Improvement Of Material Flow In Assembly Line
In Harita Seating Systems Limited

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Abstract: The Purpose of this study is to improve the Material flow in the Assembly Lines. The study begins with the Initial Observations in the Stores, Powder Coating Plant and the Assembly Lines. The data was collected through Observations and was used to find root cause for the Problems. Depending upon the Problems, a few Solutions were Implemented to solve the Problem. From those solutions finally a solution was concluded based on Lead Time Calculation, Line Stoppage and the Waiting Time in the Assembly Line. A consumption Based Material Flow process was implemented to solve the problem. Before that, there was a Plan based Material Flow. With the Final solution, the problem has got solved and it is going to be implemented for all the Assembly Lines. The solutions are implemented only for a few Lines at this time. From this, the lean waste like Waiting Time, Motions, and Defects have got reduced. A future Research is going to be conducted to implement this solution in all the Assembly Lines.

Index Terms: Material Flow, Lean Waste, Assembly Line, Lead Time

1 INTRODUCTION

Material flow is a significant factor in the design of manufacturing systems. To design a material system, not only the specifications of individual system components but also the overall objective of the manufacturing system should be considered. For a production enterprise material flow run through the production line, the route ways between factory and suppliers and customers. Manage and control material flow effectively is a method to increase profit. How to optimize the material flow takes important part in production. In order to optimize production line and supply chain, material flow analysis is necessary. To analyse material flow, each point in it needs to be clearly presented. In the manufacturing system, there are lots of steps and workstations. It is hard to keep all of them with a high reliability. Material flow through all over the steps and can be divided into several types. In real production, there is usually at least one unreliable component in different types of material flow system. This feature makes it particularly important to design such a system carefully by taking into account the uncertainties introduced by the component unreliability. One solution for an improved materials flow can be a reordering system, established across the production line to a fixed timetable and with a defined path, picking up any empty packages (or magazines), and supplying full packages to the same point. This system can be a transport system for the horizontal movement of materials, such as an automated guided vehicle, container or conveyor, appropriate to the needs of each production area and to the volume of parts to be transported. The adopted solution is not usually automation.

2 AUTOMOTIVE INDUSTRY IN INDIA

The automotive industry is a wide range of companies and organizations involved in the design, development, manufacturing, marketing, and selling of motor vehicles. Some of them are called automakers. It is one of the world’s most important economic sectors by revenue. The automotive industry does not include industries dedicated to the maintenance of automobiles following delivery to the end-user, such as automobile repair shops and motor fuel filling stations. The industry accounts for 7.1 per cent of the country’s Gross Domestic Product (GDP). The Two Wheelers segment with 80 per cent market share is the leader of the Indian Automobile market owing to a growing middle class and a young population. Moreover, the growing interest of the companies in exploring the rural markets further aided the growth of the sector. The overall Passenger Vehicle (PV) segment has 14 per cent market share. India is also a prominent auto exporter and has strong export growth expectations for the near future. Overall automobile exports grew 13.01 per cent year-on-year between April-December 2017. In addition, several initiatives by the Government of India and the major automobile players in the Indian market are expected to make India a leader in the 2W and Four Wheeler (4W) market in the world by 2020. The automobile industry is supported by various factors such as availability of skilled labour at low cost, robust R&D centres and low cost steel production. The industry also provides great opportunities for investment and direct and indirect employment to skilled and unskilled labour. The Indian automotive aftermarket is estimated to grow at around 10-15 per cent to reach US$ 16.5 billion by 2021 from around US$ 7 billion in 2016. It has the potential to generate up to US$ 300 billion in annual revenue by 2026, create 65 million additional jobs and contribute over 12 per cent to India’s Gross Domestic Product.
3 LITERATURE REVIEW

“Applying the Value Stream for Improvements in Automotive Seat Manufacturing Processes” Manoj Bhalwankar and Sachin Mastud (2014). The Objective of this Study is to achieve an Optimized Value Stream by understanding the customer, Mapping the Process, Material and Information Flow by calculating the Lead time, Takt Time and Change Over Time. They have used the VSM technique for the Improvement process. Tools that are used over here are VSM tools. This Implementation of VSM tools have resulted in self Examination in the present process performance against the customer demand. This study has reduced the Non Value Added Activities by using the Scientific Techniques like Time and Motion Study, Kaizen and 5S.

“Productivity Improvement using Value Stream Mapping on Seat Assembly Line” Najuka Mhase, Moit Shandilya, Binayak Nag, Ghajanan Ghambhire (2016). The Objective of this Paper is by knowing how the bottlenecks affect Productivity and how it is getting eliminated. It has been done in ancillary MNC company located in Pune. They have used a VSM tool for knowing about the Customer demand and worked back documenting all processes and collecting the data for Manufacturing a Product. They have Reduced the Total lead time by Lean Implementation. They have focused on studying the process in detail and reduced the waste by related to motion and Over Processing. “Defining Improvement Areas & Reducing the Waste - With Lean production philosophy & tools” Frederic Aslund (2013). The Objectives of this study is how to eliminate the gap, and implementing the improvement Proposals, and finding the bottleneck and largest gap between the current state and future state. Their problem is they are struggling to meet their customer Demand. Their Target Audience is people who are working in Production, Logistics and Process Optimization as well as students in Engineering School. They have used an Explanatory strategy for data collection through interviews, Observations and Archival Data. Their Key focus is to move from batch Production to Single Piece flow together with an efficient material supply.

“Measuring and Increasing Performance of a Material Supply System” Linus Hagberg and Victor Eriksson (2017). The Objective of this Study is to design, Measure and Increase the Material Supply System for Production System. This Study has been Done in Adient in Gothenburg. The data is collected through Qualitative Method such as Interviews and Observations. The sample Size is 200. This study shows how the performance Measurements can be Transferred into concrete Suggestions for increased performance in Material Supply System. “Efficiency Improvement of Assembly Line” Yeoh Kim Hao (2013). The Objective of this study is to make assembly line more efficient and Productive through improving its line efficiency and also to propose the optimum Efficiency of assembly line in Bus Seat Manufacturer. It also Concentrate on Manufacturer’s Problem. They face difficulties in Delivery Time. The data is collected through both Qualitative and Quantitative method such as Interviews and Observations and survey. This study has minimised the number of stations and also has minimized the balanced delay time. “Value Stream Mapping to reduce the Lead - Time of a Production Development Process” TYAGI (2015). The objective of this Study is to maintain the performance level and quality This Study has been done in Gas Turbine Manufacturer. The data is collected through qualitative method. They have used a VSM method to develop the current state Map to find the waste and action plan to eliminate the waste for future state. A Brain Storming session is conducted to find out the root cause of the waste. Drawing from the Practical Strategies they had improved product development performance to achieve lean goals by reducing waste and shorter Lead Time. “Impact of working environment and productivity improvement on assembly line through reduction of down time lean approach” T. Narendiranath babu and D. Rama prabha (2015). The Objective of this study is to evolve and test a few strategies to eliminate waste on the assembly line. It is focused on improving the productivity of the seat welding and assembly plant by reducing the down time using lean tools. The goal of this paper is to identify and reduce the downtimes. The data has been collected based on the qualitative method. The findings for this paper is they have used several tools to increase the productivity of the plant. They have identified 7 deadly waste of production to provide the Continuous Improvement.

4 OBJECTIVES OF THE STUDY

- To identify the root cause of Material Flow Delay to the Seat Assembly Systems.
- To shorten the Lead Time for the Material Flow.
- To Eliminate the Waste that occurred due to the Material flow Delay from Powder coating Plant.

5 RESEARCH METHODOLOGY

The proposed study is carried out with the help of primary source of data. It is collected through Observations in the Assembly Line and the Powder Coating Areas. The tools used for analysis is Pareto Analysis and Value stream mapping.

6 DATA ANALYSIS

The data was collected through Observations. The empirical data was analyzed to achieve a result, recommendations and conclusion. Data obtained by the observations have been structured in Microsoft Excel workbooks. The time study provided information about the material supply activities and their time requirement. These activities have been analyzed to see if they are providing value or not.

7 OBSERVATIONS

Observation is a commonly used method to collect information about behaviour patterns in natural situations. In order to gather information to solve the problems, several observations were performed with different purpose. The first observations were performed in order to get an overview of the case company including the main functions and the internal material flow layout. Thereafter, two additional observations were performed at the assembly line to get an understanding of what inefficiencies were caused by the material supply.

8 PRODUCTION

Observed about the Powder Coating and Welding Process of Materials and have observed the time taken for the Materials for Loading and Unloading.
TYPES OF POWDER COATING PROCESS
- Zinc phosphating PT process
- Iron phosphating PT process
- Chromate conversion coating process (Aluminum)
- Oxsilon PT process
- Nano PT process

Zinc phosphating dip type pre-treatment process includes,
- Pre-degreasing and degreasing
- Water rinsing - 1 & 2
- De-rusting
- Water rinsing - 3 & 4
- Surface conditioning
- Phosphating
- Soft water rinsing
- DM water rinsing
- Dry off oven

PREDEGREASING & DEGREASING
The purpose of this process is to remove oil on the parts after various processes like welding forming, bending etc. Base type chemical (NaOH) used in this process. Chemical bath circulation needs to avoid the removal oil floating on the top of the chemical bath cause against sticky on the parts. To increase the oil removal rate we maintain optimal temperature. In the chemical bath Frictional type oil skimming is going to separate the oil and remove from the bath. Both the chemical baths are maintained same process parameters due to chemical concentration.

WATER RINSING - 1 & 2
The purpose of this process is to remove the base chemicals which are sticky on the parts and reduce chemical reaction on the parts while etching. Bath make by RO water < 300 TDS is supplied and maintain constant PH value in the water by adding 1KL water every hour. Air agitation should be done in both water rinsing bath to remove chemicals effectively on the parts.

DERUSTING
The purpose of this process is to remove pale rust deposited on the loaded parts. The chemical (HCL) is used in this process. Chemical bath needs to addition chemical periodically due to decrease the iron content formation.

WATER RINSING - 3 & 4
The purpose of this process is to remove the etching chemicals which are sticky on the parts and reduce chemical reaction on the parts while etching. Bath make by RO water < 300 TDS is supplied and maintain constant PH value in the water by adding chemical by volumetric analysis. Air agitation should be done in the bath to remove chemicals effectively on the parts.

PHOSPHATING
Phosphating is process to make fine layer of phosphate coat on the parts (around 7µ-12 µ). It prevents the parts from rusting and increase the electrostatic effect on the parts while powder coating. Bath make by RO water < 175 TDS is supplied and maintain constant PH value in the water by adding chemical by volumetric analysis. Zinc phosphate reacts with metal surface cause a sludge formed in the bath. It will be remove from the chemical bath with Damper type filter press. Process time is most important in this process due to phosphate coating will be forming on the parts while parts inside the bath. A rexine type cloth is inside the damper unit if the chemical flows inside the sludge is settled on the cloth by damping action done. Then the damper releases the sludge settled inside the cloth will removed by air pressure (6 bar). A conical type portion collects the sludge removed from the process. It will take outside and dispose it.

SOFT WATER RINSING
The purpose of this process is to remove rest of (alkalinity and acid) chemicals on the parts. Bath make by soft water < 175 TDS is supplied and maintain constant PH value in the water for complete cleaning and sustain phosphate coating on the parts.

DRY OFF OVEN
Pretreating the material the parts should be preheated with temperature of max 110°C it must be maintain if it exceeds the temperature will cause to remove phosphate coating. Dry off oven is used to remove water droplets in the parts and kept dry condition for powder coating. The temperature is very important if water droplets avail in the parts while coating cause chemical carry over defect surely. So we need to carefully maintain the temperature level in this process.

TABLE 1 : OBSERVATIONS DURING LOADING AND UNLOADING

<table>
<thead>
<tr>
<th>S.No</th>
<th>Materials</th>
<th>Quantity</th>
<th>Loading time</th>
<th>Unloading Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mounting</td>
<td>36</td>
<td>7:45</td>
<td>12:15</td>
</tr>
<tr>
<td>2</td>
<td>Mounting</td>
<td>3</td>
<td>8:30</td>
<td>1:00</td>
</tr>
<tr>
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<td>Mounting</td>
<td>6</td>
<td>9:05</td>
<td>1:30</td>
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<td>25</td>
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<td>2:30</td>
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<td>top frame</td>
<td>21</td>
<td>10:00</td>
<td>2:30</td>
</tr>
<tr>
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<td>32</td>
<td>10:00</td>
<td>2:30</td>
</tr>
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<td>30</td>
<td>10:10</td>
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</tr>
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<td>top frame</td>
<td>5</td>
<td>12:52</td>
<td>5:00</td>
</tr>
</tbody>
</table>

9 FINDINGS
- Information Gap from Assembly line to Powder Coating Loading.
• Process Delay in PCP due to Conveyor Problem
• Reworks of Materials is 20% in Powder Coating Plant due to Excess Materials Processing.
• Sometimes Materials Shortage in Store due to Supplier Problem.
• There will be 20% Quality Problems of Materials.
• Materials not Arranged in the proper Trolley due to the Shortages of Trolleys. Only few Trolleys are available.
• The Maximum time for the Line Stoppage will be 40 Minutes due to Materials Delay and Machine Problem.
• Lead Time is More in all Stages from stores to powder Coating Area the average Lead Time is 10 Minutes.
• The Average Lead Time from the Powder Coating Unloading to F.G is 10 Minutes.

10 SUGGESTIONS
• Proper Trolley must be maintained for every materials
• Load the Material in Powder Coating Plant as per the Bin Quantity Size.
• Reduce the Reworks of Materials in JIT process.
• Maintain the 5S in the Powder Coating F.G Area.
• Quality of the Materials must be checked Properly.
• Modular Trolley must be Provided for all Assembly Line.
• Don’t allow the Reworks and Rejection Materials to the F.G Area.
• Don’t Overload the Materials in the Trolley.

11 CONCLUSION
To improve the efficiency of the material supply it is important to identify what causes inefficiencies. To be able to improve the efficiency of the material supply this study focuses on identifying and reducing the non-value adding activities. By classifying the activities into wastes the reduction of non-value adding activities became more organized and manageable. There were three wastes identified that contributed to an inefficient material supply. These wastes were thereafter analysed and potential improvements were compiled. There is at least one improvement proposal for every identified waste and combinations of these improvement proposals can reduce the non-value adding activities. The improvements mentioned require continuous work with 5S and Kanban. By implementing those improvement proposals the non-value adding activities could be reduced and thereby the efficiency of the material supply will be improved. Different non-value adding activities can be identified in other circumstances which could lead to different improvement methods.

12 REFERENCE