International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

# Process Improvement by using Value Stream Mapping:- A Case Study in Small Scale Industry

Mr. Rahul.R.Joshi[1], Prof.G.R.Naik[2]
[1]*PG. Student,*
*Department of Production Engineering,KIT's College of Engineering,Kolhapur*
*Shivaji University,Kolhapur(India)*

[2] *Asso.Professor*
*Department of Production Engineering, KIT's College of Engineering,Kolhapur*
*Shivaji University,Kolhapur(India)*

***Abstract***
*"Process improvement" means making things better. However, when we engage in true process improvement, we seek to learn what causes things to happen in a process and to use this knowledge to reduce variation, remove activities that contribute no value to the product or service produced, and improve customer satisfaction. Process Improvement means examine all of the factors affecting the process: the materials used in the process, the methods and machines used to transform the materials into a product or service, and the people who perform the work.Lean Production Starts from the argument that adding value and reducing waste are the key goals of any business. But for many stills, the teething pains of change and a steep climb are too much bear and Sustain. Organization may contain with a number of a weak points in it which makes them difficult to achieve the promised gains for the efforts they put in it. Value stream mapping (VSM) is a lean manufacturing technique and it has emerged as the preferred way to support and implement the lean approach. Value stream mapping is different than conventional recording techniques, as it captures the information at individual stations about station cycle time, uptime or utilization of resources, setup time, WIP inventory, manpower requirement and the information flow from raw material to finish goods. This Paper details the use of the value stream mapping in reducing waste in manufacturing Company.With a Case study in a one of the Die manufacturing industry, the production process path is visualized by mapping the current state value stream map. After tracking the entire process, wastage affecting the cycle time are identified and its causes analyzed. A Future state value stream map is developed and improvement ideas are suggested. With the suggested improvement ideas the cycle time is expected to be shorten from 14400 minutes to 9600 minutes, representing 30% reduction. Value Stream mapping is proved as a useful technique to minimize the cycle time and increase the Production.*

**Keywords:** - Value stream mapping, cycle time, Production Process, wastages, bottleneck Operation.

## "1.Introduction"

A process is no more than the steps and decisions involved in the way work is accomplished. Even without Changing the process flow, speed can be injected into the system doing the away with the costs of waiting, and the resulting confusion by simply streamlining and debottlenecking the flow by reorganizing the flow of work. The current business environment has placed an increased focus on operational efficiencies while maintaining a high level of quality and innovation excellence.(1).With manufacturing becoming a more and more competitive market, companies globally strive to increase their efficiency. Value Stream mapping technique involves flowcharting the steps, activities, material flows, communications, and other process elements that are involved with a process or transformation. Companies are experiencing intense competitive pressure due to globalization hence they cannot afford to operate with waste in their processes.(3). A value stream is all the actions (value-added and non-value added) required to take aproduct from raw material to the customer, the design flow from concept to completion.(2). Value-added activities are considered the actions and theprocess elements that accomplish those transformations and add value to the productfrom the perspective of the customer (e. g., tubing, stamping, welding, painting, etc.).Non-value-added activities are the process elements that do not add value to theproduct from the perspective of the customer such as setting up, waiting for materials,and moving materials.

## "2.Case Study"

### "2.1 Problem statement"

Few of the small scale units graduate in to a middle scale industry with a variety of functions and activities closely knit into organizational network following a set of objectives. Although lean manufacturing is becoming a popular technique for Productivity Improvement. The case study is carried out in a small scale industry namely Ablepvt.Technology ltd. to achieve certain tangible and intangible benefits. If the shop floor is the well spring of Competence, it is also a den of vice and waste is its king. To promote the use of lean manufacturing within the company is the challenge. Its focuses on the addressing identified manufacturing Problems through the application of selected lean tools. The Problem approach is that the lean tools which are applied are drawn exclusively from those which have been found to be successful in a Able pvt. Technology ltd. The entire process from raw material entry to customer is studied. While studying the entire process from different departments it is clear that tool room consists of a Problem. Tool Room for manufacturing the Sheet Metal Dies is piled up with jobs and this has been consistently noted for the past few months regularly. Even after working for a more time rather than shift time, the assignment doesn't seem to cease. Due to the overtimethe manpower requirement has been rising along with additional inventory for tools and other equipments. The cycle time required to complete is high and it is 14400 minutes. The work-place seems cluttered with work all over the working area.Therefore, there is enough scope for streamlining and debottlenecking the process flow. The aim is to reduce the cycle time and improve the process. .

## "2.2 Methodology Adopted"

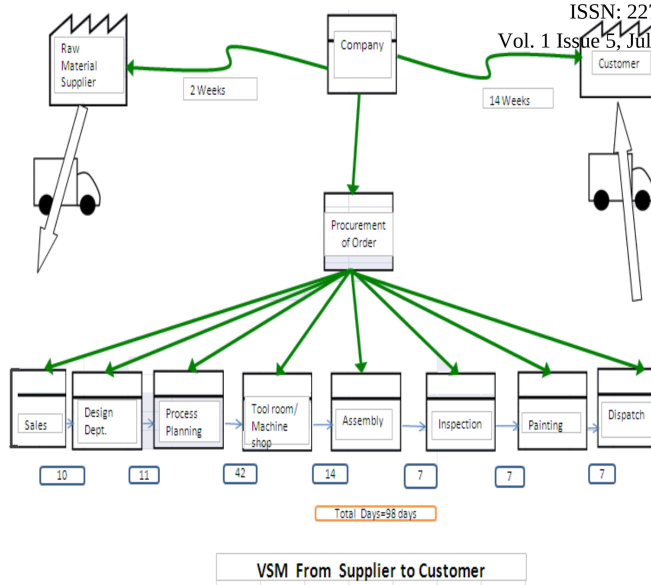
Main objective is to achieve cycle time reduction by employing the following steps:-
**Step I)**To draw a Current State Map by using following substeps:-
Substep I)Identification and Drawing the Product flow from the raw material entry point of the Manufacturing division (MFD) to the finished goods exit point of the MFD.
Substep II) Calculating the number of Work in Process (WIP) for each component at each work cell.
Substep III)Calculating the cycle time and utilization percentage of each process.
Substep IV)Plotting the current State Map that is essentially a Snapshot capturing how things are currently being done.
**Step II)** Create a Future State Map, Which is a Picture of how system should look after the inefficiencies in it have been removed.

## "2.3 Current State Map"

Data Collecting Method:-
Method that will be used in collecting data needed is observation to theactivities that performed in the production shop floor. We gown throughthe manufacturing facility and identified each operation process involved from rawmaterials to finished goods, identified all the places where inventory is storedbetween the processes, and observed how the material flows from one operation toanother.Statistical data collection methods for measuring machine setup time were used in this study to summaries and describe the data. Production process flow and standard operation procedure are reviewed briefly before setting up the data collection table is done. The data was collected by using a stopwatch. Based on the actual production, data was collected and recorded on a daily basis. The data was collected for 40 days and subsequently, a statistical bar chart was drawn to monitor and analyse the problems. These methods helps to identify the main contributor to high time loss and help to visualize and better understand the root causes and finding possible solutions to the problems.

## "2.4 Analysis of a Current State Map"

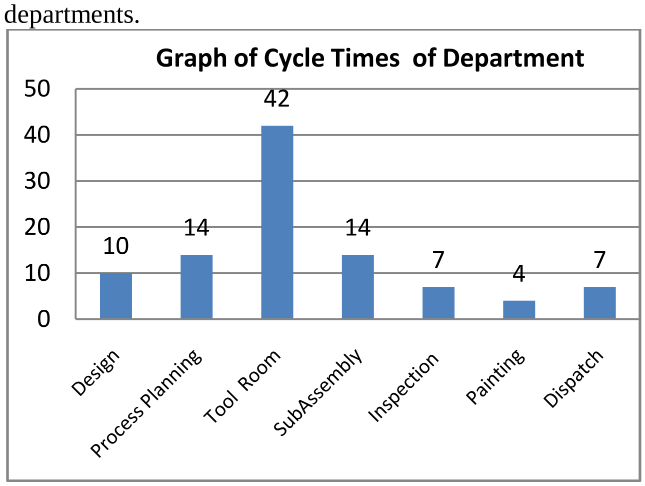
| Sr.No | Lead Time | Cycle Time (in Weeks) |
|---|---|---|
| 01 | Company to Customer | 14 |




"Figure I.CVSM of Supplier to Customer"

| Sr.No | Department | Cycle Time (Days) | Percentages |
|---|---|---|---|
| 01 | Design | 10 | 10.20% |
| 02 | Process Planning | 14 | 14.24% |
| 03 | Tool Room | 42 | 43% |
| 04 | SubAssembly | 14 | 14.24% |
| 05 | Inspection | 07 | 07.14% |
| 06 | Painting | 04 | 04.08% |
| 08 | Dispatch | 07 | 07.14% |
| 09 | Total Days | 98 | |

The following graph shows the cycle time in days for departments.

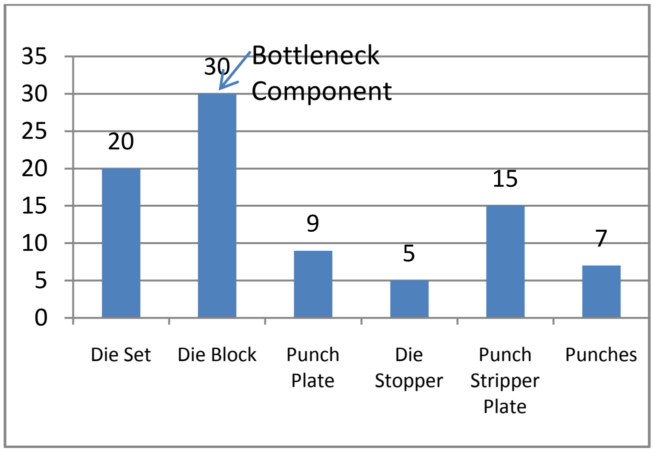



From The Graph it is clear that the Cycle time required for tool room is 42 days which is Highest. The Tool room consists of following Components. All the Components are made parallel to each other. The following table shows the Components with Their Cycle time in days.

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

| Sr.No | Components | Cycle Time(days) |
|---|---|---|
| 01 | Die Set | 20 |
| 02 | Die Block | 30 |
| 03 | Punch Plate | 09 |
| 04 | Die Stopper | 05 |
| 05 | Punch Stripper Plate | 15 |
| 06 | Punches | 07 |

.

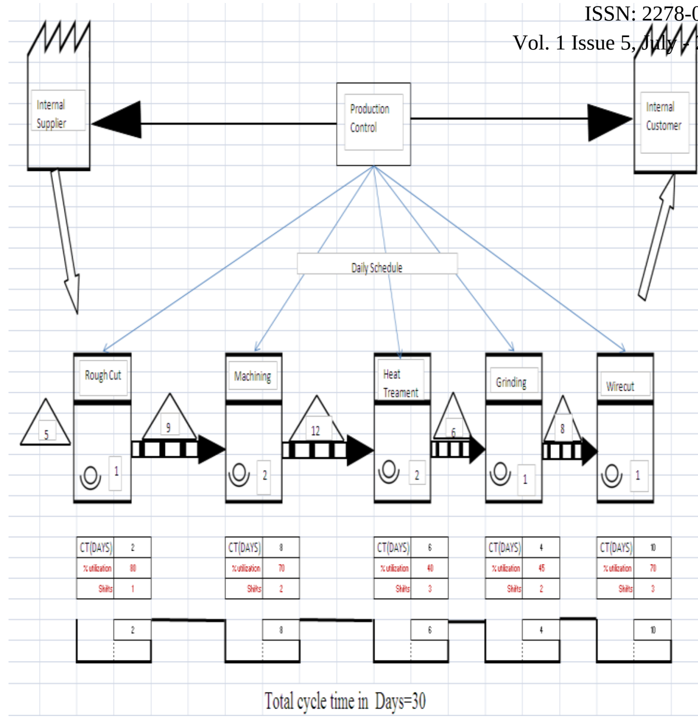



While reviewing the entire process in a tool room for a die manufacturing, a die block acts as an a Bottleneck Component which causes the sheet metal die to pile up with the jobs. The entire operations for making a single die block was studied which takesan 30 days to complete it

Value Stream Mapping Data Set:-

| | |
|---|---|
| Customer Order | 50 per month |
| Working Hours | one shift 8 hours(per day) |
| Lunch Break | 45min(per day) |
| Raw Materials.Purchase | Every 15 days |

The Figure II of Current State map of a Particular single die block with value stream mapping Symbols is Follows:-




"Figure II:- Current State map for Die Block"

The following table Shows the operations performed on die block, with Their Cycle time in days, WIP, machine Utilization.

| Sr.No | Operations on Die Block | Cycle Time (min) | WIP (No) | Machine Utilization(%) |
|---|---|---|---|---|
| 01 | Rough Cut | 960 | 5 | 80 |
| 02 | Machining | 3840 | 9 | 70 |
| 03 | Heat Treatment | 2880 | 15 | 40 |
| 04 | Grinding | 1920 | 8 | 75 |
| 05 | Wirecut | 4800 | 10 | 70 |

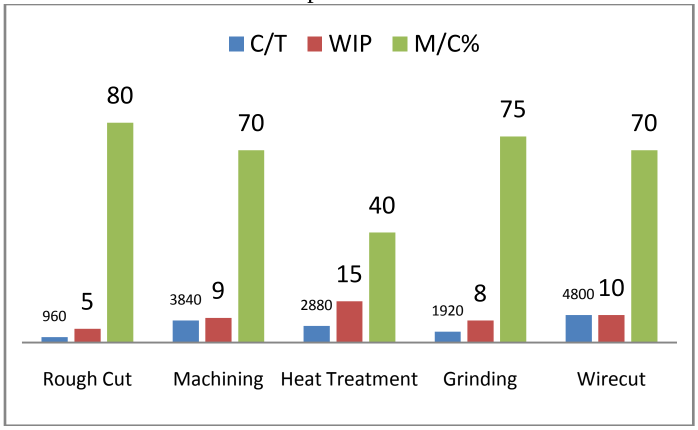
1.Cycle Time Reduction(C/T):-
The periodrequired to complete one cycle of an operation; or to complete a function, job, or task from start to finish. Cycle time is used in differentiating total duration of a process from its run time.

*2.Work-in-process inventory(WIP)*
*Work-in-process inventory* is inventory that has been partially converted through the production process, but for which additional work must be completed before it can be recorded as finished goods inventory. The partially finished goods that are held in inventory for completion and eventual sale.

3.Machine Utilization:-
Machine utilization computed as a percentage of the available hours (Number of the machines available for production multiplied by the number of working hours), The percentage of time that a machine is actually in use.

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

The Following Graph Shows the Cycle time ,WIP, Machine Utilization. Combine with operation.




## "3.Proposal for the Future State Value Stream Mapping"

Having Visualized the Current State Map of a die block, identified the Wastages and associated Problems, some of the necessary Changes in the value Stream of die block were outlined in the draft of the future state map.

Production Processes:-
1.Rough Cut
2.Machining
3.Heat Treatment
4.Grinding
5.Wirecut

## "3.1Identification of Wastes in each operation of die block"

**I) Rough cut:**

1. excess stock casuing more time to do rough cutting

**II) Machining**

1) Delay in latest (revised/updated) model/drawing to reach the manufacturing cell
2) Inappropriate format of 3D model for CAM software
3) Absence of expertise for creating CAM program
4) No provision of standard library for reference to verify compatibility of formats/ programs/ codes of CAM program vis-a-vis controls on the `Machining Centre'.
5) Delay in creating machining program due to insufficient memory/ RAM of the desktop computer
6) Incompatible interface of CAM program with m/c interface
7) Inadequate operator skills for interfacing CAM program with m/c
8) Table size insufficient for the stock and the program. This is largely due to incoherent/ redundant data shared to Design Engineer by Tool Room
9) Tools selected in the CAM program not available in Tool Room/ Tool Stores
10) Gouging/ fouling with stock observed during the `verification' at Tool Room
11) Inefficiency in machining operation since program created to remove too little stock removal in the rough cut operation
12) Unnecessary tool change introduced by the CAM programmer in the machining program
13) hard spots observed in the stock during machining
14) Pencil tracing/ Finish cut improperly introduced in the program
15) Frequent tool breakage for tools with longer length and lesser diameter (less than 4mm)
16) Delay in removal of finished stock from the machine
17) Breakdown of machines- no preventive maintenance
18) More MTTR- No identification of critical spares and inventory
19) Low speed/ feeds or changes in process parameters due to cutting tools not standardized and cutting tools inventory not maintained
20) Absentism of operators- No substitutes identified- operator skill matrix not made (improper)

**III) Heat treatment:**

1. Loading for furnace not planned- there is either no load at furnace or excess load suddenly coming up. Machining and Heat treatment not synchronized.
2. Daily power cut off- no back up available resulting into reheattreatment of parts after power comes back.

**IV) grinding:**

1. Minimum stock removal not planned- there are more stocks which can be optimised
2. only one gridning machine availble
3. machine is too old and frequently undergo maintenance

**V) wire cut:**

1. Electrodes are outsourced- dependent only on one vendor.
2. electordes sourcing is not planned/ synchronised with requirement.
3. only one wire cut is available- looking for another machine or source non critical wire cutting from outside.

Classification of Wastages into Standards forms and Technique to Elimination of Wastage:-

| Operations | Wastage | Type | Technique of Elimination |
|---|---|---|---|
| **Rough Cut** | excess stock casuing more time to do rough cutting | Errors | DFM- Design for manufacturing |
| **Machining** | 1) Delay in latest (revised/ updated) model/ drg to reach the manufact | Underutilized People | Job description and role & responsibility,HR selection process training |

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

| | | | |
|---|---|---|---|
| | uring cell | | |
| **Machining** | 2)unsuited format of 3D model for CAM software | Errors | Design and process review |

| Operations | Wastage | Type | Technique of Elimination |
|---|---|---|---|
| **Machining** | 3) Absence of expertise for creating CAM program | Underutilized People | Job description and role & responsibility,HR selection process training |
| **Machining** | 4) No provision of standard library for reference to verify compatibility of formats/ programs / codes of CAM program vis-a-vis controls on the `Machining Centre'. | Errors | Data management |
| **Machining** | 5) Delay in creating machining program due to insufficient memory/ RAM of the desktop computer | Waiting | Design and process review |
| **Machining** | 6) Incompatible interface of CAM program with m/c interface | Errors | Design and process review |
| **Machining** | 7) Inadequate operator skills for interfacing CAM program with m/c | Underutilized People | Job description and role & responsibility,HR selection process training |
| **Machining** | 8) Table size insufficient for the stock and the program. This is largely due to incoherent/ redundant data shared to Design Engineer by Tool Room | Underutilized People | Job description and role & responsibility,HR selection process training |
| **Machining** | 9) Tools selected in the CAM program not available in Tool Room/ Stores | Waiting | MRP- Material resource planning, inventory control, 5S |
| **Machining** | 10) Gouging/ Fouling with stock observed during the verification' at Tool Room | Underutilized People | Job description and role & responsibility,HR selection process training |
| **Machining** | 11) | Underutil | Job description |

| | | | |
|---|---|---|---|
| | Inefficiency in machining operation since program created to remove too little stock removal in the rough cut operation | ized People | and role & responsibility,HR selection process training |
| **Machining** | 12) Unnecessary tool change introduced by the CAM programmer in the machining program | Underutilized People | Job description and role & responsibility,HR selection process training |
| **Machining** | 13) Hard spots observed in the stock during mmachining | Defects | incoming quality control, supplier selection process |
| **Machining** | 14) Pencil tracing/ Finish cut improperly introduced in the program | errors | Design and process review |
| **Machining** | 15) Frequent tool breakage for tools with longer length | Errors | Design and process review |

| | | | |
|---|---|---|---|
| | and lesser diameter (less than 4mm) | | |
| **Machining** | 16) Delay in removal of finished stock from the machine | Transport | CPM/PERT |
| **Machining** | 17) Breakdown of machines - no preventive maintenance | Waiting | Preventative Maintainance |
| **Machining** | 18) More MTTR- No identification of critical spares and inventory | Errors | Standard work |
| **Machining** | 19)Low speed/ feeds or changes in process parameters due to cutting tools not standardised cutting tools inventory not maintained | Waiting | MRP |
| **Machining** | 20) Absentism of operators - No substitutes identified - operator skill | Underutilized People | Skill Matrix,Contigency Planning |

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

| | | | |
|---|---|---|---|
| | matrix not made(improper) | | |
| **Heat Treament** | 1. Loading for furnace not planned- there is either no load at furnace or excess load suddenly coming up. machining and HT not synchronized. | Waiting | Production plan/ line balancing, visual management |
| **Heat Treament** | 2. Daily power cut off- no back up available resulting into reheattreatment of parts after power comes back. | Errors | Contingency planning |
| **Grinding** | 1. Minimum stock removal not planned- there are more stocks which can be optimised | Errors | DFM- Design for manufacturing |
| **Grinding** | 2.only one gridning machine availble | Waiting | Line balancing, CPM/PERT |
| **Grinding** | 3.machine is too old and frequently undergo maintenance | Waiting | Analysis of breakdown maintence and actions thereafter, strategic plan, Depreciation analysis |
| **Wire Cut** | 1. Electrodes are outsourced- dependent only on one vendor. | Waiting | Make or buy decision, sourcing startegy, capacity assessment at sub supplier |
| **Wire Cut** | 2.electordes sourcing is not planned / synchronized with requirement. | Underutilized People | Job description and role & responsibility, HR selection process training |
| **Wire Cut** | 3.only one wire cut is available - look for another machine or source non critical wire cutting from outside | Waiting | Make or buy decision, sourcing startegy, capacity assessment at sub supplier |

## “4. Methodology Eliminiate the Techniques”

**1.DFM- Design for manufacturing**

1.Identify all dimensions by sr no, 1,2,3…..
2) identify the dimensions which are having machining
3) calculate the stock removal

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

4) Highlight all those dimensions which has excess stock (>5mm)
5) modify the drawing to reduce the excess stock.

**2.Preventive maintenance**
1) identify all machines with sr no.
2) prepare the master list of machines
3) identify the areas of preventive maintenance
4) Capture past history associated with each machine and include those points in preventive maintenance
5) prepare the detailed work instructions for each point of preventive maintenance
6) prepare themaintenance schedule based on the recommendation

**3.MRP- Material resource planning**
1) capture past history of spares utlilised for each machine
2) discuss with machine manufacturer and identify the critical spares
3) have agreement with them @ which spares he will maintain and which one not
4) include all such spares in the master list
5) identify the lead time for each spare
6) based on the history of consumption, identify the reorder level
7) Review and Update the data on daily basis

**4.Standard work:**
It is basically a very specific instruction given to operator to follow on daily basis. Operators should be able to read the standard work and identify the next steps wherever issue comes.

**5.MRP- Material resource planning, KANBAN, Visual management**
For visual management, we can put the board showing clearly the status of the inventory or we can use the board with the tags showing the status of the inventory

**6.Skill matrix, and contingency planning**
**Skill matrix:**
1) Line manager should identify the operations performed by all operators
2) each operator is judged by his immediate supervisor for the skill level for each identified operations. Sometime written/ oral exam is also helpful
3) Thejudgment is divided into 4 categories- No skill, trained, can work but with supervision, can work independently and can supervise others.
4) this matrix helps the line supervisor to nominate the other person based on the skill in case one person is absent.

**7.Contingency planning:** based on the above mentioned skill matrix, identify the critical operations which requires more skill and plan the shift in such way that alternate person will always be there to support in case the other person is absent.

**8.Production plan/ line balancing, visual management**
Production plan: shows the parts which will undergo Furnace for the month. Based on the cycle time for each part, define the loading cycle. Dispay a big board near furnace which shows the status of each planned part

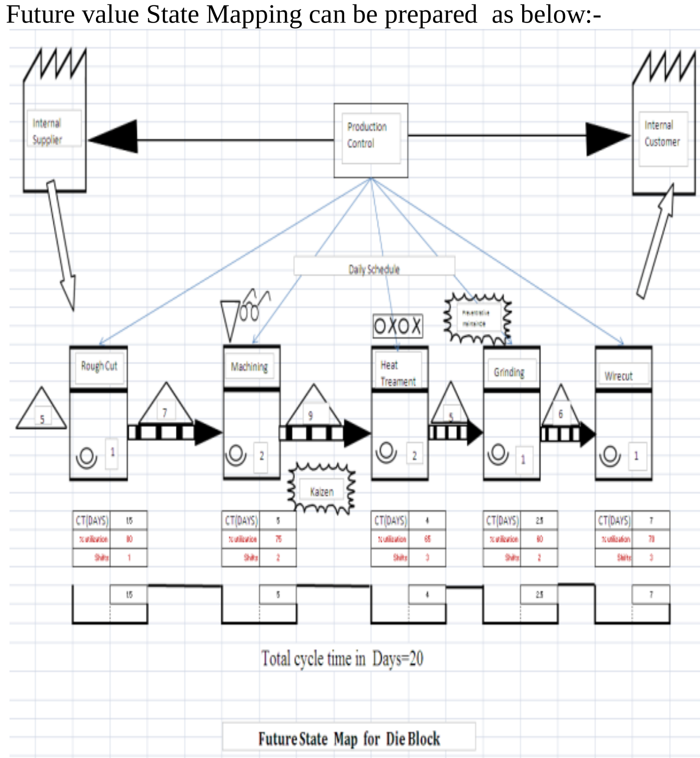
**9.Contingency planning**
Identify the areas which affects on the production e.g. natural calamities, critical machine breakdown, strike, power failures etc. for the identified issue, the tool room can plan for gen set or else hav an agreement with MSEB so that they will get advance notification before power goes off so that better planning is possible.

**10. Make or buy decision, sourcing strategy, capacity assessment at sub supplier:-**
Electrode making in house is not viable since it requires EDM and special manpower and hence it is decided to outsource only. But now we have anlaysed the overall capacity available at supplier by using the simple formula= available minuts/ day- committed time . This has triggered us that the supplier is already overloaded and hence we have decided to go for another source as backup. Also as a strategy, now capacity assessment is made mandatory for any outsourced parts.

**11.Job description and role & responsibility,HR selection process training**
Defined clear job description for the purchase person and re-examined all persons. We found 2 person especially who were taking care of electrodes sourcing were not having sufficient knwoledge of the supplier selection. Hence training has been organized for them by senior member within the function. Also Job descriptions for each category clearly made and being used by HR while selection of the candidate.

**12.Design and process review:**
As a part of initial feasibility review, we have added a step of comparison of 3D model with CAM program and corrections either in model or program based on the requirement.

By adopting the above methodology,the propose Figure of a Future value State Mapping can be prepared as below:-



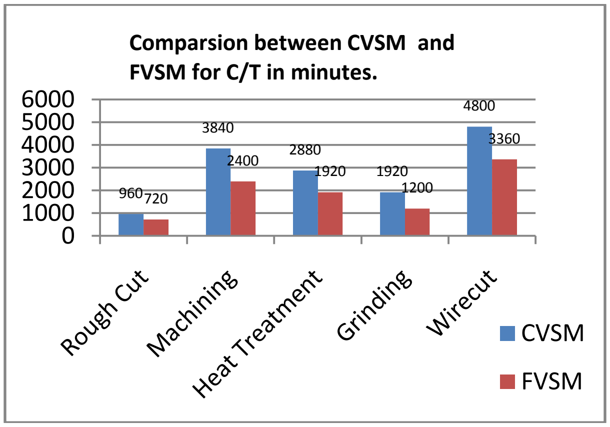

"Figure III:- Future State map for Die Block"

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

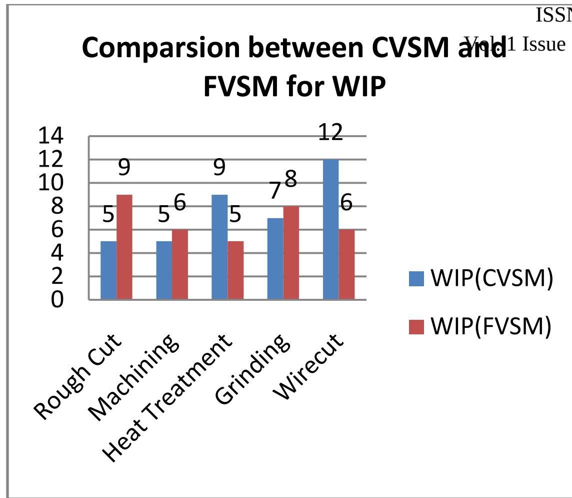
The Future State Shows the Following Results:-

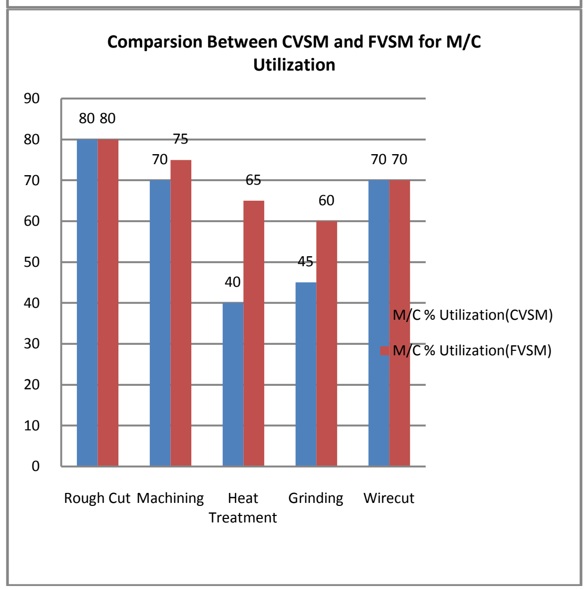
| Sr. No | Operations on Die Block | Cycle Time (min) | WIP | Machine Utilization (%) |
|---|---|---|---|---|
| 01 | Rough Cut | 720 | 5 | 80 |
| 02 | Machining | 2400 | 7 | 75 |
| 03 | Heat Treatment | 1920 | 9 | 65 |
| 04 | Grinding | 1200 | 5 | 60 |
| 05 | Wirecut | 3360 | 6 | 70 |

## "5. Comparison of Current State Map and Future State Map for Die Block"




| Sr. No | Operations on Die Block | Cycle Time | | WIP | | MachineUtilization(%) | |
|---|---|---|---|---|---|---|---|
| | | CVSM | FVSM | CVSM | FVSM | CVSM | FVSM |
| 01 | Rough Cut | 960 | 720 | 5 | 5 | 80 | 80 |
| 02 | Machining | 3840 | 2400 | 9 | 7 | 70 | 75 |
| 03 | Heat Treatment | 2880 | 1920 | 12 | 9 | 40 | 65 |
| 04 | Grinding | 1920 | 1200 | 6 | 5 | 45 | 60 |
| 05 | Wire cut | 4800 | 3360 | 8 | 6 | 70 | 70 |

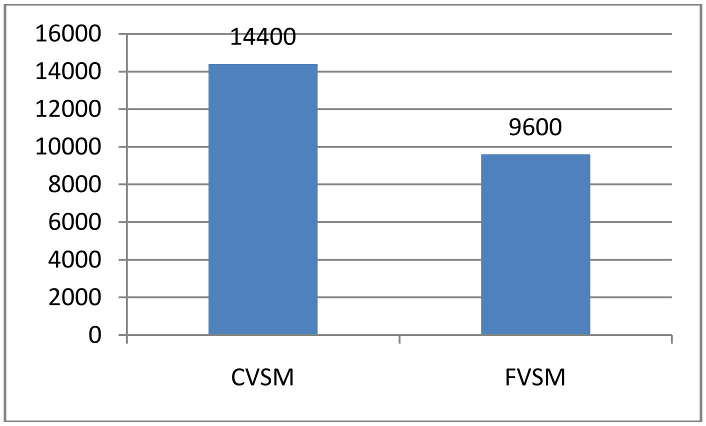



It was observed that, due to enormous potential in the lean manufacturing tools, value stream mapping study was carried out in a small scaleindustry. By creating current state value stream map, the non-value added activities in the production process are visualized and identified. A future state value stream map is created with the waste activities eliminated. With the future state value stream map, the production cycle time of die block is significantly shortened from 14400 minutes to 9600 minutesrepresenting a 30% reduction. Value stream mapping is proved as a useful technique to shorten delivery time and reduce production costs

ISSN: 2278-0181
Vol. 1 Issue 5, July - 2012

## "5.1 Comparison of processing lead time in minutes"




## "6.Conclusion"

On the Shop floor time is money. On the shop floor need is elimination of wastages and delays. It is helps in mapping the process it manifests itself as the objective of designing a process for which manufacturing is a low cost process. Value Stream mapping helps the in attaining higher usage levels by the proficiency of shop floor practices aimed at increased human and machine productivity and thus improving the process. Approach is only that do just what you are doing -do it quicker and by extension, cheaper. The goal of it is to identify, demonstrate and decrease activities that add no value to the final product. Value stream mapping, primarily a communication tool, but also is used tool as a strategic planning tool, is a kind of technique that helps to understand and streamline production processes. By applying the Value Stream mapping tool in a die manufacturing industry, a current state map is developed. A future state value stream map is created by eliminating non value added activities.The future state value stream shows marked improvement in the process and the cycle time for production of making die block is reduced from 14400 minutes to 9600 minutes resulting in improvement of 30% in cycle time. A case study discussed outlines importance of Value Stream Mappingtool to achieve effectiveness by using efficiently the process improvement Strategy to shorten the cycle time.

## "7.References"

[1] William M. Goriwondo&AlphonceMarecha, "Use of the Value Stream Mapping Tool for Waste Reduction in Manufacturing: Case Study",Proceedings of International Conference on Industrial Engineering and Operation Management(2011)pp 236-241.

[2]Fawaz A. Abdulmalek&JayantRajgopal" Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A Process Sector case study",International journal of Production economics(2007) 107:pp223-226.

[3]John Fargher "Lean manufacturing Implementation tools"

[4]Lixia Chen & BoMeng, "The Application of Value Stream Mapping Based Lean Production System",InternationalJornal of Business and Management(2010)Vol.5 pp203-208

[5]V.Ramesh&T.R.Shrinivas "Implementation of a Lean Model for carrying out Value Stream Mapping in a Manufacturing Industry", Journal of Industrial and systems Engineering(2008) Vol 2 pp 180-196

[6]Guo-qiang PAN & Mei-xian JIANG " Application Research of Shortening Delivery Time Through Value Stream Mapping Analysis",
IEEE(2010) pp 733-736

[7] Bhim Singh & Suresh Garg" Value Stream Mapping:- Literature review and implications for Indian industry",International Journal of Advance Manufacturing Techonology(2011)pp 799-809

[8] Handbook for Basic Process Improvement