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Implementation of Lean Tools to Reduce Lead Time in Double Block Bleed Valves (DBBV) Manufacturing Industry

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Abstract - *Lean manufacturing is the methodology used in the manufacturing process to reduce waste, and also helps to improve productivity. [1] This project deals with the problems of bottleneck in assembly and valve painting. Double block bleed valve (DBBV) are the valves produced in this industry. Spaghetti diagram is a visual representation of a process using a continuous flow line tracing the path of an item or activity. Spaghetti diagram is used to track the material's movement and the process time is also calculated by the total lead time, measured from inspection section to section SCN. [2] Once the information is collected, the material is expressed in step-by-step process and the total distance from one operation to another is calculated. [11] Value Stream Mapping is a visual tool that displays all critical steps in a particular process, and easily quantifies the time and volume taken at each stage. Value stream map is used to measure lead time and distance of painting process. [19] The total lead time and distance for the current state of the painting process are calculated by using the above information. Since the lead time is more in the current assembly and painting process, some improvements are made in the process layout, line balancing and in the overall process. The future state of value stream mapping was also suggested, which helps to reduce the total lead time and increase the overall productivity.*

Key Words: Lean manufacturing, Double block bleed valve (DBBV), continuous flow, Value Stream Mapping, lead time, process layout, line balancing.

1. INTRODUCTION

Lean manufacturing involves the process of increasing production in manufacturing sectors by identifying and eliminating wastes. [1] There are seven basic wastes in the industry they are Transport, Inventory, Motion, waiting time, Overproduction, over-processing, Defects by eliminating these wastes in industry production get increased. [2] There are several lean tools to identify the wastes in an industry they are Process mapping, Time observation, lead time, cycle time, Spaghetti diagram, Communication circle, Waste walk, Voice of the customer, Root cause analysis and some of the tools to eliminate wastes in the industry they are 5S, Poke yoke, Kanban, Kaizen, Single minute exchange of die, Single piece flow, Total quality management, Total preventive maintenance, and FMEA, etc...[5] In this project, we are identifying the waste in the DBBV line in production by using the Spaghetti diagram and Time observation for different machining and other processes. The DBBV involves the production of Double Block Bleed Valve. Valves are wont to control and direct the flow of fluids. Double block bleed valve (DBBV) provides bubble-tight sealing and it will safe and reliable replacement of valve system, and its mechanism is enabled the segment to moves the seat during valve operation, and its reduced wear and tear to improve service life.

Spaghetti diagram involves the process of gathering information from the employees about the material movement. Once the information is gathered, material movement is to be represented in the form of step by step marking. By using the above information total lead time and the distance is to be calculated. [9] By combining and reducing the process flow total lead time and distance are reduced, which helps in improving the production rate. Spaghetti diagram is drawn for valve movement in the double block bleed valve (DBBV) line. By drawing the spaghetti, the waste movement of the valve can be identified. By changing the layout these waste can be reduced. Time observation involves the process of observing time study on different machining processes from loading of the job to unloading of job and it provides the length of time to complete the process. By observing the time study on different machining process certain waste can be identified. These wastes are eliminated by providing suitable improvement ideas. Provided ideas are to eliminate the waste time and thereby to reduce the operator work. In the painting of the valve, the total lead time and cycle are calculated by using Value stream mapping for a particular sized valve. The value stream mapping is a lean technique used to collect data visualization for a flow process in an industry. [17] The VSM helps to measure the inventory to maintain the level for each step by step operation. If there is any waste identified in the current state by using VSM the improvement idea suggested reducing waste, material movement, processing time. [23] The completion of the SCN process the valves move to the painting process and dispatch. In the painting process and dispatch, there are

various procedures involved they are masking, blasting, painting, de-masking & cleaning, touch-up, nameplate printing, nameplate fixing, painting TPI, packing, packing TPI, customer clearance, dispatch. [9] By Appling lean tools and techniques, the total lead time is calculated in the manufacturing process. To reduce the total lead time, the improvement ideas, suggestions and it helps to increases the production rate.

2. PROJECT METHODLOGY

1. Process study for DBBV Valve production.
2. Layout prepare for the current state of DBBV line
3. Spaghetti diagram drawn for material movement in DBBV line.
4. Time study for each step by step process in DBBV line.
5. Waste movement of material and total lead time is reduced by changing the layout using spaghetti.
6. Value stream mapping is drawn for painting process.
7. Bottleneck as identified by collected present data using VSM.
8. Improvement ideas as suggested for reduced lead time using lean tool and techniques.
9. By this, the resulting total lead time and increase the production rate.

3. IMPLEMENTATION OF LEAN TOOL IN VALVE MANUFACTURING PROCESS

3.1 Process flow in DBBV line:

Valve from the vendor is moved to the receiving area in the DBBV line. After quality is checked, it is moving on to the storage area in the DBBV line. When the material receipt from the shop floor is provided to the store they provide the required material to the valve assembly. After MR is provided, the body, bonnet, bottom plate will move to the body store. Then it will travel to the hot phosphating area. In the phosphating used to reduce rust in the material. After the phosphating process the body, bonnet, bottom plate, will move to the assembly area. The stem and housing is the move from the receiving area to the HDF store bin. Then it travels to the assembly area. The nut, stud, O-ring, gasket are move from the receiving area to DBBV stores. Then it moves to the assembly area. After the completion of the assembly the valve travel to the testing. When the testing process is completed the valve move to the pit assembly area to drain the water for the valve. The valve travel to the VTL machine for the serration process. Then the valves move assembly area for the SCN process. The valve's size of 6 inches to 24 inches has been manufacturing. When the SCN process is completed the valve move to the painting block.

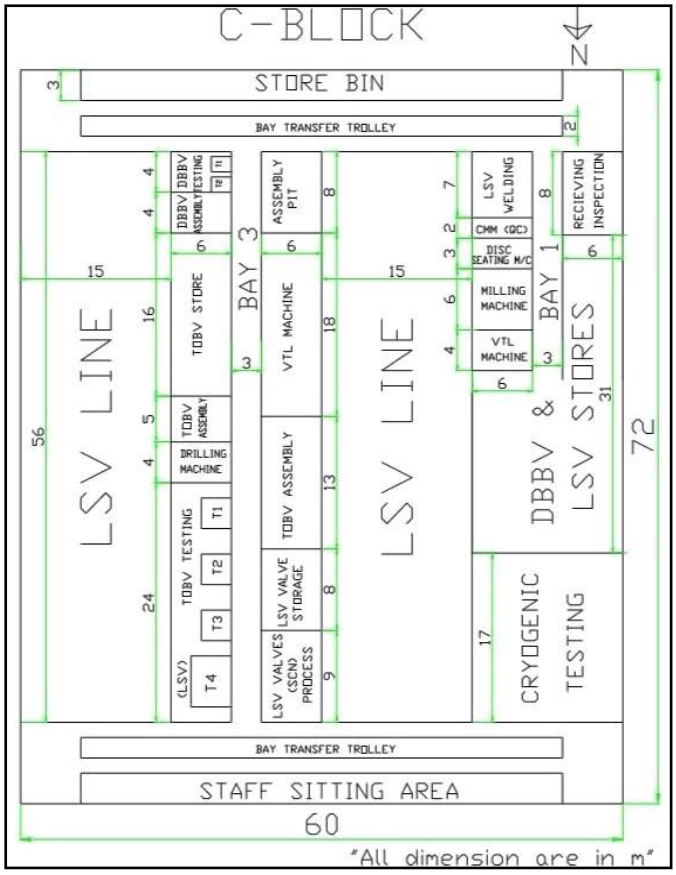

Fig.1. Current state layout of DBBV line

PRESENT SPAGHETTI DIAGRAM AND INDICATION

S.NO	Indications
1)	Receiving inward
2)	Movement of Receiving to the Body store
3)	Movement of a body store to Hot Phosphating
4)	Movement of Hot Phosphating to DBBV assembly
5)	Movement of Receiving to DBBV stories
6)	Movement of DBBV stories to Assembly
7)	Movement of Receiving to HDF stories bin
8)	Movement of HDF stories bin to DBBV assembly
9)	Movement of DBBV assembly to Testing of DBBV
10)	Movement of DBBV Testing to pit assembly
11)	Movement of the pit to VTL machine for serration
11)	Movement from VTL machine to the assembly for SCN process
12)	Movement of DBBV assembly to painting

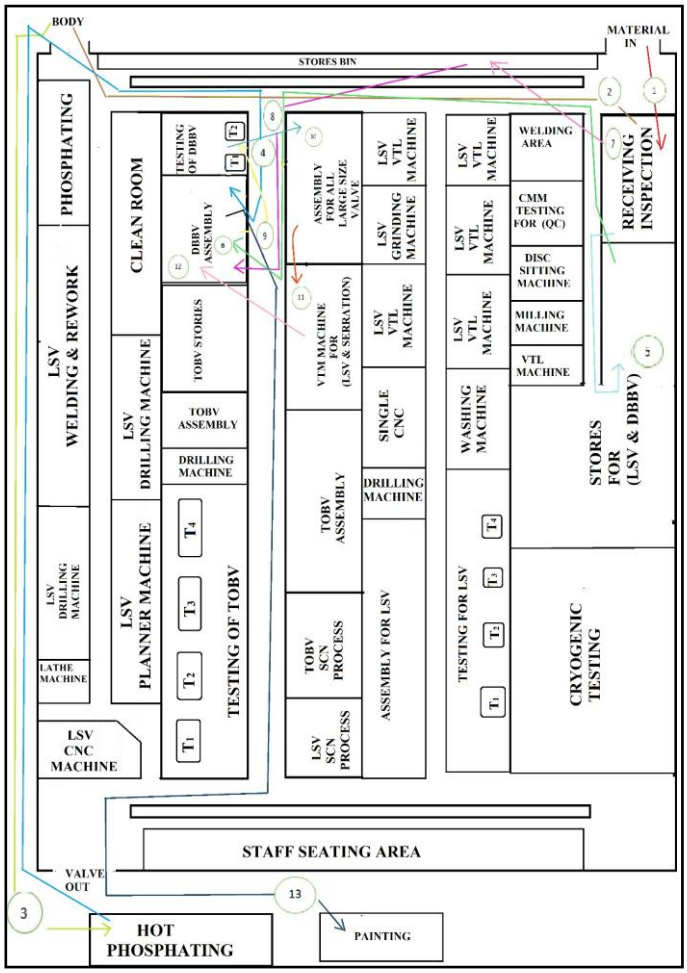

Fig.2. Material movement for DBBV line

The spaghetti diagram used to track the material movement and the total distance traveled is 436 meters and the total material movement and process is 712.23min/valve. The total lead time contains 2848.92 min (4 days 22 hours) from the receiving area to the valve moves to the painting area.

3.2. Process flow in painting block:

The completion of the SCN process the valves inward to the painting process and dispatch. In the painting process and dispatch, there are various procedures involved they are masking, blasting, painting, de-masking & cleaning, touch-up, nameplate printing, nameplate fixing, painting TPI, packing, packing TPI, customer clearance, dispatch.

3.3. Value stream mapping:

The value stream mapping is a lean technique used to collect data visualization for a flow process in an industry. The VSM helps to measure the inventory to maintain the level for each step by step operation. If there is any waste identified in the current state by using VSM the improvement idea suggested reducing waste, material movement, processing time. The current state process as presented in the industry and provides the idea where changes and improvement required in the process flow.

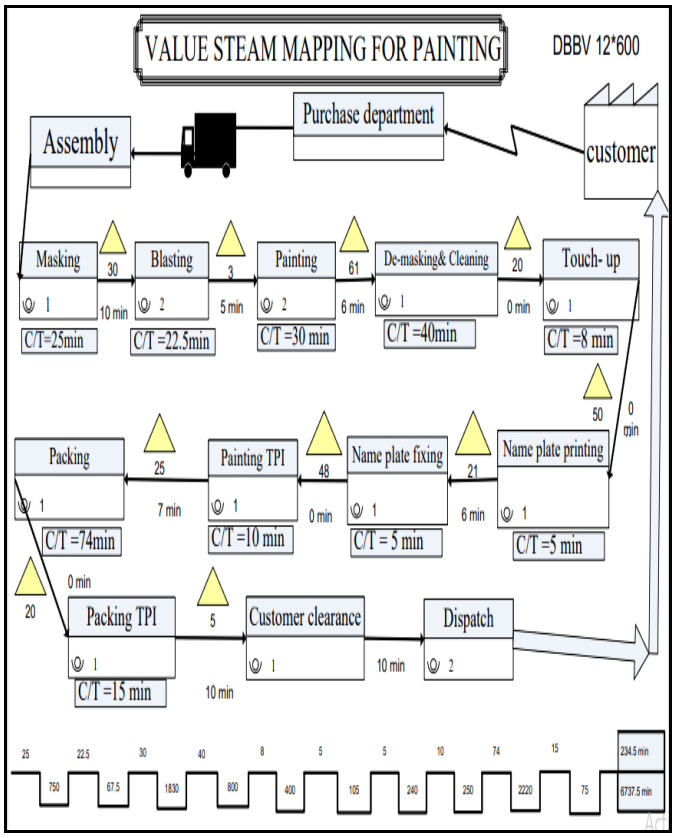

Fig.3. Value stream mapping for Painting process

The above value stream mapping shows the processing time for an individual process. The inventory maintained between each process and the material movement timing as calculated. The overall process timing is 234.5 min and the lead time from masking to dispatch is 6737.5 min.

4. RESULTS AND DISCUSSION

4.1. Improvement in DBBV line:

The current state Process that is carried out in the DBBV line is Assembly, Testing, Serration, SCN. The total cycle time and material movement are calculated. To reduce the lead time, the improvement idea suggested, and it as shown in the tabulation.

Table 1: IMPROVEMENT IDEA SUGGESTION FOR DBBV LINE

S.No	Part/ operation/activity	Cycle Time (min)	Suggestion
1	Material Receiving	15	
2	Body, Bonnet, Bottom head move to body store travel for phosphating	40	Material movement can reduce by change the layout to avoid activity of body stores
3	Phosphating process	150	
4	After phosphating Body, Bonnet, Bottom head move to assembly	35	Reduce timing change the layout
5	stem and housing is move from receiving area to the HDF	5	
6	Steam and housing move to assembly	15	Electrical trolley
7	The nut, stud, O-ring, gasket are move from the receiving area to DBBV stores	10	
8	The nut, stud, O-ring, gasket are moves to the assembly area	20	MR- Trolley
9	Assembly process	190	Assembly stand with tool are required
10	Testing process	125.23	Test stand required instant of test plate
11	Testing process completed valve move for drain water to pit assembly	10	Proper drain system required
12	Water drain	18	Pump to suck water
13	Movement for serration	10	Reduce distance
14	Serration process	35	Setting time as reduce by required space
15	SCN process	15	RFID tag
16	Valve movement for painting	20	Layout change
	TOTAL LEAD TIME	***712.23 min***	

The spaghetti diagram used to track the material movement and the total distance traveled is 436 meters and the total material movement and process is 712.23min/valve. The total lead time contains 2848.92 min (4 days 22 hours) from the receiving area to the valve moves to the painting area.

The improvement ideas suggested will reduce to cycle time for each operation. The proposed layout is created to reduce material movement and the distance travel for each processed form the receiving area to the SCN process for the DBBV Line. The proposed layout of the DBBV Line and spaghetti diagram for each process as shown below.

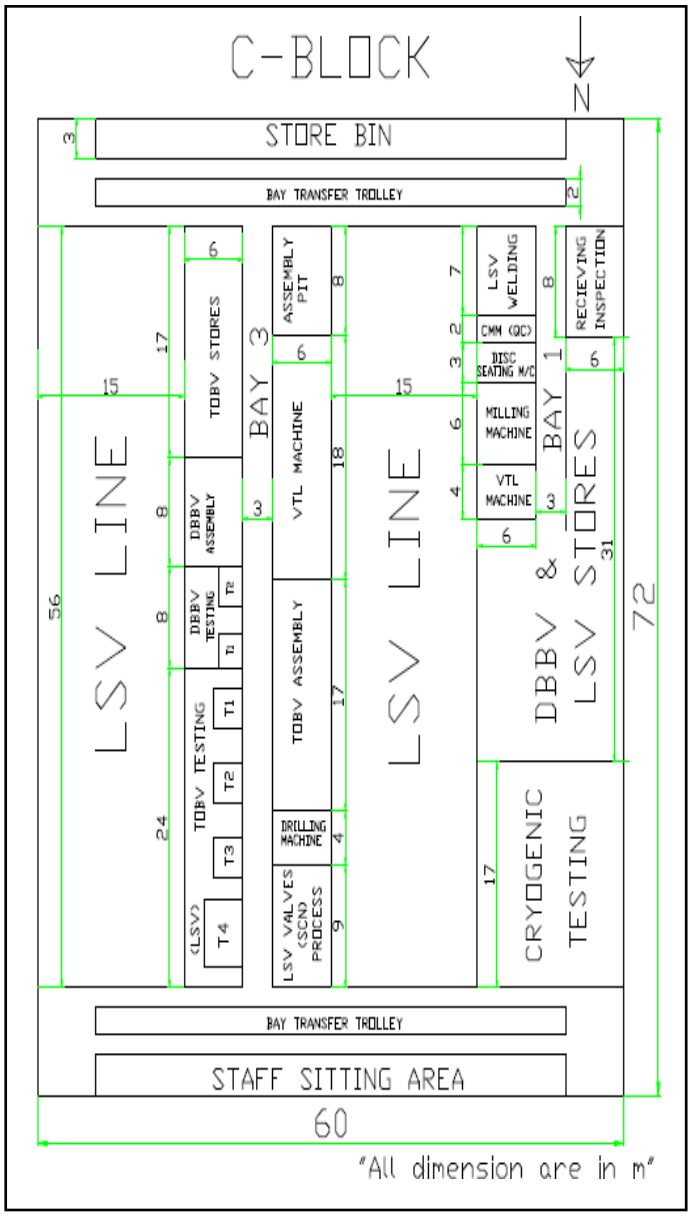

Fig.4. Proposed layout for DBBV

PROPOSED LAYOUT SPAGHETTI DIAGRAM FOR DBBV

S.NO	Indications
1)	Receiving inward
2)	Movement of body store to Hot Phosphating
3)	Movement of Hot Phosphating to DBBV assembly
4)	Movement of Receiving to DBBV stories
5)	Movement of Receiving to HDF stories bin
6)	Movement of stories material and HDF stories bin and to DBBV assembly
7)	Movement of DBBV assembly to Testing of

DBBV

8) Movement of pit to VTL machine for serration
9) Movement from VTL machine to assembly for SCN process
10) Movement of DBBV assembly to painting

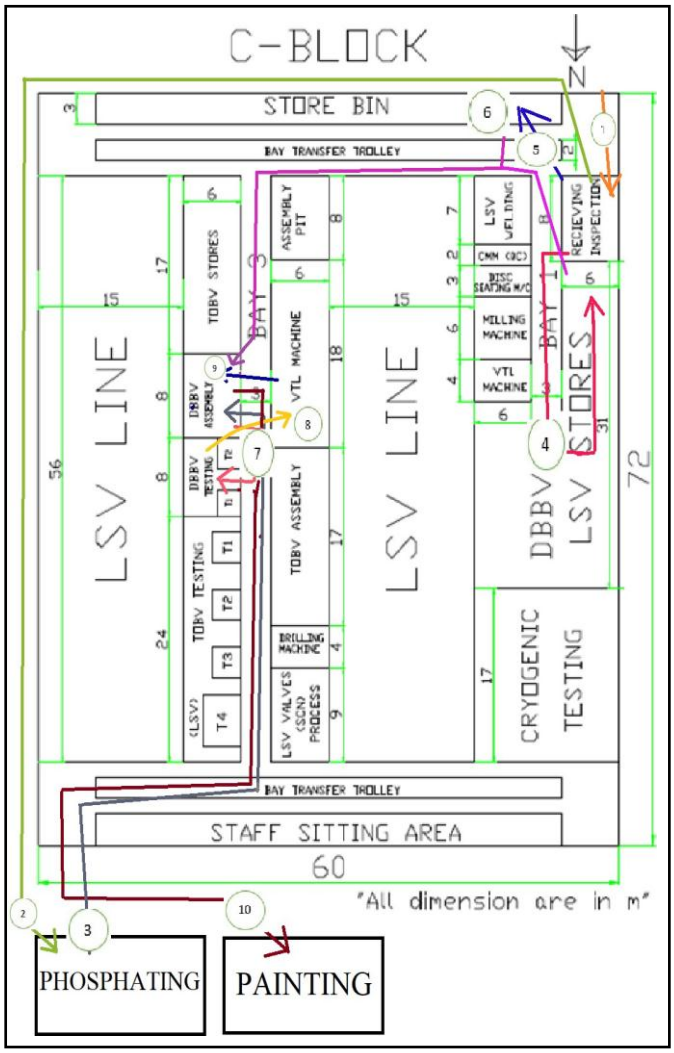

Fig.5. Material movement for proposed DBBV line

Table 2: Result in future state.

S.No	Part/ operation/activity	Cycle Time (min)	Reduced cycle time (min)
1	Material Receiving	15	15
2	Body, Bonnet, Bottom head move travel for phosphating	40	20
3	Phosphating process	150	150
4	After phosphating Body, Bonnet, Bottom head move to assembly	35	15
5	stem and housing is move from receiving area to the HDF	5	5
6	Steam and housing move to assembly	15	8
7	The nut, stud, O-ring, gasket are move from the receiving area to DBBV stores	10	10
8	The nut, stud, O-ring, gasket are moves to the assembly area	20	10
9	Assembly process	190	180
10	Testing process	125.23	90
11	Testing process completed valve move for drain water to pit assembly	10	-
12	Water drain	18	5
13	Movement for serration	10	5
14	Serration process	35	30
15	SCN process	15	5
16	Valve movement for painting	20	15
	TOTAL LEAD TIME	***712.23 min***	***563 min***

The spaghetti diagram used to track the material movement and the total distance traveled is 314 meters and the total material movement and process is 563min/valve. The total lead time contains 2252 min (3 days 21 hours) from the receiving area to the valve move to the painting area. Percentage of 20.5% waste as reduced.

4.2 Improvement in painting block:

In the painting process, there are various processes involved by value stream mapping the cycle time, and the lead time is calculated. The overall cycle time from masking to dispatch is 234.5 min and the lead time is 6737.5 min (11 days 16 min). To reduce the lead time, the bottleneck to identify and improve ideas suggested. In the blasting process the bay transfer trolley as used. In the painting, process valves place at the inclined position on the plain surface paint as sprayed. After the painting process completed the painted valves as dry in the atmosphere air. So it contains more cycle and lead time. To reduce this bottleneck, the improvement idea is suggested. The improvement idea is blasting instead of using bay transfer trolley and valves painted in the plain surface at

the inclined position the electrical mono rail conveyor. After the painting process completed instead of paint dry in atmosphere air the valves will move to the infrared boosted oven for dry the paint quickly.

After the improvement in the painting block, there are various processes involved by value stream mapping the cycle time, and the lead time is calculated. The overall cycle time from masking to dispatch is 202 min and the lead time is 3420 min (5 days 20 min). The above all improvement in painting block will reduce the total lead time and it helps to increase production. The improvement percentage after reducing wastage is 49.23%

5. CONCLUSIONS

From the above results, it is observed that the total lead time is reduced in the production of double block bleed (DBBV) valve by applying lean techniques. [2] The data from inspection section to SCN section is calculated by using a spaghetti diagram to visualize process flow. Also, this method is used to track the routing through factories and the distance is measured in the current state. [11] The processing time and movement of the material is reduced by implementing some improvements in changing the assembly layout and in line balancing. These improvements are made in future state of value stream mapping and by implementing the future state the total lead time is reduced. In the painting process from masking process to dispatch of the valves the value stream mapping is calculated. Value stream mapping helps to calculate the total lead time and used in finding the bottleneck problems in the painting process. [19] In the current state the bay transfer trolley in blasting process consumes more time. So, the improvement idea suggested like infrared booster oven, electrical monorail conveyor in the future state of painting process has reduced the total lead time. [10] As the total lead time is reduced assembly and painting of valves, the overall productivity increases.

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