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VALUE STREAM MAPPING

R.KAARTHIKEYAN, DR.P.NIVETHA

Abstract

A value stream includes all activities required to transform a product from raw material into the finished goods. Value Stream Mapping scrutinizes business processes from beginning to end and a visual representation map is drawn of every process involved in the material and information flows.

Then a future state map is drawn to show how things should work for best competitive advantage. Value Stream Mapping helps to identify the current flow of material and information in processes for a family of products, highlighting the opportunities for improvement that will most significantly impact the overall production system. In this research paper, myself addresses method of value stream analysis, which is a tool for helping manufacturing companies to go lean and to achieve larger control of their value stream. It is a qualitative tool that is supposed to give an understanding of the value stream / value chain as a basis for reducing the pipeline of inventory and time compress the throughput time.

Keywords: *Value Stream Mapping, Lean Manufacturing.*

Introduction

Quality has become one of the most important competitive strategic tools, and many organizations have realized that it is key to developing products and services that support continuing success. Quality systems are designed to set a clear direction for organizations to follow enabling understanding and involvement of employees proceeding towards a common goal. There is an increasing focus on quality throughout the world. With increased competition, companies have recognized the importance of quality system. Quality management is not only to assure good quality rather than it is ensuring four main components quality planning, quality control, quality assurance and quality improvement within organizations. These four components involve management of quality continuously improving the quality of products and processes. It leads to new integrative philosophy Total Quality Management or TQM.

Lean Manufacturing:

Assembly Process Lean Manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste. It is derived from the Toyota Production System and its key thrust is to increase the value-added work by eliminating waste and reducing incidental work. The technique often decreases the time between a customer order and shipment, and it is designed to radically improve profitability, customer satisfaction, throughput time, and employee morale.

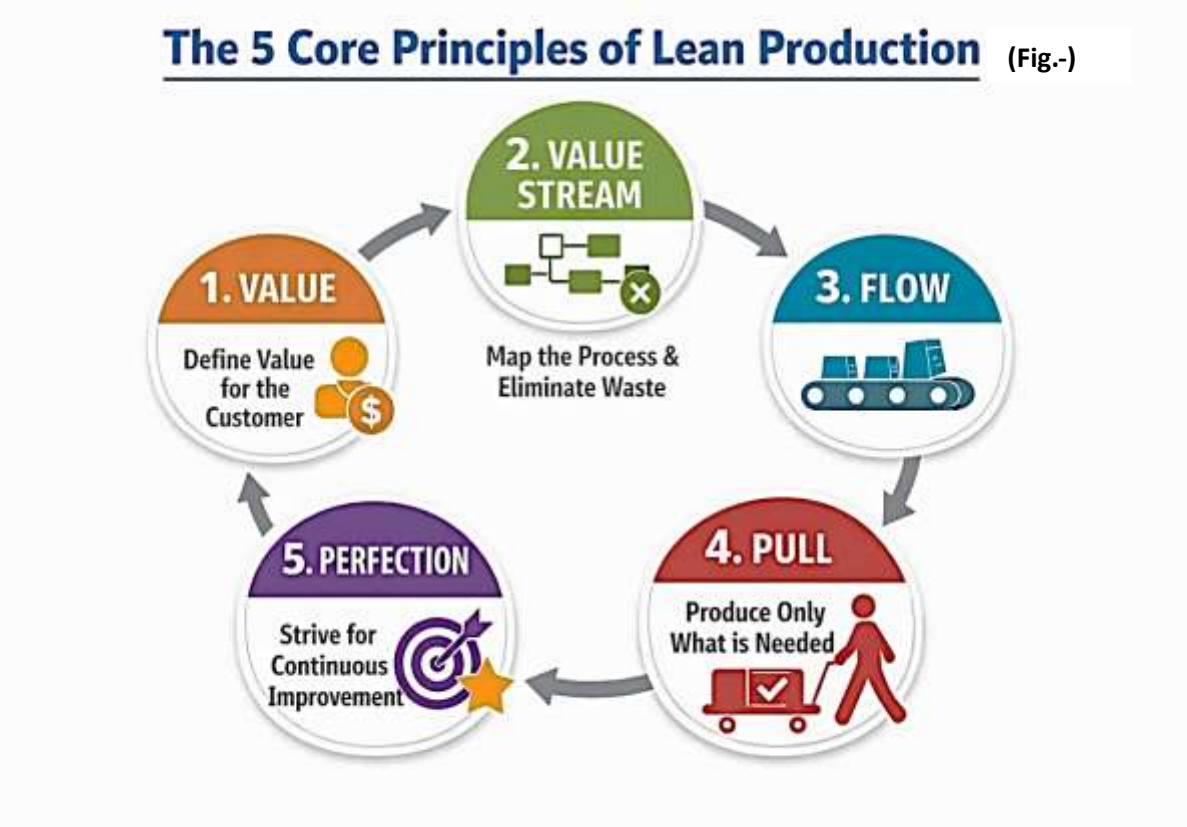
The core principle in implementing **LEAN MANUFACTURING** is to eliminate waste to continually improve a process. By reducing waste to deliver process improvements, lean manufacturing sustainably delivers value to the customer.

The types of waste include processes, activities, products or services that require time, money or skills but do not create value for the customer. These can cover underused talent, excess inventories or ineffective or wasteful processes and procedures.

Removing these inefficiencies should streamline services, reduce costs and ultimately provide savings for a specific product or service through the supply chain to the customer.

Waste in industry, whether that is idle workers, poor processes or unused materials are a drain on productivity, and lean manufacturing aims to eliminate these. The motives behind this vary depending on opinion, from increasing profits to providing benefits to customers. However, whatever the over-arching motives, there are four key benefits to lean manufacture:

- **Eliminate Waste**: Waste is a negative factor for cost, deadlines and resources. It provides no value to products or services
- **Improve Quality**: Improved quality allows companies to stay competitive and meet the changing needs and wants of customers. Designing processes to meet these expectations and desires keep you ahead of the competition, keeping quality improvement at the forefront
- **Reducing Costs**: Overproduction or having more materials than is required creates storage costs, which can be reduced through better processes and materials management
- **Reducing Time**: Wasting time with inefficient working practices is a waste of money too, while more efficient practices create shorter lead times and allow for goods and services to be delivered faster



WASTES OF LEAN MANUFACTURING

The Toyota Production System originally detailed seven wastes that don't provide value to the customer. These wastes were:

- Unnecessary transportation
- Excess inventory
- Unnecessary movement of people, equipment or machinery
- Waiting – either people or idle equipment

- Over-production of a product
- Over processing or adding unnecessary features to a product
- Defects that require costly correction

An eighth waste has since been highlighted by many lean practitioners:

- Unused talent and ingenuity

These types of waste can be broadly split into three specific types:

1. **Mura:** Unevenness or waste as a result of fluctuating demand, whether from customer requests or new services (and thereby additional work) being added by an organisation.
2. **Muri:** Overburden or waste due to trying to do too much. This relates to resource allocation and involves people being asked to do too much. Time can be wasted as people switch tasks or even lose motivation due to being overburdened.

Muda: This is process-related waste and work that adds no value. If an activity doesn't add value, or directly support one that adds value, then it is unnecessary and should be eliminated.

TYPES OF WASTES

(Fig.-2)

Value Stream Mapping:

A value stream is a collection of all actions value added as well as non-value added that are required to bring a product or a group of products that use the same resources through the main flows, from raw material to the arms of customers .These actions are those in the overall supply chain including both information and operation flow, which are the core of any successful lean operation. Value stream mapping is an enterprise improvement tool to assist in visualizing the entire production process, representing both material and information flow.

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How Does Value Stream Mapping (VSM) Work?

The process of Value Stream Mapping (VSM) begins with identifying the key processes and activities involved in creating and delivering value to the customer. These processes and activities are visualised in a process description that shows the flow of materials and information within the process.

Data in the Value Stream Map

During the creation of the Value Stream Map (VSM), various types of data are collected and analysed, such as lead times, waiting times, inventories, quality levels, and other performance indicators. This data helps organisations identify inefficiencies and waste, allowing them to implement targeted improvement initiatives to enhance overall process performance.

Value Added and Waste

With the VSM, we visualise which activities add value for the customer and which activities are wasteful. Lean focuses on eliminating non-value-adding activities and reducing waste. The VSM always takes the customer's perspective and aims to deliver according to their expectations, KPIs, needs, and wishes, making these quantifiable.

Activities and Data

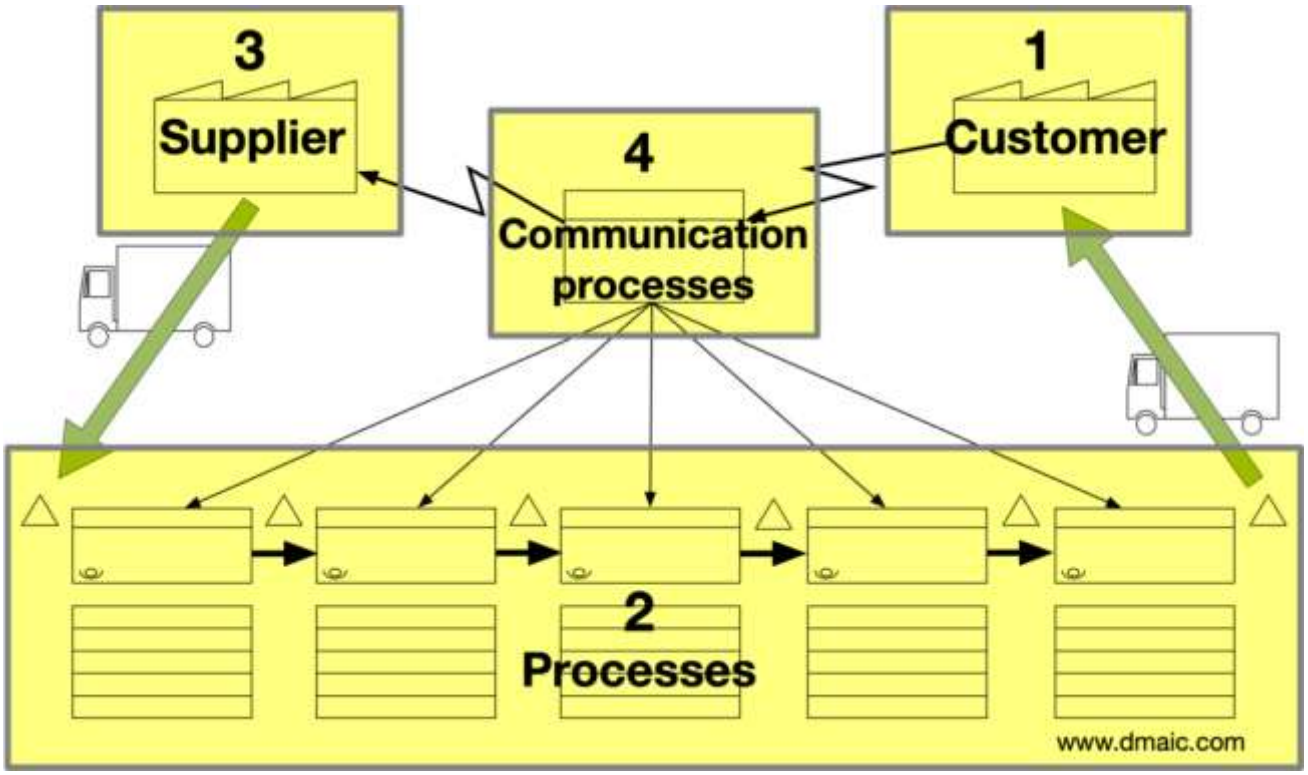
The Value Stream Map does not focus on functions and tasks but on activities in the process based on facts (data and information). It shows how much time actions add to customer value and how much is wasted by not adding value. Unlike flowcharts and swimlanes, a Value Stream Map is more of a visualisation with images, using specific symbols frequently.

The Four Main Areas of a Value Stream Map

Value Stream Maps have four main areas in their structure and always start with the customer. Within these four areas, the necessary information is collected. The four areas of a Value Stream Map are:

1. Customer
2. Processes
3. Suppliers
4. Communication Processes

(Fig.-3)



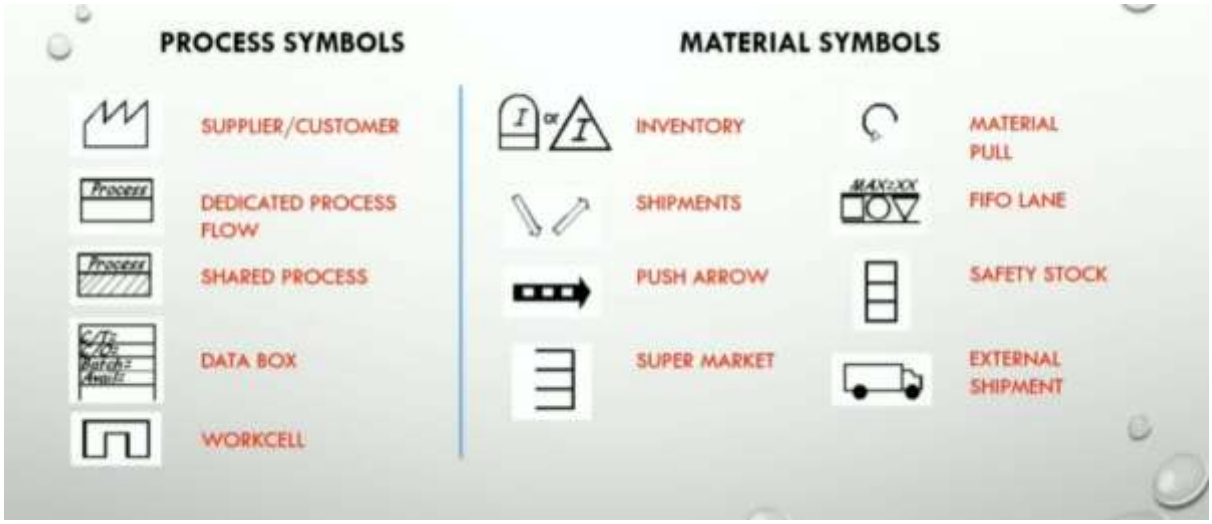
Symbols in Value Stream Map (VSM)

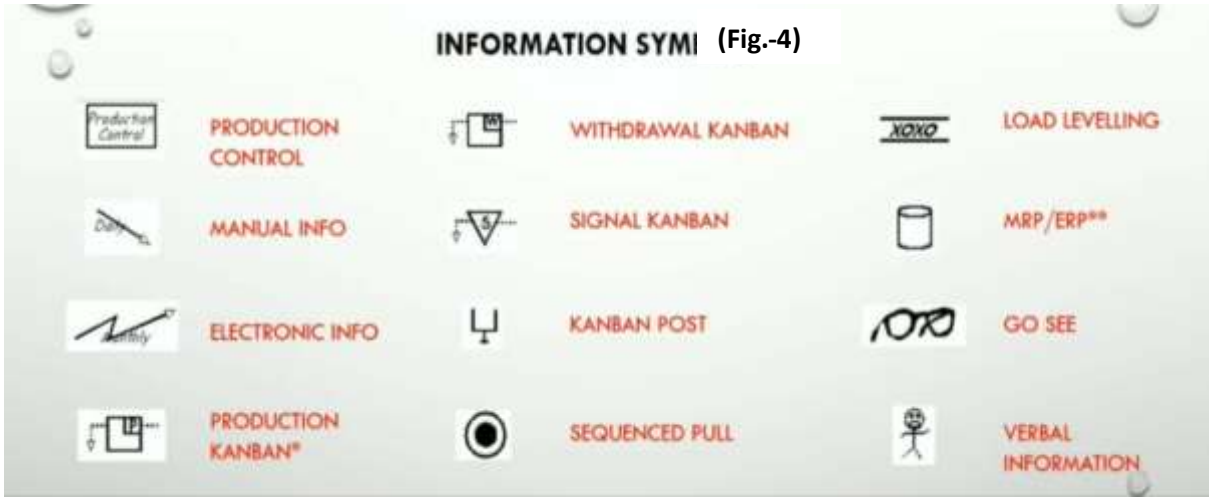
A Value Stream Map (VSM) uses symbols and visuals to graphically represent the flow of the process. These symbols are not standardised, so might encounter many different variations. The most important thing is that the symbols help quickly understand the flow of the process and identify waste or opportunities for improvement. These symbols help create a clear and understandable picture of the process, allowing us to quickly see where optimisations are possible. Here are a few commonly used VSM symbols:

- **Process Box**: A rectangle representing a specific process step.
- **Data Box**: A small rectangle below the process box that contains key data such as cycle time, wait time, and inventory levels.
- **Inventory Arrow**: An arrow indicating how materials move between process steps.
- **Electronic Information Flow**: A lightning bolt symbol representing the flow of electronic information.
- **Manual Information Flow**: A straight arrow indicating the flow of manual information.
- **Push Arrow**: An arrow showing that products are pushed to the next step.
- **Pull Arrow**: An arrow indicating that products are pulled by demand from the next step.
- **Safety Stock**: A “castle” symbol representing safety stock.
- **Kaizen Burst**: A star shape indicating where improvement initiatives should take place.

SYMBOLS IN VALUE STREAM MAP (VSM)

(Fig.-4)





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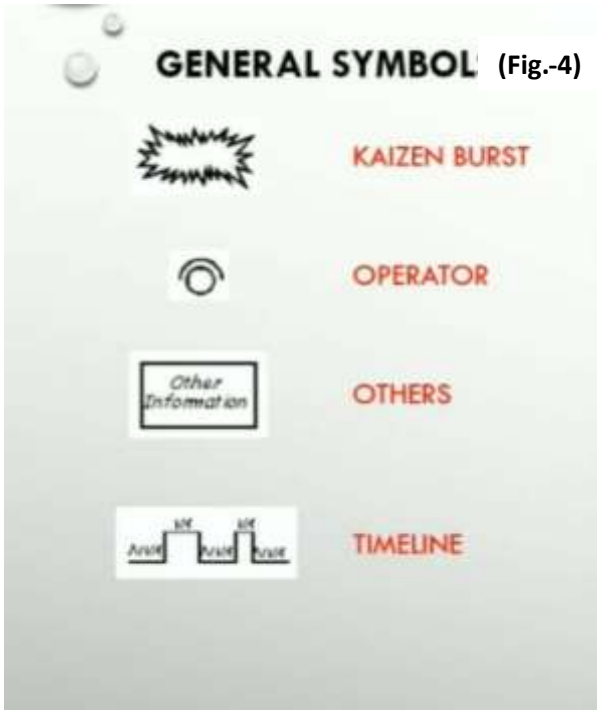

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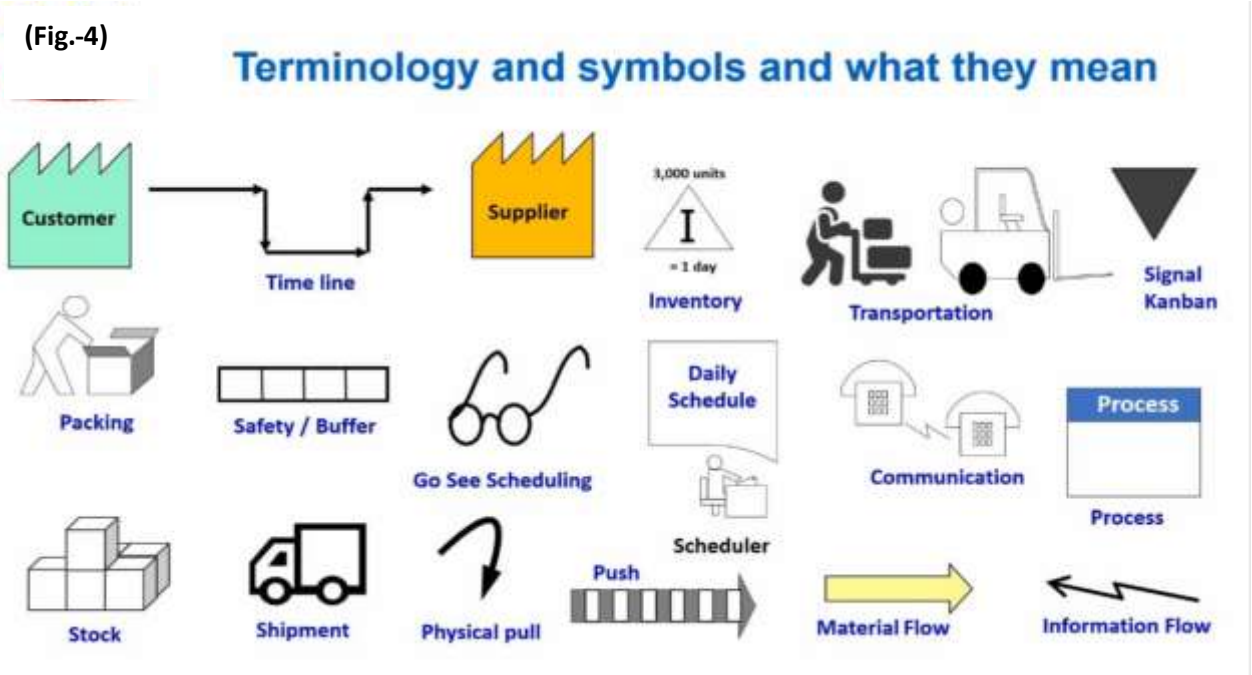
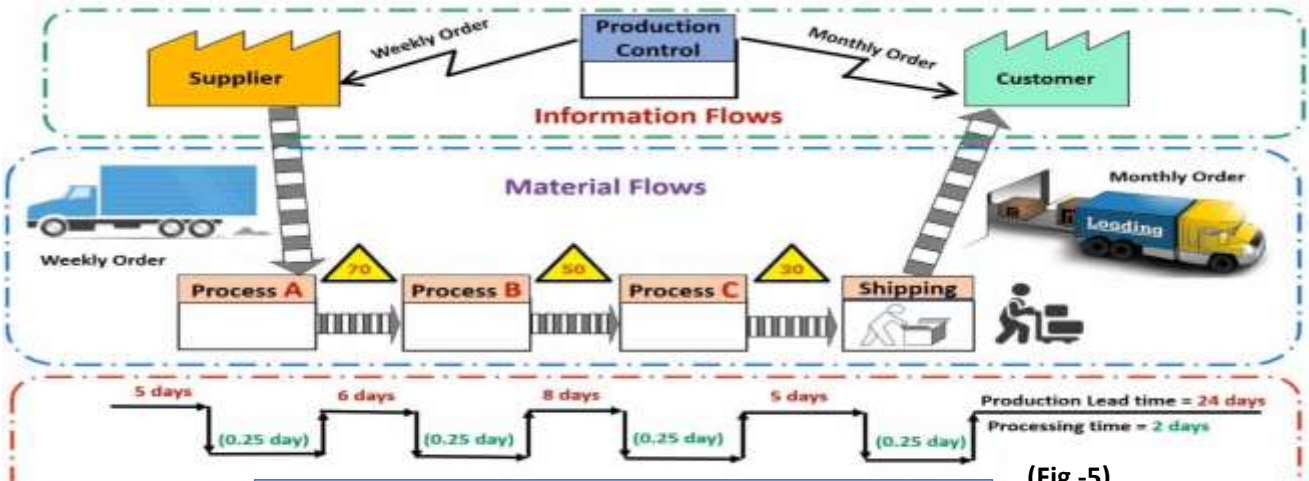


Key Benefits of Using VSM

Mainly, this mapping is focusing on converting business processes into different states:

- Can easily understand the entire material movement.
- Helps to understand the information flow that is supporting to flow the materials.
- Can identify the value adding percentage from the entire process.
- High level improvements can be easily identified.
- Improvements can focus into areas such as lead-time /change over times/ defect rates /Downtimes/in process WIP/,etc.



(Fig.-5)

MODEL KEY FLOW DIAGRAM OF A VALUE STREAMIMG

METHODOLOGY :

This chapter presents the systematic approach adopted to analyze and improve the manufacturing process of the disc brake assembly. The methodology is structured into six steps, each building upon the previous to ensure a comprehensive Lean transformation.

Step 1: Selection of Product Family

The disc brake assembly was selected as the product family for this study. The choice was based on:

- **High production volume**: It represents a significant share of overall manufacturing output.
- **Critical functionality**: As a safety-critical component, quality and reliability are paramount.
- **Improvement potential**: Historical data indicated recurring inefficiencies and bottlenecks in its production line.

This selection ensures that improvements will have a meaningful impact on both operational efficiency and customer satisfaction.

Step 2: Collection of Process Data

To establish a baseline, detailed process data was collected through direct observation, production records, and operator interviews. The key parameters include:

- **Cycle time**: Measured at each workstation to determine throughput capability.
- **Changeover time**: Recorded during product variant switches to assess flexibility.
- **Uptime**: Captured as a percentage of available machine time versus downtime.
- **Inventory levels**: Quantified for raw materials, work-in-progress (WIP), and finished goods.

This dataset provides the foundation for mapping the current state and identifying improvement opportunities.

Step 3: Current State Mapping (CSM)

A Current State Map was developed using Value Stream Mapping (VSM) techniques. The CSM illustrates:

- Material flow from suppliers to finished goods.
- Information flow between scheduling, production, and quality control.
- Bottlenecks, delays, and imbalances across processes.

The CSM serves as a diagnostic tool, making inefficiencies visible and enabling structured analysis.

Step 4: Waste Identification

Applying Lean's "Seven Wastes" framework, the following wastes were identified:

- **Waiting**: Idle time due to machine breakdowns, material shortages, or unbalanced workloads.
- **Overproduction**: Excess units produced beyond immediate demand, leading to inventory build-up.

- **Defects**: Scrap and rework caused by quality issues in machining and assembly.
- **Excess motion**: Unnecessary operator movements, poor workstation layout, and inefficient material handling.

Other wastes such as transportation and over processing were also noted but found to be less significant compared to the above.

Step 5: Future State Mapping (FSM)

A Future State Map was designed to eliminate waste and align production with customer demand. Key Lean tools integrated into the FSM include:

- **Kanban system**: To control material replenishment and reduce excess inventory.
- **Pull production**: Ensuring that processes produce only what is required by downstream demand.
- **Takt time alignment**: Synchronizing production pace with customer demand rate to balance workloads.

The FSM envisions a streamlined flow with reduced lead time, lower inventory, and improved responsiveness.

An implementation roadmap was developed to guide the transition from the Current State to the Future State. The roadmap includes:

- **Kaizen events**: Short, focused improvement workshops targeting specific issues such as setup reduction, layout optimization, and quality improvement.
- **Phased implementation**: Gradual adoption of Lean practices to minimize disruption and allow for learning.
- **Performance monitoring**: Continuous tracking of key metrics (cycle time, uptime, inventory levels, defect rates) to ensure sustainability and drive further improvements.

This roadmap provides a practical pathway for embedding Lean principles into daily operations.

METHODOLOGY **(Table -2)** **(Fig.-6)**

Lean VSM Methodology – Tabular Format

No	Step	Description	Key Outputs
1.	Selection of Product Family	Choose a group of products with similar processes for analysis.	Target product family identified
2.	Collection of Process Data	Gather cycle times, inventory levels, changeover times, and resource data.	Process metrics and baseline data
3.	Current State Mapping	Create a visual map of the existing process flow.	Current state VSM diagram

4.	Waste Identification	Analyze the current map to highlight non-value-added activities.	List of wastes (e.g., delays, excess motion)
5.	Future State Mapping	Design an optimized process flow with reduced waste and improved efficiency.	Future state VSM diagram
6.	Implementation Road Map	Develop a phased plan to implement the future state.	Timeline, action plan, responsible stakeholders

Conclusion

The purpose of this research was to develop a value stream map for assembly process of tractor parts. The goal was to identify and eliminate waste which is any activity that does not add value to the final product in the assembly process. It also aimed to reducing lead time and increasing throughput rate of parts.

The research demonstrates a clear path from a current state dominated by inefficiencies to a future state of streamlined flow and customer alignment. By reducing lead time considerably and aligning cycle times with takt time, the manufacturing company can achieve significant improvements in efficiency, flexibility, and responsiveness. The integration of Lean tools such as supermarkets, Kanban, SMED, FIFO, and Kaizen provides a robust framework for eliminating waste and embedding sustainable practices. Ultimately, this transformation not only enhances operational performance but also strengthens the organization's ability to deliver value to customers consistently and competitively.

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