

# Value Stream Mapping based Lean Production System

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## ABSTRACT: -

Lean manufacturing can be used as a effective business strategy since its implementation eliminates all non-value added waste and improve the process operation.

Value and non-value added process steps, opportunity for various lean techniques, combining material processing steps, along with information flow can be identified by the visual lean tool that is value stream mapping. To find how things actually operated on the production floor current state map is drawn, after that the future state map is created to implement the lean techniques through the reduction of the root causes of waste. In this paper demonstrate the review of value stream mapping techniques and discuss the benefits of lean manufacturing in manufacturing industries. The objective of this paper is to focus the effective utilization of the value stream mapping for eliminating waste and productivity improvement.

**Keywords-** Lean Production System, Value Stream Mapping, Lean Tool, Production Systems Evaluation.

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## 1. INTRODUCTION:

Lean manufacturing is a technique which is used for improving the productivity and quality. Many manufacturing companies in India have been implementing to sustain in market. Lean is an approach that reduces cost through eliminating non value added activities via implementing a management philosophy which has objective to identify and eliminate waste from each and every steps in the production line.[1] there are many tools in Lean manufacturing since the birth of Toyota production system.[TPM,JIT,SMED,.....all these techniques used for keeping the cost down and stay ahead in race. All these techniques and activities would differ accordingly; nevertheless, they have the same core principle. Identification and elimination of all non value-adding activities and waste from the production line.

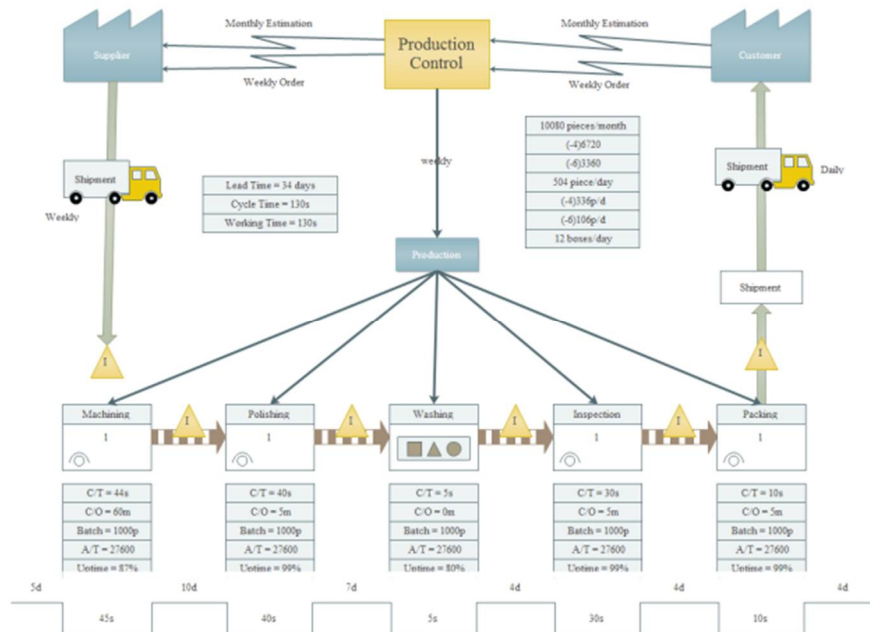


Figure1: VSM Example

A production with higher satisfactory service is one of the most imperative elements for the social welfare and economic development [2]. Companies have to knuckle down on reducing and eliminating waste through steps of process to increase the effectiveness of production.

Effective production cohabited with high quality control has become essence for manufacturing companies to guarantee on-time delivery and meet customer's satisfaction [3].

The objective of this paper is to use a case based approach to determine the utilization of lean manufacturing tools to reduce the waste, maintain better inventory control. Out of all the tools value stream mapping is an extra ordinary tool.it is used to identify what give value to customers and they are ready to pay for it later map is then created to mention the improvement in the area and the applied lean tool.

## 2. VALUE STREAM MAPPING: -

“If there is a product for a customer, there will be a value stream. The main challenge is to recognize it.”

All the activities value added or non-value added that are necessary to produce final product from the raw material through manufacturing process can be visually represented by value stream mapping.

Womack and Jones define value as capability provided to customer at the right time at an appropriate price, as defined in each case by the customers [4]. Value stream mapping includes sub manufacturing activities like flow of material and information as well as a lot size, losses by non-value added practices is exposed by value stream mapping.

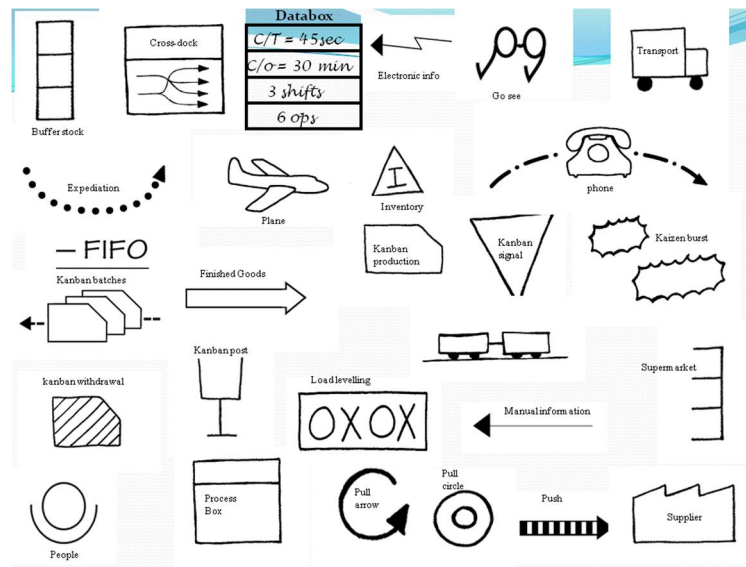


Figure2 : VSM Symbols

value stream mapping completed the entire operation in three steps[5].the first step is preparing current state map in which a diagram showing the actual material and information flow and it is also describe how the actual process operates.

Secondly, future state map is created to identify the root cause of waste and through process improvement that could give great financial impact to the process. These improvements are then carried out, the implementation plan as part and partial details and action needed to gain the project objectives in process kaizan and poka yoke[6].

### 3. LITRATURE REVIEW: -

#### (A)Peter hines, Nickrich, Annesain [1999]

With the use of multi group supplier association together with supplier integration need value stream mapping was employed to raise awareness. To work with supplier both more quickly and more effectively this approach helps partsco a lot. Development work to be handled out with competing supplier, permitting in previous stages benchmarking data to be added back by using disguise name of provider involves is also being allowed by value

stream mapping and another executive described this as “Not rocket science but very effective and who want rocket science anyway?” In many cases the views of supplier is very positive, and in some cases the motivation and navigation is coming from supplier rather than partsco as a side benefit which was not expected, the performance of the supplier not in the supplier association program also seems to be upgrading. This can be describe as two ways (i) The effect has been seem as similar improvement is implemented to the product team. (ii) As some of the enterprises are not being the part of this activity but they are trying hard to become member in future. For a changed program companies involved have developed the VSM framework, the companies are also trying to make a major or supplement breakthroughs as a part of this single process. [7]

**(B)Anthony J.Donatelli, GregoryA.Harris[2001]**

For the use of simulation with value stream mapping following conclusions are made, VSM is the most useful tool in lean manufacturing and sustain improvement effort. Fourth dimension, time is added by simulation in VSM. Value stream mapping is no longer just a depiction after being simulated. It provides the internal sights that may have been missed if value stream mapping is used alone. To not get “paralysis by analysis” is one belief of lean manufacturing. Value stream mapping’s simulation lets the lean team to do more rapidly and without causing disturbance in production process. Not only testing of ideas got easier, cheaper and quicker but also the instant evaluation proposed changes to the system, by the simulation of value stream mapping the model and the data making simulation has got easier to do. Value stream mapping and simulation both enhances each other value since they are the natural combination in lean manufacturing effort.[8]

**(C)John C. Tinoco 2004**

One part or total product cycle time for value stream was made in 177 minutes. However it takes 20 days for the total lead time. All the non value added activities such as material moving, machine setup and waiting for material is equal to the lead time minus cycle time i.e. (20 days) minus (177 minutes). This means there is lot of room for improvements.

The cumulative available uptime result shows that company is spending very much time on machine setup. Stumping process is being affected by this uptime issue which further becomes the reason for late time delivery. This is also the reason for high inventory which are kept between the stumping and the welding process. It was observed by the researchers that the each operator runs the work centre in different ways and they also change tools in different ways. This takes almost two hours to set up work center. Each operator’s skill determines the speed of the process.

Product lead time is almost same to the total number of days of the WIP inventory. It means company has enough safety inventories to satisfy customer’s demand in lead time. If the lead time of the company is shorter then it will result in less safety inventory and less fund tied up in inventory. Parts which were initiated on 23<sup>rd</sup> January were stuck at stamping process because there were no operators available to run the process. Many other works at the center were also incomplete because of mechanical problems and poor maintenance. There was too much waiting time after the parts were made it was observed that there was poor communication between machine operator and production supervisor or between machine operator and forklift operator. Lots of defective parts were placed without any specific place. Overall the place was very much unorganized.[9]

**(D)William M. Goriwondo, Samson Mhlanga, Alphonse marecha2005**

This Study is to use Value stream mapping tool in solving the waste generated in lean manufacturing and also find the ways for the reduction of waste. While increasing the process proportion which adds value to product the future state map development achieves the increase in throughput by 16%. Although there is a significant cost to complete the change in need but by the increase in throughput against takttime improvements will be paid. Areas of potential improvements are identified with the help of CSM while ways to reduce waste and increase throughput is being suggested by FSM. Tough the analysis is only of production line 1 but similar trend will occur on the other production line also. The Value stream mapping can be applied to many industries like Bank, Hospitals etc. With little adjustments it is not only limited to manufacturing organization. The contribution of this paper is for the advancement of world class manufacturing practices in developing countries. [10]

**(E)TONY MANOS, 2006**

The main objective of this paper is to focus on that current state map indicate the flow of material and flow of information with value added and non value-added. Then the future state map is created by changing the sequence of process, redesigning the layout and pulling the production from downstream. We decrease the lead time, increase the value added ratios, increase the WIP inventory and solve the bottleneck problem.[11]

**(F)Soudabeh Khodambashi[2007]**

In this paper the application of IS needs to be examine to raise the alignment between the new applied information system and the processes in the clinical process. This paper mainly focused on the evaluation of health information system adopted by intra-operating management of the anesthesia procedure in heart operation. This is the case study based on the implementation of lean method in intra-operating management process. In which we use value stream mapping and A3 method to examine the anesthesia.

Value stream mapping and A3 problem solving tool helped us to map the process and eliminated the wastes from the various steps in the processes. It also increased the data integration and process integration. Results outcome from this paper can help the clinicians and practitioners in the application of the lean method to HIS so that the wastes can be decreased from the clinical workflows. [12]

**(G)Roberto alvarez, Roquealbo, Marta M.ena2008**

Evaluation of case study result is done across Value Stream Mapping. If the manufacturing process improves or degrades according to the norms previous established is indicated by calculation of several critical magnitude. The outcome fetched is the diagram of VSM and its justificatory and comparative stages of result. Reduction of inventory is down which leads to the reduction of ideal time from initial 32 to final 10.9 in August. There were two folds in improvement objectives. Reduction of Stock while eliminating ideal times or worker movements due to material accumulation both are being reached LR and DtD matrices has been improved. From 19.75 days in March the DtD is reduced to 17.1 days in August and also at same time LR is increased from 0.38% to 0.44%. According to global result in spite of implementation of KANBAN the Milkrun effect to improve the matrices has been got better between March and May. Patterns have been improved by lean manufacturing.

The second analysis of LR and DtD result shows that it is gone worse than the First one but good tendency of reduction of stock should be appreciated. With KANBAN fully implemented in third month the analysis shows the clear progress in both matrices and accumulated stock in milkrun. [13]

**(H)Jose Gramdi [2009]**

Worldwide acceptance of many lean management initiatives are there .lead time reduction can improve the responsiveness of enterprise and financial health. Lead time prediction draw up by value stream map and estimation of inventories and flow time all along it. In this paper we are focusing a new way of giving a detail of lead time for each product taking in to account all its components and using lineage and purchasing costs data.[14]

**(I)N.L. Coppini and L.C. Bekesas[2011]**

In lean manufacturing, value stream mapping is a tool that has been used in various industries to redesign production system.VSM is a part of lean technique uses a pictorial technique to recognize various kind of wastes presenting in the floor area and enables us an easy way to visualize possible option to eliminate them. This paper shows that company using ancient technology for manufacturing gear box and auto parts, who has started implementing the VSM to locate and eliminate wastes from family of product. This paper suggested the use of Pro-Model 7.0 software as a simulation tool to build up and evaluate various alternatives for the future state value stream map. As a result it was possible to wind up with that simulation represent a valuable strategy to obtain an optimized solution for future state value stream map, as its allows the analysis of various alternatives and many manufacturing indicators.[15]

**(J) RAHANI AR, MUHAMMAD AL-ASHARAF, 2012**

By revealing the obvious and hidden waste that affects the productivity of D45T production, the use of VSM improved the LP capability. There is abundance of time products spent on production system mainly was waiting and non-value added. There were many evidences which showed that many lean tools have expected impact related to time reduction. The development of these improvements by using CT evolution shows the economic impact of time improvement. To a certain amount application of VSM analyses the extended impact of a change in production process in lowering rejection rates, a positive view was there because of abundant gaps between standardized work and real work, which means assembly standards were not followed strictly. Improving the SOP can play a crucial role in continuous improvement sustainability on the production floor as operator knows the long term commitment to practice lean.[16]

**(K)Danijela Gracanin , Borut Buchmeister, Bojan Lalic 2013**

This paper aims to highlight the importance of relationship between time and money and give a schema for value stream optimization. Every measures gives different result saving (money and time) was shown in previous analysis of cost time profile with different specification values for same value stream. Before the starting of improvements the defined company's objective function decide that which measure will be applied. Cost time profile isn't

completely new support tool for decision making which can be useful in different strategies for making choices. Value stream casting, cost time profile tools as well as lean accounting has not been widely known and accepted by companies. So making them popular and establish their importance are still a big task. To create the more customer value modern companies should be value oriented and implementation of these manufacturing strategies should be done. Better result of the company can be achieved by creating value for customer.[17]

**(L) BENJAMINHAEFNERA, ALEXANDRA KRAEMERA, TORSTEN STAUSSA, GISELA LANZAA, 2014**

Systematic visualization, analyzation and optimization multistage manufacturing process from a quality assurance view point can be done by the development method of quality VSM. There are four consecutive phases in procedure model: preparation, quality value stream analysis, quality value stream design and implementation. The anticipation of inspection process, quality key indicators and quality control loop within the process flow can be done by this method. Illustration of the quality related cost of production line is done. Integration of common quality management tools such as Ishikawa analysis and FMEA in a structured way can be further done by QVSM. The QVSM benefit was shown by an exemplary application of the method in an industrial case study. Both the rate of defect and quality related costs were reduced in this example.[18]

**(M)FRIEDRICH MORLOCK, HORST MEIER, 2015**

IPS<sup>2</sup> Performance Management approach as a PDCA-Cycle with the phases of Performance Planning, Performance Measurement, Performance Assessment and Performance Improvement have been introduced in this paper. The central role is taken by formally developed IPS<sup>2</sup> to provide KPIs for performance management. So far there were no method for analysis visualization and improvement of delivery processes in operation. So for this the introduction of the Service Value Stream Mapping as a connection of the Value Stream Analysis with the Service Blueprint is done because of this customer and corresponding time interaction with a process depiction of production and service together is possible. Service VSM application for IPS<sup>2</sup> performance management has been characterized in use case. A support for the removal of pertinent business goal is necessary during plan phase in order to make sure an integrated approach of IPS<sup>2</sup> performance management. A new method is required especially to acknowledge characteristics like different business models. By this data provider of IPS<sup>2</sup> knows which KPIs are important to get company's goal. KPIs should be considered during the use phase of IPS<sup>2</sup>. [20]

#### **4. VALUE STREAM MAPPING METHODOLOGY:-**

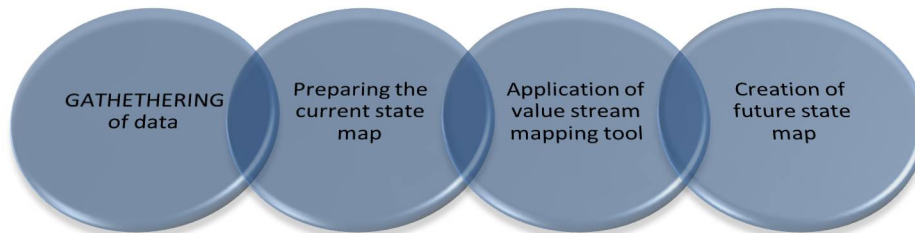
Various informations can be collected from experts in shop floor level, labors and by participating in calculating times for different processes. Various processes can be carried out by getting list of data.

There are three steps for value stream mapping methodology:-

- GATHERING of data
- Preparing the current state map
- Application of value stream mapping tool



➤ Creation of future state map



#### 4.1 GATHERING OF DATA:-

For creation of current state map a team gathered the data and information by collecting the data from operator who performs the individual task. The advantage in collecting the data from the operator is handy way to create the map rather than summing up the information collecting in office meeting and discussion.

Second advantage is that team has a chance to know all the process actually done and all the wastes can be easily found. The drawing and design of value stream mapping is depended on the simplified application by Sean M. Gahagan (2012) which collects all the data and details in a simple way.

The main elements available in the value stream mapping that are documented on the map establish the sequence of the following details (7)

- ✓ The end user i.e. Customer
- ✓ Steps of main process involving undocumented works
- ✓ Metrics of process involving process time, wait time and first time quality.
- ✓ Supplier with flow of material by using value stream walk through.
- ✓ Physical and information flow to know how each process prioritizes work.
- ✓ Calculate total lead time i.e. overall performance of value stream.



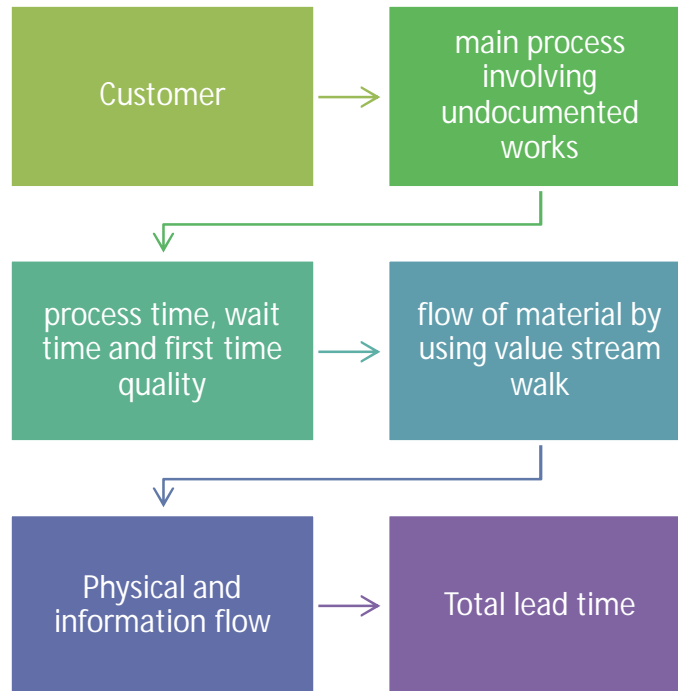


Figure3: VSM DATA flow graph

#### 4.2 CREATION OF CURRENT STATE MAP: -

Current state mapping starts with knowing the customer's requirements. It is the graphical representation that shows a sequence of activities using flow chart symbols. Process mapping in Six Sigma methodology is commonly used as tool. A thing that separates VSM from other mapping tools is the insertion of the information flow into the map. How the product is ordered by the customer, its frequency, method and how we response back to our supplier is mapped in it. We can also show multiple customers as one if there requirements are same. Timeline can also be created to give us the information about the total process time and pilot time for records through our process. Current state mapping also provides the information to map a future state map. It is used for identifying the concerned areas that are required to overcome in coming days.

Below is a list of the information you need to collect at each process step for drawing a current state:

1. C/T Cycle Time - how often a part is completed by a process. Use a stopwatch if necessary. (In some cases, machines will give you this information).
2. C/O Changeover time - the time required to switch from producing one product type to another type.
3. Uptime - the percentage of time in which a machine or process is available on demand.

4. EPEI (production batch sizes) - the batch size expressed in time (days, etc.). EPE stands for "every part every \_\_\_\_\_."
5. Number of operators
6. Number of product variations
7. Pack Size - the number of items in a shipment
8. Working Time (minus breaks)
9. Scrap Rate

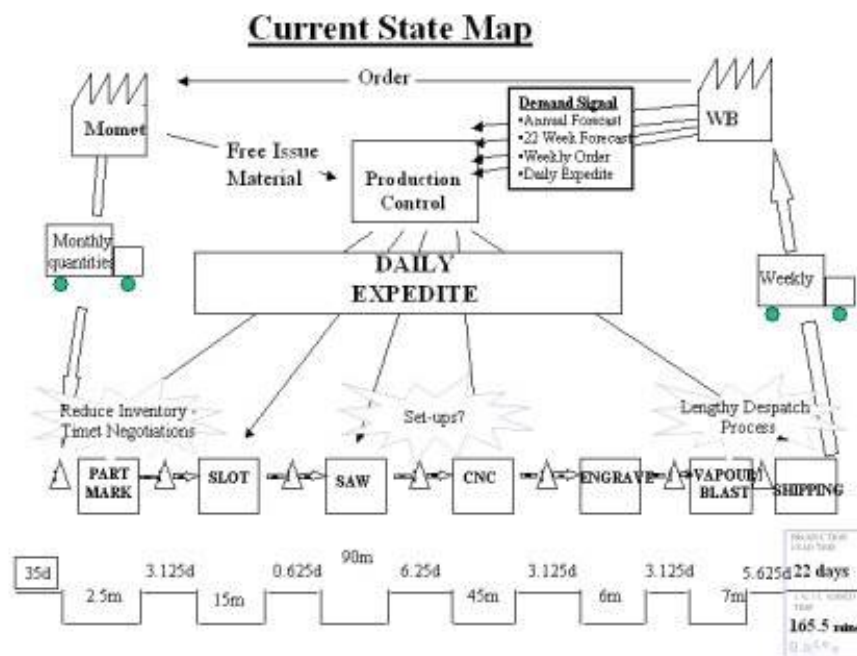


Figure4: CSM Example

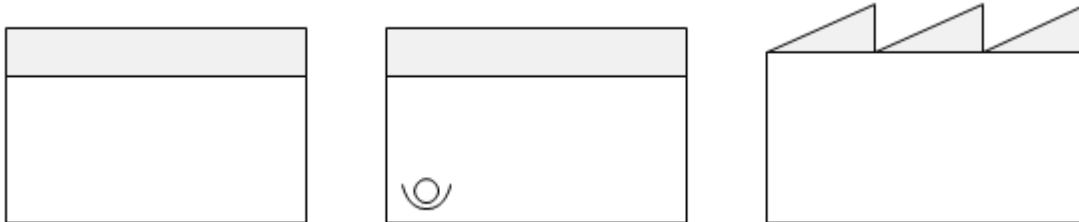
#### 4.3 APPLICATION OF VALUE STREAM MAPPING TOOL:-

After creating the current state map find out the seven waste involve in the process and design, then prepare a ranking and priority chart and on the other hand to find effective lean tool applied to improve the lead time such that 5S, Kanban, Kaizen, Line balancing etc.

**Process** represents a step in your process and shows flow of process steps required to complete a product, service or administrative function from order to delivery.

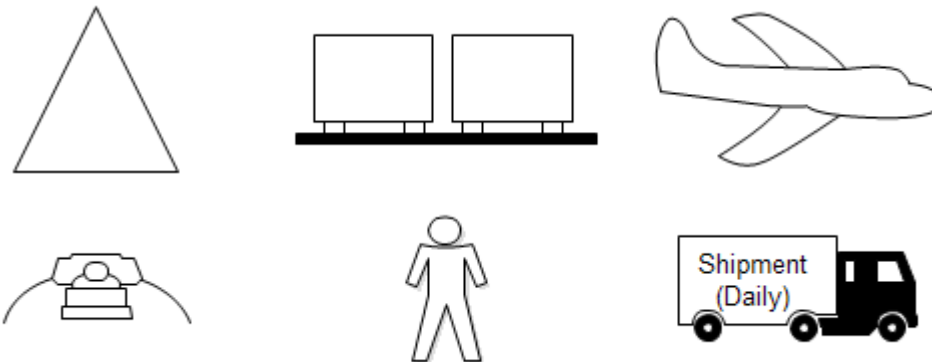
**Customer / Suppliers** have already adjusted to the requirement for more frequent delivery. Often, to get small batch delivery, all one has to do is ask. But to make this change successful, suppliers

need something in return: They need good information, steady schedules, and a non-adversarial relationship.



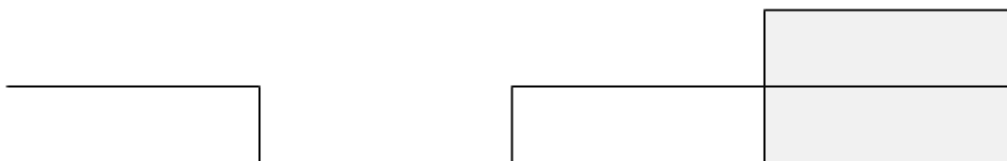
**Inputs and outputs** identify changeover and cycle time, labor, and rework.

**Inventory** uses an equilateral triangle in the value stream mapping.



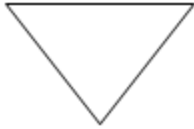
**State Map** is simply a set of connected operations and queues, starting with a supplier and ending with a customer.

**Timeline** is used to represent and compare the two, but didn't focus on the resources consumed and waste generated in making the product.

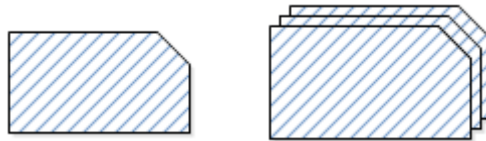


**Materials line**, located on the bottom of a value stream map, shows the amount of raw materials used by each process in the value stream and the amount of materials that end up in the product and add value from a customer's perspective.

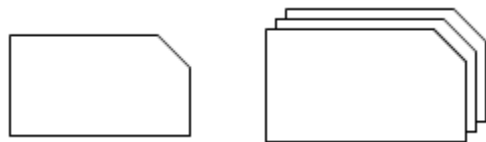
**Signal kanban** is sent upstream, to an operation which is shared by a number of product families.



**Withdrawal kanban** is used to authorize movement of material from a supermarket or storage location, usually in small quantities.



**Production kanban** is like signal kanban, except that they are sent only to dedicated upstream resources.



**Batch arrival** is used if withdrawal happens in a large quantity, such as when a truck is loaded and sent to a customer.

**Sequenced pull ball** is a method of sending a requirement to a subassembly station for a particular subassembly to be built

**Supermarket** is another form of kanban square, where one or more items are held in each opening, and a signal kanban is sent when the minimum quantity is reached.

**Fifi lane** is a kind of kanban square. This means that an empty storage spot is self-authorization to produce a product for that square.

**Funnel shaped value streams** are those with large incoming amounts of material, and fast initial processing.

**Pyramid shaped value streams** are the opposite of funnels. They have slow, steady incoming materials and orders, and intermittent, large outputs.

**Pipe shaped value streams** are already well on their way to becoming lean, because they have the basic shape required for flow.

#### 4.4 CREATION OF FUTURE STATE MAP:-

Future state value stream map is in the acting stage between your current state map and the optimal state. Ideal Future state map should balance the requirements, chances and resources.

Future state map includes:

- Time reduction cycle
- Reduction that is the purpose of whole effort. It is simply the prediction of the value stream that how it should be in the future months of groups/ batches
- Performance improvement
- Delivery schedule changes.

The main target is to build a series of production where every single process is linked to their customer by continuous flow or pull and each processes main motive is to more accurately producing only what is the need of customer and when they need it. So for designing future state map engineering, Art as well as strategy than present state mapping is required.

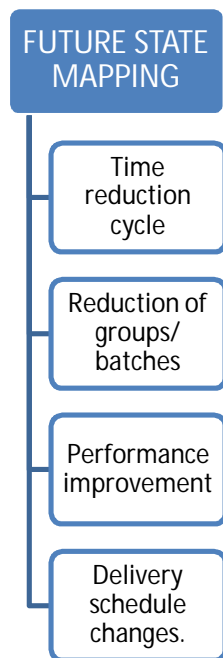


Figure5: Future State Map graph

## 5 CONCLUSIONS: -

After considering many papers we get to know that Value Stream Mapping is an effective tool in order to gather the information's and improve of the lead time. This paper aims to highlight the importance of Value Stream Mapping and relationship between time and money. The systematic visualization, analyzation and optimization multistage manufacturing process from a quality assurance view point can be done by the development method of quality VSM. There is abundance of time products spent on production system mainly was waiting and non-value added. There were many evidences which showed that many lean tools have expected impact related to time reduction. To create the more customer value modern companies should be value oriented and implementation of these manufacturing strategies should be done. Better result of the company can be achieved by creating value for customer. So for this the introduction of the Service Value Stream Mapping as a connection of the Value Stream Analysis with the Service Blueprint is done because of this customer and corresponding time interaction with a process depiction of production and service together is possible.

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