Reduction of defective products by empiric analysis: the production line case in a factory of automotive parts.

Ramses Lugo-Telles\textsuperscript{a}  
María de los Ángeles Navarrete\textsuperscript{b}

Universidad de Sonora, Blvd. Luis Encinas y Rosales Hermosillo, Sonora México.  
C.P. 83000

ramses.lugo@hotmail.com\textsuperscript{a}  mnavarrete@industrial.uson.mx\textsuperscript{b}

Abstract. As all massive line production, in the production line under study, exist the possibility of produce defective products, so like all companies based in continuous improvement, it wants to know all the facts about these defective products, for example, how many are they? in which areas do they arise? Why do they arise? And among other questions, in order to suggest and implement some solution alternatives

1. Introduction

This paper was made in a manufacturing company of harness for the automotive production, located in Hermosillo, Sonora, Mexico. Through this study, we will see how some data of defective products can lead to the root cause. To clarify, the data provided in this paper, was generated during 28 weekends, the 4 lately weeks of 2015 and the first weeks of 2016.

On the other hand, an empirical analysis will help us to find the problematic root cause, because empirical analysis is a scientific model of investigation based on observation and experimentation\cite{1}.

Moreover, a defective product is when it does not meet with the standard characteristics established by the company\cite{2}, and a defective product is considerate as the main kind of west\cite{3}. In the company under study the defects can be classified by 44 types, however, there are someone that are more important than others, for example, the three main defects are: Lock open, exposed filaments and no hipot point. Figure one shows a graphic of defects, where it can be observe that the defects mentioned before are the most important.

Through figure one we can observe that the defect named “Lock open” it’s the one that generate more defects, however, we can know how the defect is named, but, do we know what is it? This is fundamental to propose solution alternatives.
2. Backgrounds
To understand what is “Lock open” is necessary mention the main components of a harness. A harness is composed of 4 main components: The cable, sub-assembly, housings and locks. For a harness function in the correct way this component must work as the following way: The sub-assembly is adhered to the cable, one time adhered, the housing is assembled in the sub-assembly and finally the lock is stuck in the housing to avoid that the sub-assembly get separate from the housing (Go to figure two).

![Figure 2. Harness components (Own elaboration, 2016).](image)

When a lock does not get down until the housing is safe, the “Lock open” appears (go to figure three).

![Figure 3. Lock open defect (Own elaboration, 2016).](image)

One time defined what lock open is, it identified in what product (part number) it comes frequently this kind of defect. The part number with more “lock open” are show in the figure 4.
The figure above shows us that the part number 1832195-5 with 229 defects, it’s the one that more lock open generate. To understand better the defects nature of this product go to the figure 5, which is a pie chart that shows the kind of defects and their percentage.

In the figure 5 we can realize that of 229 defects shown in the part number under study, the lock open represents the 44% whence, it’s considerate the principal factor to cause defects in this part number. This numeric data made us research closely about this defect, particularly in this part number. However, despite the analysis done until this moment, some questions arise: The lock open is already something of the past? Why this defect happens? And, is it a defect that will be more frequent?

3. Analysis and discussion

In order to initiating the analysis, it has been created a time chart, which it shows Parts Per million (PPM) of lock open defect, starting from the week number 50 of 2015 year, and ending at the week number 24 of the 2016 year, moreover, to the time chart it has been added a trend line, that displays the growing data.
It is worth to mentioning, the missing weeks in the chart above, it’s because there was not an inspection of that part number, because there was not production that days. During the problematic analysis, it questioned the way that the operators did the assemble between the housing and the lock. To the operator can do this assemble (in this part number in specific), is necessary that the operator wear bandage in their fingers. However, to produce others part numbers this bandages are not necessary.

In a quick talk with the operator that produce this part number (1832195-6), all of them agreed that the lock for this part number is more difficult to assemble than others, moreover, because of this kind of lock that it came a 90 grades clip, made the cable bend 90 grades (go to figure 6).

The operators supposed that for this kind of assembly they need more force in their finger. It made an experiment in the own company lab of metrology. The experiment consisted in realize three times the assemble with a force gauge. The first time, it was made with no cable and, only the housing and a normal lock. The second time was made with cable, normal housing and the lock, and finally, the last experiment, was made normally: cable, housing and the 90 grades lock. The results of these experiments are show in the table 1.

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**Figure 5.** Kinds of defects of the 1832195-6 part number (Own elaboration, 2016).

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**Figure 6.** Normal Lock vs 90 grades lock (Own elaboration, 2016).
Table 1. Experiment results.

<table>
<thead>
<tr>
<th>Assembled with</th>
<th>LbF (Pounds strength)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing and lock</td>
<td>8.06</td>
<td>Any part numbers go with this assemble</td>
</tr>
<tr>
<td>Housing, lock and cable</td>
<td>13.28</td>
<td>The most of part numbers (except the under study product) the assemble is like this.</td>
</tr>
<tr>
<td>Housing, cable and 90 grades lock</td>
<td>54.28</td>
<td>In this way is how the part number under study is manufactured.</td>
</tr>
</tbody>
</table>

4. Conclusions

Based in the figure 5 we can say that the lock open quantity in the part number 1832195-6, it will rise according with the trend line. Hence the importance of attack this kind of defect. In other words, the lock open is going up, moreover, is one of the most common of all kind of defects in the production lines in the company under study.

According with the table 1, the difficulty of this kind of assembly is because of 90 grades lock. The same table shows a big gap between the LbF used in the assembly with a normal lock and the other one assembled with a 90 grades lock, therefore in this part of the analysis we can realize that the 90 grades lock made the assembly more difficult, however, this component (90 grades lock) it can’t be removed of this part number, because is a request of the client.

To avoid this type of defect, the authors decided to implement a fixture that helps with this assemble. This fixture is intended to be a semi-automatic, this in order that the operator just put the components into a fixture, and it active a sensor (or a button), and the fixture would do the task currently made by an operator. By the implementation of this fixture we will avoid the fingers weathering of the operators, and by this way we care the health of these. Furthermore, the quantity of open locks it would significantly reduce, because of the fixture would do this operation, so the process variation drops, according to the settings of the fixture, which are manipulated by the engineering team of the company.

Finally, we conclude that an empiric analysis can help to solve a problem from the root, or well, it can let find the problematic from an unfavourable situation, moreover, trough by the same analysis find the solution.

References

Effect of Deposition Speed on the Flatness and Cylindricity of Parts Produced by Three Dimensional Printing Process

Assoc. Prof. Muhammad Fahad, Mehmood Khalid, Muhammad Nauman, Maqsood Ahmed Khan
NED University (Karachi), Pakistan

The idea of layer-by-layer deposition of materials to obtain three dimensional shapes, known as three dimensional printing, has gained much popularity during the last decade. Investigations related to understanding the effect of process parameters on the output of the accuracy of parts produced by three dimensional printing processes have been performed by various researchers. This study is also aimed at investigating the effect of deposition speed on the accuracy in terms of geometric dimensions and tolerancing such as flatness and cylindricity of the parts produced by open source three dimensional printers. The repeatability of the parts printed were also investigated.

A Methodology to Determine the Level of Automation to Improve the Production Process and Reduce the Ergonomics Index

Mr. Alejandro Chan-Amaya, María Elena Anaya-Pérez, Víctor Hugo Benítez-Baltazar
Universidad de Sonora, Mexico

Companies are constantly looking for improvements in productivity to increase their competitiveness. The use of automation technologies is a tool that have been proven to be effective to achieve this. There are companies that are not familiar with the process to acquire automation technologies, therefore, they abstain from investments and thereby miss the opportunity to take advantage of it. The present document proposes a methodology to determine the level of automation appropriate for the production process and thus minimize automation and improve production taking in consideration the ergonomics factor.

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Mr. Ramses Lugo-Telles; María de los Ángeles Navarrete
Universidad de Sonora (UNISON), México

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