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Lean Manufacturing Application for Process Improvement in Pump Manufacturing Industry

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Abstract - A Manufacturing defects or errors are always the key concern of any manufacturing and pump manufacturing industry. The Lean management is dedicated to the improvement of productivity, efficiency, quality and in general of business. Kaizen, 5S and Six-sigma remain the foundation of lean Six-sigma Management System. Those tools for cleaning, sorting, organizing and providing the necessary groundwork for improvement and preventing the small errors and problems of machine, man and management as well as reduction of rework and variation with better process control. Now a day, all the Pump manufacturing industry are moving the direction of Errors free production with higher safety provision. After applying Lean management, we can achieve better result as per production in cost and good working environment with less human errors and cycle time reduction. Lean methodology also increases better SHE (safety, health and environment) standard of any organizations. Sis-sigma Methodology is basically used to reduction in variation, rework and give better Process Control. In pump industry, Pump defects can come from any of the unite operation and from the pump press. The Turning and Grinding operations often the source of defect. Such as pressure drop, mechanical issue, noise, less discharge, leakage are among the most mutual problems during pump testing.

Keywords - Kaizen, Lean Manufacturing, Pareto Analysis, DPMO (Defects Per Million Opportunity).

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INTRODUCTION

VBC Hydraulics established in 1995. VBC taking full advantage of its forward-looking management policies and by incorporating unique R&D activities has made constant effort on development and Innovation. as a result, VBC Hydraulics currently produce a wide variety of outstanding Hydraulic Gear pumps for Agriculture & constructionmachinery, industrial hydraulic power pack, rubber and plastic molding machinery, material handling equipment and so many other industrial applications with global standard. The corporation, which relies on its design & patents, advance technology and management, always keep improving to be better.

Nowadays, high number of Industrial Accidents Occurs due to human Error. There some methods to prevent such an industrial accident and the most effective method is to develop the human behaviour by giving particular training for the work, conducting behavioural based study to reduce the accident rates and to improve the safe environment in industry. From the various studies, we can clearly say that, one of the causes for initiation of industrial accident is poor management system such as policy, safety systems etc. For improving the safety culture and behaviour of the employee, industry needs to provide training, education, meeting, review etc. For this purpose, the industry is in the position to spend money for the following aspects; Training, Education meeting. Communication also plays a major role in accident because the performance of communication from top level to low level management is very poor. This paper deals with potential causes of accident and rework and productivity improvement with better process yield.

LITERATURE REVIEW

Dr. JA doshi et. Al [1]. To Minimization of defect and rework is an important factor ensuring the quality of product. It indicates eliminating non value-added activity like rework, man hour spent on rework and taking effective measures will enhance the net profit, saves time and improve overall quality ofproduct.

A.P Chaple et. al [2]. Kaizen and why-why analysis are the effectives tools for improving the effectiveness of procurement process. Kaizen is also help to reduced higher lead time, paper work and good employeemorale.

Singh jagdeep et. al [3]. Kaizen is a Philosophy that needs the improvement of all people in the company. It should be placed on reduction in throughput time, addition of work station to meet the takt time and elimination of unnecessary activities.

Chakravorty, s.et. al [4]. The tools of the LSS Practice enriched the efforts towards waste reduction and rework reduction. LSS was proved to be a valuable tool in the case of systematic waste reduction objectives. The 80/20 rule of the pareto analysis was used to identify the most important causes of waste and rework.

Tarba Larisa. et. al [5]. Quality Control Tool might improve process performance by reducing product variability and improves production efficiency by decreasing scrap and rework. Pareto chart and cause and diagram are used to identify and evaluate different defects and causes for these defects responsible for rejection/rework of materials at different stages in the process.

Xue wan get et al [6] Lean Manufacturing and Six sigma in industries, has a dramatic change in the industry process and quality of the product produced. This was also denoted as Lean Six sigma. This Lean Six sigma can be implemented to any kind of industry, for better performance, Lean Six sigma is a continuous improvement tool for advancement. Lean Six sigma make powerful union with reduction of variations and wastes.

Shah A. et al [7]. Defects in the tablets can arise during manufacturing process, storage and transport. These visual defects can reduce the capability by the users an effectiveness of the product. To resolve common defects at the tablets press, and identify the root cause of each and finally resolve the defect before it reaches the tabletpress.

Rajesj Kumar Mehta et al [8]. The successful Lean Manufacturing system implementation needs integration and instantaneous implementation of Lean elements along with proper sequence. The survey also proposes the detailed implementation road map which gives a unified theory of Lean Manufacturing System implementation. The employee perception can be achieved through training and awareness by defining road map, and measurement.

U. Dombrowski, et al [9]. To apply Lean Kaizen analysis, is was help to reduced man motion, lead time and idle time by standardizing valves for various operations. Improved visual and quality of workplace. Also improve safety and maintenance activity.

K Sadashivappa, et. Al [10]. Lean is seen as a highly versatile tool and is adopted over a various range of work environments as seen in earlier works of research. It was used to improve the manufacturing throughput time and also reduce rework/manufacturing cost.

Deros, B.M., et. Al [11]. The beyond review indicates that factors such as communication between the top management and its employee, clear strategy, the need of a personnel who can champion the implementation of kaizen in a company, having good knowledge and provide employee with certain level of empowerment are important to ensure a successful Kaizen implementation.

Karaulova, T. et. Al [12]. A new framework for continuous improvement of production process allows improvement in product throughput and product delivery to a customer. In the FMEA, the weight of each failure type was assessed with risk priority Number by calculating Severity, Occurrence and Detection ratings. Further, these RPN values showed most critical failures in the production process.

U. Nimkar. Et. Al [13]. To apply a combination of Lean Methodologies to a Textile Industry, which was successful achieved. Methodologies such as PDCA cycle, 5S and 5W2H were combined departing form the PDCA cycle, producing excellent results solving just one problem, proving that the methodology can be extended to other identified problems and improve efficiency and productivity in a controlled way, without the risk of making large scale.

Abhijit Chkraborty rt. Al [14]. Positively implementation of kaizen and 5s process, there will also use as productivity improvement with better safety standards. It can also increase working culture of employee.

METHODOLOGY& ANALYSIS

Kaizen is Japanese Word Which also Known as Continuous improvement by every day, everybody, everywhere. Kaizen is most important for step by step small improvement and get better result in production line [15]. Kaizen is focused on productivity, reducing variation.

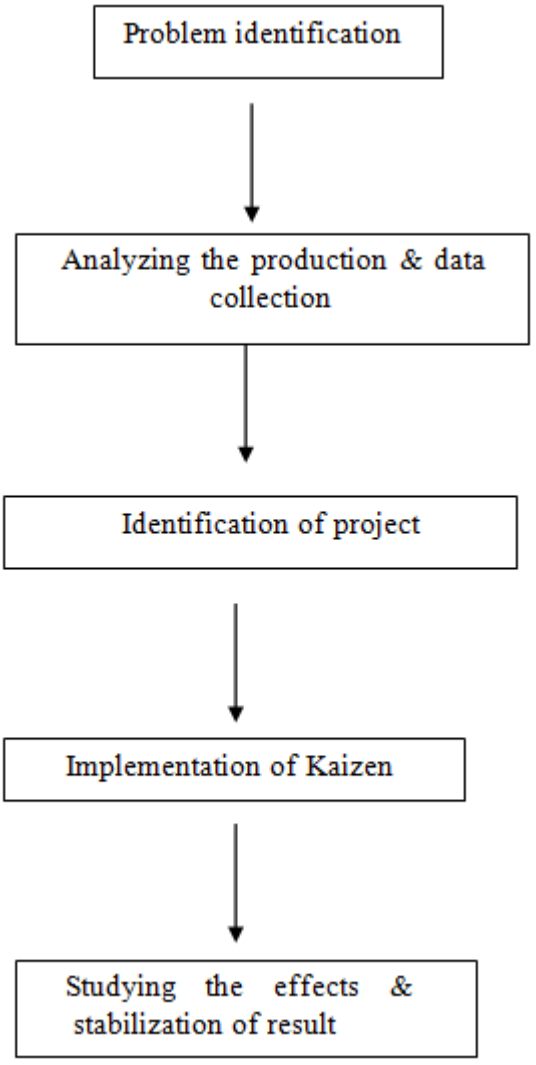

Table1: Monthly defect pump observation (November) 2019

Days	No. of pump Manufacturing	No. of. Defects
Day1	111	10
Day2	120	10
Day3	150	10
Day4	145	5
Day5	135	3
Day6	135	11
Day7	147	8
Day8	140	8
Day9	140	7
Day10	140	9
Day11	139	9
Day12	125	9
Day13	130	7
Day14	130	7
Day15	130	2

Currenr Data Analysis

Days	No. Of. pump Manufacturing	No. of. Defects
Day16	135	6
Day17	140	6
Day18	136	6
Day19	136	8
Day20	142	6
Day21	140	11
Day22	140	11
Day23	140	8
Day24	130	8
Day25	130	7
Day26	135	7
Day27	135	4
Day28	145	6
Day29	145	6
Day30	147	7

- **Check current process yield and DPMO**

Total Pump manufactured 4093, out of which 216 pumps are reprocessed.

- **Yield of the process**

Y= Actual Output / Expected output* 100

Y= 4093/ 3877*100

=10.55%

- **DPMO (Defects per million opportunities)**

= No. of Defects*(10)^6/((No. of unit) * (No.of Opportunity))

= 216*10^6/(4093*6)

- **Current DPMO:** - 8795.5

IMPLEMENTATION OF KAIZEN

Continuous improvement

Table 2: Provide collet chuck for mounting plates

Before	After
 Old threejaw chuck	 New collet chuck
General Comparison	
Safety	**Safety**
Less part gripping capacity. Accident risk possibility of part gate away from gripper jaw.	Good part gripping capacity. Very low risk possibility of part gate away from gripper jaw.
Production	**Production**
M/C part set up time more. Its time consuming.	M/C part set up time less. (time save)
Quality	**Quality**
Some parts not proper position grip in jaw, its variation affects the quality of part.	Part proper position grip in jaw, so part made without any variation. (improve a quality of part)

Table 3: Provide collet chuck for gear turning department

Before	After
 Old threejaw chuck	 New collet chuck
General Comparison	
Safety	**Safety**
Less part gripping capacity. Accident risk possibility of part gate away from gripper jaw.	Good part gripping capacity. Very low risk possibility of part gate away from gripper jaw.
Production	**Production**
M/C part set up time more than 25-30 min.	M/C part set up time less & done in just 5-10 min.
Quality	**Quality**
Gear shaft run out some 20 microns.	Gear shaft run out in some 10 microns. Improve a part quality.

Table 4: Provide debburing cutter for burrs remove

Before	After
	
Burrs are remove in manually	Burrs are remove in debburing cutter
General Comparison	
Safety	**Safety**
Its risk possibility to injure hand by knife of operator.	No risk to injure hand of operator.
Production	**Production**
Particular one operator required to remove a burrs. It's a time-consuming process.	Not need particular one operator for remove burrs. In M/C, debburing cutter remove a burrs in very short time.
Quality	**Quality**
Its manual process, not a proper remove a burrs from shaft.	This is auto debburing process, proper remove a burrs from shaft.

STABILIZATION OFRESULT

Table 5: Monthly defects pump observation (February) 2020

Days	No.of.pump Manufacturing	No.of. Defects
Day1	111	9
Day2	120	10
Day3	150	9
Day4	145	4
Day5	135	3
Day6	135	9
Day7	147	8
Day8	141	4
Day9	140	7
Day10	140	9
Day11	140	7
Day12	125	8
Day13	130	7
Day14	130	8
Day15	130	5
Day16	135	6
Day17	140	6
Day18	136	4
Day19	142	9
Day20	142	4
Day21	145	9
Day22	140	3
Day23	140	6
Day24	130	8
Day25	130	5
Day26	137	4
Day27	137	5
Day28	143	7
Day29	145	7
Day30	142	5

- **Check current process yield and DPMO**

Total Pump manufactured 4103, out of which 195 pumps are reprocessed

- **Yield of the process**

Y= Actual output / Expected output * 100

Y= 4103/3908*100

Y= 10.45%

- **DPMO (Defects Per Million Opportunities)**

= No. of Defects*$(10)^6$/((No. of unit) * (No.of Opportunity))

= $195*10^6/(4103*6)$

- **Current DPMO:** - 7921.33

Table 6: Parameters Comparison before and after the implementation of Lean Techniques

Parameters	Before Implementation	After Implementation
Process yield	10.55%	10.45%
Rework Rate	216	195
Plant Utilization status	Effective	More Effective and Efficient
Cycle time	More	Less

CONCLUSION

In this research to apply a Kaizen Methodologies to a Pump manufacturing industry. Which was effectively achieved. By using Effectives techniques such as Kaizen, RAC (Root cause analysis) benefits were recorded in the area as reduced cycle time, Improve Process yield, Improve Plant utilization rate with better efficiency of the product and also help to rework production in manufacturing of product. The problems occurs during pump testing such as pressure drop, mechanical issue, noise, less discharge, leakage were identify by Root cause of each and lastly resolve the defects.

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