

Through-Put Time Reduction by Lean Manufacturing

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Abstract: - To stand up in today's Globalization world, Manufacturers need to find ways to reduce Production time and cost in order to improve operating performance and Product quality. Lean manufacturing is the systematic elimination of waste. Lean is focused at cutting non value-added activities from production. This Paper details the use of lean manufacturing Techniques in reducing waste in Pump manufacturing Company. This Study Shows the 35% reduction in Through-Put Time is achieved to increases the productivity

Keywords: - Lean Manufacturing, Waste, Muda, Mura, Muri, Process.

I. Introduction to Lean manufacturing:-

Lean manufacturing is an overall methodology that seeks to minimize the resources required for production by eliminating waste (non-value added activities) that inflate costs, lead times and inventory requirements, and emphasizing the use of preventive maintenance, quality improvement programs, pull systems and flexible work forces and production facilities. Principles of lean include zero waiting time, zero inventory, scheduling (internal customer pull instead of push system), batch to flow (cut batch sizes), line balancing and cutting actual process times.[1] &[5]. To find out the Muda, Mura, Muri in process we go for detail time study of all activities. Time studies consist measuring the time taken in series of operations in such a way that the ineffective time is shown up and can be separated out. In practice, proving existence of the ineffective time is the most difficult task. Breaking the job into elements to ensure that productive work (or effective time) is separated from unproductive activity (or ineffective time). Then, distinct part of a specified job selected for convenience of observation, measurement and analysis. We carried out time study for all activities of BHR240 Bowl.[4]

II. Problem Statement:-

As explained earlier in introduction, the number of BHR240 pumps dispatched by large pumps division 4 set / month. Our aim is to increase the number of BHR240 pumps to be dispatch. It could be done by reducing the cycle time of process. Reduction of process cycle time could be done by, Eliminating the non value added works in each individual process stage. As concentrated to reduce the cycle time of material flow. As per physical observation, there are some non value added works. To eliminate those non value added works Time Study & Activity sequence need to be modified & need to use lean manufacturing techniques. This improvement horizontal deployed for all other pump models. In pump major components is Impeller, Pump Bowl, Discharge head, Bell Mouth, Impeller Guide piece, Shafts etc. All mentioned components having long lead time in process. Pump bowl is most critical component to achieve on time delivery due to more activities involved in process such as Cleaning, Hydro Testing, Check-fitment, and Third party witness, Assembly, Painting and Packing. So focus reduction of lead time of pump bowl. **The Existing throughput time for BHR240 Pump Bowl (FC to Dispatch) is 3222 Minute. The Targeted throughput time is 2125 Minute (35% time reduction).The Gap of 1085 minute throughput time to be reduced by Lean Manufacturing Techniques.**

III. Methodology to address Problem:-To reduce cycle time we Employed the following process for manufacturing change.

1. Observation of Process To Identify 3 M's

Lean manufacturing is a Japanese method focused on 3M's.

These Ms are:

1. "Muda" the Japanese word for *waste* in process.
2. "Mura" the Japanese word for *inconsistency* in product, processes and systems.
3. "Muri" the Japanese word for *unreasonableness* physical strain of operators.

(Activity like: Bending, Climbing, Stretching, Lifting heavy wt.)

“Muda” means waste. Muda specifically focuses on activities to be eliminated. Waste is broadly defined as anything that adds cost to the product without adding value to it. [3] and [10].

1. Identify Projects for Improvements.

Reduction of process cycle time by using Lean manufacturing techniques. For this project we Selected component of BHR240 pump bowl. Our objective is to reduce process time of bowl from assembly to dispatch.

2. Measuring Cycle Time for Each Process.

Breaking the job into elements to ensure that productive work (or effective time) is separated from unproductive activity (or ineffective time). Then, distinct part of a specified job selected for convenience of observation, measurement and analysis. We recorded time for all activities of BHR240 Bowl.

IV.PARETO ANALYSIS:-

We carried out time study of BHR240 Bowl and for Pareto diagram analysis is as shown in table following:

Sr. no.	Activity	Cycle Time (Min.)	% Total	Comm.%
1	Cleaning	930	28.86	28.86
2	Hydro	468	14.53	43.39
3	Painting	423	13.13	62.85
4	Packing	421	13.07	79.99
5	Waiting	300	9.56	85.7
6	W. Transport.	180	5.74	88.55
7	Inspection	150	4.78	91.4
8	Fitment	120	3.83	94.25
9	Dry	120	3.83	97.1
10	Transport.	110	3.51	100
	TOTAL	3222	100	

Table No.01 Pareto diagram analysis of BHR240 Bowl

After analysis from Pareto Diagram we find out major activities to be focused so as to reduce through put time to credit the component. Following major activities are to be focused as per 70-30 rule of the Pareto analysis.

- 1) Cleaning.
- 2) Hydro testing.
- 3) Painting.
- 4) Packing.

Total time required time for above major activity=2238 min. It is to be reduced.

We focused on above major activities with lean techniques, we reduced total through put time of credit the component BHR240 Bowl by following process improvements.

1) **Cleaning Improvements.**

SR. NO.	ACTIVITIES	EXTERNAL ACTIVITIES	INTERNAL ACTIVITIES	TIME (MIN)	ACHIEVED (MIN)	ACTION TRIGGERED / MUDA IDENTIFY	ACTION IMPROVEMENTS /
1	Template Fitting- Inlet and Out let vanes. 1.1. Handling for tilting, locating suitable for working position etc. 1.2.Grinding. 1.3. Inspection by template	EXT		600	0	Muda of processing.	Find root cause of problem. Activity shifted to Foundry.

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2	Hydraulic passage cleaning. 2.1.Handling for tilting, locating suitable for working position etc 2.2.Grinding where ever roughness noticed	EXT		180	0	Muda of processing.	Find root cause of problem. Activity shifted to Foundry.
3	Cleaning before assembly		INT	30	30		
4	Cleaning before painting 4.1. Cleaning by Polish paper. 4.2. Cleaning by compressed air. 4.3. Thinner wash		INT	120	120		Mainly time consumed due to Heavy corrosion of Bowl surface. Surface protection at foundry stage can help to save 90 min.
	Total			930	150		

Results:

- Initial time required for Cleaning the BHR240 bowl = 930 min.
- After improvements time required for cleaning the BHR240 bowl. =150 min.
- Total time reduced for cleaning the BHR240 bowl. = 780 min.

2) Hydro Testing improvements:

SR. NO.	ACTIVITIES	EXTERNAL ACTIVITIES	INTERNAL ACTIVITIES	TIME (MIN)	ACHIEVED (MIN)	ACTION TRIGGERED / MUDA IDENTIFY	ACTION IMPROVEMENTS /
1	Locate bowl in yard	EXT		15	0	Muda of searching/ idle	Done before hydro loading. Identification marked on bowl.
2	Taking bowl from yard to hydro testing station.	EXT		30	30	Muda of transportation.	Propose to change the layout of storage location near work center.
3	Measure PCD, number of holes of flange.	EXT		5	2	Muda of over processing.	PCD & No. of holes marked during machining.
4	Search hydro plate from yard	EXT		71	30	Muda of searching / idle & 2S.	Reduce time by coding system. Separate location to be given so that searching time come down up to 5 min
5	Collect pressure plates at hydro station	EXT		14	0	Muda of transportation.	Do this activity before loading of Hydro
6	Cleaning pressure plates.	EXT		11	11	Muda of over processing.	After Hydro test plates need to clean
8	Take & Put " O" ring in groove of plate with applying grease		INT	14	14		
9	Locate wooden blocks suitable for bowl size and weight, put wooden blocks in hydro area and put the bottom plate on the blocks.		INT	25	18	Muda of over processing.	Make painted wooden block storage location in hydro location.
10	Check the drill size, decide stud size. Searching for studs & nuts (Around 24 nos.) for fastening		INT	17	12	Muda of over processing	Modified rack based on size
11	Lifting bowl for vertical position		INT	15	15		
12	Make arrangement to lift bowl vertically. (D-shackle & chain)		INT	30	0		Do when pressure apply & retain
13	Filing of water into bowl.		INT	30	20	Muda of idle / waiting	Use 2" pipe for filling water
14	Fitting of top pressure testing plate. Fix the pressure gauge.		INT	38	33	Muda of motion	Provide threading socket for pneumatic-studder.
16	Apply the pressure, Retain pressure (30 min.) inspection.		INT	60	60		lifting provision

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17	Removing fasteners of top pressure plate with help of pneumatic studder. Keeping nuts & bolts in rack.		INT	60	60		
18	Remove water from bowl (30 min.)		INT	30	30		
19	Remove bowl from pressure testing arrangement. Collecting used nuts & bolts & kept in rack.		INT	7	7		
20	Remove bottom plate and send top and bottom plates to stores by forklift.	EXT		22	22	Muda of transportation	Layout to be modified.
Total				464	338		

Results:

- Initial time required for hydro testing of BHR240 bowl = 464 min.
- After improvements time required for hydro testing of BHR240 bowl. =338 min.
- Total time reduced for hydro testing of BHR240 bowl. = 126 min.

3) Painting :

SR. NO	ACTIVITIES	EXTERNAL ACTIVITIES	INTERNAL ACTIVITIES	TIME (MIN)	ACHIEVED (MIN)	ACTION TRIGGERED / MUDA IDENTIFY	ACTION IMPROVEMENTS /
1	Offer for Q.A. Check (Pump No,Q.A. Assembly sticker) prior to painting		INT	20	10	Muda of over processing.	Inspection done at assembly end with QA sticker
2	Movement the bowl to paint booth.		INT	30	30		
3	Clear the space in the paint booth.	EXT		48	0	1S implement	Clear space after completion of each component
4	Lift component with EOT crane, move to paint booth.		INT	30	10	Muda of searching/ idle	Standardize "D" shackle
5	Clean the component with solvent & polishing paper.		INT	30	30		
6	Mask the machined surfaces.		INT	35	25	Process improvement	Use of 3" size masking tape instead of 1"
7	Primer preparation.	EXT		25	0	Muda of waiting	Keep primer ready in paint booth.
8	Apply primer as per the decided painting procedure (surfaces inside & outside & also bottom side by lifting the component with the help of crane)		INT	40	40	Process improvement	Can be reduced to 30min. By using High pressure guns.
9	Wait for the drying the primer		INT	30	30		
10	After dry out the primer, polish all the surfaces.		INT	20	20	Process improvement	By using orbital sander, time can be reduced to 10 min.
11	Apply finish coat of final paint as per the decided painting procedure (inside ,outside & bottom side by lifting the component with the crane)		INT	30	30		
12	Wait for drying of this coat & offer for Q.A. check		INT	30	30		

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13	After inspection of finish coat, remove all masking from machined surfaces		INT	25	25		
14	Apply rust preventive oil on the machined surfaces.		INT	10	10		
15	Offer the component for final inspection w.r.t. pkg. note		INT	20	20		
		Total		423	310		

Results:

- Initial time required for painting of BHR240 bowl = 423 min.
- After improvements time required for painting of BHR240 bowl. =310 min.
- Total time reduced for painting of BHR240 bowl. = 113 min.

4) Packing :

S R. N O.	ACTIVITIES	EXTERNAL ACTIVITIES	INTERNAL ACTIVITIES	TIME (MIN)	ACHIEVED (MIN)	ACTION TRIGGERED / MUDA IDENTIFY	ACTION IMPROVEMENTS /
1	Offer for Final Q.A. Check prior to packing			20	20		
2	Preparation of packing material.		INT	120	85	Process Improvements	Drilling of sides for lifting done at box mfg. stage
3	Keep Bowl on wooden base		INT	25	15		Standardize "D" shackle
4	Place & nail 04 side panels one after other.		INT	40	40		
5	Fix 10 Nos. of side supports (Wooden Rafters), to restrict movement of bowl.		INT	80	70	Muda of over processing.	2 nos of rafters reduced.
6	Create Stencil mark -- To have packing details.	EXT		23	0		Do this activity while final inspection being done
7	Offer for Final inspection to Q.A. Prior to dispatch.		INT	20	20		
8	Enclose signed Packing note. (Packing details)		INT	5	5		
9	Load the bowl in the Trailer with the help of D-shackles provided for lifting it.			60	60		
10	Fix wooden top panel		INT	23	23		
11	Ready to Dispatch.		INT	5	5		
				421	343		

Results:

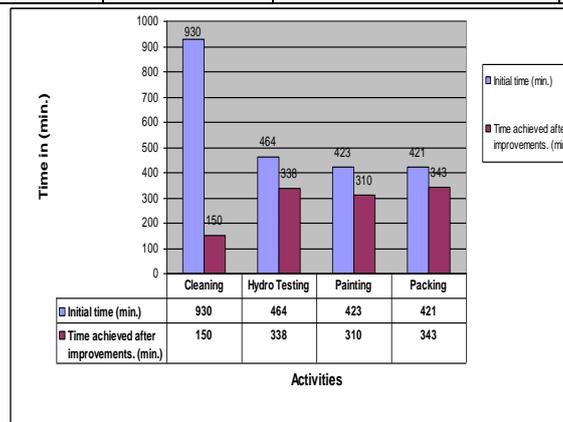
- Initial time required for packing of BHR240 bowl = 421 min.
- After improvements time required for packing of BHR240 bowl. =343 min.
- Total time reduced for packing of BHR240 bowl. = 78 min.

Benefits obtained: The cycle time of BHR240 pump reduced by eliminate some non value added works as per Lean Manufacturing System. Ultimately due to cycle reduction the number of pumps dispatch per month has been increased to 8 as below in table. It show increase in the total monthly production of large Pump Division.

MONTH	NOV	DEC	JAN	FEB	MARCH
BHR240 PUMP DISPATCHED QTY	4	5	6	6	8

Final result after improvements:

Sr. No.	Activity	Initial time (min.)	Time achieved after Lean (min.)	Time reduced by project. (min.)
1	Cleaning	930	150	780
2	Hydro Testing	464	338	126
3	Painting	423	310	113
4	Packing	421	343	78
	Total:-	2238	1141	1097



V.Conclusion:- Lean manufacturing appears to hold considerable promise for addressing a range of simultaneous, competitive demands including high levels of process and product quality, low cost and reductions in lead times. This Case Study addresses the application of lean manufacturing concepts to the continuous production sector with a focus on the Pump manufacturing industry. The EXISTING THROUGHPUT TIME before Application of lean Manufacturing = 3222 MIN. The reduced THROUGHPUT TIME = 2125 MIN. Totally saving of 1085min are achieved which shows 35% reduction in THROUGHPUT TIME.

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