw process boxes on the map (machines, assembly, paint, etc.).
Step 9: Include all of the information the team retrieved from the production floor in data boxes below each process box, such as cycle time, number of shifts, available time or any other, Total available time, and Lot size or any other.
Step 10: Finish the loop by adding the correct material flow icon from one process to the next. A push system with WIP is one example. This is represented by a slashed arrow and an inventory icon.
Step 11: Next, draw a truck shipment from the suppliers to the first internal icon in the map's bottom left corner. For outbound freight, repeat the process on the right side. Write the frequency of shipments in the truck bed for both icons and connect the production control system to each process icon using the appropriate flow line.
Step 12: To outline the production lead-time, draw a time line under each process box and inventory triangle. Lead Time is calculated practically for each inventory triangle.
This step brings our current state map to a close.
Waste must now be identified and eliminated throughout the process to reduce lead time and increase value-added percentage - in other words, to transform the production system from batch and push to one-piece flow and pull. This is where the true power of VSM lies.

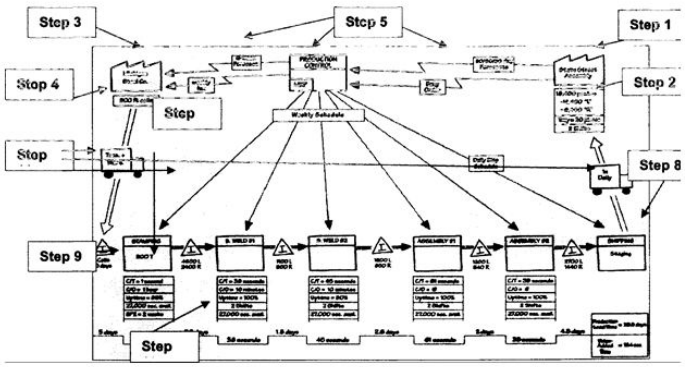

Fig. 6: Current State VSM

Steps for drawing Future State VSM
The future-state map is simple to create, but it takes determination and persistence to put into action. There is also a unique method creating the future state.

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Step 1: We are discussing the all steps to calculate the takt time. The following formula that is showed below need for finding out takt time:
Takt time = (net available time) / (customer requirements)
Takt time is very different from cycle time. In a lean process, however, cycle time plus a small efficiency standard equals takt time. When the cycle time exceeds the takt time, the process generates WIP, waiting, excess motion, damage, and other waste. Changes within departments, machine cells, and warehouses that must be required to promote onepiece flow and meet takt time.
Step 2: The next question about the future state is: Where can the production system use continuous flow? An automated assembly line is an example of continuous flow. The automation requires a continuous, one-piece flow. Because continuous flow does not imply 100 percent efficiency, the line can most likely be stopped, but system of automation forces line support and engineers to balance the operation and ensure continuous flow. Furthermore, the continuous flow can proceed at a rate that ensures takt time is met. Continuous flow eliminates WIP, excess waiting, material handling, and over-processing; several techniques are available to aid in the implementation of these lean manufacturing principles. Teamwork, SS, kaizen events, total productive maintenance (TPM), and visual management are examples of these.
Step 3: Before drawing the future state, two more questions must be answered: Where in the manufacturing system do we initiate production? How do we balance the production mix? Answering these questions and addressing the seven wastes yields the foundation for a future-state map.
After you've answered these questions, draw the map with the changes you want to make. Figure above depicts a future state map for the previously mentioned current state.
The future state describes what could be (a lean flow), not what is. This state is not defining the final future state. After drawing the future state, examine the waste generated throughout the process and re-evaluate the map. Repeat this process as needed during the event and in the aftermath. Figure above depicts an example of a future-state map. Following the creation of the future-state map, an action plan and extended value stream plan are required. To make the transition from the first state to the future state, an action plan is developed. Simply list the differences about the couple of maps and make a to-do list. There are manycompanies first VSM event, focus the action plan on the location where success is most likely. This will motivate the team and foster the aggressive attitude that will be required for the more difficult action items.

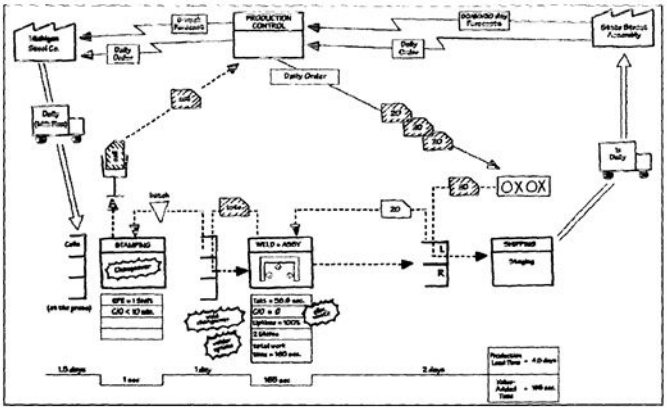

Fig. 7: Future State VSM

Once implemented, the extended value stream plan includes kaizen and re-evaluation of the future state. The long-term strategy will also include redefining the metrics used to assess the production system. This strategy entails expanding the mapping. Once this is completed, begin working with suppliers on VSM. Collaboration or joint ventures can eliminate massive amounts of waste.

V. RESULT AND DISCUSSION

Escort tractor's Limited proposed future state eliminates a great quantity of waste.Thus, by applying this method efficiency of the industry is high compare to the previous and we know also efficiency is also greater compared to previous, resulting in higher the capital of the industry. We all see the result in Table 2 given below which compares previous status and status after future implementation for crank case.

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Table 2: Comparison between previous and proposed conditions

	Production lead time	No. of operators
Before	49.5 Days	23
After	24.5 Days	17

With respect to tables above

- Much waste has been demolished by using Pull system in Escort Tractor Ltd.
- Work in process inventories between operations have been reduced to a low level.
- After applying the concept there is result in less cycle time.
- It also results in less lead time from 49.5 days to 24.5 days. Crank Case reduces total lead time in production by 50.5%.
- The number of operators involved in crank case making also got less from 23 to 17. From all the workers also less dwindle by 26.08%.
- Hence it is more efficient and suitable usageof workers.

It is clear that the VSM tool is a valuable technique for the global competitiveness environment. It gives a company

VI. CONCLUSIONS AND FUTURE SCOPE

The methodology acquired to do this study for making crank case system at Escort Tractor Ltd in Faridabad. There is a system which we used to control the production and manage material known as raw material using Kanban system, and many operations are connected within a single cell where possible to ensure continuous production between them.It is a system which is compared to the generally used manufacturing system. In comparison, the manufacturing system known as lean the existing manufacturing system.Total lead time of the process is decreased by this system by 50.5%. Total number of operators involved in crank case processing dwindle from 23 to 17.The term mapping of the value stream demonstrates forpowerful technique for future arrangement by which the company get a "blueprint" through which the rules of lean set to the industry for transforming to a lean business.

VII.FUTURE SCOPE

VSM concepts and techniques can be make larger on the other side of or further than suppliers and customers for detailed and particular installations were saving of the cost is needed. Lean Manufacturing fundamentals can be applied in the business.Value mapping tools, in conjunction with simulation, can be used to forecast the outcomes of Lean tools before they are implemented.This project can be expanded by introducing new variables such as reduced configuration, worker attitude, and work environment.

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