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Evaluation of Process Capacity Applied to a Practical Problem

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Original Research Article

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Abstract: The purpose of this project is to evaluate the process capacity using the methodology proposed by Restrepo, 2017. The example proposed by Summers, 2006 was used and specialized software Minitab® 15 was used in its student version. The study concluded that the process is stable and that the production capacity index meets the requirements requested by the client.
Keywords: evaluation, capacity, production, processes, stability.

INTRODUCTION

An industrial process is constituted by a series of variables, which are classified as controlled variables and uncontrolled variables. Every industrial process must take care of its stability at the moment it is operating. What is sought in any industrial process, is that the variability of the process is stable or minimal. Manrique [1] mentions that the notion and use of statistical sampling and analysis techniques, in production environments, had its beginning in 1920. The objective of these concepts is the systematic reduction of variability. Montgomery [2] points out that the application of statistical control of the process in a company, will bring the stability of the process, and the reduction of variability. Ruiz-Falcó [3] points out that Statistical Process Control is a useful tool to achieve this second objective. Since its application is at the time of manufacture, it can be said that this tool contributes to the improvement of manufacturing quality. It also allows to increase the knowledge of the process (since it is taking "the pulse" in a habitual way) which in some cases can lead to its improvement.

Arbildo [4] points out that process control consists of two clearly differentiated functions: data acquisition and control. La Asociación Española para la Calidad [5] mentions that the statistical process control. is a statistical tool that is used in the workplace to get the right product and the first. Mendoza [14] mentions that the capacity of the processes refers to the uniformity of the processes measured as the variability of the product, there are two ways of thinking about this variability:

- The natural variability in a certain time (instantaneous variability) and
- The variability in time.

In the technical report ISO / TR-1001716 [6] defines the analysis of the capacity of the process as the examination of the inherent variability and distribution of a process, to estimate its ability to produce the performance according to the range of variation allowed by the specifications. Duncan [7] mentions that this study is used to find out if the process can meet specifications, and otherwise to estimate the defective fraction. Cariño [8] says that the process is out of control or unstable when the variations are caused by special causes and therefore its behavior is totally unpredictable. The process is under control when the variations are caused by common causes or inherent to the process, if so, it is possible to apply statistical techniques to study their behavior and even make predictions through statistical inference. Hernández & Da Silva [9] mention that currently there are many tools that can be used for possible improvements and diagnostics, but one of the main ones is the use of statistical techniques that has been developed over the years, improving the entire operational system besides

allowing to make the manufactured products more competitive. Minitab is a compact, versatile and easy to use tool. The reliability of its statistical algorithms and the solid combination of power and friendliness have earned it the trust of users all over the world [10].

MATERIALS AND METHODS

The methodology proposed by Restrepo [11] was used, Figure 1 represents the stages of the methodology.

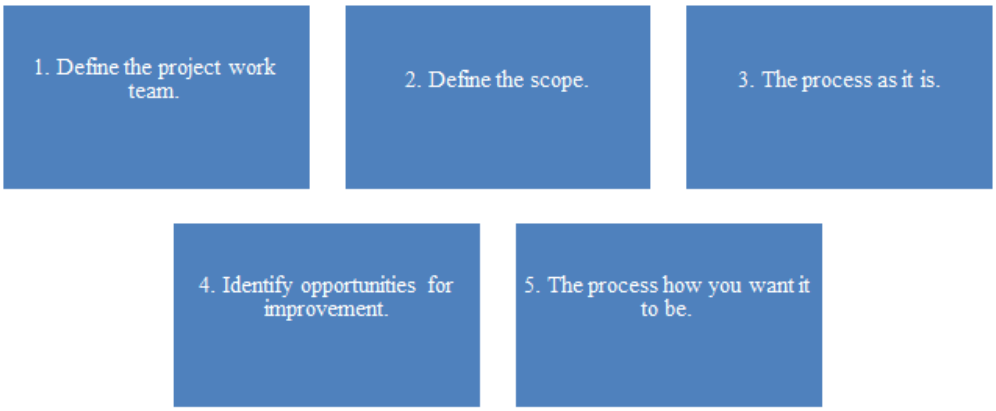

Fig-1: Example of Methodology Used

Define the project work team. The team was required by the team in charge of carrying out the analysis of the processes. For this, the team worked the following work minutes. Figure 2 represents an example of the minute.

PLANTILLA DE TRABAJO EN EQUIPO		Fecha:	
Nombre del Proyecto:		Tiempo/ Cantidad de Sesiones	
Objetivo de la Reunión:		1	
		2	
		3	
		4	
		5	
		6	
Recursos TIC : Computadora_____ Canon_____ Pintaron_____ Plumones_____ Impresora_____ Material de papelería_____ Impresiones_____ Otros_____			
Actividades de la Sesión			
Temas Tratados		Acuerdos	
1. 2. 3. 4. 5. 6.		1. 2. 3. 4. 5. 6.	
Reflexión Final (cierre):			
Lista de Asistencia			
Nombre del Asistente	Firma	Nombre del Asistente	Firma

Fig-2: Example of working minutes

Definition of the Scope

Asociación Española para la Calidad [15] states that the Nominal Group Technique is a methodology that shapes the collection, organization and evaluation of the information provided by the participants. For this reason, the work team developed

periodic meetings to reach a consensus on the development work. One of the techniques used was the nominal group technique.

The process as it is

In this stage, the description of the process was made, for which the Minitab 15 software was used in its student version. Figure 3 represents an example of the main screen of the Minitab 15 software.

Fig-3: Example of the main screen of the Minitab 15 software.

Example 10.9 proposed by Summers [12] was made. Said example consists of 30 samples divided into 5 subgroups. Table 1 represents the first 5 samples and their 5 subgroups.

Table-1: Example of the data to analyze

Sample	Subgroup				
	1	2	3	4	5
1	0.0625	0.0626	0.0624	0.0625	0.0627
2	0.0624	0.0623	0.0624	0.0626	0.0625
3	0.0622	0.0625	0.0623	0.0625	0.0626
4	0.0624	0.0623	0.062	0.0623	0.0624
5	0.0621	0.0621	0.0622	0.0625	0.0624

Once the data to be analyzed was identified, Minitab 15® software in its student version was introduced with two data columns: Readings and Subgroups. The first column was entered for the 30 readings and subgroups 1 to 5 were introduced in the second column. Figure 4 shows an example of the first 25 readings and the first 5 subgroups.

	C1	C2	C3
	LECTURA	SUBGRUPO	
1	0.0625	1	
2	0.0626	1	
3	0.0624	1	
4	0.0625	1	
5	0.0627	1	
6	0.0624	2	
7	0.0623	2	
8	0.0624	2	
9	0.0626	2	
10	0.0625	2	
11	0.0622	3	
12	0.0625	3	
13	0.0623	3	
14	0.0625	3	
15	0.0626	3	
16	0.0624	4	
17	0.0623	4	
18	0.0620	4	
19	0.0623	4	
20	0.0624	4	
21	0.0621	5	
22	0.0621	5	
23	0.0622	5	
24	0.0625	5	
25	0.0624	5	

Fig-4: Example of the first 25 readings and the first 5 subgroups.

Identify opportunities for improvement

In this stage, the analysis resolution process is explained with the Minitab 15 software in its student version. Figure 5 represents an example of how to perform the capacity analysis of the industrial process.

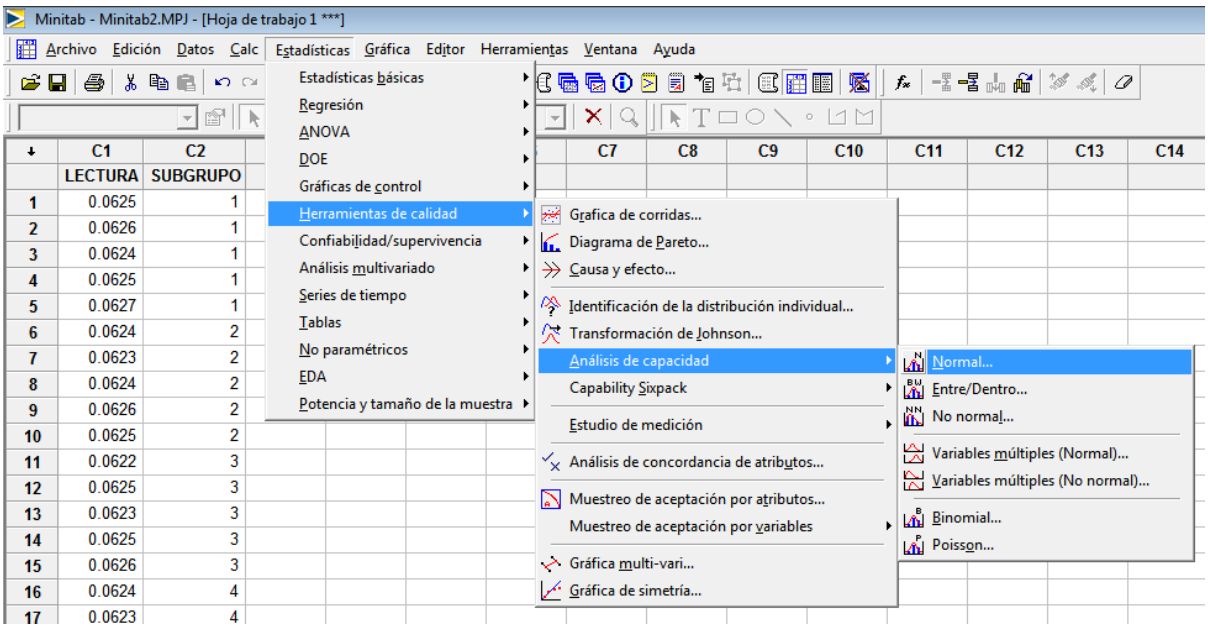

Fig-5: Example of carrying out the capacity analysis of the industrial process

The process how you want it to be

After completing the previous stage, they will have been able to identify how the process behaves. To achieve this, the graph of data distribution was visualized. Figure 6 represents an example of the aforementioned.

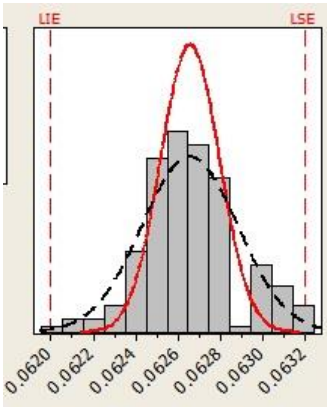

Fig-6: Example of distribution of industrial process capacity

The previous figure shows that the data follow a distribution almost in a normal way, with an almost symmetrical shape and the data stand out 0.0625, 0.0626, 0.0627 and 0.0628, where the majority of the analyzed data is concentrated.

RESULTS

In this section, the results obtained after the analysis will be explained. Figure 6 represents an example of how the data was entered. In the individual column the column cell was introduced, in the subgroup size the number 5 was introduced and in the specifications both internal and superior, the values that the problem mentions were introduced: internal specification is of 0.0622 and the superior specification is of 0.0628. These specifications are pointed out by the problem, since it mentions that the engineers have specifications of 0.0625 ± 0.0003. Figure 7 represents the analysis of the data.

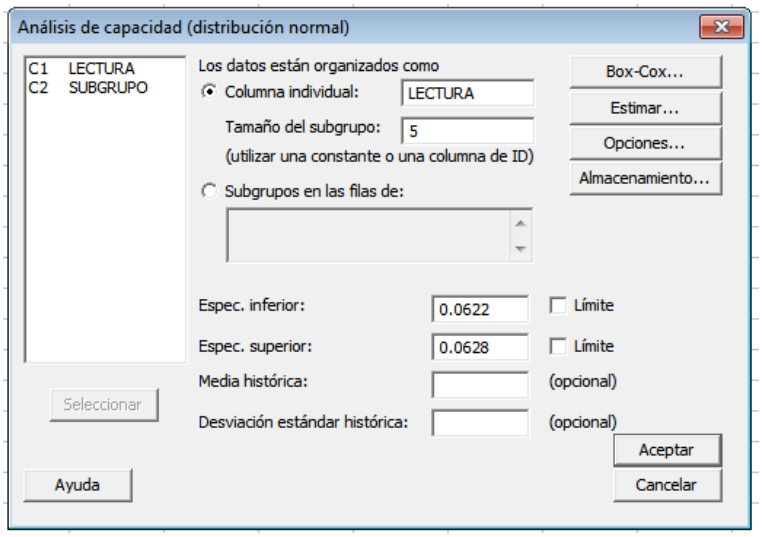

Fig-7: Example of data analysis

The advantage of using Minitab 15 software in its student version is that it is a very useful program in the statistical analysis of data. Figure 8 represents the results of the analysis of the readings and the subgroups.

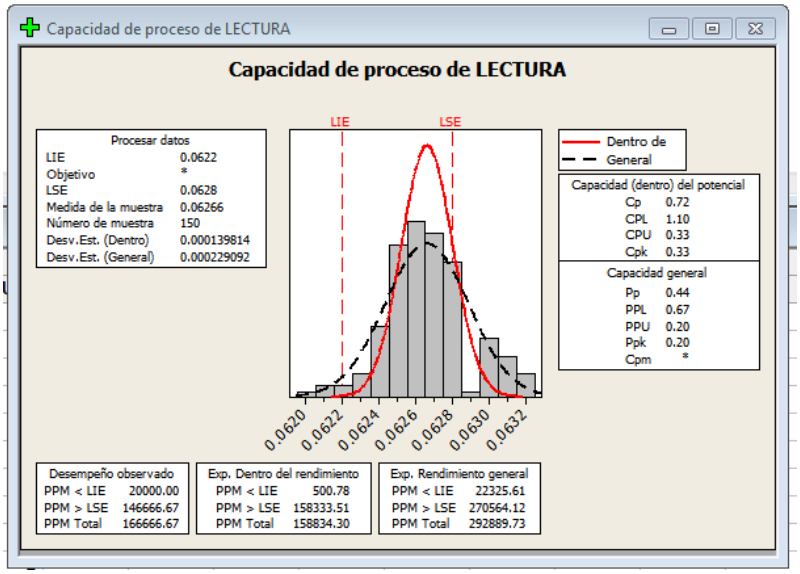

Fig-8: Example of data analysis

The previous figure shows that the CP index is 0.72, which according to Salazar [13] indicates that a value that ranges between 0.67 and 1, has a world class metric number 3, which means that it is not suitable for work. Likewise, Salazar [13] points out that an analysis of the process is required.

Continuing with the problem proposed by Summers [12], it is proposed to extend the internal specification to 0.0620 and the superior specification is 0.0632. The analysis was carried out again but the specifications were changed. Figure 9 represents the results of the new analysis of the readings and subgroups.

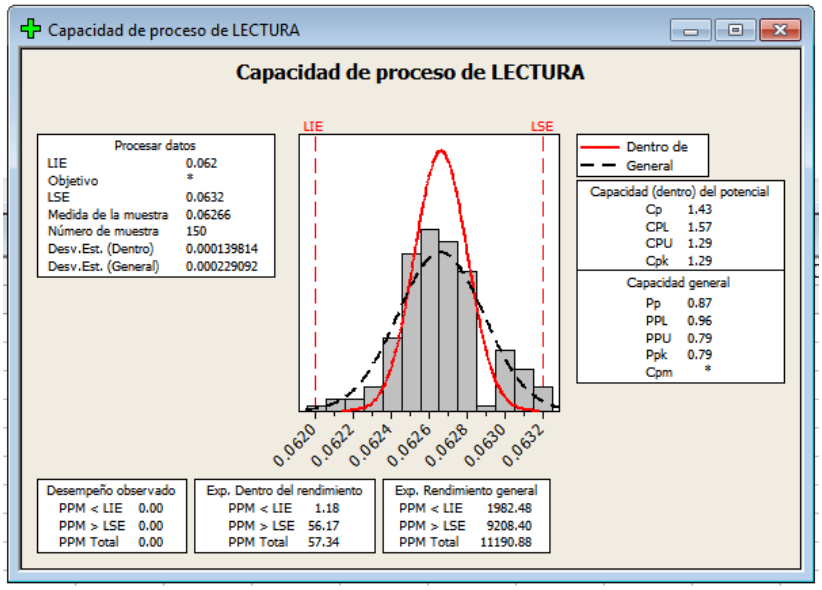

Fig-9: Example of data analysis.

The previous figure shows that the CP index is 1.43, which according to Salazar [13] indicates that a value that ranges between 1.33 and 2, has a world class metric number 1, which means that the process is very appropriate.

CONCLUSIONS

It is important that a company knows its processes in detail, so it can more easily identify the problems and shortcomings that affect the productivity of its processes. With its proper identification and solution, it is possible to avoid these problems and significantly increase its operation, its quality and ultimately its productivity.

Being able to implement the statistical study in the evaluation of process capacity represents a significant contribution in the study of industrial processes and services, which currently represent a high percentage in the business sector.

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