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A Comparative Defect Waste Occurrence in Major Processes of Automotive Assembly Line

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ABSTRACT

This paper addresses on identifying a selected waste or 'muda' and verifying through comparison between the four major process in automotive assembly line. Amidst eliminating seven wastes verify in lean manufacturing (LM) philosophy, waste of defect is selected in this study due to its higher defects percentage in automotive assembly line. LM is known for its advantages in industry especially in automotive sector. Eliminating waste of defects is important in meeting customer demand. These will not only ensure customer satisfaction, but it is a significant factor in the success of a company. Throughout this study, the data is collected during three months in year 2012 consecutively that lies on four major processes in automotive assembly line. From initial to the final process, the finding gains are also visualized as well as being analyzed before its reach to the end user. Overall, this paper offers a comparative review on waste of defect occurrence in a complete automotive assembly process with collective data demonstrated and can be extended for problem solving application method for future improvement.

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INTRODUCTION

LM has attracted vast interest from academician, researchers and practitioners. Over the last decade, LM hold as a universal production method and widely used in numerous other manufacturing industries. Albeit, LM started in the automotive industry, the approach has been applied and extended successfully in other disciplines as well. According to Womack and Jones (1990), LM combines the best features of both mass production and craft production: the ability to reduce costs per unit and dramatically improve quality while at the same time providing an ever wider range of products and more challenging work.

Nowadays, automotive industry becomes more challenging due to technology advancements, market competitors, global sourcing and industry restructuring. As explained by Chryssolouris (2008), the transition of the automotive industry from mass production to mass customization is based on the need for more customized vehicles to be produced, providing many variants, with the use of fewer resources and materials, in the shortest time possible. Increased complexity in the automotive assembly requires a holistic perspective of the main manufacturing attributes that need to be considered when manufacturing decisions, as regards cost, time, quality and flexibility, are taken (Fleischer, 1997). Following this, the capability of offering more variants per model and introducing new models that refers to product variability resulting high operational, cost, and higher potential of waste occurrence during production.

This paper performed a collective data on waste of defects encounter at each four main processes based on real situation in assembly line of automotive plant. Michalos et al (2010) mentioned the typical structure of an assembly plant in automotive industry involved four stages that involved stamping, body shop, paint and final assembly (FA). The study takes place in FA due to its majority assembly operations. It reveals that high levels on waste of defects is generated during three months; August, September and October production in year 2012. In the context of analysis, the data is represented in graph for each assembly major processes.

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Lean manufacturing concept:

The concept of LM is derived from the Toyota Production System (TPS) that was originated by Taiichi Ohno and Shigeo Shingo in Japan after the Second World War. It emerged when Japanese manufacturers realized they are not able to withstand the vast investment needed to build facilities identical to those in the USA. LM has been increasingly adopted as a potential solution for waste elimination for many organizations, particularly within the automotive and aerospace manufacturing industries (McDonald, 2002). As defined by Melton (2002), any activity in a process which does not add value to the customer is called 'waste' whereas Womack, Jones & Ross (1990) described the term 'lean' as manufacture only what is needed by the customer, only when it is needed and only in the quantities ordered by the customer. This indicate by Fleisher and Liker (1997) that LM is the method that can delivered to the organizations mastered with LM methods having substantial cost and quality advantages over those who still practicing traditional mass production. So the essential focus of LM is the efficient use of scarce resources through the minimization of all forms of waste and other non-value-adding activities (Shingo, 1992).

Shingo and Ohno (1997) identified seven different types of manufacturing wastes: overproduction, waiting time, transport, inventory, motion, defects and processing. Taking into account one of the waste categories among seven, waste of defect relatively has it's correlation with common quality management practices known as Zero Quality Control (ZQC). Zero Quality Control (ZQC) is recognized as 'Quality control approach for achieving zero defects'. It is based on the principle that defects are prevented by based on the principle that defects are prevented by controlling the performance of a process so that it cannot produce defects, even when a mistake made by the machine or a human operator (Shingo, 1986). ZQC's approach doesn't blame at people, at some point it identifies that machines and people make mistakes; therefore it finds ways to retain those errors from converting into defects. Zero Quality Control means a quality control that ensures zero defects, not just reducing in defects. It is the concept of low-inventory production resulting in unnecessary level for buffer inventory to replace defective products. A Zero Quality Control system is built on the following basic ideas (Womack, 1990):

i. Use source inspections, i.e., inspections for preventing defects, to eliminate defects entirely. This does not mean dealing with the results of defect generation, it means applying control functions at the stage where defects originate.

ii. Always use 100 percent inspections rather than sampling inspections

iii. Minimize the time it takes to carry out corrective action when abnormalities appear.

iv. Human workers are not infallible. Recognize that people are human and set up effective poka-yoke devices accordingly. Poka-yoke devices fulfill control functions that must be effective in influencing execution functions.

By identifying one of these waste categories, the process taken to eliminate it will be much easier. Each production section can focused on higher percentage of waste at each major process at assembly line. Whilst these aspects of problem identification are vital it is agree that a next process after data collection, problem analysis should include a systemic problem solving method to deliver a solution as well as a considerably greater benefits for the organisations.

Taxonomy of waste of defect in assembly line production:

During three months study, out of 1,162 inspection performed, 77 defects are encounter at sub assembly from belting of air-condition noise as shown in Figure 1.

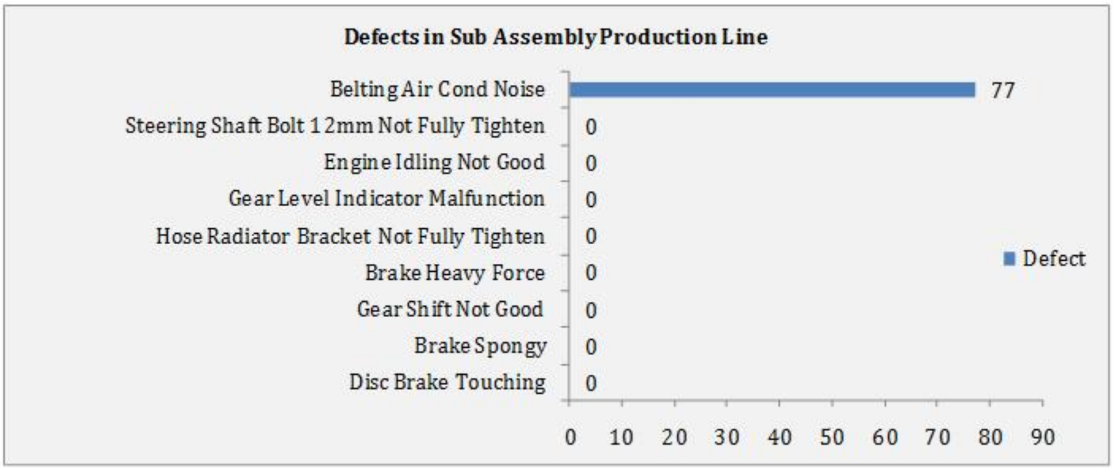

Fig. 1: Defects in Sub Assembly Line (QC TEAM, 2012)

In the initial process of assembly line, trimming section shows that defect due LHS side mirror gap was at the higher percentage with 35 units discovered as seen in Figure 2. The total vehicles inspected were 1,267 units.

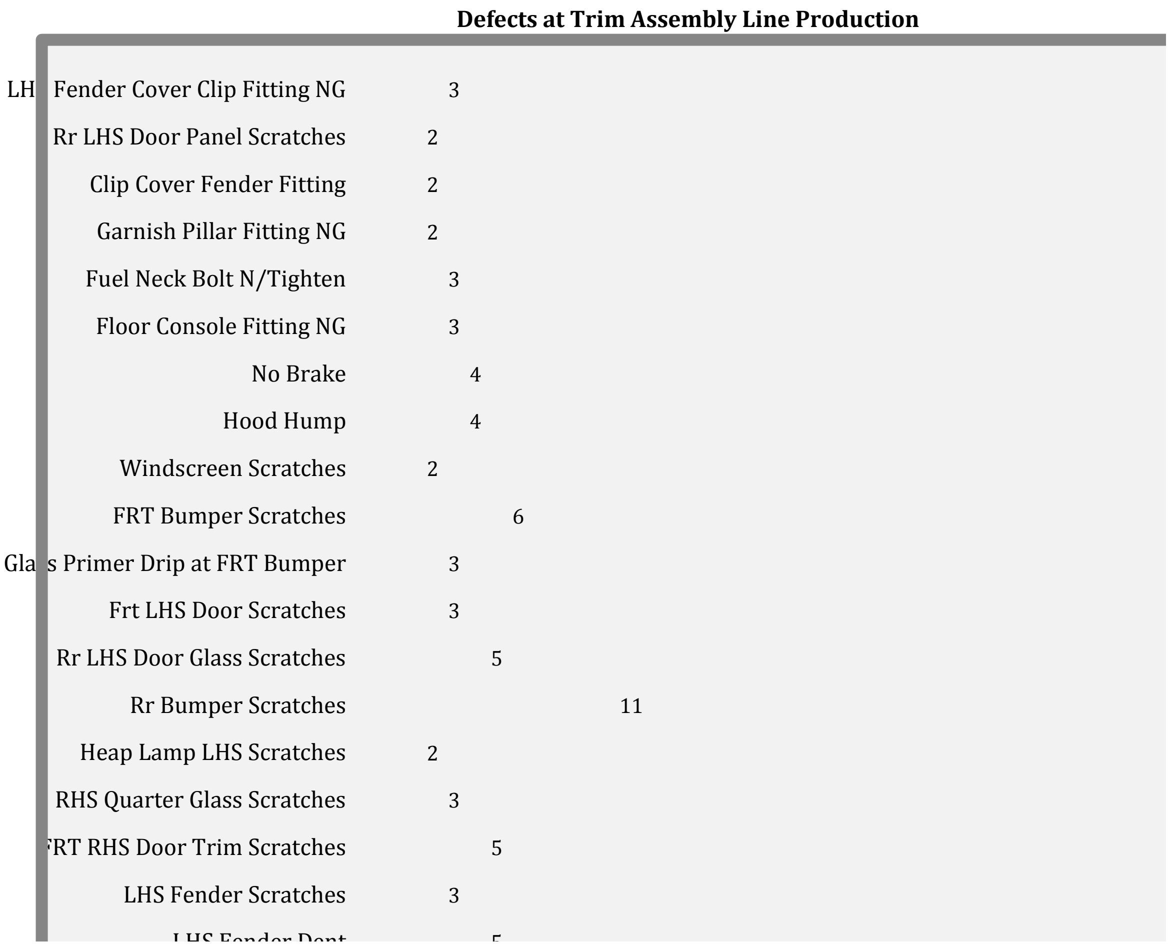

Fig. 2: Defects in Trim Assembly Line (QC TEAM, 2012)

Chassis assembly line production is the shortest section in the assembly line production. Fig. 3 depicted 10 defects of front suspension noise is detected with a similar total units inspected at sub assembly.

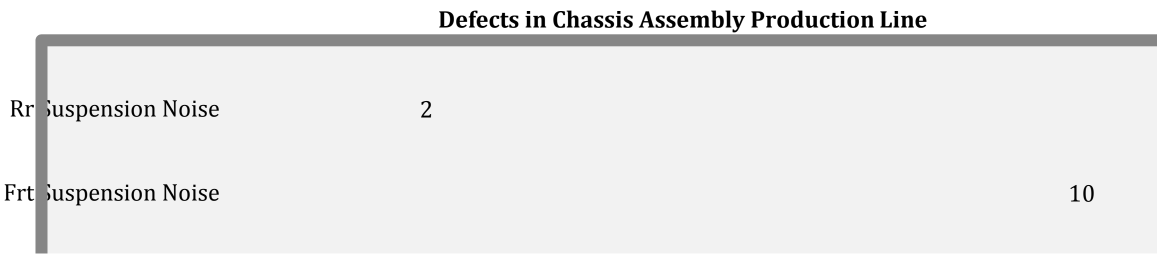

Fig. 3: Defects in Chassis Assembly Line (QC TEAM, 2012).

Final assembly line production is the last section in the trim and final. The result of 94 defects from 1,161 vehicles checked is detected as seen in Fig. 4.

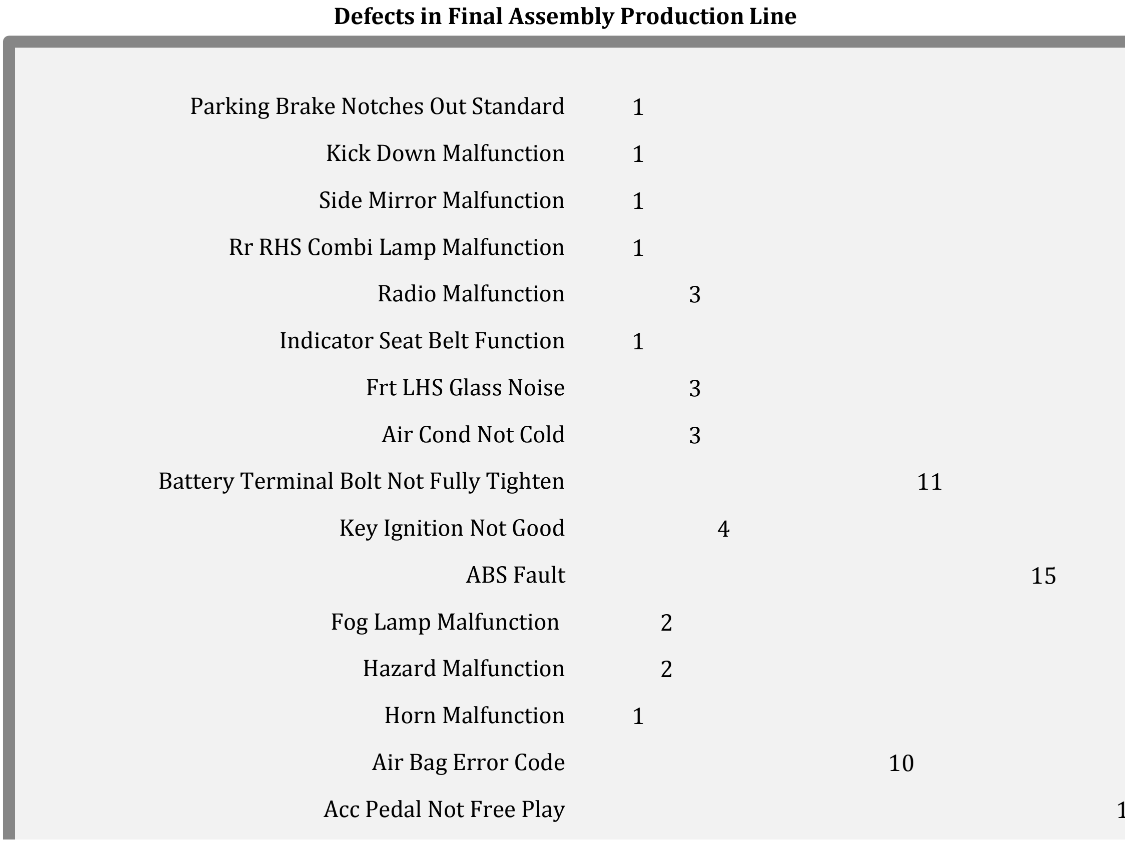

Fig. 4: Defects in Final Assembly Line (QC TEAM, 2012)

Results:

Table 1 shows the combination of defects according to the section in assembly line. From the data, belting air-conditioning noise at sub assembly demonstrates a highest quantity of defect follow by left hand side mirror gap that encounter at trim section. Defect occurs at final assembly fall at third with 18 units of vehicles whereas chassis section at fourth with 10 units of defects. The number of defects is varying since the process at each section is different as well.

Table 1: Defects at each major assembly process.

Items	Assembly line section	Defects description	Quantity (unit)
1.	Trim	Left hand side mirror gap	35
2.	Sub-assembly	Belting air-conditioning noise	77
3.	Chassis	Front suspension noise	10
4.	Final	Acceleration pedal not free play	18
Total			140

Conclusions:

By accumulating the quantity, the data demonstrate about 140 units of vehicles or about 12 percent from average 1,188 of total vehicles in four major processes inspected was discovered defective. Sub assembly line section encounters many defects among other major processes. This due to many parts assembles result to higher potential defect to occur at this station. From the collection of data, further recommendation and suggestion in short and long term problem solving method can be deployed. There are variety of problem solving method can be selected to solve most of production issue which relate to the quality of products. The implementation of the proposed method will alleviate the waste of defects that result to cost deduction. As a result, the quality of the products as well can be improved and fulfill the customer satisfaction, at most.

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