International Conference on Innovative Research in Engineering, Management and Sciences
International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2019 IJSRCSEIT | Volume 4 | Issue 9 | ISSN : 2456-3307

Modification of Milling and Turning Tool Inserts Plant Layout in a Tool Manufacturing Company

Bopanna K D[1] , M S Ganesha Prasad[2]
[1]*Assistant Professor, Department of Mechanical Engineering, NHCE, Bangalore*
[2]*Dean, Professor & HOD-ME, NHCE, Bangalore*
Email: kd.bipinbopanna@gmail.com[1], dean_mee@newhorizonindia.edu[2]

ABSTRACT

This work is pertaining to modification of milling and cutting tool inserts plant layout in Production Unit.. Extensive work has been carried out using value stream mapping (VSM) to identify the problems, bottlenecks, cycle time, down time, work-in-process inventory, material movement constraints, production flow lines etc in the existing system. Modification of present layout in PU5 leading to creation of separate layout for five operations of milling inserts manufacturing activity, addition of machines required, and reducing the job allocation time from 24 hours to 6 hours has resulted in a lot of improvements. Significant improvements are;

(i) Lead time of milling inserts manufacturing is reduced from 14.092 days to 5.95 days and that of turning inserts is reduced from 12.392 days to 5.58 days. Percentage reduction in Lead time is 57.77% and 54.97% respectively.

(ii) Work-in-process Inventory is reduced from 210550 units to 110600 units, reduction of 47.5 percent.

(iii) Material handling distance is reduced from 315 meters to 265 meters. Value added percent for Turning Inserts is increased from 15.04 % to 45.02% and for milling inserts from 13.012 % to 42.02%.

(iv) Centralization of coolant supply system resulted better space utilization and flexibility in effecting changes in machines locations.

(v) With the new overhead electric connections, the power line can be dropped down and used by the required machines and the need to re-wire and re-do the entire electric connection for layout changes is eliminated.

Based on the study and in consultation with company executives the present Mixed-flow line is converted into ***Mixed-flow line zone To Parallel dedicated flow lines zone To Mixed-flow line zone*** *in two plants.This resulted in development of separate reconfigured layout.*

Keywords*: Value Stream Mapping, Lead Time, WIP Inventory, Flow Line*

I. INTRODUCTION

Success of the manufacturing industry is largely determined by its ability to respond rapidly to market changes and to immediately adjust to customer demand. This has resulted in an increasing demand for deployment of systems that can cope with agility and efficiency. Companies must respond with modifying production processes. It has been studied by several authors that, in order to respond to customer´s requirements [1].

VSM has been defined as a powerful tool that not only highlights process inefficiencies, transactional and communication mismatches but also provides inputs and guides for improvement /modification of manufacturing layouts. This tool is proved to be successful in different applications under different environments and contexts.

Large manufacturing organizations have been achieving productivity improvements for decades using what is commonly known as lean production. Less is known about the extent to which small and medium sized firms have benefitted from adoption of lean practices such as VSM. This tool helps in tracing out system constraints and overcome them by implementing new proposals in production units [2].

VSM is a method of visually mapping the flow of materials and information from the time. The product comes in as the raw material, moves through all the manufacturing process steps and off the loading dock as finished product. Mapping out the activities in the in the production process with the cycle times, down times, work-in-process inventory, material movement, information flow paths, will help to visualize the current state of the activities and guide towards the future desirable state. When all the possible improvements have been identified and considered in VSM, the next stage is to develop a single, future state map to show how to operate the process in the future. The new process is tested against the Lean principles and any waste or flow issues are identified and removed [3].

II. EXISTING MANUFACTURING SYSTEM

In cutting tool inserts manufacturing company PU5 is engaged in the process of manufacturing turning and milling tool inserts, these inserts are mainly used for metal cutting. Cutting tool inserts are manufactured by adopting powder metallurgy process. Powder metallurgy uses sintering process for making various parts out of metal powder. The metal powder is compacted by placing in a closed metal cavity (die) under pressure. This compacted material is placed in an oven and sintered in a controlled atmosphere at high temperatures below the melting point of the main constituent for the purpose of increasing its strength by binding together of particles. Manufacturing steps after sintering are top and bottom grinding, periphery grinding, edge rounding, cleaning and blasting.

Most of the manufacturing procedure of milling and turning inserts is common, only additional process in milling tool inserts is periphery grinding operation. Presently turning and milling tool inserts are manufacturing in mixed flow process.

III. Existing System VSM

VSM is a mapping tool that maps not only material flows but also information flows that signal and control the material flows. This visual representation facilitates the process of lean implementation by helping to identify the value adding steps in a value stream and eliminating the non-value adding steps, or wastes. The focus of VSM is on a product "value stream" for a given "product family". The future state map forms the basis for the implementation plan, for focused improvement initiatives such as layout modification.

A. Current State Mapping

Value stream mapping of the current state identifies the essential and non-essential value added activities in the existing process. In PU5 it is identified that several bottlenecks raised due to increase in customer demand rate than the current production rate or operation cycle time. Comparing takt time; which depends on demand rate and quantity in the process flow, with the operations cycle time, it may be noticed that for both products, operations cycle time is greater than the takt time (Table 1).

B. Observations and Discussions

Production activity carried out in PU5is of mixed flow process which has many pit falls. In each flow workers are required to travel longer distances between machines / workstations, this causes increase the work in process inventory. Routing of process flow is long and difficult to follow. Important observations made in existing layout are given below;

Manufacturing operations of turning inserts and milling inserts have common machines, minimum distance between machine to machine is 3 meters and maximum distance is 48 meters which causes longer time for material movement, this contributes for higher machine idle time. Also it is observed that, because of independent coolant system for individual machines, effective space utilization of shop floor is only 32.7%. Further it was found that coolant leakages are taking place at many machines.

Huge total inventories of inserts are accumulated at work stations. Some machines are common in function and shared by other process where the pile up inventory occurs.

Demand rate is more than production capacity.

It is observed that value added percent for Turning Inserts is 15.04 % and for milling inserts it is13.012 %which is very low.

Sintering is a monumental process, where in batch quantity is more than 10000 numbers in inserts and cycle time is more than 24 hours. Hence this activity may be kept out of the dedicated flow lines proposed for turning inserts and milling inserts manufacturing. As pressing operation is done prior to sintering operations, this operation also needs to keep out of flow lines. But work in process inventory at this operation is 236 kg and it stays for0.8401 days.

IV. FUTURE STATE MAPPING

Inputs for developing the future state are taken from current state, where target areas of improvement are discussed. Current demand rate of turning inserts is of 4.5 seconds per insert and 6.75 seconds per insert for milling inserts. Production activity in PU5 is modified into partly mixed flow line and partly dedicated flow line. Accordingly future state developed comprises *mixed flow line zone* consisting pressing and sintering operations, followed by *dedicated flow lines zones for turning and milling inserts* consisting top and bottom grinding, periphery grinding (only for milling inserts), edge rounding, cleaning, and blasting operations, and *continued with mixed flow line* for operations such as coating, inspection, mark and dispatch[7-11].

Jobs are allocated to each operation for every 6 hours by considering their capacity i.e. by matching the demand rate and production capacity of machines. With proper job allocation and inclusion of new machines in certain operation where it needs future state map has projected substantial improvements in terms of reduced in process inventory, reduction in non-value added time, lead time etc. Important improvements which can be achieved are;

In process inventory has reduced at all the operations. Presently, with the future state map, total in process inventory is reduced up to 47 percent.

Reduction in production lead time from 12.392 days to 5.58 days for manufacturing of turning inserts and 14.092 days to 5.95 days for manufacturing of milling inserts.

Value added percent is increased to 45.02% for turning inserts and 42.02% for milling inserts.

V. DEVELOPMENT OF NEW LAYOUT

It is required to separate the certain operations of milling inserts manufacturing from existing layout due to increased requirement of space and for smoother the flow of inserts. In view of t~~his it is~~ necessary to develop new layout to ho~~use the~~ machines required for top and bottom grinding, periphery grinding, edge rounding, cleaning and blasting machines. New layout is developed by considering the factors such as; machine area and other requirements, material movement distance, machine to machine distance and flow of inserts[4].

Layout developed is shown in Figure 1 for separated 5 operations of milling inserts manufacturing. Smoother flow of inserts has obtained with the separation of *five operations* of milling inserts manufacturing from existing layout. This separation made the availability of free shop floor area in PU5 to improve further in turning inserts manufacturing process and eliminating the mix up of inserts. Figure 2 depicts the modified layout of existing Production Unit which leaves out the separated machines of milling inserts manufacturing process. There are no big changes made in machine allocation of turning inserts manufacturing process[3].

VI. COMPARISON OF PROPOSED SYSTEM WITH EXISTING SYSTEM

Compared to existing system, several improvements are achieved with the adoption of proposed system; selected improvements are given in Table 2. In the new system dedicated machines are allocated for turning and milling inserts manufacturing process in some operations. Compared to existing system, new proposed system reduces in process inventory level by 47.47 %, reduces lead time from 12.392 days to 5.58 days for manufacturing of turning inserts, and reduces from 14.092 days to 5.95 days for manufacturing of milling inserts[6,12].

VII. CONCLUSIONS

Modification of existing layout leading to creation of separate layout for five operations of milling inserts manufacturing activity, addition of machines required, and reducing the job allocation time from 24 hours to 6 hours has resulted in a lot of improvements. Significant improvements are;

Lead time of milling inserts manufacturing is reduced from 14.092 days to 5.95 days and that of turning inserts is reduced from 12.392 days to 5.58 days. Percentage reduction in Lead time is 57.77% and 54.97% respectively.

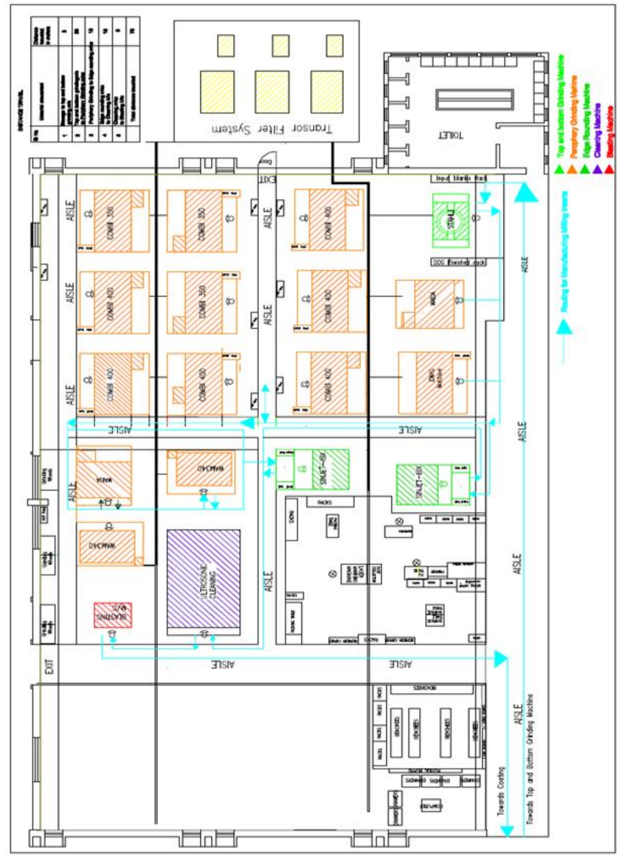
Work-in-process Inventory is reduced from 210550 units to 110600 units, reduction of 47.5 percent.

Material handling distance is reduced from 315 meters to 265 meters

Value added percent for Turning Inserts is increased from 15.04 % to 45.02% and for milling inserts from 13.012 % to 42.02%

Better space utilization and flexibility in effecting changes in machines locations[5].

Existing mixed-flow line in Production Unit is converted into *mixed-flow zone to parallel dedicated flow lines zone mixed-flow zone* in two plant Units. Company has accepted the layouts and taken up for implementing the changes.



Products	Takt Time (seconds per part)	Operation Cycle Time (seconds/part)
Turning Inserts	4.5	5.943
Milling Inserts	6.75	8.91

No.	Details	Existing System	Proposed System
1	WIP	210550	110660
2	Layout Type	Traditional	Process
3	Process	Mixed Process	Dedicated Process
4	Lead Time	12.392 days for turning inserts	5.58 days for Turning inserts
		14.092 days for milling inserts	5.95 days for milling inserts

Table 2: Comparison of Proposed System with Existing System

REFERENCES

[1] Muther R. Systematci Layout Planning. Cohners Publishing Company, 1973.
[2] Heragu SS. Facilities Design. CRC Press Taylor & Francis Group, 2008.
[3] Djassemi M. Improving Factory Layout under a Mixed Floor and Overhead Material Handling Condition. Journal of Manufacturing Technology Management 2007; 18(3):281-291.
[4] Tompkins W, Bozer & Tanchoco. Facilities Planning. John Wiley & Sons, Inc., 2010.
[5] Chien TK. An Empirical Study of Facility Layout Using a Modified SLP Procedure. Journal of Manufacturing Technology Management 2004;15(6):455-465.
[6] Hassan MMD. Toward Guiding the Selection of a Layout Procedure. Journal of Manufacturing Technology Management 2007;18(3):292-303.
[7] Ermin Z, Kelou C, Yanrong Z. Overall Layout Design of Iron and Steel Plants Based on SLP Theory. IFIP International Federation for Information Processing 2010;345:139-147.
[8] Wiyaratn W, Watanapa A, Kajondecha P. Improvement Plant Layout Based on Systematic Layout Planning. IACSIT International Journal of Engineering and Technology 2013;5.
[9] Foulds LR, Gibbons PB, Giffin JW. Facilities Layout Adjacency Determination: An Experimental Comparison of Three Graph Theoretic Heuristics. Operations Research 1985:1091-1106.
[10] Leung J. A New Graph-Theoretic Heuristic for Facility Layout. Management Science 1992;38:4.
[11] Entezari A. Facilities Planning. Tehran: Jahan Jame Jam, (Farsi Text Book) 2005.
[12] Tompkins JA, White JA, Bozer YA, Tanchoco JMA. Facilities Planning. Fourth Edition. John Wiley & Sons, Inc. 2005.