Abstract— Today, Manufacturing companies and their plants must operate efficiently and effectively to remain competitive in the global economy. One of the general approaches that has been successful in these efforts is lean manufacturing. Generally, there are some unneeded activities in manufacturing operations which do not add value to the production. In the manufacturing process of cryogenic vessel, welding defects is the major problem which leads to major loss to the companies. To improve the process, it is desired to implement quality management. During our practical implementation, we will learn philosophical and analytical technique by applying same during the production process.

Keywords—: Lean Manufacturing, Welding Defects, Cryogenic Vessel

I. INTRODUCTION

Lean Manufacturing means doing work with fewer resources. It is an adaptation of mass production in which work is accomplished in less time, in a smaller space, with fewer workers, and with less equipment, and yet achieves higher quality levels in the final product. The term “Lean Manufacturing” was coined by researchers in the International Motor Vehicle program at the Massachusetts Institute of Technology to describe the way in which production operation were organized at the Toyota Motor Company in Japan during the 1980s. Lean Manufacturing is a set of potentially competing principles whose goal is cost reduction by elimination of waste. These principles include processes like Pull processing, waste minimization, perfect first-time quality, continuous improvement, flexibility, production flow and visual control.

Worker teams who participate in a Lean Manufacturing project are trained in the use of statistical and problem solving tools as well as project management techniques to define, measure, analyze, and make improvement in the operation of organization by eliminating defects and variability in its processes. The main concept of lean manufacturing is that defects in a given process can be measured and quantified.

Once they are quantified, the underlying causes of the defect can be identified, and corrective action can be taken to fix the causes and eliminate the defects. The results of the improvement effort can be seen using the same measurement procedures to make a before and after comparison.

problem statement:

Fig. 1 Cause and effect diagram of welding defects.

Sound welding quality is not achieved in first attempt. Due to this problem the cost of the product increases and quality of the welding decreases. There are many factors which affect the increase of cost of product due to welding defects such as electricity cost, labour charge, wastage of time, scheduling problem, delay of production, filler material wastage, decrease in productivity, NDT cost etc.

Objective Of Study

The main objective of study is to reduce the waste and defects on one hand and to increase the productivity, quality, establish good management system and continuous improvement system on the other hand.
II. LITERATURE REVIEW

Title: “Internal obstacles to quality for small scale enterprises” (2011)

Author: Abhijit Chakrabory, Sudip Kr. Deb, Ranjan Bhattacharya

Chakrabory et al. (2011) studied the critical problems facing by small scale industries while selling their product. As SSE (Small Scale Enterprise) do not have huge financial backup and so they are depending upon the revenue eared after selling their product. Thus the product sales can only be increased by reducing the cost of the product.

Title: “Lean manufacturing system for medium size manufacturing enterprise: An Indian case” (2010)

Author: Nitin Upadhye, S. G. Deshmukh & Suresh Garg

Upadhye et al. (2010) studied the importance of small and medium scale industries in Indian context. Small and Medium size manufacturing industry plays an important role in Indian economy. Due to their contribution to the economic development of the nation is indeed significant. But the productivity level of these industries is quite low as compared to other country.

Title: The 5S methodology as a tool for improving the organization (2007)

Author: J. Michalska, D. Szewieczek

According to this paper 5S implementation results in increasing of an efficiency, safety and reduction of the industry pollution. The proceedings to research clearly show that training of workers about the 5S rules is very essential. The important task is to divide activities on some main steps and to maintain the continuous improvement. It is also important to understand the need of executing the routine inspections of usage the 5S rule. This inspection is executed by helping of so-called check list and created on its basis the radar graph of the 5S, which serves in the estimation of the workplace.

Title: “Areas of Lean manufacturing for productivity improvement in a manufacturing unity” (2010)

Author: Hudli Mohd. Rameez, K.H.Inamdar

Hudli and Inamdar described the development of key areas which could be used to assess the adoption and implementation of lean manufacturing practice also presented some of the key areas developed to evaluate and reduce the most optimal project so as to enhance their production efficiency.

Title: “Defining and developing measures of lean production,” (2007)

Author: Shah, R. and Ward, P. T.

Shah and Ward defined Lean manufacturing as an integrated system composed of highly inter-related elements and a wide variety of management practices, including Just-in-Time (JIT), quality systems, work teams, cellular manufacturing.

III. METHODOLOGY

Lean manufacturing is the step by step elimination of the waste. Waste in this sense is define as any activity that adds cost but not value to the end product such as excess production, idle work in progress, stock, unnecessary movement and scarp.

Tools of Lean manufacturing:

5S – it is the base for every continuous improvement process and a housekeeping activity. It’s slogan is “A place for everything and everything on its place”. 5S acroynms seri, seiton, seiso, shiketsu and shitsuke.

TPM – it is a continuous improvement strategy that embraces all aspects of an organization. TPM is a preventive maintenance programme in which unplanned stoppages due to equipment failure are minimized.

Poka yoke – it is a powerful and comprehensive tools for identification , measurement and analysis of defects at the real place of the work and implementation of measures that prevent the activity from being incorrectly performed, thereby ensuring production of quality goods and services.

Process Mapping - Process mapping the value stream using ideas and techniques such as Value Stream Mapping (VSM) or simple Flow charting or spaghetti diagrams are very powerful ways to identify and highlight the wasteful steps in your processes which allows us to create future state maps and create action plans to simplify your work and drive improvements.

Kaizen – it is a management support, employee driven process where employee seek development of their own capability by challenging existing system and finding improvement in them.

IV. IMPLEMENTATION STEPS

For implementing Lean Manufacturing Process we use Demming Cycle/PDCA Cycle.
**Plan:**
1. Creating Pareto Chart and analyze the welding data 1 month before.
2. Conduct literature study and discuss with welding engineer/qc on welding process.
3. Interviewing the project team such as welder, QC welding inspector, fitter, welding engineer and project Project coordinator.
4. To prepare a presentation
5. To conduct a meeting in order to set targets for improvements, socialization of action plan and safety awareness.

**DO:**
1) Welding jobs at offshore.
2) Quality monitoring by QC
3) NDT activities.

**CHECK:**
1. Welding quality inspection and control by QC Welding inspector.
2. Welding repair rate report.
3. NDT Report (Radiographic report)

**ACT:**
1) Recommendation for improving the quality of welding.
2) Quality awareness and good workmanship.

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V. **RESULTS**

“Karmyogi Engineers (KE)” company specialist in manufacturing and supply of pressure vessel, Chemical vessel, structural fabrication Heat Exchangers, and job works. From last four years company is fabricating outer jacket (CS Vessel) of the cryogenic tank for INOX INDIA LTD, a leading manufacturing company of cryogenic equipment’s worldwide.

The below listed data is taken from the same company during my industrial defined project (IDP) hours.

**Table.1**

<table>
<thead>
<tr>
<th>Defect type</th>
<th>Qty</th>
<th>Cum. Qty</th>
<th>Cum. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porosity</td>
<td>8</td>
<td>8</td>
<td>40%</td>
</tr>
<tr>
<td>Lack of Fusion</td>
<td>6</td>
<td>14</td>
<td>70%</td>
</tr>
<tr>
<td>Slag inclusion</td>
<td>3</td>
<td>17</td>
<td>85%</td>
</tr>
<tr>
<td>Crack</td>
<td>2</td>
<td>19</td>
<td>95%</td>
</tr>
<tr>
<td>Incomplete Penetration</td>
<td>1</td>
<td>20</td>
<td>100%</td>
</tr>
<tr>
<td>Tungsten Inclusion</td>
<td>0</td>
<td>20</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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![Pareto chart analysis of before data](image)
Table 2: Welding Defect Rate Report after implementation

<table>
<thead>
<tr>
<th>Defect type</th>
<th>Qty</th>
<th>Cum. Qty</th>
<th>Cum. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porosity</td>
<td>4</td>
<td>4</td>
<td>50%</td>
</tr>
<tr>
<td>Lack of Fusion</td>
<td>3</td>
<td>7</td>
<td>88%</td>
</tr>
<tr>
<td>Slag inclusion</td>
<td>1</td>
<td>8</td>
<td>100%</td>
</tr>
<tr>
<td>Crack</td>
<td>0</td>
<td>8</td>
<td>100%</td>
</tr>
<tr>
<td>Incomplete Penetration</td>
<td>0</td>
<td>8</td>
<td>100%</td>
</tr>
<tr>
<td>Tungsten Inclusion</td>
<td>0</td>
<td>8</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Welding Defect Rate Report for reduction of defect.

<table>
<thead>
<tr>
<th>Defect type</th>
<th>Qty left</th>
<th>Reduce %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porosity</td>
<td>4</td>
<td>50%</td>
</tr>
<tr>
<td>Lack of Fusion</td>
<td>3</td>
<td>50%</td>
</tr>
<tr>
<td>Slag inclusion</td>
<td>1</td>
<td>33.33%</td>
</tr>
<tr>
<td>Crack</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Incomplete Penetration</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td>Tungsten Inclusion</td>
<td>0</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8</td>
<td>-60%</td>
</tr>
</tbody>
</table>

VI. CONCLUSIONS

1) A reduction in number of welding defects by 60%.
2) Reduction in Cost due to elimination of reworking of jobs and other waste such as electricity, filler material, labour cost, time, NDT test etc.
3) Through these activities, the project team with high enthusiasm and good cooperation has been successfully improved welding repair rates (WRR) by 20 units from July 2014 to 8 units in September 2014.

REFERENCES


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