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Booklets

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Title: Optimization of the drilling process in the vertical stabilizer area to reduce defects in a company in the aerospace sector by implementing the DMAIC methodology

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INTRODUCTION

- ✓ The importance of complying with quality standards achieves an increasingly strict market, seeking continuous improvement, standardization and control of processes and customer satisfaction.
- ✓ The aeronautical industry currently covers a large part of our economy, being one of the most demanding in engineering matters.
- ✓ Currently, the development of the aeronautical sector in the world is growing faster every day and that is why Mexico plans that by 2020 it will be among the top 10 most important countries in the world.
- ✓ All this great development that the aeronautical sector is presenting demands that the methods be increasingly competent for the manufacture of more sophisticated products, demanding perfection

INTRODUCTION

- ✓ The state of Querétaro is the main destination in the country for foreign investment in the aeronautical sector, capturing 31% of the 3,138 million dollars registered between 1999 and 2018.
- ✓ This problem has antecedents since 2018 in another plant of “Company A” located in the El Marquez industrial park
- ✓ Today the introduction and implementation of Six Sigma has had a great impact on manufacturing companies.
- ✓ DMAIC is a methodological tool focused on the incremental improvement of existing processes. The name is an acronym for the steps of the methodology: define, measure, analyze, improve and control.

METHODOLOGY

The percentage to be reduced was discussed among the departments taking into account that it is a critical process, for which it was decided to reduce defects by 15%. And to identify how this problem affects the quality KPI in the process, the critical quality characteristics shown in Figure 1 are analyzed.

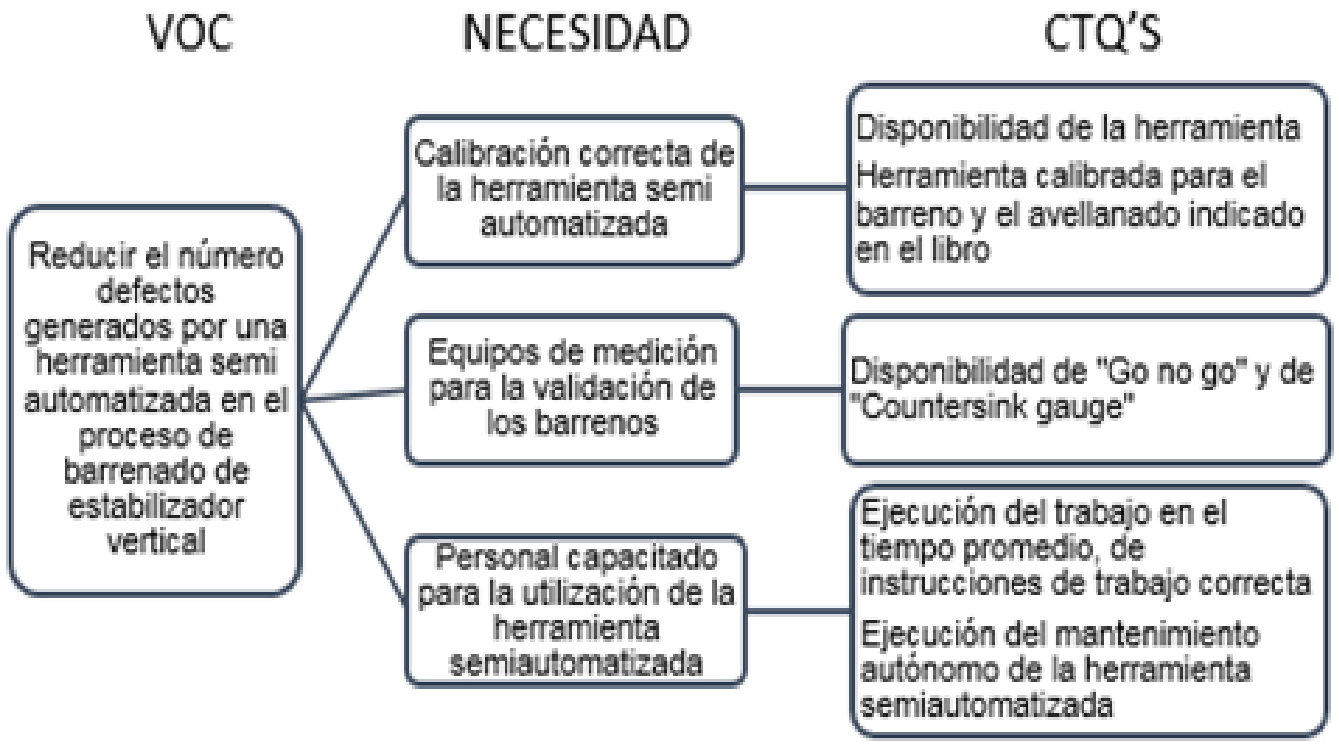

Figura 1. *Quality critics according to the voice of the client, own elaboration*

METHODOLOGY

Process description

It is important to describe the process to understand how the vertical stabilizer is made.

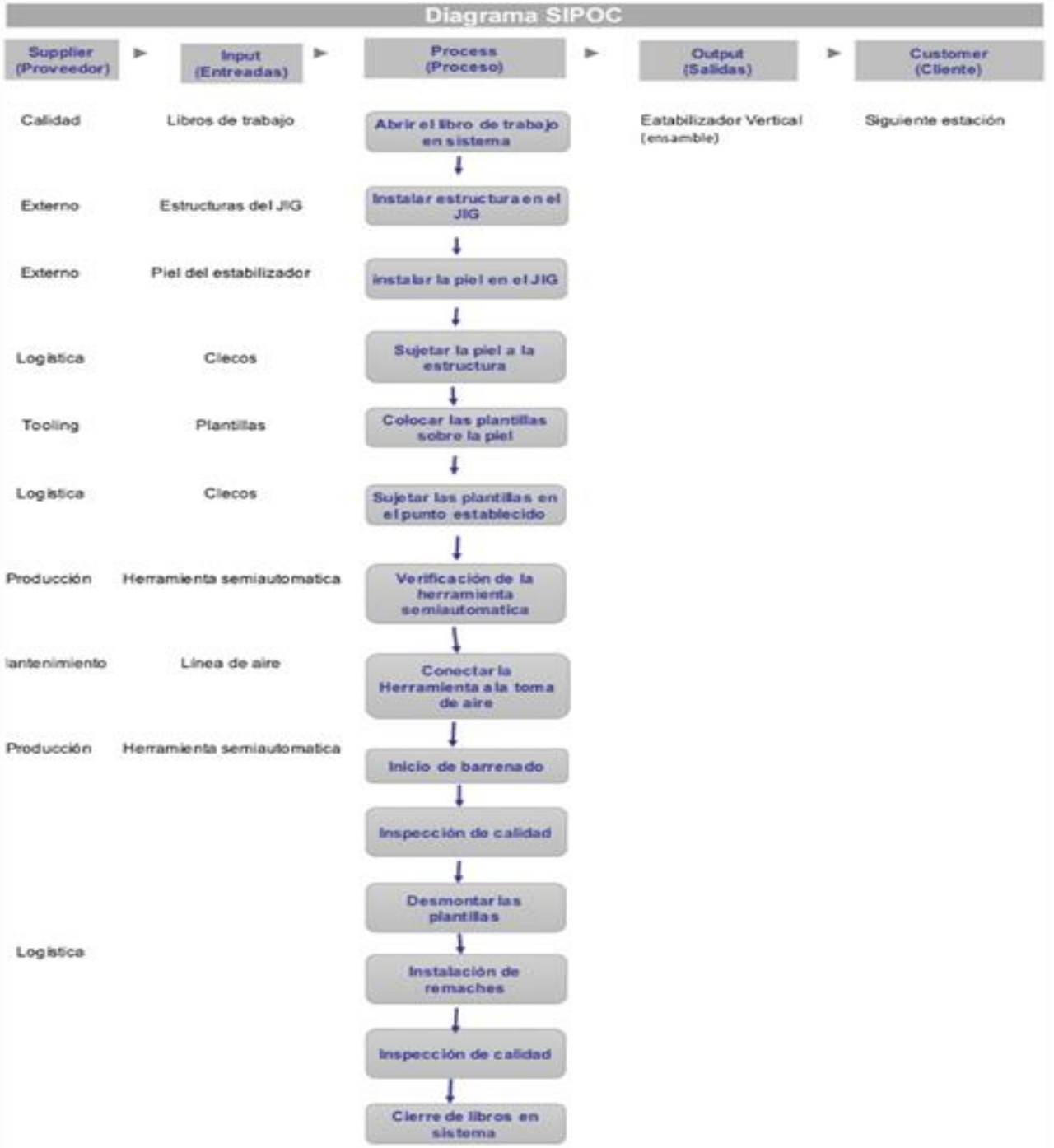

Fig. 2. *SIPOC diagram, own elaboration.*

METHODOLOGY

Measurement phase

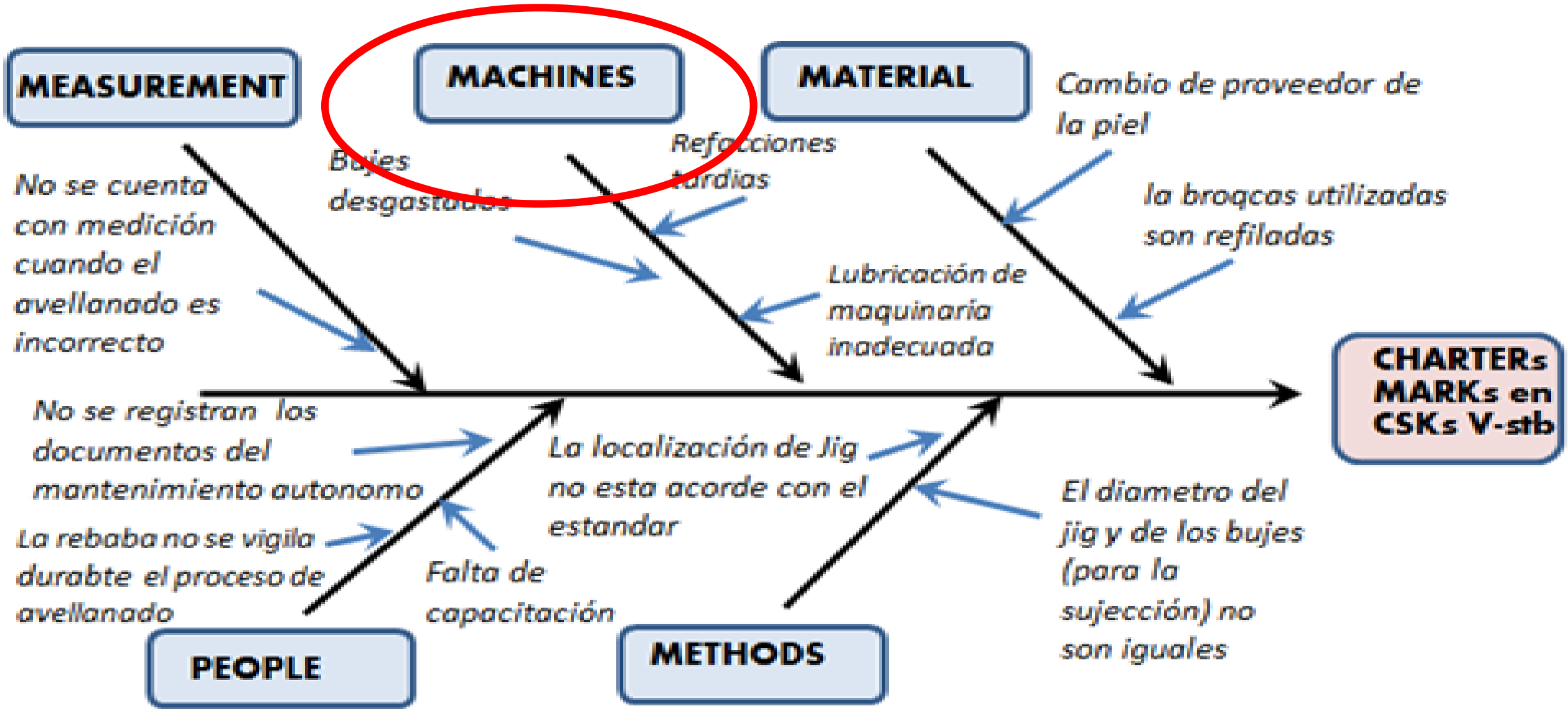

Fig. 3.Ishikawa diagram, own elaboration

METHODOLOGY

To analyze the process in detail, a table will be developed with the important variables of the process and thus, by being able to identify them, know how they should be controlled so that the process is carried out properly.

Description of operation	Variable to control
Fixation of the insoles on the skin of the vertical stabilizer.	The correct template placement and proposed standard clamping.
Verification of the conditions of the semi-automated and cutting tool	Follow semi automated tool (HRI) check parameters Adequate lubrication operation Bit Life Verification (Semi Automated Tool Counting)
Positioning of the semi-automated tool that is indicated by the diameter of the hole it makes.	Placement of the tool on the template corresponding to the diameter to be drilled. Verification of a correct subjection to avoid vibration.
Validation by the operator of the diameter and countersink of the hole made	Cleaning before and after each hole. Verification of the established borehole diameters with the Pass Fail Tool. Verification of the established depth of the countersink without any mark present on it.

Table 1 Process variables, own elaboration.

METHODOLOGY

For the calculation of the sigma level of the drilling process in the vertical stabilizer, it is taken into account that 1,697 holes are made in the skin of the stabilizer, of which 9 RNC are raised per holes with marking conditions in the countersink, of which they had to rework.

Nivel de Sigma	Defectos por Millón de Oportunidades	Nivel de Calidad	Costo de Calidad Promedio	Clasificación
6	3.40	99.9999998%	Menos del 1% de Ventas	Clase Mundial
5	233.00	99.98%	5 - 10% de Ventas	Industria Promedio
4	6.210	99.4%	15 - 25% de Ventas	Baja Competitividad
3	68.807	93 3%	25 - 40% de Ventas	No Competitivo
2	308.537	69.2%	No Aplica	No Competitivo
1	690.000	30.9%	No Aplica	No Competitivo

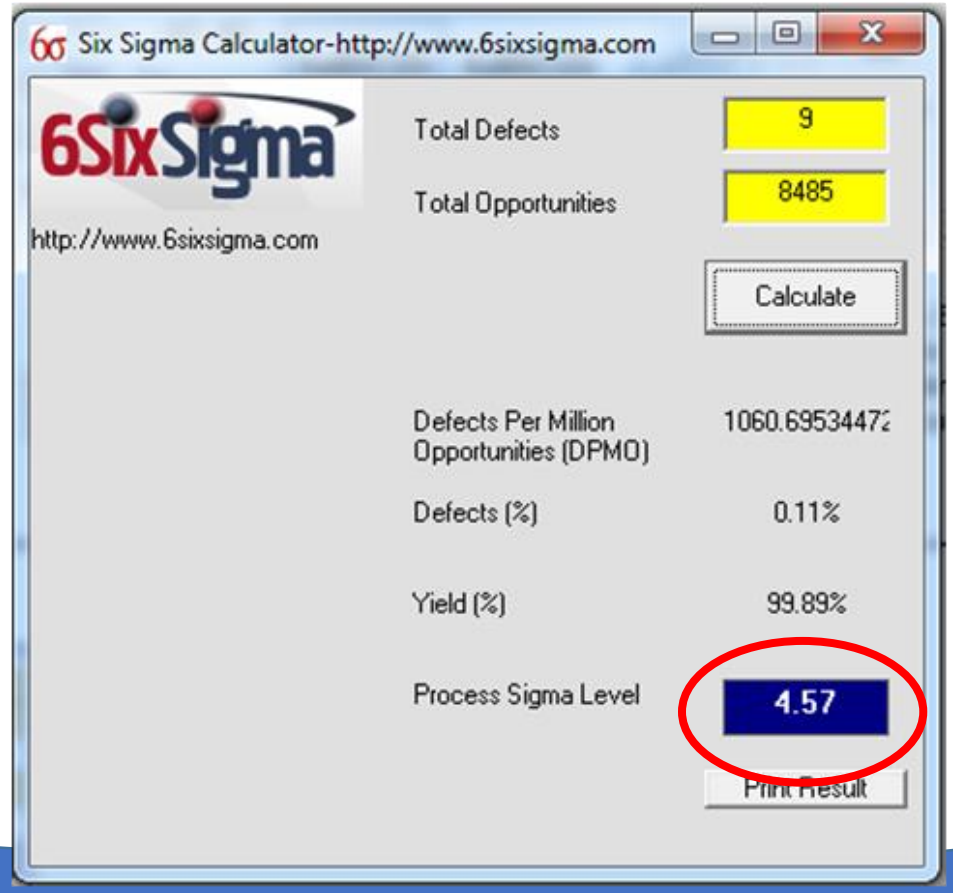

Fig. 4 Six Sigma Calculator, 6Sixsigma.com (2019), online.

METHODOLOGY

Control Phase

It is important to mention that these results were obtained after applying the DMAIC methodology

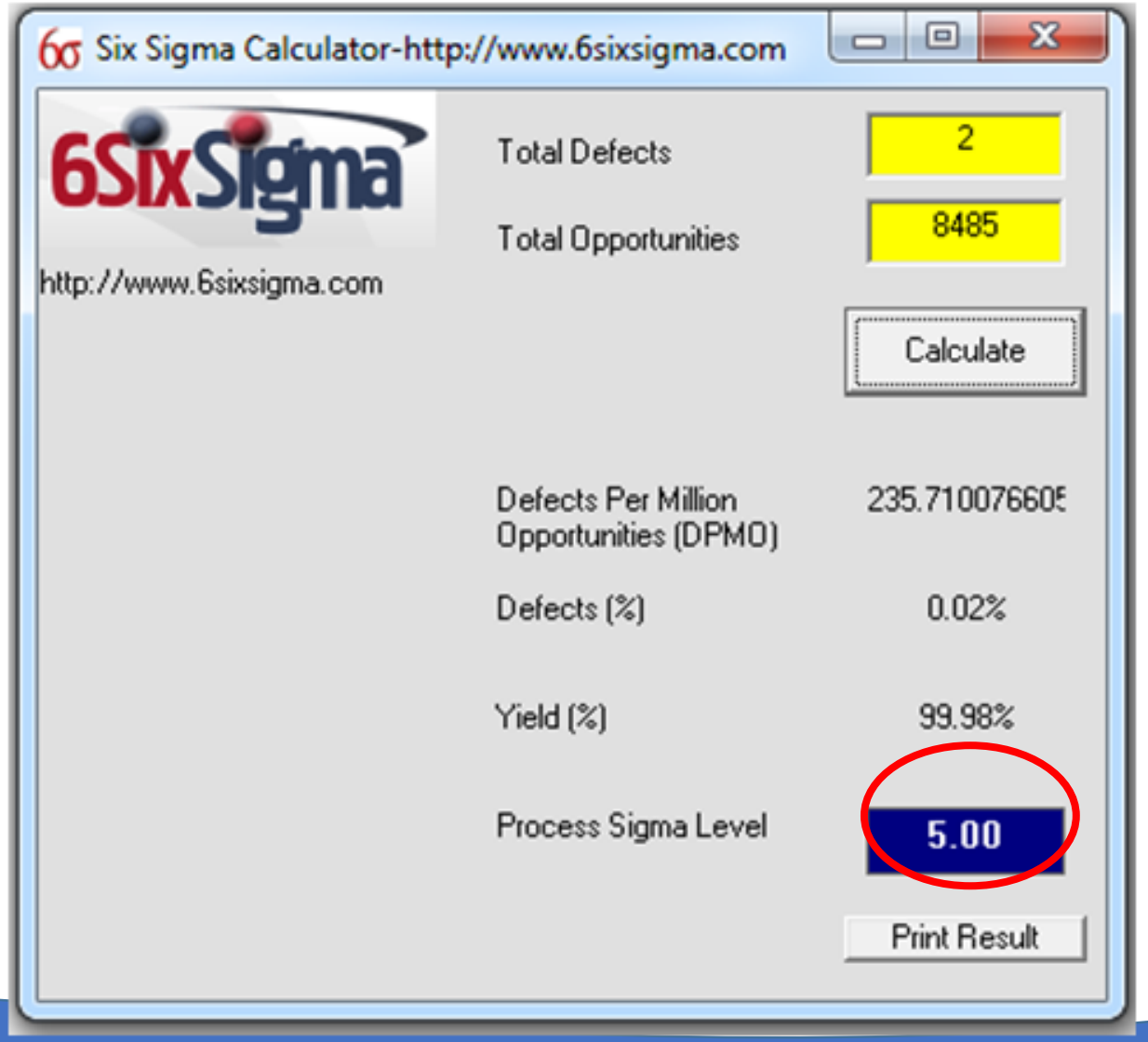

Fig. 5 Sigma level reached after applying the methodology, 6Sixsigma.com (2019), online.

METHODOLOGY

- To prevent the defects from increasing again, the following is mentioned: the follow-up to the standards established for the subjection of the templates and with the verification of the same templates for the placement of the semi-automated tool, the procedure for the correct use of the same as well as the follow-up of preventive maintenance with the change of worn parts for new ones and with autonomous maintenance carried out by the operators for the verification of the semi-automated tool.

- Training conducted for new operators and use under the supervision of an experienced operator.

METHODOLOGY

Analysis phase

For this Stage, the causes that affect the process (variable x) were identified, for which an FMEA (Failure Mode and Effect Analysis) was carried out to identify the failures in the process and thus evaluate and classify in a manner Objective its effects and causes

Fase de Mejora

Acciones correctivas
a. Mejorar y estandarizar la sujeción de las plantillas para el barrenado
b. Inspeccionar las plantillas y reemplazar las desgastadas
c. Seguimiento del mantenimiento autónomo de las herramientas semi automatizadas
d. Seguimiento del plan de mantenimiento preventivo de la herramienta semiautomatizada
e. Concientizar y capacitar al personal sobre el correcto posicionamiento y uso de las herramientas semi automatizadas
f. Corroborar la entrada de herramientas de corte en buen estado (nuevas/rellenadas)
g. Comparación antes y después de implementar el modelo Six Sigma
h. Estandarización de tiempos de abastecimiento de herramientas de corte
i. Estandarización de tiempos de abastecimiento de refacciones de las herramientas semiautomatizadas

Tabla 2. *Corrective actions, own elaboration*

RESULTS

In the improvement phase, 9 corrective actions were established.

Is calculated at 77.76% compared to the DPMO before and after Six Sigma, with a process performance (Yiel) of 99.89% to 99.98%, which impacts raw materials, machinery and equipment, work methods and labor mainly.

In the last phase corresponding to the control, it should be mentioned that regarding the operational personnel, a training strategy was established

Regarding machinery and equipment, a preventive maintenance plan was carried out

The evaluation of the results of the project portfolio shows that fundamental changes must still be generated to achieve better results

CONCLUSIONS

- It is considered significant to comment that the DMAIC methodology was in accordance with the quality problem raised in the company
- The use of theoretical terms favored the discipline of quality and productivity that were below the standards established in the company
- Communication between departments improved, weekly meetings of 10 minutes were held just to keep abreast of the follow-up that the production, quality and methods department had.
- Leadership was achieved by the author of this project due to all the activities that were carried out and they were in charge of giving a great presentation to their managers, helping them stay within the company.
- It can be received that this project showed the tools used so that other departments can implement Six Sigma because this methodology improves processes and focuses on reducing its variability, reducing defects or rework to increase the productivity of the company. .

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