RESEARCH ARTICLE OPEN ACCESS

Implementation of a Cellular Manufacturing Tool for Minimization of Non Value Added Activities

Amanparteek Singh[*], Dr. Harpuneet Singh[**]
[*] (Department of Mechanical Engineering, Guru Nanak Dev Engineering College, India)
[**] (Department of Mechanical Engineering, Guru Nanak Dev Engineering College, India)

ABSTRACT
The purpose of this study is to develop a plan for reducing lead-times and increasing profit of Centre bolt product by using value stream mapping. The Centre bolt product manufacturer is inefficient because it produces products in large batch quantities and has poor product flow as operations being departmentalized and departments are very far away from each other due to this increase in lead-times could cause a loss in the market share to its competitors. The Centre bolt product manufacturer must reduce its lead-times in order to remain competitive and continue its growth by providing quality products in a timely manner. A study will be carried out using value stream mapping to determine areas of potential improvement on the plant floor. A current state map will be developed and analyzed the areas that have potential for improvement. A future state map will then be created to suggest ways to reduce lead-times and increase profit. The map will include lean manufacturing methods to reduce wastes in the system; increasing profit and reducing lead-times. Current state and future state of manufacturing of a firm are compared and witnessed: 50 percent reduction in lead time, 4 percent reduction in processing time, 58.5 percent reduction in WIP and 22 percent reduction in manpower required to perform same amount of work.

Keywords **–** Cellular Manufacturing, Lead time, Non-value added activities, Value Stream Mapping, wastes.

I. INTRODUCTION

In production plants across the globe, lean manufacturing techniques are being used to meet increasing demands placed on manufacturers. Originally developed as a methodology to make production processes highly efficient, lean techniques have been adopted by more than 72 percent of machine shops across the country, Although the basic lean model was introduced more than 100 years ago, it has continued to evolve over time, from Henry Ford's continuous assembly lines for the Ford Model T, to the concept of interchangeable parts used by Eli Whitney and Samuel Colt, to the Toyota Production System. These concepts, in addition to a multitude of others, have come together to formulate what we know today as lean manufacturing.Cellular Manufacturing: A cell is a combination of people, equipment and workstations organized in the order of process to flow, to manufacture all or part of a production unit (Wilson, 2009, p. 214-215). Following are the characteristics of effective cellular manufacturing practice. 1. Should have one-piece or very small lot of flow.2. The equipment should be right-sized and very specific for the cell operations. 3. Is usually arranged in a C or U shape so the incoming raw materials and outgoing finished goods are easily monitored. 4. Should have cross-trained people within the cell for flexibility of operation. 5. Generally, the cell is arranged in C or U shape and covers less space than the long assembly lines. Keeping the above view present study was done on product(center bolt) in manufacturing firm near Ludhiana for reducing non-value adding activities present in the center bolt manufacturing process by using cellular manufacturing and value stream mapping(lean tools).

II. MATERIAL AND METHODS

2.1 Identify product

This firm manufactures a variety of auto parts like spring pin, king pin, u bolt, Center bolt etc. but the demand of Center bolt was high. Due to this high demand it increase load on industry which leads to increase lead time of Center bolt. So Center bolt take as a research product for study to decrease lead time of it.

2.2 Current state map

The method to obtain data for the mapping was collected data from the firm's ERP system and by making observations on the plant floor. Time study was conducted on plant floor regarding operations of Center bolt. Information was collected on cycle times, number of operators, number of shifts, inspection points, and the quantity of WIP.A current state map was then created showing the both information and material flow. Collected data added to the map to give a picture of what was happening on the shop floor as a Center bolt was produced.

Table 1 Time study table of Center bolt

NO.	OPERATIONS TO MAKE ONE PART OF CENTRE BOLT	Cycle time (sec)	Number of workers
1	STEP TURNING	2.5	1
2	PICKLING	12.5	2
3	BAR DRAWING	6.53	2
4	CUTTING	1.61	1
5	STRAIGHTING	8.3	1
6	FACING AND CHAMFERING	7.6	1
7	HEAD FORGING	24.4	2
8	HEAD AND SHANK TURNING	24.2	1
9	THREADING	14.9	1
10	POLISHING	5.75	1
11	AUTO BLACKNING	1.13	4
12	NUT AND BOLT ASSEMBLY	9.2	2
13	INSPECTION	2.64	1
14	LOGO MARK	3	1
15	PACKING	4	2
TOTAL		128	23

Using information collected for Center bolt a current state map was created. Fig.2 shows the current state map. A significant portion of the total lead-times promised to customers is used in the order entry process. There appear large areas for improvement in this current state map. However, the focus of this study will concentrate on the production Center bolt on the shop floor. Planning and scheduling activities are performed by the plant supervisor, planner, and department leads. Job direction is communicated to each person at every machine daily. A work order and traveler are printed and sent along to each operation with the job. The first operation that the work order and traveler will go to is to the step turning. When mild steel bars were ordered for a job, the material will stack on the floor for an average of 1 day before processing begins. This is recorded on the timeline chart as a non-value added activity (NVA).

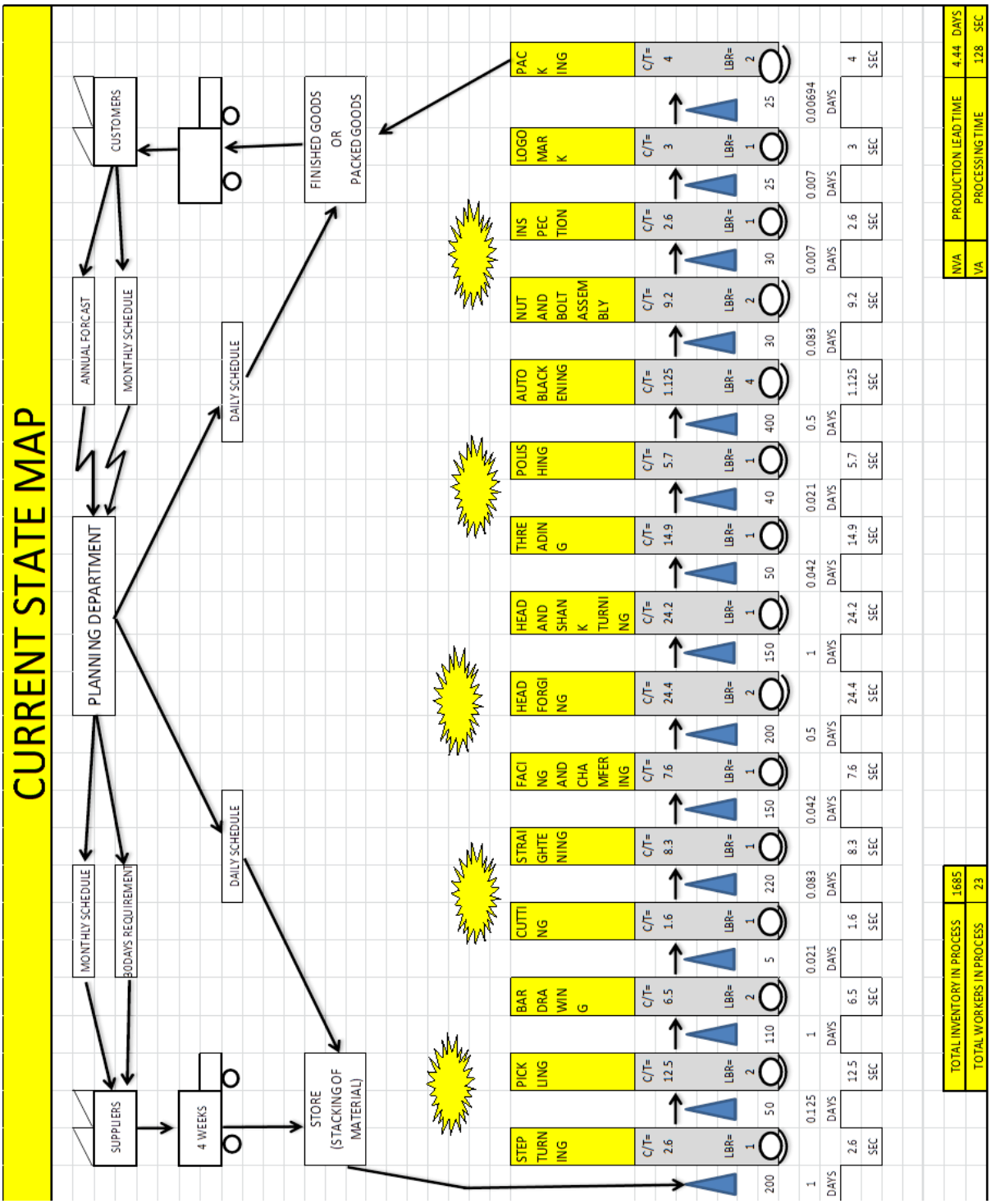

Fig 1 Current state map of center bolt.

2.3 Assess information

By analyzing the timeline on the current state map, it had been identified that 128 seconds was a processing time of Center bolt to create one part but it takes 4.44 days to make from to start. This is due to poor product flow and large distances between the sections or departments. Jobs are currently produced in a batch mode. This increases lead-times because the parts are in queue and waiting for the process. Large queue required more floor space and it disturb the operator.

2.4 Future state map

A future state map will be created by finding pin point areas in current state map which needed improvements. Fig.2 shows the future state map. The pin point areas that needed improvement can be summarized as the following

1.4.1 Batch mode production
1.4.2 Poor product flow
1.4.3 Departmentalized machines.
2.4.4 Large distance between departments

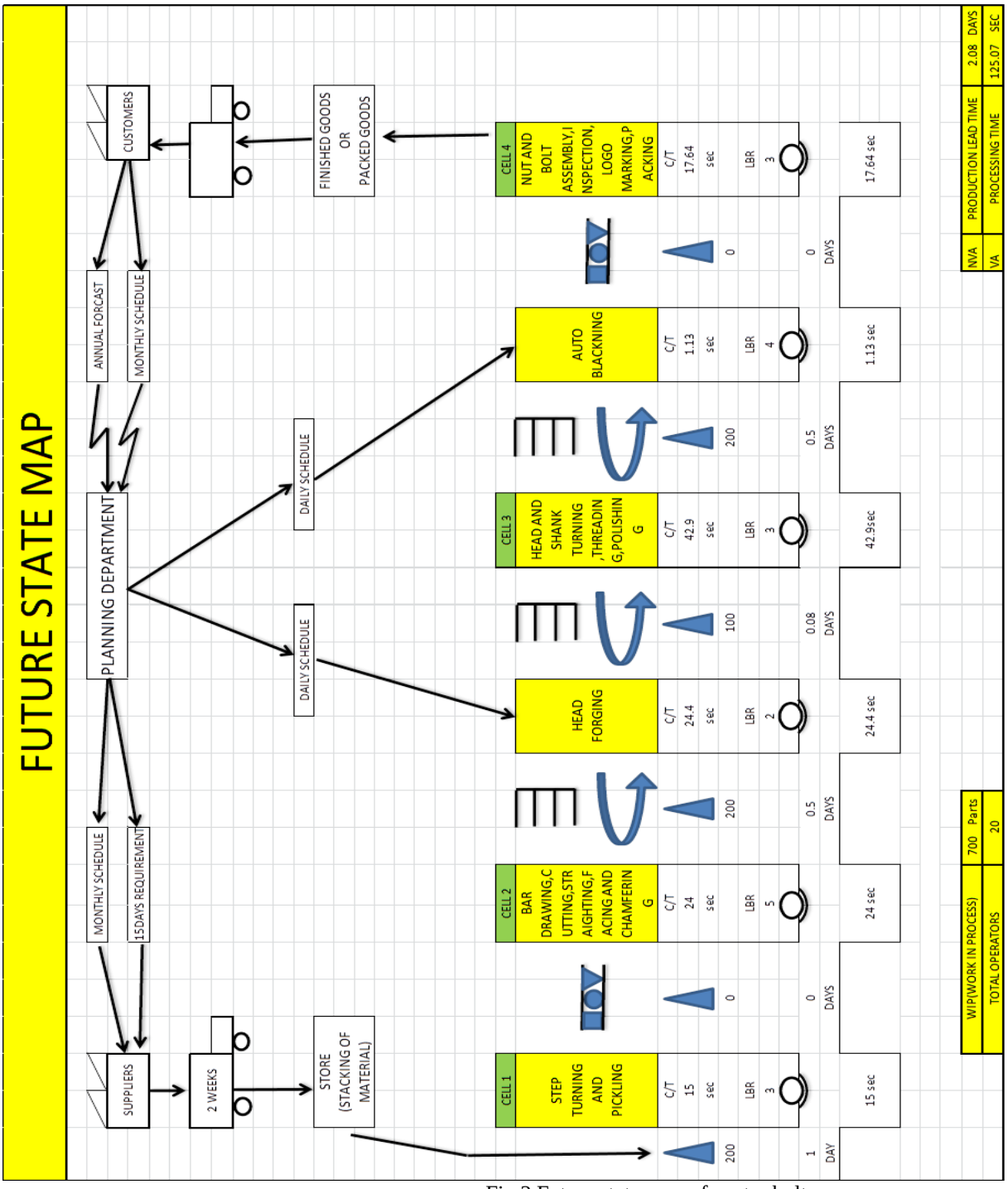

Fig 2 Future state map of center bolt.

2.5 Comparison of current and future state maps

After creating current and future state maps comparison take place between these two maps. Table given below shows the comparison of lead times, work in process, man power required for same output and processing time of Center bolt.

Table 2 Comparison of current and future state maps

NO.	OPERATIONS	Process time(sec)		Lead time (days)		NO. OF WORKERS		Work in process (parts)	
		C.S	F.S	C.S	F.S	C.S	F.S	C.S	F.S
1	STEP TURNING	2.67	2.5	1	1	1	1	200	200
2	PICKLING	12.5	12.5	0.13	0	2	2	50	0
3	BAR DRAWING	6.53	6.53	1	0	2	2	110	0
4	CUTTING	1.61	1.61	0.02	0	1	1	5	0
5	STRAIGHTING	8.3	8.3	0.08	0	1	1	220	0
6	FACING AND CHAMFERING	7.6	7.6	0.04	0	1	1	150	0
7	HEAD FORGING	24.4	24.4	0.5	0.5	2	2	200	200
8	HEAD AND SHANK TURNING	24.2	23	1	0.08	1	1	150	100
9	THREADING	14.9	14.9	0.04	0	1	1	50	0
10	POLISHING	5.75	5	0.02	0	1	1	40	0
11	AUTO BLACKNING	1.13	1.13	0.5	0.5	4	4	400	200
12	NUT AND BOLT ASSEMBLY	9.2	8	0.08	0	2	1	30	0
13	INSPECTION	2.64	2.64	0.01	0	1	1	30	0
14	LOGO MARK	3	3	0.01	0	1		25	0
15	PACKING	4	4	0.01	0	2	1	25	0
TOTAL		128	125	4.44	2.08	23	20	1685	700

III. RESULTS AND DISCUSSION

3.1 Lead time reduction

Lead time reduce from 4.15 days to 2.08 days. Using one piece flow or small batches combined with manufacturing cells.

4.15 days * 2 1 hours available per day = 87.15 hours
2.08 days * 2 1 hours available per day = 43.68 hours
% reduction = 1 - (43.68 hours / 87.15 hours) * 100 = 50
So 50% reduction in lead time of Center bolts.

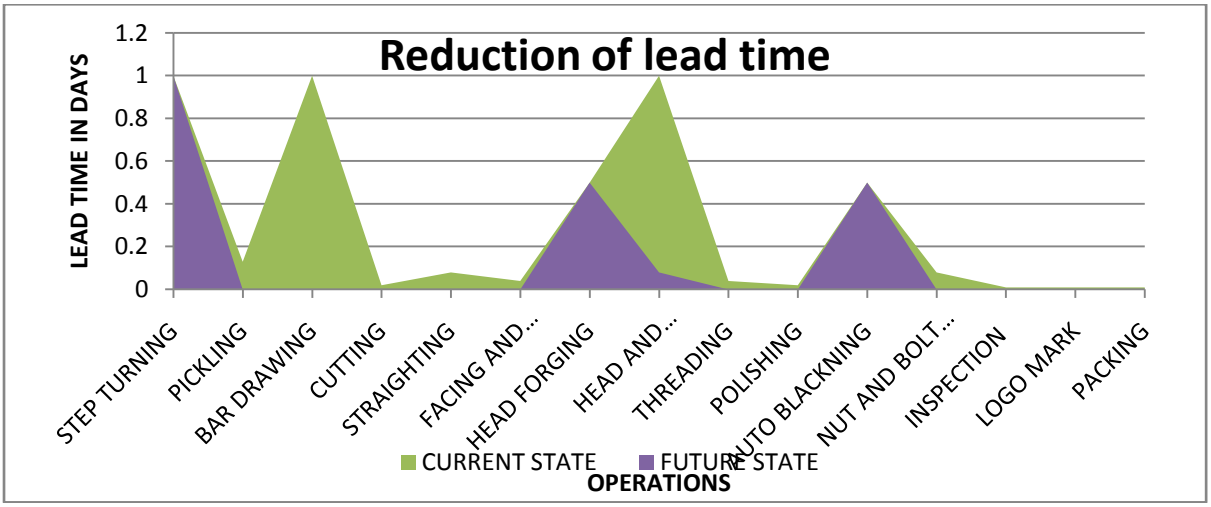

Fig 3 Reduction in lead time

3.1 Reduction in process time

With the addition of *5s* and quick changeover set-ups, current state production time can be reduced from 119 seconds to 114.1 seconds.

3.2 Reduction in man power

In current state map 23 operators are working in Centre bolt manufacturing process. A future state map was created by implementing lean manufacturing techniques which also reduce man power working in manufacturing process. In future state map 18 operators are working in Centre bolt manufacturing process, 22% reduction of man power.

3.3 Reduction in work in process

Works in process are also reduced to 58.4%.

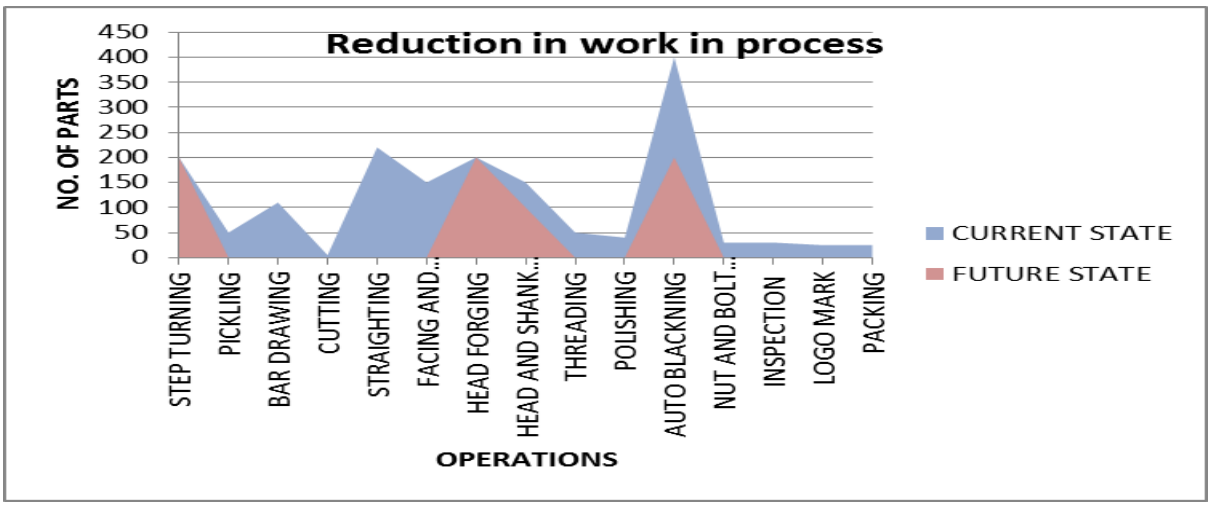

Fig 4 Reduction in work in process

IV. CONCLUSIONS

4.1 Reduction in lead time

In current state map of center bolt lead time was 4.44 days. After finding pin point areas for improvement future state map was developed with the help of cellular manufacturing. So due to this lead time reduce to 2.08 days means 53 percent reduction in lead time..

4.2 Reduction in work in process

Work in process inventory of center bolt in current state map was 1685 parts but after implementation of single piece flow work in process inventory reduce to 700 parts means 58.4 reductions in work in process.

4.3 Reduction in processing time

With the help of 5s processing time can be reduce from 128 sec to 125 sec. reduction was 2 percent.

4.4 Reduction in Man power required

In current state map 23 operators was working to produce center bolt but after implementation of cellular manufacturing operators reduce to 20 means 13 percent reduction in man power required.

REFERENCES

[1] AnandGurumurthy, RambabuKodali, (2011), "*Design of lean manufacturing systems using value stream mapping with simulation*", Journal of manufacturing technology management, Vol. 22 Issue: 4 pp. 444-473.

[2] Bhim Singh, S.K. Sharma, (2009), "*Value Stream Mapping as a versatile tool for lean implementation: an Indian case study of a manufacturing firm*", Measuring Business Excellence, Vol. 13 Issue: 3 pp. 58-68.

[3] Dinesh Seth, Nitin Seth, Deepak Goel, (2008), "*Application of value stream mapping (VSM) for minimization of wastes in the processing side of supply chain of cottonseed oil industry in Indian context*", Journal of manufacturing technology management, Vol. 19 Issue: 2 pp. 529-550.

[4] Er. Paramdeep Singh, 2012, "*Application of lean tool (value stream mapping) in minimization of the non-value added waste*", applied mechanics and materials, Vols. 110-116, pp. 2062-2066.

[5] Ibon Serrano Lasa, Carlos ochoaLaburu, Rodolfo de Castro Vila, 2008, "*An evaluation of value stream mapping tool*", Business process management, vol 14 pp 39-52.

[6] Larson, A. (2003). Demystifying Six Sigma: A Company-Wide Approach to Continuous Improvement. Saranac Lake, NY, USA: AMACOM Books. pp. 46.

[7] Lixi Chen, Bo Meng, 2010, "*the application of value stream mapping based lean production system*", International Journal of Business and Management, vol 5 Issue: 6 pp 203-209.

[8] Manoj Dora, Maneesh Kumar, Dirk Van Goubergen, Adrienn Molnar, Xavier Gellynck, 2013, "*Operational performance and critical success factors of lean manufacturing in European food processing SMEs*", Trends in food science and technology, Vol. 31 Issue: 2 pp. 156-164.

[9] NitinPandhi, SanjeevVerma, 2012, "*value stream mapping in an automotive industry*", International Journal of Current Engineering and Technology,vol 2 Issue: 3 pp 313-317.

[10] Osama M. Erfan, 2010, "*application of lean manufacturing to improve the performance of health care sector in Libya*", International Journal of Engineering & Technology, vol 10 Issue: 6 pp 117-128.

[11] Peter Hines, Nick Rich and Ann Esain, (1999), "*Value Stream Mapping A distribution Industry Application*", Benchmarking: An international journal, Vol. 6 Issue: 1 pp. 60-77

[12] Rahani AR & Muhammad al-Ashraf, 2012, "*Production flow analysis through value stream mapping: a lean manufacturing process case study*", Procedia Engineering, Vol. 41 pp. 1727-1734.

[13] Ravikumarmarudhamuthu, Marimuthukrishnaswamy, Damodaranmoorthypillai, (2003), "*the development and implementation of lean manufacturing techniques in Indian garment industry*", jorden journal of mechanical and industrial engineering, vol 5 Issue: 6 pp 527-532.

[14] S. Vinodh, K.R. Arvind, M. Somanaathan, (2010), "*Application of Value Stream Mapping in an Indian Camshaft Manufacturing Organization*", Journal of manufacturing technology management, Vol. 21 Issue: 7 pp. 888-900.

[15] S.K. Garg, S.K. Sharma, ChandandeepGrewal, Bhim Singh, (2010), "*Lean implementation and its benefits to production industry*", International journal of lean six sigma, Vol. 1 Issue: 2 pp. 157-168.

[16] YikunXie, QingjinPeng, (2012), "*Integration of value stream mapping and agent-based modeling for OR improvement*", Business Process Management Journal, Vol. 18 Issue: 4 pp. 585-599.