Scientific Journal of Impact Factor(SJIF): 3.134

e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 5, May -2015

Lean Manufacturing Implementation Using Value Stream Mapping In an Automotive Industry

Hardik.B.Pandya[1], Sagar.I.Shah[2]

*[1]P.G. Student, Mechanical Engineering Dept., A.I.T.S, Rajkot, India
[2]Asst. Professor, Mechanical Engineering Dept., A.I.T.S, Rajkot, India

Abstract-*Lean manufacturing initiative is being followed by various organizations in the recent years which mainly focus on improving the efficiencyof operations by eliminating and reducing wastes. This paper aimed to explain the implementation of lean manufacturing techniques in theCrankshaft manufacturing system at an automotive manufacturing plant located in Rajkot Gujarat. Lean manufacturing implementation is very wide concept. There are uses of various tools of lean manufacturing to reduce waste.Lean implementation using value stream mapping and kaizen. By the help of value stream mapping we identify wastes in industry. After identifying wastes we use continuous improvement or kaizen. By using continuous improvement we reduce waste in some processes. Reducing waste establish single piece flow of product. By applying lean with value stream map and kaizen reduce transportation waste, high cycle time, rework and breakdown.*

Keyword-*Lean Manufacturing; Value stream map; Kaizen; Crankshaft*

I. INTRODUCTION

This Paper is a case study explaining about the successful implementation of lean manufacturing tools and techniques in the development and implementation of crankshaft manufacturing system at the case industry plant. Crankshaft manufacturing is a critical process and it involves 13 operations starting from facing and centring, where the datum is created to finish grinding of journal diameter and pin diameter, washing and oiling [1]. Lean it means manufacturing without waste. Lean consist various tools and techniques. Lean is adjustable approach to customer demand. It covers quality circle, just-in-time, supply chain management, kaizen, kanban etc.Lean also minimize inventory level; improve labor productivity, utilization of equipment. By using lean concept industry satisfy its customer requirement. Many Companies choose lean concept because today competition is very tough and survive in this market lean concept is very helpful.Research will study some standard steps for lean implementation which are helpful to various organization. By using this lean concept we achieve quality system. Produce finished goods as per customer requirement. In this paper we use value stream map for identifying wastes. After identifying wastes use kaizen for improvement and waste reduction in some various processes. After reducing wastes single piece flow of product is established.

II. LITERATURE REVIEW

Lean Manufacturing is very wide concept. Today every industry works with aim of waste reduction. Lean manufacturing is very wide concept so it covers many tools techniques for waste reduction. Kaizen, Kanban, Value stream map, 5s housekeeping, Single point exchange die, Six sigma, Total productive maintenance, etc. are effective tools of lean manufacturing. After survey the literature review we know that lean manufacturing concept very helpful to automobile industry. By survey we know that value stream map important tool for identifying waste. And kaizen is a tool which is very helpful to improvement in every stage of industry. By improvement in process we reduce wastes. Hence single piece flow of product is generated. After improvement prepare value stream map with improvement and waste elimination.

III. PROBLEM DEFINITION

In industry they are produce crank shafts. Crank shaft is a very critical component it include various operation from facing centring to washing & oiling. By value stream mapping identify problem of more transportation. Cycle time in some processes is high. Rework is more in keyway milling operation. Break down is occurring in some machines. Due to this problems single piece flow of product is not established.

IV.METHODOLOGY

First of all by choosing product or product family then study of manufacturing methods and sequence of operation is done. After that data is collected by time and motion study for each operation and current plant layout is studied. Then construct process value stream map for current state. After value stream map identify waste occurs in company. After identifying waste use kaizen tool of lean manufacturing for waste elimination [2]. After eliminating waste future level process values stream map is constructed with improvement. Hence single peace flow of product is generated.

V. PROCESS VALUE STREAM MAP OF CURRENT STATE

Value stream mapping is one of the tools of lean manufacturing. By value stream mapping we identify wastes occur in present production line. Industries which are wants to become lean for those types of industries value stream mapping is best way to implement lean manufacturing. Value stream mapping is powerful tool which highlights process inefficienciesas well as improvement guidance. Value stream mapping is combination of all actions value added as well as non-value added. Value stream mapping shows material flow, information flow etc.

5.1 Methodology of value stream map

- Calculate the Takt time

Takt Time = Available time/ customer demand

= 26*1200*60/2700

=693.3 second

Number of shift per day=2

Number of working days=26

Net Working time per day=1200min

Demand for month=2700

- Understand customer demand
  In step2 we understand customer demand. Customer demand is 2700 pieces per month. Demand is also in weekly or daily.

- Map the Process flow
  This step involves various processes to complete the product. In addition, measure relevant data to put in a value stream mapping box. Moreover, see the WIP between two processes.

- Map the material flow
  The flow of material from raw material to finished goods is given by supplier to customer.

- Map the information flow
  The information flow provided demand information. Information are given by electronic or manually.

- Draw the time line
  Calculate production lead times for inventory triangles by dividing quantity of inventory by the customer daily requirement.

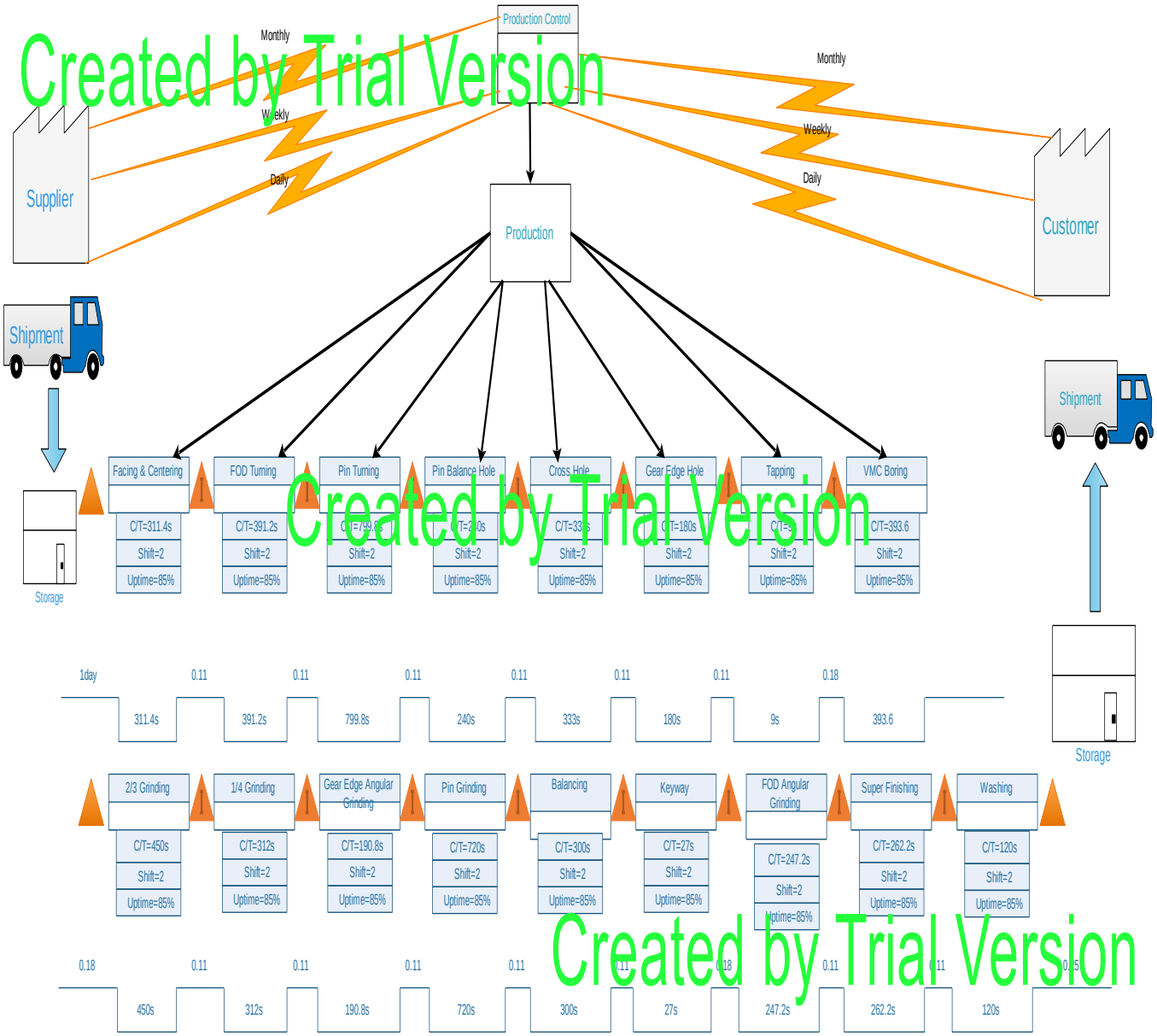
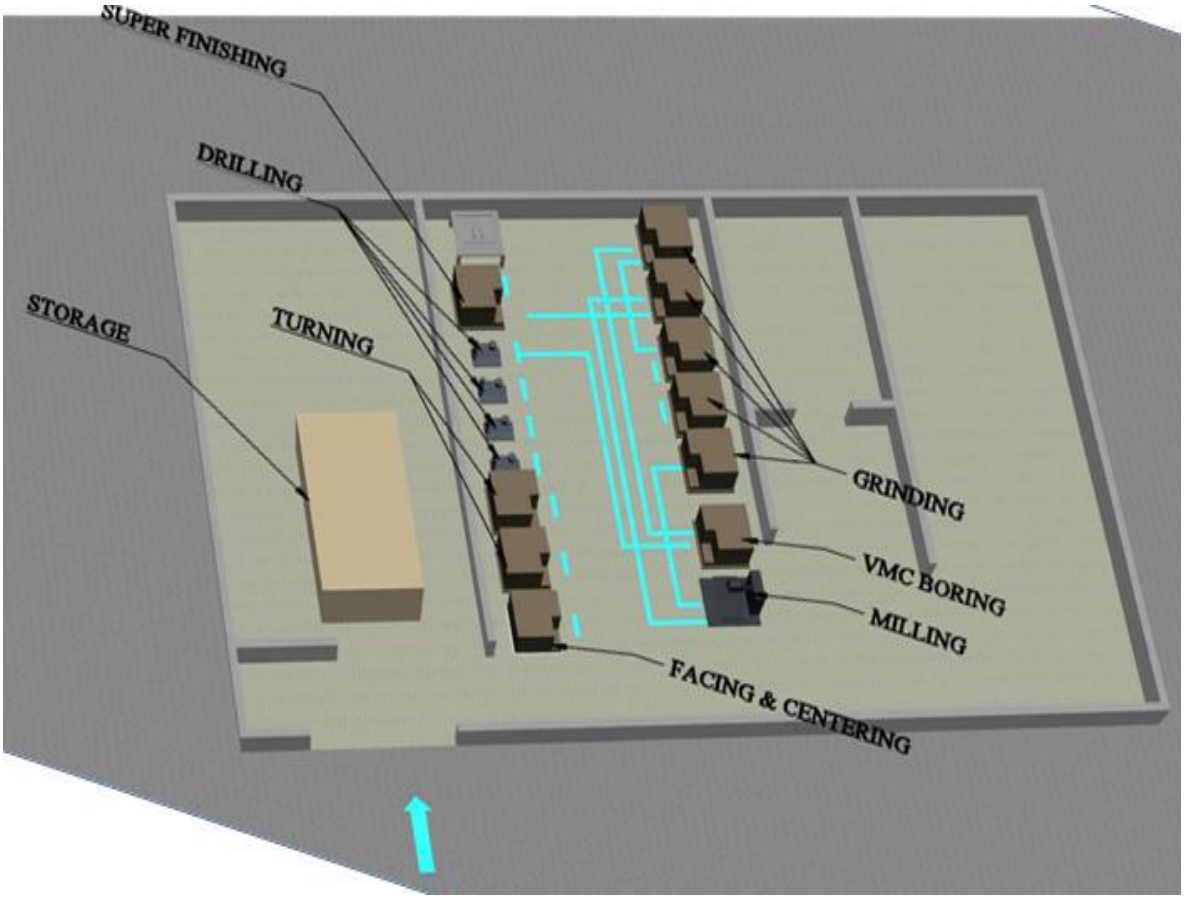


Figure1. Current level process value stream map

5.2 Existing layout of company

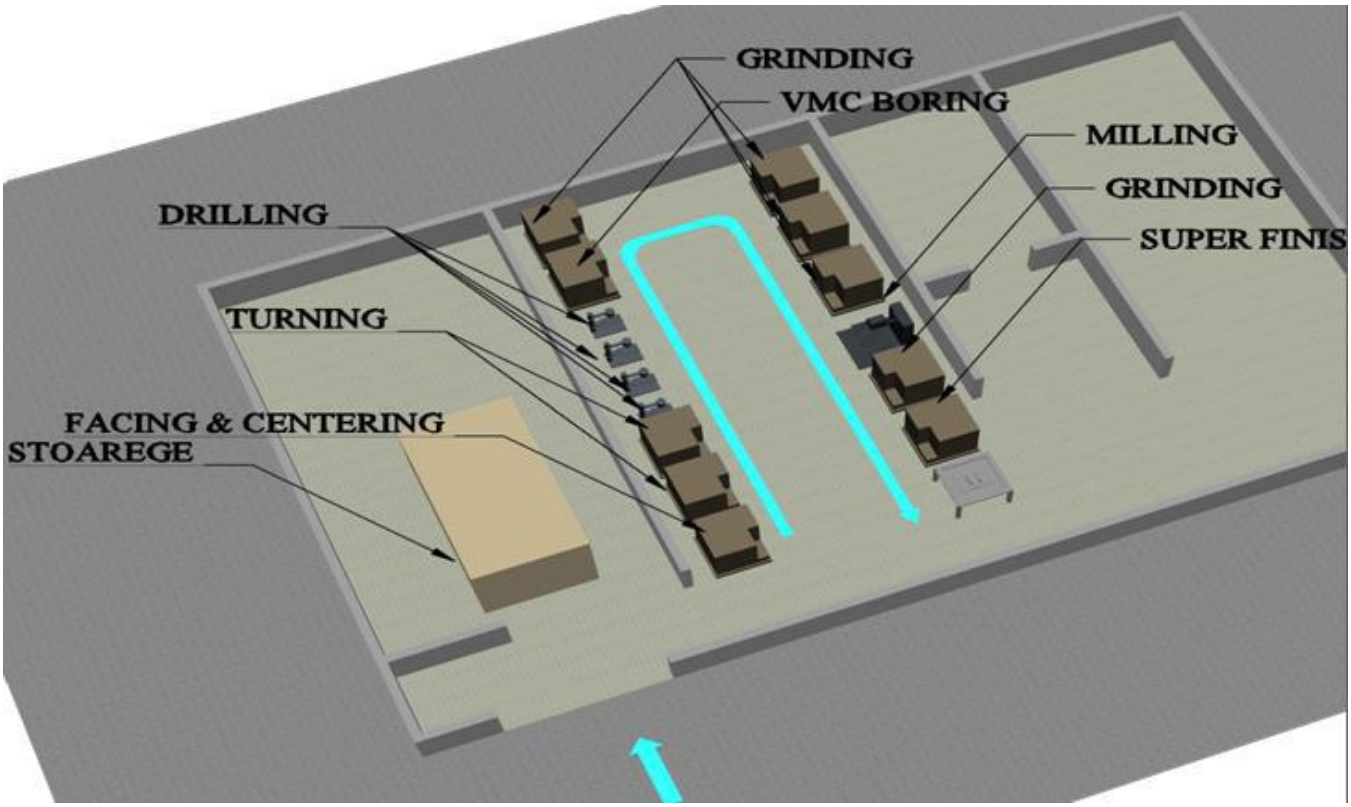
Layout of the company is improper. There are transportation waste is occur due to improper layout of the company. Current layout of the company is in zigzag shape so transportation waste is occurring. To implement lean manufacturing "U" shape or "L" shape layout is require. By flow process chart we know distance travelled and time require for travel this distance. Distance travelled is 169m and time require for that is 48.87 min.



Figture2. Existing layout of company

5.3 Suggested layout of company

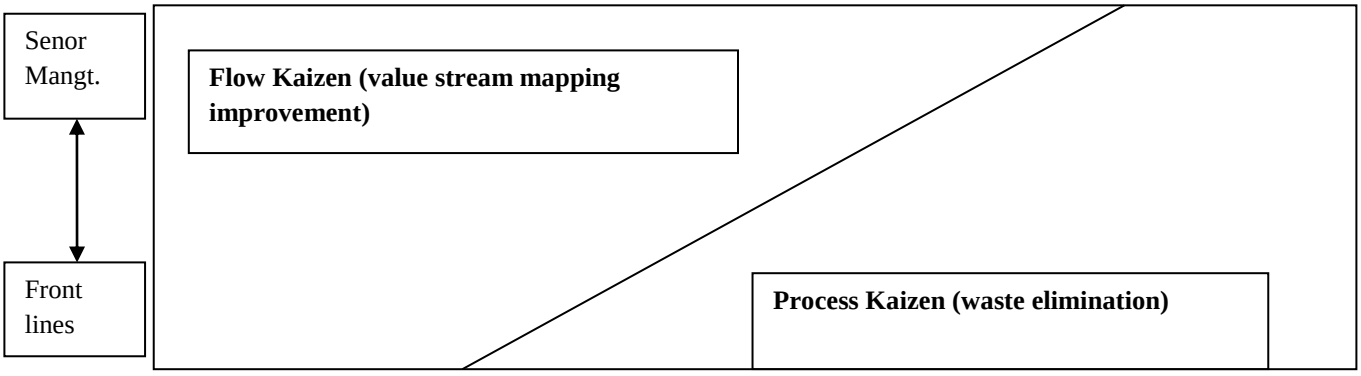
Company's existing layout is in zigzag shape. So more transportation waste is occurring in this zigzag layout. And for lean implementation this type of layout is not preferable. So we suggest "U" shape layout for company. Transportation time is reducing by suggesting layout. Distance travelled is 30m and time is requiring 17.03min. Transportation waste is one kind of seven type of waste we reduce transportation waste by give suggested layout for company. Here two type of layout "U" shape and "L" shape. But "U" shape of layout is more preferable to working area or working space of company.



Figture3. Suggested layout for company

VI. CONTINUOUS IMPROVEMENT (KAIZEN)

By the value stream map we find various wastes in various processes. To reduce these wastes we use continuous improvement (KAIZEN). Kaizen is important tool of lean manufacturing. By kaizen we do small improvements in processes which are very helpful to final results. Using kaizen we reduce wastes and established single piece flow of product in production line.**KAI** it means **CHANGE** and **ZEN** it means **GOOD** thus kaizen it means good change. Kaizen is Japanese word and it is effective tool of lean manufacturing. Kaizen require employee involvement, team approach and good communication among all employees. Kaizen it means continuous improvement which involve all the staff member start from the top management to workers. Kaizen use customer driven strategy for continuous improvement. It uses common sense, scientific method using statistical quality control and frame work of industrial values and beliefs which keep on workers focused on zero defects.

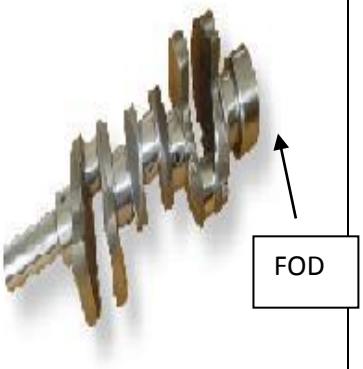
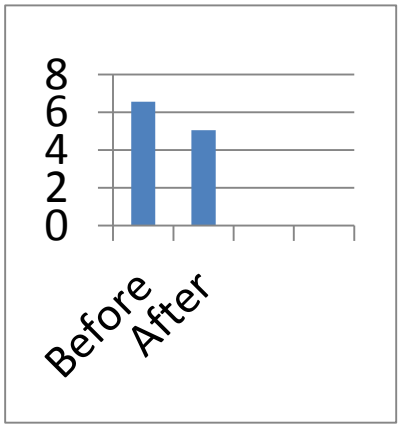


Figture4. Kaizen types

KAIZEN 1:- Implement the modified process by optimizing process parameters.

In the exiting process cutting speed and feed are studied. By optimizing these machining parameters we improve process and cycle time of the process is reduced. Here we use trial and error method to optimizing machining parameters. In existing process machine cutting speed is 180mm/min. By trial and error method we choose various cutting speed and show that which speed is maximum and not affect product quality. After this trial and error method we find speed 240mm/min. If machine running at this speed that time require for turning is less. If now we increase speed that it affect on product quality. Feed of existing process is 0.35mm/rev. Feed also increases when cutting speed is increase.

Table 1 Optimizing parameters

<table>
<tr><td colspan="3">Operation:- Flange outside diameter turning (FOD Turning)</td></tr>
<tr><td colspan="3">Modified process by optimizing machining parameters</td></tr>
<tr><td>Before</td><td>After</td><td>Benefits</td></tr>
<tr><td>Cutting time is 6.56min
Cutting speed 180mm/min
Feed-0.20mm/rev
 
</td><td>Cutting time is 5.06min
Cutting speed 240mm/min
Feed -0.30 mm/rev</td><td>Cutting time reduce 1.5 min
 

No side effects on quality of product</td></tr>
</table>

KAIZEN 2:- Reduced rework because of dent marks on journal 1 & journal 4 diameter

Keyway milling process is requiring on crank shaft. During the keyway milling process there are dent marks are found in jounal1 and journal4 because of improper clamping device. By these dent marks crankshaft go to rework during inspection. About 50% of crankshaft is reworked due to dent marks. So to reduce or overcome this problem spring loaded receiving block with brass pad is arrange so when crank shaft is loaded it first contact with receiver which keeps crank shaft away from fixture pads due to high tension spring. After that operator slowly load crank shaft to fixture using handle. By providing this

type of arrangement rework cost is reduced 15%. Dent marks on journal1 & jounal4 is reduced. Operator hazardous to load crank shaft is reduce.

Figture5. Reduced dent marks

KAIZEN 3:- Quick clamping arrangement on VMC boring machine

VMC machine is used to boring operation. In VMC boring machine clamping of the crankshaft is more important. Before arrange quick clamping simple clamping is used. Operator used spanner to clamp the crank shaft as well as unload the crank shaft. Sometime when operator used spanner at that time nut or stud of the fixture is broken down. And time require is more to clamp the crank shaft. So we used quick clamping arrangement done on VMC boring machine. We use toggle clamp for clamp the crank shaft. It is easy to use and no chance of damage nut and stud of fixture. Cycle time is also reducing 15 seconds.

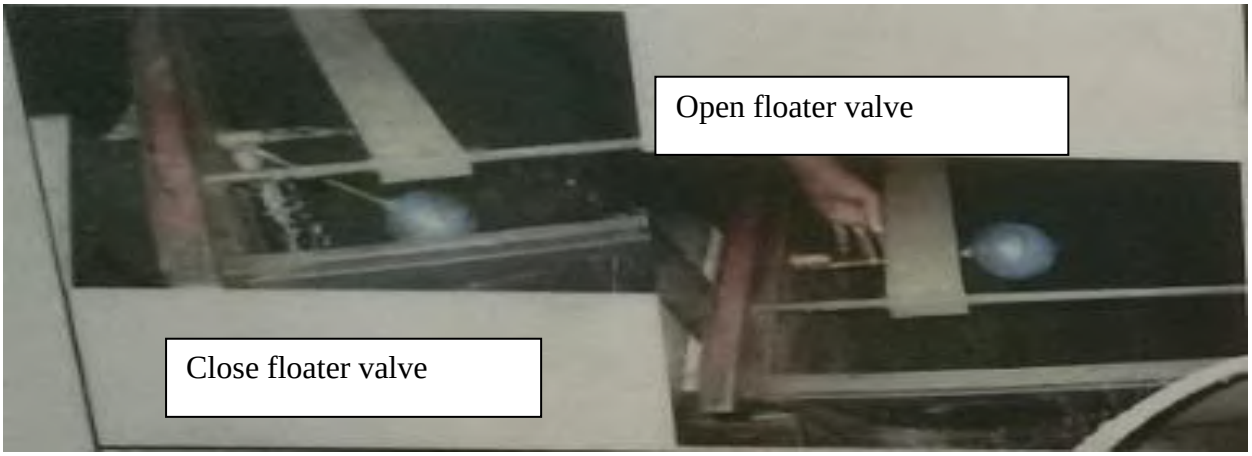
Before improvement

After improvement

Figure 6 Clamping arrangement

KAIZEN 4:- Reduce waste of coolant in pin grinding machine

In every machine coolant is require. Cost of coolant is high so waste of coolant not avoid by industry. In pin grinding machine there are problem of coolant waste. Before improvement manual valve is provided to coolant tank. So sometime coolant overflow and spoil out on shop floor, so waste of coolant and shop floor become dirty when operator forget to turn off valve. Now floater valve arrange instead of floater valve so when coolant level reduces valve opens and water is added to coolant tank. When coolant level reaches at maximum level it automatically closed. No waste of coolant is observed after fitting floater valve, hence use of cutting oil and distilled water is reduce.



Figture7. Floater valve

KAIZEN 5:- Reduce tail stock jam problem in CNC turning machine

In CNC turning machine there are problem of breakdown. Breakdown occurs due to tail stock is jam. Lubrication is not provided to tail stock so tail stock of turning center is jam. This problem is happen one or two times per month. So production of crank shaft is stopped until machine is not repaired. By overcome this problem arrange lubrication supply to tail stock by making way in cylinder to both end and lubrication supply connected to lubrication motor. So now we overcome this problem by providing lubrication supply to tail stock. Breakdown is reduced due to this problem.

Figture8. Tail stock

VII COMPARISION OF CURRENT STATE AND FUTURE STATE WTH IMPROVEMENT

7.1 Future level process value streammapwith improvement

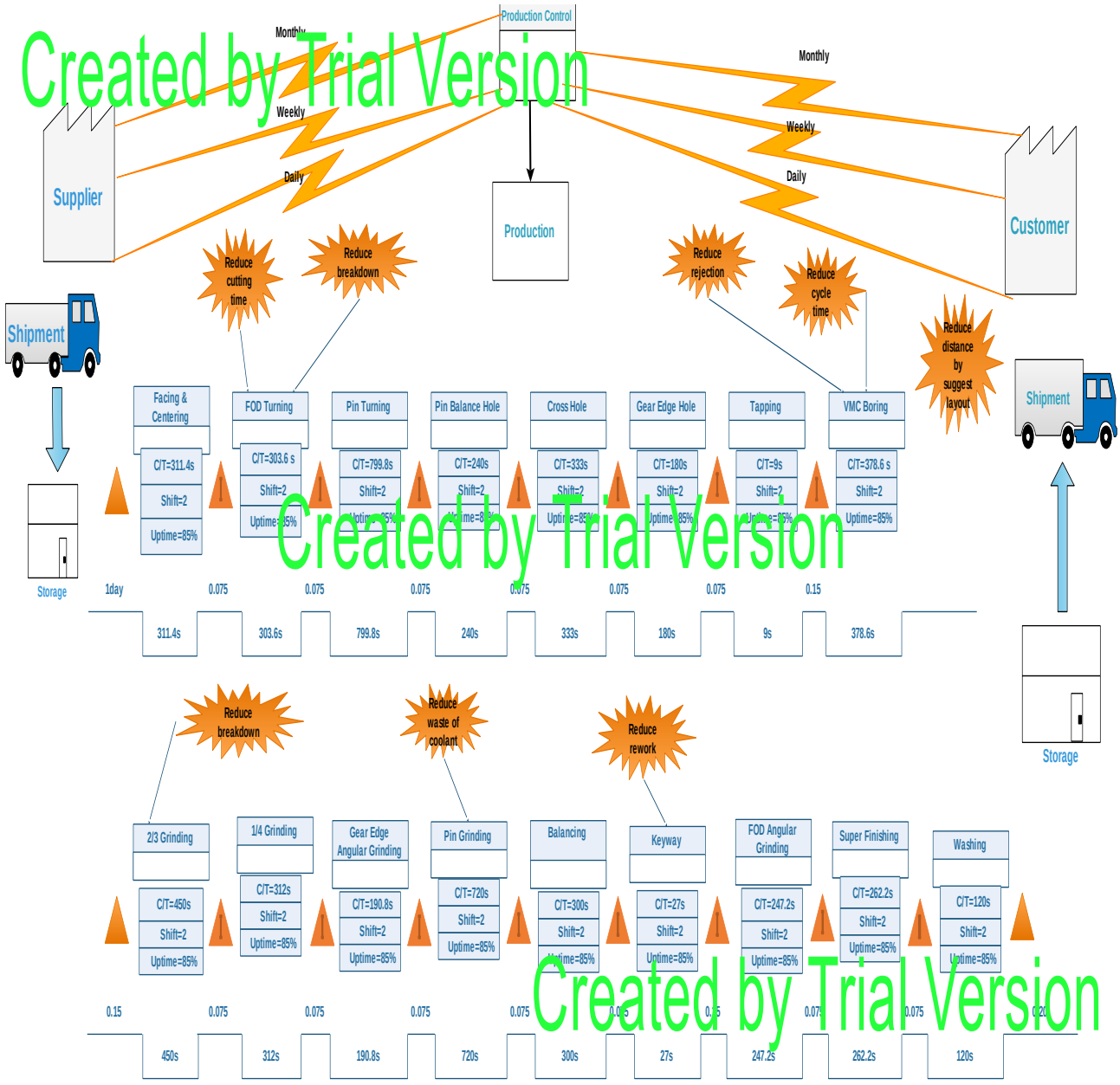


Figure9. Process value stream map with improvement

7.2 Comparison of current state and improved state

Table2. Comparison table

Activity	Before	After
Processing Time	5289 sec	5184 sec
Lead Time	3.22 days	2.62 days

Loading & Unloading	Automatic	Automatic
Layout	Zigzag shape	"U" shape
Transportation Time	48.73 min	17.03 min
Productivity	2000 Piece/month	2500 Piece/month
Breakdowns	2-3 breakdowns	0 breakdowns

VII. CONCLUSION

Lean manufacturing implementation in crank shaft manufacturing industry to reduce waste like more transportation time, rework, break down, high cycle time etc. By reducing these wastes and establish single piece flow of product. We use value stream map for identifying wastes. Some kaizen were implemented to process to reduce wastes. Future state process value stream map construct with improvement. There are future scopes of waste reduction in crank shaft industry using various lean tools like Just in time, Kanban, Total productive maintenance, Single minute exchange die, six sigma, etc.

REFERENCES

[1]. K. Venkataraman, B.VijayaRamnath, V.Muthu Kumar, C.Elanchezhian **"**Application of Value Stream Mapping for Reduction of Cycle Time in a Machining Process" 3rd international conference of on materials processing characterization(ICMPC)2014

[2]. B.VijayaRamnath, C. Elanchezhian, R. KesavanResearch Scholar "Application of kanban system for implementing lean manufacturing" Journal of engineering research studies

[3]. MadhubalaRauniyar "Value Stream Mapping at XYZ Company"American psychological association 5th edition May, 2007

[4].Nor K. M. Khalid, Ahmad Y. B. Hashim, and Mohd R. Salleh "On Value Stream Mapping and Its Industrial Significance" Journal of Industrial and Intelligent information Vol. 2, No. 2, June 2014

[5].Gleison Hidalgo Martins, Marcelo GecheleCleto"Value Stream Mapping and Earned Value Analysis: A Case Study in the Paper Packaging Industry in Brazil" 22nd International conference on production research

[6].William M. Goriwondo, Samson Mhlanga, AlphonceMarecha, "Use of the Value Stream Mapping Tool for Waste Reduction in Manufacturing. Case Study for Bread Manufacturing in Zimbabwe" Proceedings of the 2011 international conference of industrial engineering and operation management January 2011

[7].Bhim Singh and S.K. Sharma"Value stream mapping as a versatile tool for lean implementation: an Indian case study of a manufacturing firm" Emerald Group publishing limited ISSN 1368-3047 Vol.13 No.3 2009

[8]. Lucas Simmons, Robbie Holt, Glenn Dennis "Lean Implementation in a Low Volume Manufacturing Environment: a Case Study", Proceeding of the 2010 industrial engineering research conference

[9]. Nordin, Baba MdDeros and DzuraidahAbdWahab "A Survey on Lean Manufacturing Implementation in Malaysian Automotive industry" International Journal of Innovation, Management and Technology, Vol. 1, No. 4, October 2010

[10]. R.M. Belokar, Vikas Kumar, Sandeep Singh Kharb "An Application of Value Stream Mapping In Automotive Industry: A Case Study" International Journal of Innovative Technology and Exploring Engineering Volume-1, Issue-2, July 2012

[11]**.** K. P. Paranitharan, M. ShabeenaBegam, S. SyathAbuthakeer, M. V. Subha "Redesigning an Automotive Assembly Line through Lean Strategy" International Journal of Lean Thinking Volume 2, Issue 2 (December 2011)

[12]**.** Silva, S.K.P.N "Applicability of value stream mapping in the apparel industry in srilanka" International journal of lean thinking Volume 3 Issue1 (June 2012).

