

Implementation of Total Productive Management in Manufacturing Companies through TQM & Process Improvement Techniques

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Abstract— The main goal of any manufacturing company is to raise its profitability by proper improvements in the quality and quantity of company output. In this global economy and furious competitors, total Quality management is considered to be major way to long term profitability. Quality is basically a business strategy leading to growth, success, and to enhance competitive position. In this research there is a description of implementation of different process improvement tools to enhance quality for engineering products in manufacturing company. First of all overall Equipment Effectiveness is calculated and in second step, implementation of different tools like 5s, Six Sigma, TQM, PVR and QCO are used to increase company efficiency.

Index Terms— Mechanical production companies, Industrial Engineering, Total Productive Management, Total Quality Management, Six Sigma, 5 S, Quick Change Over

RESEARCH HISTORY

Overall Equipment Effectiveness

OEE is the best way to improve and monitor the efficiency of any manufacturing business. It is very simple, practical, and excellent way of measuring where is company standing and improvement can be made in it.

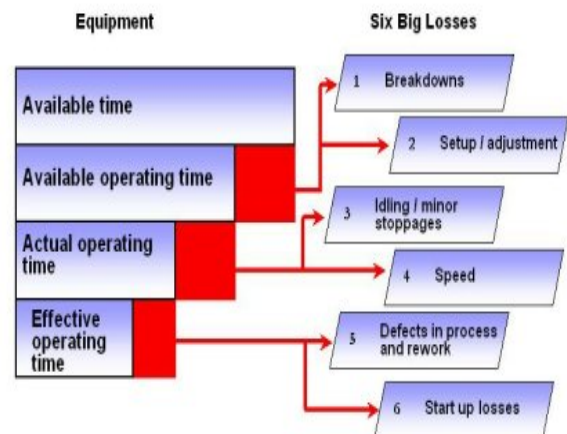
$$OEE = \frac{\text{Availability} * \text{Performance rate}}{\text{Quality rate}}$$

OEE should be 85% for any highly ranked company. This OEE is achievable if 90% is availability, 95% is performance and quality is 99.9%. In any manufacturing company following are the six big losses that have worst effect on OEE.

1. Breakdown losses
2. Setup and adjustment losses
3. Idling and minor stoppages
4. Reduced speed losses
5. Process defects
6. Reduced yield

For a manufacturing company to improve its quantity and quality outputs, it is necessary to completely eliminate or reduce these losses.

Loss Elimination through TPM?



(<http://www.google.co.uk/images?hl=en&source=imghp&biw=1024&bih=456&q=quick+change+over&gbv=2&aq=f&aqi=g1&aql=&oq=&gs>)

Introduction

The calculations for Availability, Performance rate, Quality rate to calculate OEE is made to detect current situation of manufacturing company. The formulas used to calculate OEE are as follows.

Availability = (Planned run time-downtime)*100/ Planned run time

Performance rate = (Total output)*100/ (Machine design rate* Actual operating time)

Quality rate = (Total output defects)* 100/ (Total output)

OEE = Availability *Performance rate *Quality rate

Tools to tackle reduced OEE

In order to improve the current position of the company to the world class level, it will take almost 02 years of journey. In this 02 years journey there will be proper implementation of different tools and in order to implement these tools we need team of right people.

Methodology:

Different resources and different readable print versions were used to create strong literature review for this task.

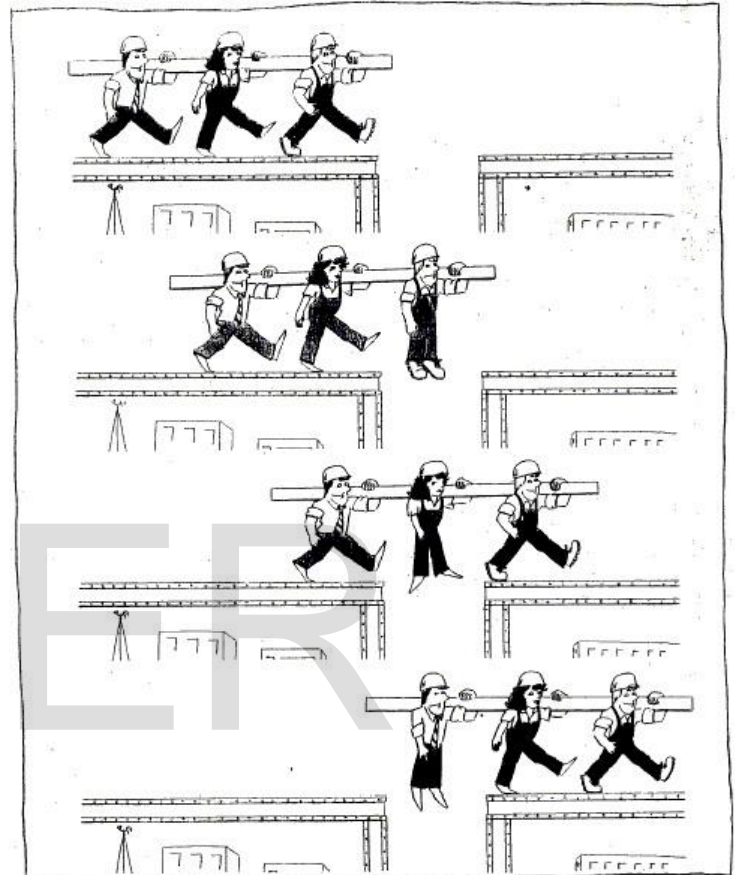
The major resources used for research are following: Proper search and study of literature available in research journals, text books, websites and collection of data through discussion with world automobiles companies & specialists.

Explanation:

Making a team of right people

The right team consists of a good experienced people who work inside the boundaries of the process and have an intimate knowledge of the way it works. The common goal of the whole team must be to make the company a worldwide company by improving the overall efficiency through proper implementation of process improvement tools. It is always easy to make a team but it is always difficult to

have a proper team work. But it is a fact that if team starts working really like a team then they can do any thing of the world. So it's the responsibility of team leader of the team to make his team a team. The following sketch shows the successful team work strategy.

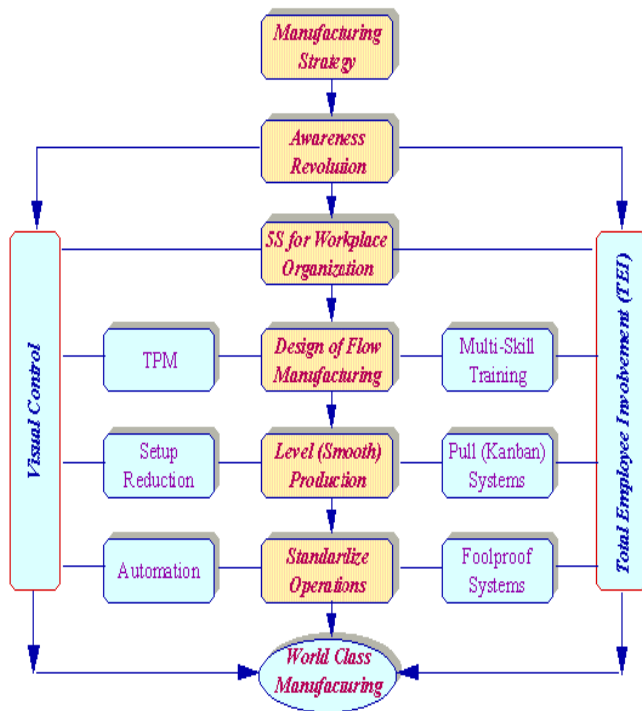


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Tool used and their Order

Following are the tools and techniques which can be used to improve the quantity and quality outputs of a manufacturing company.

- 7 wastes identification
- Value stream mapping
- 5S
- TPM
- Quick changeover
- PVR



(<http://net1.ist.psu.edu/chu/wcm/frame.htm>)

7 wastes identification

Transport: Movement of materials is a waste and it should be minimized.

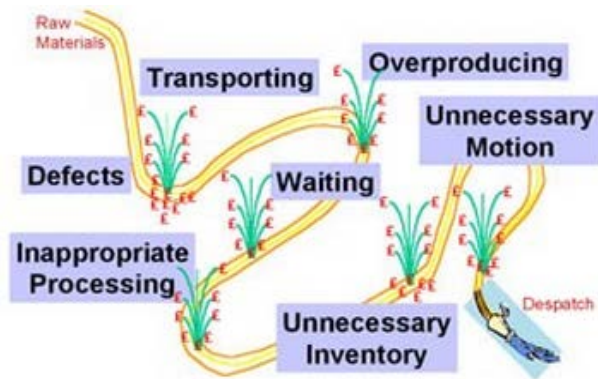
Inventory: There is a loss of sales on the basis of very short inventory but there too much inventory can also create a lot of problems. There must be JIT manufacturing to reduce cost and expose problems.

Motion: Removal of unnecessary motion always improve operation of system.

Waiting: In order to have a value adding time there must be a removal waiting time.

Overproduction: Always try to produce exactly what the customer orders, just in time, to the correct quality level.

Over Processing: Use proper machines which have a proper capacity to minimize over processing



(http://www.mas.bis.gov.uk/north-west/resources_local/what-is-lean/introduction-to-the-7-wastes)

Defects: Reduction in defects gives reduction in wastes so always aim for zero defects.

These wastes are productivity bases but quality linked. These wastes are the biggest cause of quality and quantity losses for a manufacturing company's outputs. It is really important for a manufacturing company to completely eliminate these wastes or to reduce them to the minimum, in order to improve its quantity and quality outputs.

Steps Involved dealing with wastes

Following are the steps involved manufacturing company to deal with these wastes.

Observe and try to write wastes on a post-it note. At the same times try to write possible solution.

- After finishing try to attach all the post-it notes on to large sheets for each person seen.
- Consider big hits to eliminate urgently and less critical hits in future.
- Try to have follow up sheet to ensure future actions to remove waste are actively followed up

- Once you are sure that cheap solution are working then try use it to remove wastes as much as you can.

- Pull production systems
- Quick changeovers

Value Stream mapping

The Value stream mapping is basically a pencil and paper tool that helps to understand the flow of material and information as a product makes it way through the value stream.

A map that produced shows the visual representation of every process in the material and information flow.

Then a future state map is drawn after identifying all the problems and their solutions.

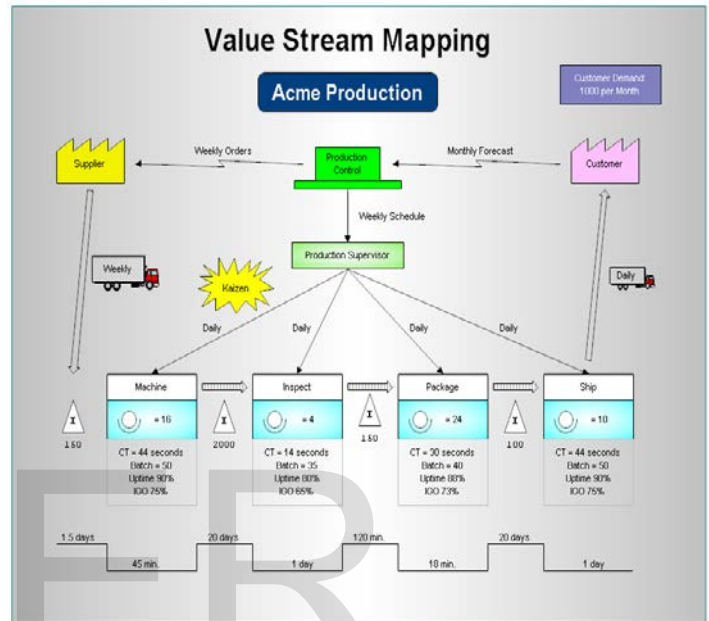
Advantages of value stream mapping

- help to make decisions about flow
- common language for talking in manufacturing process
- Shows links of information
- Visualise more than just a particular process
- Allows making decisions about flow.
- Allows implementation plans.
- It shows where the lead time and processing time can be reduced, so quantity improves.
- It helps to reduce the large inventories and start small batches, so quality improves.
- It shows how quality improves when the lead time and processing time got reduced.

All the wastes and the problems in the manufacturing process are easy to realize when value stream map is drawn. Techniques are always required to solve these problems, such as

- Daily orders and delivery to reduce lead times
- Small batches

For example consider a value stream map for any manufacturing company



(http://www.google.co.uk/imgres?imgurl=http://www.rff.com/value_stream_1.png&imgrefurl=http://www.rff.com/value_stream_1.htm&us)

5S

5S is basically a excellent method to organize, order, clean and standardize a workplace and to keep it in that way. 5S methodology was first developed by Japanese. 5S is a system which is used to optimize productivity and to reduce wastes by maintaining an orderly workplace. This method is basically helpful in Implementation of methods to "cleans up" things and organizing the workplace in its existing configuration. It is the first lean method which organizations implement.

5S pillars are

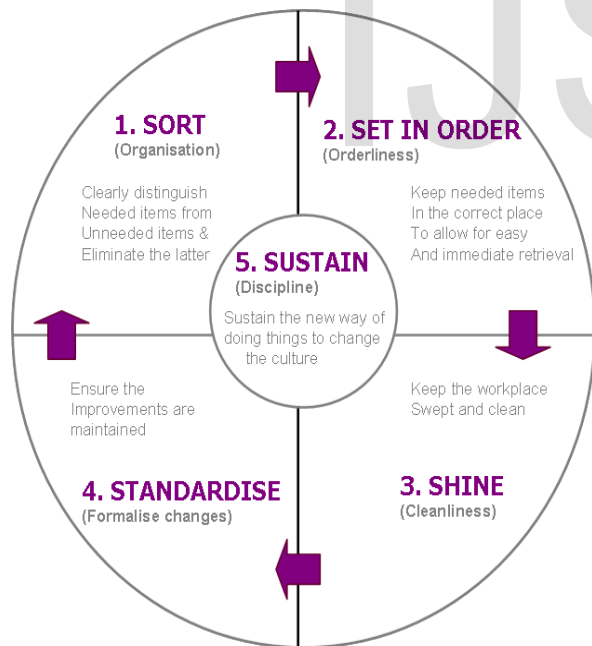
1. Sort(seiri)
2. Set in order(Seiton)

3. Shine(Seiso)
4. Standardize(Seiketsu)
5. Sustain(shitsuke)

Benefits of 5S

A manufacturing company which implements 5S methodology in its workplace achieves the following benefits

- Meets deadlines better
- Safer working areas
- Focus on root causes
- Total participation to check process
- boost workforce
- Removal of non value added activities
- Higher output
- Lower defects
- quality is improved



<http://www.google.co.uk/imgres?imgurl=http://www.arwconsulting.com/images/5S%2520Graphic.jpg>

Helps in creation of work environment which is self-explaining, self-regulating and self improving. All these 5S are explained in figure.

SIX SIGMA

It is the requirement of all manufacturing companies to have frequently improved output, lessen costs and better customer service. 6 Sigma helps companies to have all these things. There is no surprise that a rapidly increasing number of companies are looking to introduce the “Six Sigma” process improvement methodology.

Six Sigma is a quality execution program to achieve “Six Sigma” levels of quality. It was pioneered at Motorola in the Mid 1980s by Bob Galvin.

Basically, Six Sigma is a measurement based strategy for removing defects that emphasize on systematic and project-based process improvement and variation reduction – targeting to achieve a process that does not produce more than 3.4 defects per million opportunities.

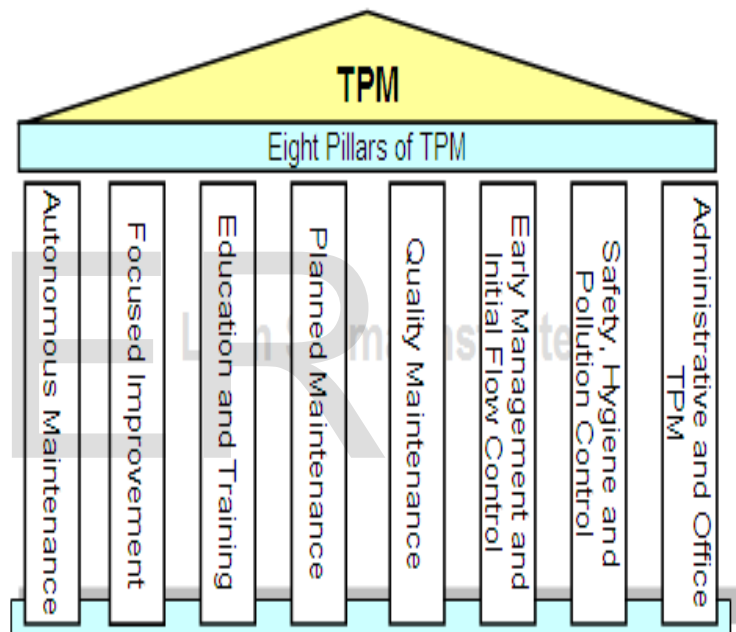
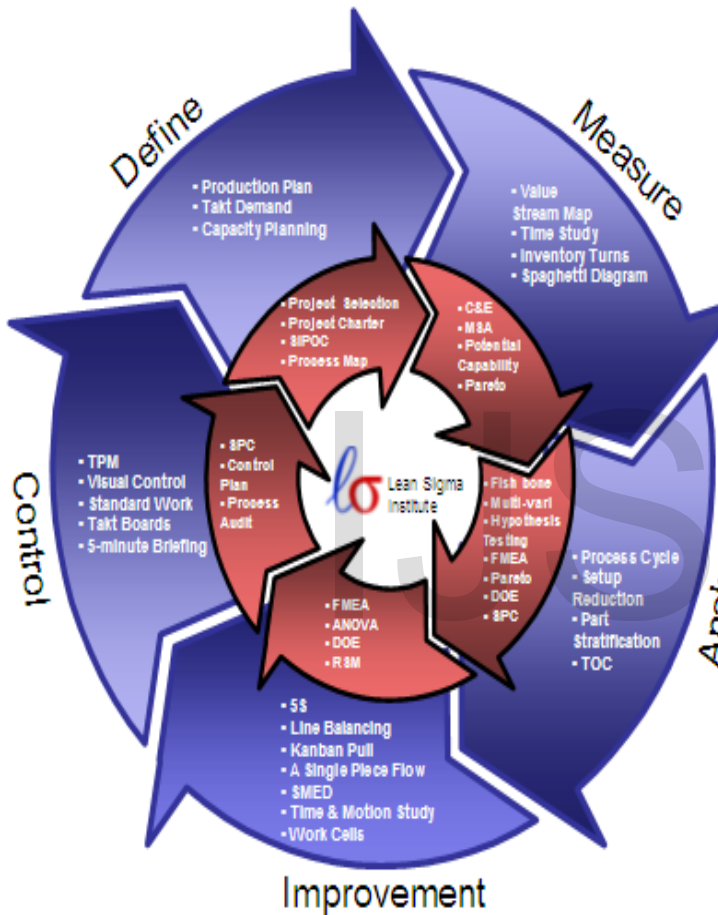


<http://hyderabad.olx.in/total-productive-maintenance-total-quality-management-iid-26554588>

team undertake these projects, which apply existing concepts and statistical tools within a process structure. The DMAIC process (Define problem, Measure, Analyze, Im-

prove, and Control) is the most common framework for handling existing processes falling below requirement and looking for improvements. While **DMADV (Define, Measure, Analyze, Design, Verify)** is an step up system used to build new processes or products at Six Sigma quality levels. There are Black and Green Belts experts who are trained to guide and manage individual projects.

it is limited to equipment but includes: employees, processes, product and the work environment in its improvement activities. TPM is a proactive philosophy that has a direct connection to corrective maintenance (fix it when it breaks). It aims to reduce failures in poor production, setup losses and other causes of poor or reduced production by involving the operators directly in the maintenance of their respective machines, which is a requirement of TQM application.



(http://www.google.co.uk/imgres?imgurl=http://www.sixsigmainsttute.com/images/TPM_Eight_Pillars.png&imgrefurl=http://www.sixsigmainsttute.com/lean)

(<http://www.google.co.uk/imgres?imgurl=http://robertjgraham.com/wp-content/uploads/2010/10/lean-six-sigma-DMAIC>)

TPM (Total Productive Maintenance)

TPM is evolved from Preventive maintenance and it quite common with TQM. Both TPM and TQM have same targets to minimize defects. TPM has a relation with the principles of maintenance engineering and total quality management (TQM). TPM is like PM (Preventive Maintenance),

Benefits of TPM

- Management by fact
- Make work easier and safer
- Eliminate need for equipment adjustment
- TPM attempts to make problems visible
- Aim at “spread the load”
- Prevent quality defects and breakdowns

Quick change over-QCO

QCO is basically a method to minimize time it takes to change a line or machine from running one product to the next. The main aim of this tool is to execute setup in less than ten minutes. This tool is helpful in minimizing set up time of next product. The need for quick changeover programs is required more in our Radiator and heat exchanger manufacturing company because in accordance to our Pareto analysis the 02 leading losses are reel change and set-ups. So by implementing QCO these losses can be minimized through QCO. QCO is also a significant component of Lean Manufacturing, allowing companies to minimize batch sizes and shorten lead time, making it easier to meet customer demands for high-quality, low-cost products, delivered quickly and without the expense of excess inventory.

The goal of QCO

Shift as many internal setups as possible to external setups.

External Setup

Can be performed while machine is running.

Internal Setup

Can only performed when machine is off

Jobs within QCO

List everything required to setup and run next operations i.e; tools, proper values for working conditions, specifications, workers required etc

- Use of multi functional tools
- Divide setup operation between two or more people
- Use of Standard Operating Procedures(SOPs)
- Videotape changeover on pilot line

- Analyze flowchart
- Function checks
- Implement parallel operations

PVR

Process Variability Reduction is a multi-part strategy to minimize product variation and make a product better regardless of variation. This tool consumes the most of time to make this company a world class company.

Taking example of our company, the tube that is manufactured in radiator and heat exchanger manufacturing company is of two different materials brass and tin but they have metallic core tubing in both products. Company is facing a waste which cost it so much and its reason is and its reason is that machine used for the making tubes is same but every tube is not same and its different from other even if its of same material. This really effect quality of company and increase cost.

In order to tackle this production cost PVR is used. PVR could be achieved by Six Sigma – The DMAIC approach. There is a involvement of Standard Operating Procedure (SOP) or Work Instruction (WI) in it. First we define issue, then we measure it either as key measure or process measures. For analyzing following are tools.

Next stage of the PVR is **Analysis**; following are the simple analysis tool:

Brainstorming:-

A group discussion with equal chance to all and no criticism allowed.

Fishbone Diagram(Cause and Effect diagram):-

Fish bone shows potential causes for a specific effect.

Failure mode effect analysis(FMEA):-

It is the analysis process to know the risk of failure, from concept design through to volume production.

Pareto chart:-

Explained earlier

Histogram:-

Histogram is a graphical summary of data, helpful to visualize whole process, that has been collected from a process over a period of time.

Run chart(Control Chart):-

A run chart shows the variation in process over the time.

Scatter Diagram:-

Scatter diagram helps to know the effects of the input processes on the output.

5 why's :-

This is the technique to get from symptom to root cause by asking "Why" 5 times.

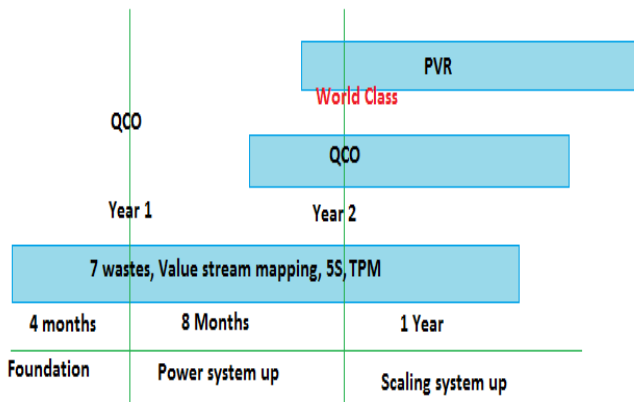
Next step is Improve, reporting process help completes this step and Last tool is **Control**, which simply means to keep the gain by using control tools.

PVR Benefits

It increases

- Process quality
- Process stability
- Process consistency

Time Scale Road Map



This road map would be highly supportive to execute the process improvement tools like Identification of 7 wastes, TPM, 5S, QCO, PVR act on the tools which make the company a make this company a world class company. From road Map it is obvious that for the first starting 4 months team will execute tools like identification of wastes and

value stream mapping. After that from next 8 months, in start there will be execution and 5S, 6 Sigma, and TPM. In the last month of month span and for the next whole year there will be a working on both of 02 tools named as QCO and PVR.

Conclusion

A manufacturing company should do following things in order to improve Ist select a process which needs to be improved.

- Select a proper team that will work on detection of losses and identification of 7 wastes and their causes.
- Draw a value stream map
- Draw a future state map with solution of the problems
- Than implementation of certain tools for improvement and elimination of quality and quantity related problems . these tools are

1. 5S
2. six sigma
3. TPM
4. Quick changeover(QCO)
5. PVR

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