Article **Journal-Industrial Organization**
June 2023, Vol.7 No.12 26-33

Assessment of quality defects in a production area of an SME

Evaluación de los defectos de calidad en el área de producción de una PYME

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DOI: 10.35429/JIO.2023.12.7.26.33 Received January 25, 2023; Accepted June 30, 2023

Abstract

The importance of this study lies in the support SMEs require in terms of the limitations of technologies and work methods for carrying out their daily activities in some manufacturing processes that businesses conducts. The objective was to measure the dependence of the quality defects found in fuses when considering using a new welding component in the production lines. Even with a quality management system, some defects were presented in the final product. Therefore, the methodological design was performed to identify variable defects in fuses, welding components, and production lines. Likewise, the chi-square statistical test was applied to determine the dependence between the variables that intervene in the process. The information obtained was analyzed through the SPSS 20 statistical program. The results showed dependence between the variables, allowing proposals to be established to correct the defects.

SMEs, Dependence, Manufacturing processes

Resumen

La importancia del presente estudio, radica en el apoyo que requieren las PYME´s en cuanto a las limitaciones de las tecnologías, métodos de trabajo para la realización de sus actividades diarias en algunos procesos de manufactura que llevan a cabo en su negocio, el objetivo planteado fue medir la dependencia de los defectos de calidad que presentaron los fusibles, considerando el uso de un nuevo componente de soldadura utilizado en las líneas de producción, aun con un sistema de gestión de calidad, se presentaron algunas defectos en el producto final; el diseño metodológico se realizó identificando las variables defectos en los fusibles, componente de soldadura y líneas de producción, así mismo se aplicó la prueba estadística chi cuadrado para determinar la dependencia entre las variables que intervienieron en el proceso. La información obtenida se analizó a través del programa estadístico SPSS 20. Los resultados presentaron dependencia entre las variables, permitiendo establecer propuestas para corregir los defectos.

Pymes, Dependencia, Procesos de manufactura

Citation: PORTILLO-CASTILLO, Víctor Manuel, MENDOZA-GINER, Lorena, ROJO-SIMENTAL, Erick Octavio and BATISTA-VEGA, Ma. del Socorro. Assessment of quality defects in a production area of an SME. The case of the bachelor's educational program in administration. Journal-Industrial Organization. 2023. 7-12:26-33.

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Introduction

Support for small and medium-sized SMEs in different areas and activities generates a positive and decisive impact on activating the competitiveness of these businesses. Most of the time, these companies do not have the experience, preparation, equipment, technology, and personnel that allow them to solve problems quickly and efficiently during line production activities. Therefore, the external practical, theoretical contribution allows to support and solve situations that affect the company. Furthermore, methodological and statistical support provides conclusive results for identifying and resolving the effects of the causes mentioned above.

The previously proposed practice allows these businesses to make effective decisions and apply changes suggested in the problem raised providing certainty and security in the processes. Additionally, this allows application changes in implemented modifications and provides continuous growth and security in the search for a competitive advantage through all elements and processes that integrate the activities of SMEs.

Additionally, the company detected the problem in the middle of 2022 when integrating a new welding component for elaborating different types of fuses manufactured in the production lines. As a result, the quality department detected that the finished product did not meet with the requirements and resistance specifications that the clients requested, causing delays in the production and delivery of the orders. Furthermore, the quality department points out that the defects found in the fuses are not uniform in the production lines, which differ from the supervision area. Also, the quality department considers that the problem arises due to the human factor when carrying out the welding operation.

Therefore, it is established as a hypothesis that the new welding component is generating the quality defects of the fuses in the company's production lines.

Literature review

Small and medium-sized enterprises (SMEs) form a sector of great importance for the economic development of the region and the country. Although these businesses have been built through entrepreneurship, their contribution is the primary source of the generation of jobs, growth, productivity & innovation. In this context, an essential determinant of the development of the local economy lies in the support and monitoring of small and medium-sized companies, seeking to generate competition through the experience gained with their approach and participation in the business sector (Kruja, 2013).

Many countries have been seeking economic progress, most of the developing countries mainly recognize the SME sector. Considered as a promoter of growth and the labor force of a region, it contributes and provides economic growth and business resources as well as employment sources and opportunities.

On the other hand, the roles played by SMEs in the economic development of a nation have been empirically explored, finding a factor of ambiguity. It can be concluded concretely, when examining the economic progress by sector, the specialists in the economic areas, generally ignore the industrial structure of the economy and the impact of the advantage that it may have on the development of the country (Ming-Wen, 2010) .

It can be noted that quality is based on a concept that is very fashionable in these times in companies and throughout the business world. The dialogue between all organizations on this subject is typical. It has reference to receiving a bad service or due to a problem with a product. One key element of total quality management is competitiveness because companies without competitiveness could not achieve great success in today's market, thanks to using the quality tool to achieve their objectives. It could also be said that consumers are looking to satisfy their needs and find products, goods, and services that follow the client's needs (Guajardo, 2003).

ISSN-Online: 2524-2105

In the 1980s, researchers considered raising awareness about the importance of the strategic quality field and the critical aspects of their philosophy of integrated improvement and fulfilling immediate customer satisfaction. From publications generated in Japan and sufficient arguments on this subject, many businesses and organizations in the western world started with total quality management programs focused on taking strategic action to improve performance and competitiveness (Gutierrez, 2010).

The generation of competitiveness of companies is of crucial importance to generate a focus on their ability to maintain advantages that participate in that same competitiveness against other companies, generating a sustainable panorama with a greater impact on the region and society. It is of great importance to avoid and reduce losses and waste by increasing production efficiency, no organization should be exposed to waste and misuse of resources to develop its production process (Gonzalez, 2011).

Another author Cuatrasecas, (2009) established that a production process represents a central element made up of a series of coordinated activities for the development of physical operations.

In addition, there are activities in which a series of productive factors interfere to transform them into products. The integration of processes and quality generate wealth; that is, they add value to the raw material acquired by the company. The acquired materials represent valuable elements, increasing the potentiality of satisfying the client's needs with each activity of the production process. Therefore, it is important to identify the processes of raw materials and products being used to obtain the final product. Generally, these processes are executed through tasks, flows, and storage (Mayorga, Ruiz, Marcelo, & Moyolema, 2015)

On the other hand, Miranda & Toirac, (2010) pointed out that production generates a phase in the economic process. Some productive factors are transformed to make goods and services and meet needs. The neoclassical theory establishes the creation of wealth with a focus on increasing the well-being of a social group, demanding the efficient application of scarce resources to enhance the achievement of well-being; resources are generally directly related to the factors of production.

In the 1980s, researchers considered raising awareness about the importance of the strategic quality field and the critical aspects of their philosophy of integrated improvement and fulfilling immediate customer satisfaction. From publications generated in Japan and sufficient arguments on this subject, many businesses and organizations started with total quality management programs focused on taking strategic action to improve performance and competitiveness (Syamsul, Djabir, & Ria, 2012).

However, the standards published by ISO, considered as Quality Management standards, generated their first edition in 1987 by the ISO 9000 series, provided what is currently an example of quality worldwide, providing general well-being to manufacturers and consumers of goods and. Services with thousands of certified companies around the world, leading the European continent with more than 500,000 companies (Carrera, Ligña, Mortreno, & Morales, 2018).

Another aspect of total quality management focuses on preventing repetitive processes for an activity to eliminate problems that could arise at the end of each process and to have a balanced work environment in which the organization reacts quickly to customer needs and requirements. In this regard, the members of these businesses must be aware of the value and role they represent in this process. Other alternatives to manage growth and value must include the elements in which the company participates inside and outside, increasing the analysis and limits of the processes carried out (Carro & Gonzalez, 2010).

Lozano (1998) conducted a study in which he interpreted a completely close relationship in the quality field, a product quality symbol. The subject of quality means the quality of work. Another main point is the quality of service, as well as the quality of information. The study represents the product quality symbol, such as the quality industry process, medical field areas quality, and other aspects of quality, including engineers, managers, and executives who integrate the system's quality. Furthermore, it constitutes the quality contributions of the company in the planning process and the quality of the objectives. Its primary focus was to control the quality present in all manifestations.

ISSN-Online: 2524-2105

Moreover, Ramos, (2011) pointed out that quality management must be represented as a philosophy that is considered an approach to support companies to obtain excellent results, several advantages must be considered, by offering results in the development of processes and management a vision of quality. , generating a continuous improvement to define the strategic processes proposed by the organization.

Another author defines quality as a key element in survival; concretizing it allows turning it into a long-term competitive strategy focused on permanent execution. It is worth mentioning that it appears as a living standard of achievement in people, achievement of the company, its objectives, its processes, and in general of all the elements and activities of the organization. The company must have the commitment to improve products and services to gain an advantage over competitors in an approach to reduce errors and make things right the first time (Demuner & Mercado, 2011).

Quality is perceived and well received from the participation of all company members in their tasks to the effectiveness of preventive signs. In these cases, there should be no reason to neglect the order of the process, with a focus on achieving excellence. Quality allows the business to be profitable, productive, and participate in the market; it establishes a series of procedures that provide business success in a coordinated and categorical manner (Maldonado, 2018). Quality management systems must meet the following factors: improve internal operation, competitive advantages, and customer demand (Erazo, Acevedo, Guzman, & Rodriguez, 2010).

Every organization requires a great effort before, during and after having prepared and implemented a quality management system, the monitoring and control of the system through the evaluation of the system through quality audits carried out by third parties (Horovitz, 1991).

Consequently, quality is a factor that must be considered as a generator of a competitive advantage, by establishing a degree of cohesion in the inherent characteristics that provide the need or expectation, continuously implicit or obligatory, translating into terms of compliance with requirements, for which every system is obliged to perform measurements on its processes and critical attributes to determine their conformity. If a nonconformity is identified, it is defined as the absence of the quality (Santamaría, 2017).

Nevertheless, quality assurance is depicted through a series of mechanisms developed in Latin America and Europe; it emphasizes the relationship, needs, and characteristics that influence and emerge from manufacturing systems providing diverse responses. However, it is not complex to identify some common characteristics that have generated its appearance, development, and implementation. Although some differences are based on the purposes and functions assigned, in which they result in methodological analysis associated with their use, management, and application of the obtained results (Espinoza & Gonzalez, 2012).

Furthermore, quality assurance starts from the Conceptual phase of a project and concludes with a final product of great satisfaction to meet customer expectations. Finally, the quality system, represented by a technical department, intends to establish control mechanisms of the economic proposals through the implementation of key performance indicators; in these cases, they are decisive for a correct control carried out in the course of the elaboration of the calculations and the unit prices. (Chase, Jacobs, & Aquilano, 2012).

Methodology

The objective of this chapter is to explain the methodology used to collect and analyze the information used in this study. The approach or nature applied in this study was quantitative, of a non-experimental type with a cross-sectional design with a descriptive-correlational scope (Hernandez, Fernandez, & Baptista, 2014). It was applied for convenience to obtain the study information in a given time, apply the statistical tests and process the corresponding information to analyze the results (Anderson, Sweeney, & Williams, 2008).

ISSN-Online: 2524-2105

In conclusion this research was focused on determining if there is a dependency between the variables defects in the fuses, welding component and production line through the chi square test (Lind, Marchal, & Wathen, 2012).

Likewise, the research was carried out of the applied type since an attempt was made to solve a problem that arose in a manufacturing SME. The type of sampling selected was non-probabilistic for convenience and availability of schedules and manufacturing in the production lines (Levin & Rubin, 2010).

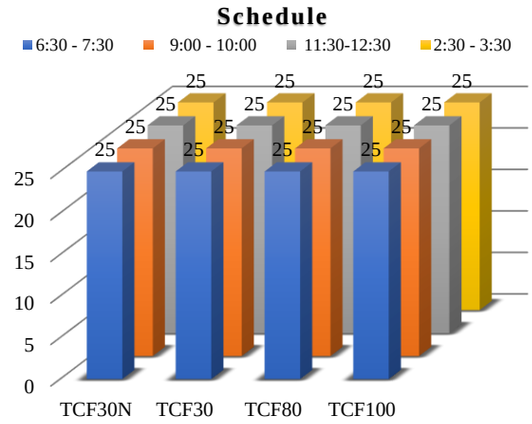
According to the production standard, 6,400 fuses must be produced daily from all production lines. For this work, a non-probabilistic sample was applied due to the easy acquisition of fuse samples and carrying out the measurement process by the quality department. The formula for finite samples was reviewed to determine the sample size (Bluman, 2007). The result demonstrated that at least 362 pieces were needed for a representative study population sample. To conclude the sample results, it was defined to apply it to 400 fuses according to the quality department's recommendations.

Whereby the information was collected through a checklist designed by the quality department, which includes the day, time of production, year, and model, assigning a consecutive number to each piece once an electrical test was conducted on the fuse. Although the collection was carried out in the first shift through the quality department, table 1 shows the schedules and fuses obtained as a sample.

Schedule	TCF30N	TCF30	TCF80	TCF100
6:30 - 7:30	25	25	25	25
9:00 - 10:00	25	25	25	25
11:30-12:30	25	25	25	25
2:30 - 3:30	25	25	25	25

Table 1 *Daily production sample by lines*
Source: Own elaboration.

Graph 1 represents the non-probabilistic sampling selected for convenience and availability of schedules and manufacturing in the production lines.



Graphic 1 Daily production sample by lines
Source: Own elaboration

Results

The results of the data obtained objectively and logically are presented below, accompanied by the respective statistical treatment. These results are shown through tables and analyzed based on the hypotheses raised, presenting the calculated values and the established probability levels.

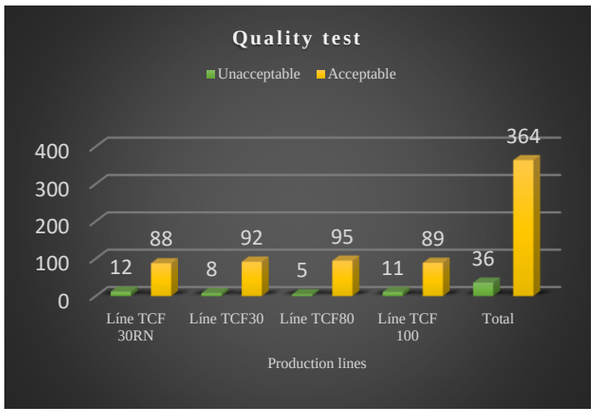
In addition, through the data analysis of the statistical program SPSS 20, the result was captured in the contingency table presented in table 2, showing 12% of resistance failures of the fuses extracted for the test in the TCF30RN line. The minimum result obtained in the TCF80 line was 5%. In general, 9% was obtained, equivalent to 36 pieces with quality problems of the 400 registered and analyzed as a sample.

		Production lines				
		Líne TCF 30RN	Líne TCF 30	Líne TCF80	Líne TCF 100	Total
Quality test	Unacceptable	12	8	5	11	36
	Acceptable	88	92	95	89	364
Total		100	100	100	100	400

Table 2 Contingency table & Quality test of production lines.
Source: Own elaboration

Graph 2 shows the results of the test in which the percentages of the fuses that do not meet the quality specifications can be seen, as well as the percentage of those that were accepted and the total sample analyzed.

ISSN-Online: 2524-2105



Graphic 2 Quality test of production by lines
Source: Own elaboration

Table 3 shows the chi-square test for the variable defects of the fuses (Anderson, Sweeney, & Williams, 2008), with the welding component verifying the hypotheses raised in the investigation. The quality defects of the fuses in the production lines are not derived from the integration of the new welding component. Since the calculated value of chi-squared (3.663) appears in the left region of 7.815, the null hypothesis is not rejectable at the 0.05 level of significance. Therefore, there is no evidence of a relationship between the welding component and the defects of the components' fuses.

	Value	gl	Sig. asymptotic (bilateral)
Pearson chi-square	3.663[a]	3	.300
likelihood ratio	3.885	3	.274
Linear by Linear Association	.219	1	.640
N of valid cases	400		

Table 3 Chi-square test
Source: Own elaboration

Gratitudes

We appreciate the support and facilities provided to the authorities of the Technological University of Ciudad Juarez.

Conclusions

In conclusion the results obtained through the statistical tests allowed us to define the methodological proposal raised at the beginning of the investigation. Furthermore, the rejection of the null hypotheses strengthened the security of great ideas remaining about the scope and effectiveness of its implementation and use.

Therefore, the breakdown of the results offered the identification of internal details of the quality department, which enhanced the opportunity for the investigation.

Consequently, the results made it possible to determine that the welding component was not presenting the problem. The sample did not yield convincing evidence to determine that it was one of the factors influencing the production process since the component was integrated at the beginning of the year. Therefore, the supervision department considered the problem generated due to the component's quality. However, the resistance tests yielded a non-significant percentage of a statistical sample that meets the requirements to determine if all the daily production generated in the production lines had to be reviewed to ensure that it was generating the quality problem.

As no problems were found in the welding component, it is essential to review the production processes of the operators since it may be one of the contributing factors influencing the defects, as well as review the calibration of the welding machines to ensure the quantity and amperage are correct, creating a new line of research.

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ISSN-Online: 2524-2105