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Downtime reduction in ventilation hole cutting operation in steel wheel stamping

Reducción de tiempos muertos en operación de corte de agujeros de ventilación, en estampado de rines de acero

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Abstract

A company's productivity improvement is multi-causal, one of the causes being the reduction of time. That is why this article presents the methodology that a transnational automotive company performs to reduce downtime in the ventilation hole cutting operation, since it is a critical process that directly affects the productivity of the company. This project was carried out with the DMAIC methodology, in which the diagnosis is made through Ishikawa and Pareto, continuing the analysis of time. As part of the analysis of downtimes, the most frequent failures are included, as well as preventive maintenance and specifically tooling. Information is presented regarding the areas of opportunity, implementation of improvement strategies delimited by the design of an awl. Finally, it shows the reduction of time in the change of tooling, through the implementation of the improvements.

Improvement, Lean Manufacturing, Downtime

Resumen

La mejora de productividad de una empresa es multicausal, una de estas causas es la reducción de tiempos es por ello que en éste artículo se presenta la metodología realizada en una empresa transnacional de giro automotriz para reducir los tiempos muertos en operación de corte de agujero de ventilación, dado que es un proceso crítico que afecta directamente la productividad de la empresa. Este proyecto se realizó con la metodología DMAIC, donde se realiza la diagnosis a través de Ishikawa y Pareto continuando con el análisis de tiempos. Como parte del análisis de los tiempos muertos incluye las fallas más frecuentes, así como los mantenimientos preventivos y específicamente los herramentales. Se presenta la información respecto a las áreas de oportunidad, implementación de estrategias de mejora delimitadas por el diseño de un punzón. Por último se muestra la reducción del tiempo en el cambio de herramental, a través de la implementación de las mejoras.

Mejora, Manufactura esbelta, Tiempos muertos

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Introduction

In any company, it is necessary to implement strategies which contribute to the decrease or, in the best case scenario, to the elimination of downtime and subsequently to the increase in productivity (Estañol, 2000).

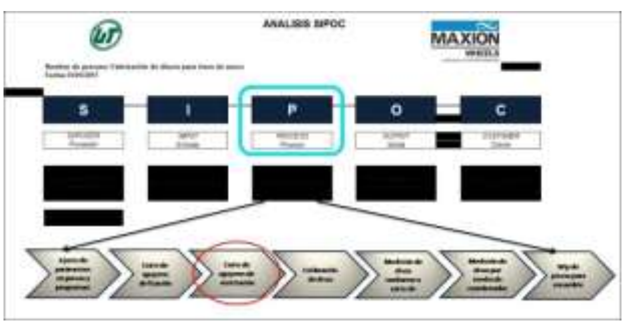
Increase in downtime in the operation of ventilation hole cuts in steel wheel stamping started in January 2017, so there was a need to reduce these times since it is one of the most critic obstacles within the productive process.

Lean Manufacturing tools (D., 1986) are used, such as: 5 why's and Ishikawa and Pareto Diagrams. Downtimes and the history of preventive maintenance are analyzed and more frequent failures are collected to rule out problems in tooling and the possibility that these generate technical stops that affect productivity. Improvements are developed and applied in an awl, since it is the main component of the tooling that causes reduction in time.

Method Description

The problem is addressed through the DMAIC methodology, acronym for the steps: Define, Measure, Analyze, Improve and Control. It is a quality strategy based on statistics, which gives primary importance to the collection of information and the veracity of the data as a basis for the incremental improvement of existing processes (Fraile, 2002).

1. **Define:** Initial phase of the methodology, the objective of this stage is to identify the possibilities of improvement within the company through the SIPOC analysis (Feigenbaum, 1961).



Graph 1 SIPOC Methodology
Source: (Maxwel Company Notes, Unpublished)

2. **Measure:** Once the problem to be addressed is defined, data are collected on the main failures that occur in the process of manufacturing disks, with the purpose of learning the cause that generates more downime and how many times the same fault is repeated.

Failure report January 2017				
Date	Cause	Frequency (No. of interventions)	(time/min)	Accumulated %
Jan-05-17	Change of awls for wear or breakage	6	45	22%
Jan-11-17	Material removal in guide holes	4	10	37%
Jan-16-17	Oscillation problems	3	35	48%
Jan-18-17	Sensor for detecting damaged parts	2	30	56%
Jan-18-17	Problems with overload	2	22	63%
Jan-21-17	Problems with poka yoke parameters	2	20	70%
Jan-23-17	Outdated stamp	2	20	78%
Jan-24-17	Damaged hoses	1	15	81%
Jan-24-17	Pneumatic type failures	1	14	85%
Jan-25-17	Stripes on bottom disk	1	12	89%
Jan-25-17	Damaged bayonet sensor	1	10	93%
Jan-28-17	Piece out of position	1	10	96%
Jan-29-17	Poka yoke system failures	1	10	100%

Table 1 Failure Report
Source: (Project Notes, Unpublished)

A Pareto Diagram was implemented to determine the main problems within the process; 20% are concentrated in the first 7 causes, which have a total of 21 interventions in the month of January. Of these, the one with the longest downtime is "change of awls for wear or breakage," with 6 of the 21 interventions mentioned above.

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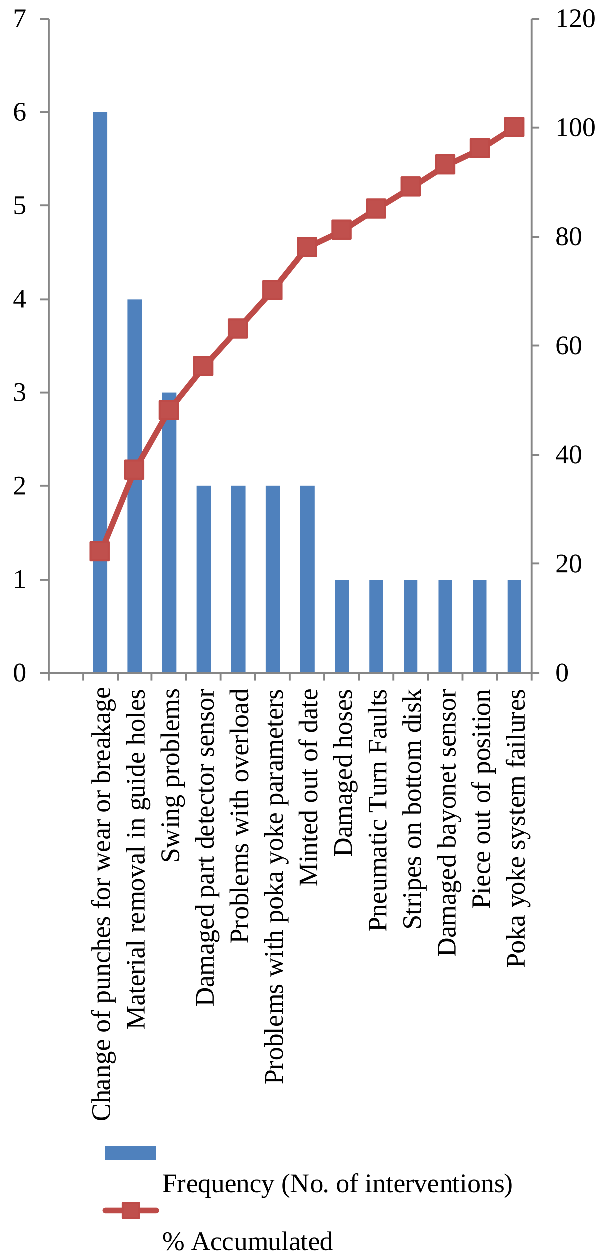
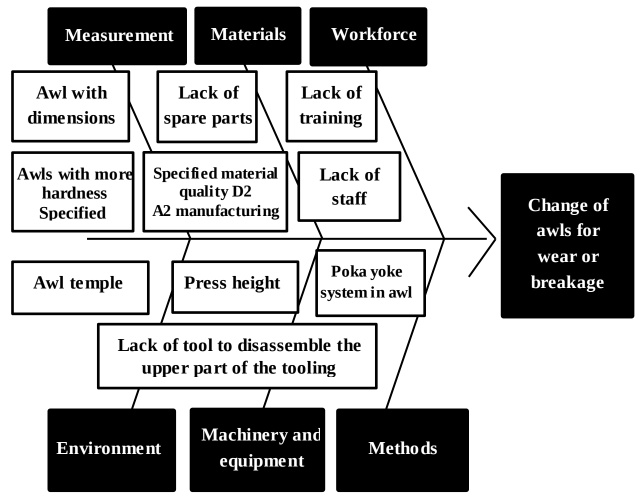


Graph 2 Pareto Chart
Source: (Project Notes, Unpublished)

After obtaining the main approach that affects the process of manufacturing disks, a cause and effect diagram was implemented. It is a diagram that helps us delve deeper into the problem using the 6M method (Guillen, 2012).



Graph 3 Ishikawa Diagram
Source: (Project Notes, Unpublished)

3. **Analyze**: After the Ishikawa diagram, a verification sheet was created with the sub-causes, where we indicate the frequency of each problem.

Subsequently, once the highest frequency was obtained, the corrective actions to follow were determined with the technique of the 5 Why's, making the decision to manufacture awl holders and awls.

Problem definition and 5 Why's			
Issue date	02/02/2017	Person in charge	José Carlos Hernández
Área	Production	Support Area	Tool Department
1. Defining the problem			
What is the problem?	Awls with dimensions outside the specification		
Where is the problem located?	In the tools for cutting ventilation holes	Who detected it?	The Tool Department
How was it detected?	When validating the measures according to design	Where was it detected?	25/02/2017
2. Quantifying the problem			
How many pieces were stopped from producing?	450	How often?	6 times in a month with a time of 45 min

3. Identifying the root cause				
Identifying the root cause		Corrective actions	Person in charge	Term
Why is the awl out of specification?	Because the supplier manufactured the awls with larger dimensions	Review of the upper part of the tooling and look for an improvement idea in the awls	Tool Department	1 month
Why did the supplier manufacture the awls with larger dimensions?	Because the dimensions in the awl socket are different			
Why are the dimensions of the awl socket different?	Because they are not standardized in the measurements of the socket upper part			
Why are they not standardized in the measurements of the top socket?	Because there is no fixed awl holder inside the tool socket			

Table 2 Analysis of 5 Why's
Source: (Project Notes, Unpublished)

4. **Improve**: While changing the component, it is sized according to the design due to the variation of the dimensions in the sockets of the upper part of the tooling and a rework is performed on the flat surfaces of the awl, enabling the placement of the component without difficulty.

The plan of awl improvement consists in making the manufacture of two components which are: awl and awl holder; when performing the awl change, the action will be carried out with single-dimension hand tools, avoiding an accident, so that the tool technician can solve the problem in the fastest way.

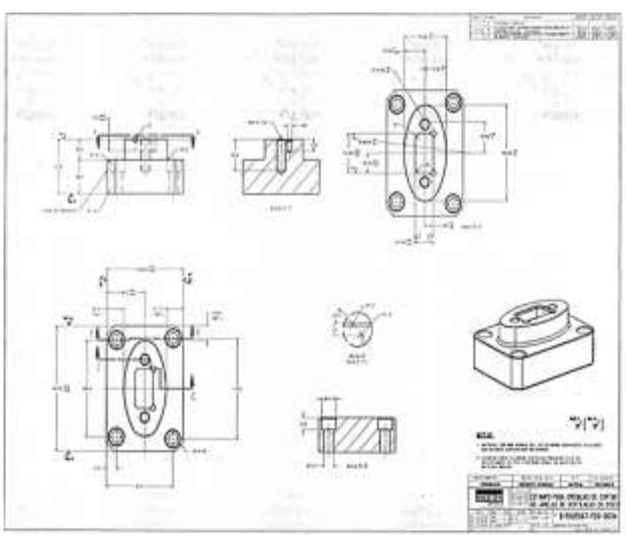
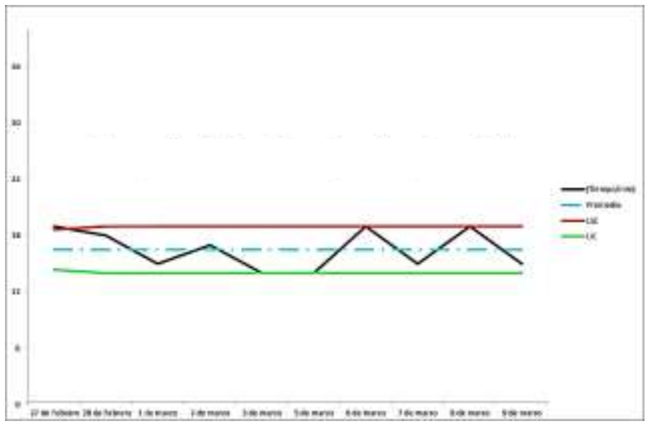


Figure 1 Tooling Design
Source: (Project notes in Maxion Company, Unpublished)

5. **Control:** In this phase, we validate, verify and monitor the improvement, in order to detect any recurrence and to correct it in time. A diagram of process control is implemented to help us identify possible instabilities and abnormal circumstances.



Graph 4 Process Control Diagram
Source: (Project Notes, Unpublished)

Results

The approximate time to make the change of a component is 40 minutes; with the implemented improvement, a 62.5.5% reduction in downtime was obtained, since the change is made in 25 minutes.

The improvement had a great positive impact, since at the time of changing the awl, an additional component called ironer had to be extracted, with an approximate weight of 20 kg.

After implementing the improvements, the extraction of the ironer will be avoided, thus reducing accidents and generating saving to the company.

Acknowledgments

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Conclusions

Within each phase of the applied methodology (DMAIC), we can observe the contribution of quality tools, which enhances a better control in the process, resulting in an improvement in service quality. Achieving the objective of reducing tool change times; by decreasing the time, safety improves, man-time is saved, among other benefits.

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