Revista Industrial Data 25(1): 137-156 (2022)
DOI: https://doi.org/10.15381/idata.v25i1.21224.g18422

ISSN: 1560-9146 (Impreso) / ISSN: 1810-9993 (Electrónico)
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The Importance of Operational Reliability Engineering for Business Development

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SUBMITTED: 23/09/2021 ACCEPTED: 25/03/2022 PUBLISHED: 31/07/2022

ABSTRACT

This study shows the development of operational reliability engineering for the economic and sustainable growth of companies that wish to maintain, grow, improve and develop their own dynamic environment. In order to propose a strategy to achieve business objectives, different competencies will be explained, including business development, economic growth as an integrating concept, business culture, and knowledge and innovation management. Thus, it is intended that entrepreneurs identify the need to train and be more competitive in terms of (1) efficiency and effectiveness of processes and (2) departments and activities of the company, so that it is aligned in terms of objectives and goals.

Keywords: strategy; model; evaluation; management; reliability.

INTRODUCTION

This work aims to demonstrate a fundamental pillar in sustainable economic and business development in order to generate profitability. Moreover, it allows for the identification, exploration, and development of new productive activities, whose dynamics allow organizations to adapt to new technologies. Planning, control, and organization are important in the improvement process, since they will allow the company to survive in the market and be highly competitive. The achievement of sustainable business development will improve leadership, growth, innovation, culture, and knowledge management (Moscoso, 2017).

It is important to obtain maximum production and profit and apply the principles of efficiency in search of profitability and methodologies that are reflected in productivity and that allow the achievement of company objectives in any given situation. The operational reliability engineering of integral management —which offers a before, during and after overview of the processes— is used to know the real situation of the company, as support in the efforts to achieve the proposed objectives, to make management decisions and to provide opportune solutions to the problems (Quispe, 2017).

Which factors of reliability engineering tip the balance for entrepreneurs to succeed in business? Reliability engineering makes it possible to propose, design and generate tools that guarantee quality and optimal conditions in organizations. It also aims to determine optimal solutions to perform work on schedule without making mistakes or failures. Likewise, it proposes a methodology that allows predicting and measuring the situational environment to establish a strategy for sustainable organizational development. (Heredero et al., 2012). The fundamental pillar of reliability engineering in business development will allow the identification and development of new techniques and strategies for sustainable growth. The reliability tools that are adapted to the development of the products will facilitate their planning, control and

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organization so sustainable business development will be achieved, that is to say, it will facilitate the creation of competitive advantage. The follow-up and control will allow the achievement of the objectives and goals established by the company (Schwertner, 2017).

What does reliability engineering have to do with the business sector? Reliability engineering represents the management of a model that seeks to provide clear and concise company information, so that it makes it possible to detect problems and take strategic measures to implement planned tactics to achieve business success even in situations that lead to rethinking strategy, policy, goals and objectives. Several studies specify the activities that must be performed when a certain number of hours or kilometers of service are reached; for example, in the case of vehicles or machinery, preventive maintenance intervals must be performed every 5000 km traveled (Cutipa et al., 2018; Girón, 2007; Padilla, 2012; Tanta, 2017). The main objective is to present a maintenance proposal based on reliability engineering to increase the availability of the system resources of the company (Jacobs, 2007).

Background

Moubray (2004) identified the reliability of the failure finding interval to establish the activities, plans and goals of an organization. This is oriented to the coordination of measures involving all management tasks, such as maintenance, distribution, planning, discipline, management, development and control of organizational rules. These tasks, in turn, from the point of view of quality, allow an effective and organized distribution of work and the opportunity to promote technological innovation of new organizational models that together promote continuous improvement in the development system (Lascurain, 2017).

Key aspect of reliability engineering for business success

Socconini (2014) proposed a system to achieve great results by identifying and eliminating all waste in each process of the value chain. To achieve business success, speed in decision making is required, so information must be provided in a timely, clear, and simple manner, without the need to resort to extensive and complex reports. Figure 1 illustrates this idea.

Aguilar, Torres y Magaña (2010) state that the maintenance plan incorporates a risk and reliability criterion that impacts the performance of the assets belonging to the different management levels and that serves to observe and analyze the company as an integrated and departmental system. It is necessary to detect improvement processes that can serve as parameters for decision making. The reliability of

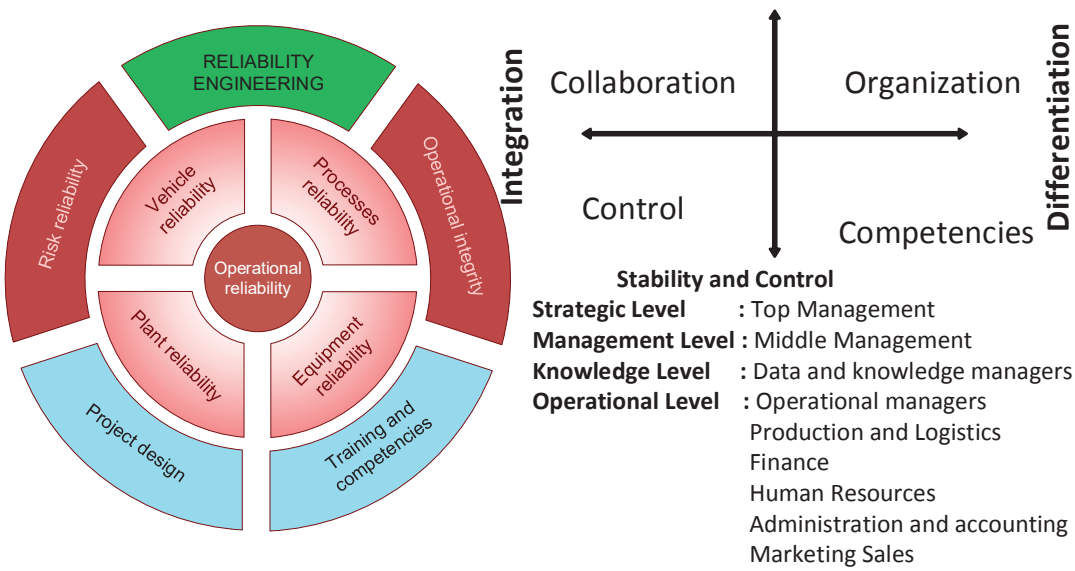

Figure 1. Characteristics of reliability engineering for a strategic vision.

Source: Prepared by the author.

equipment, machinery, vehicles or products can be expressed as the probability that a failure does not occur in a given time for a defined mission and with a given level of confidence (Ziyadin, Suieubyeva & Utegenova, 2020).

Zapata (2011) states that *El garantizar un nivel dado de calidad, seguridad y confiabilidad abarca todas las etapas de un componente o sistema: Planeamiento, diseño, fabricación, instalación y operación* [Ensuring a certain level of quality, safety and reliability encompasses all stages of a component or system: planning, design, manufacturing, installation and operation] (p. 3). He proposes the development a program, a technique, and a tool with the purpose of planning, controlling and monitoring management indicators that will facilitate sustainable business development.

Montilla, Arroyave and Silva (2007) defined the maximum process reliability as the probability that a machine will not fail during operation. The evaluation of reliability engineering in the operation of the company allows the control analysis of the company's management indicators to meet established goals and objectives. The results obtained and those planned are verified in order to formulate the plan and develop controls over the company management, which is needed to remember its distinguishing characteristics.

Grueso and Toca (2012) discuss business sustainability and analyze to what extent it is possible to achieve (1) conceptual innovation from the strategic direction of resources in the evaluation of business management, which proposes a comprehensive analysis of results in different aspects, and (2) the process capability to meet customer requirements and implement improvements in business management processes, where the main action is the collection of data, analysis, diagnosis and details of the company.

Reliability Engineering Approach

Berman (2012) mentions that change is the only certainty and that the world changes continuously, so one must know how to adapt to it in order to survive and to take competitive advantage. Thus, the author analyzes different business aspects to observe the internal and external variables of the company, which makes it possible to establish objectives to improve the processes in the control of operational reliability engineering.

Schroeder, Meyer and Rungtusanatham (2013) highlight the importance of project monitoring and evaluation to implement process improvement. Thus, an analysis of results is necessary to identify positive and negative aspects in business management, relating their cause and effects to detect problems that impede improved company operations. In this way, the use and management of information can be optimized for a comprehensive evaluation of the company and timely decision making for its success. Figure 2 graphically illustrates this idea.

Regarding management training, Mintzberg (2004) points out that the current approach must change and focus on the practical part, so that managers can learn from their experience while investigating activities. This will permit a new type of distribution of processes and areas that will operate the company through operational reliability engineering, detailing the main functions with specialists in each of the areas for the modeling of continuous process

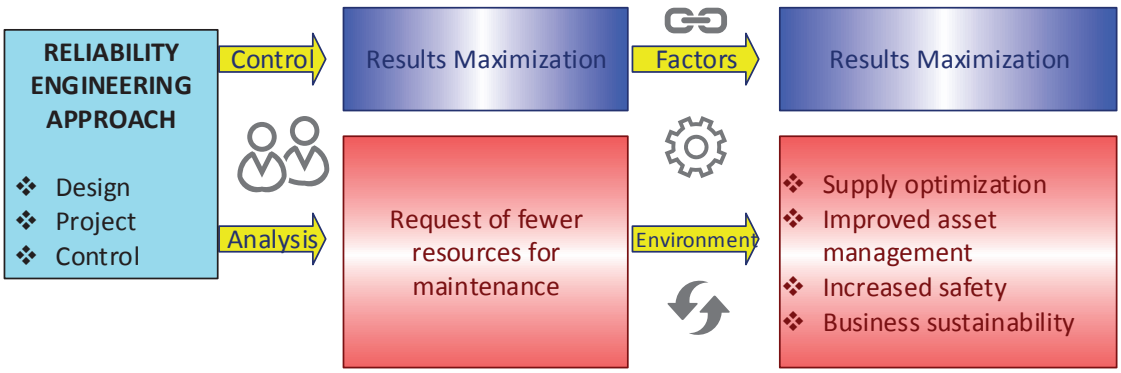

Figure 2. Reliability Engineering Approach.

Source: Prepared by the author.

evaluations. The evaluation to improve the effectiveness of the company allows the timely detection of internal and external problems that contribute to make the organization more competitive.

Chiavenato (2004) says that “change maintenance” is the way to guarantee that organizational change is carried out according to design implementation plans in order to reduce the maintenance workload without affecting the availability of machines. Its success will depend on the analysis of the key functions.

Cohen and Asín (2004) state that the current globalized world will make it possible to change the way an organization operates. Due to the adaptability of technological progress, the changing expectations of clients have set the patterns to determine and change the way of working. Thus, an optimal structure focused on a specific project, process or objective within the organization is chosen.

Mielgo, Montes and Vázquez (2007) state that, in order to innovate, it is necessary to develop capabilities not only to create a novelty but also to assimilate it and exploit it successfully. Their statement is based on a development model, a strategic design of operational reliability engineering to strengthen the organization: the design of a strategic plan to develop the company's processes, which involves combining capabilities and competencies necessary for analysis in decision-making.

David (2013) says that *las investigaciones en historia empresarial giran alrededor de los procesos económicos y sociales relacionados con los orígenes, funciones, estructura, estrategias, desempeño del empresariado* [research in business history revolves around economic and social processes related to the origins, functions, structure, strategies and performance of entrepreneurship] (p. 64). He proposed verifying the scenarios of those economic business processes that facilitate the measurement and optimization of production processes in the manufacture of products in a timely manner, considering in the first instance the quality of the product to build customer loyalty. The operational capacity and the goal of the company are oriented to production efficiency. To develop good manufacturing practices and achieve adequate performance of activities, preventive and predictive maintenance must be performed and control measures must be implemented.

Delfín and Acosta (2016) define a visionary leader as one who possesses the mental image of a desired future to describe new opportunities for the organization. Formal management training programs include the development of skills to solve problems and make decisions in the organizational structure, which makes it possible to establish a system of operational reliability, which highlights each area of the company that is aligned to the chain of command, control, monitoring, scope, and specialization of work as a model for decision making, which leads to continuous improvement of the business chain at the company.

Maintenance enables the formulation of strategies that respond to new expectations; these include awareness to analyze and evaluate the failure points of equipment, machinery and vehicles that affect safety, the environment, and energy consumption. This makes it possible to identify management characteristics and classify them in the data analysis for service, product, communication and customer satisfaction management for the operational reliability engineering structure (Espinosa et al., 2020).

Palomo (2014) details the importance of optimizing to the maximum all resources available to the organization, which will enable the implementation of techniques and tools to make timely decisions. Adequate analysis and management of processes will make it possible to make appropriate decisions and maximize the value of the company. Control measures will make it possible to establish key factors to determine the characteristics of operational risk controls that will make it possible to maximize the use of resources. The establishment of control parameters will make it possible to implement the organizational strategy to determine guidelines for continuous improvement.

Integral Control for Business Management of Operational Reliability Engineering

Operational reliability engineering is becoming increasingly important and builds credibility and trust, as it seeks sustainability (1) in meeting expectations regarding the use of various analysis tools available to the company to improve stakeholder management and (2) in the effectiveness that is linked to the results achieved and proposed according to the degree of compliance with planned objectives, such as the quantity to be produced, the purchase order to be placed, the customer to be obtained, the change in effectiveness and efficiency.

Acuña (2003) details that reliability makes it possible to establish the probability that the product unit will perform satisfactorily in a given period of time under previously specified conditions. It values the impact of the product or service provided by the company, both in quantity and quality, which is required to satisfy the customer and expand the market segment,

since a high-quality product is necessary for sustainable development.

As shown in Figure 3, operational reliability engineering must be committed to all the collaborators and managers that need to be linked in the departments or processes to coordinate efforts, by means of communication lines, as well as to delimit responsibilities and jobs according to the specific position, so that a new structure can be designed in the internal and external organization. In this way, processes are enhanced in search of maximum efficiency to maintain competitiveness in markets.

Cameron and Quinn (2011) show an approach to cultural change that is based on company differentiation and framing approaches to the total productive maintenance structure. The companies work under chains of command or a horizontal and vertical diagram in which there is an expert per field. The organization adopts a department-by-function strategy, which is a structural and multi-divisional diversification strategy that exists in direct relation to the structure of factor strategies influencing operational reliability engineering.

Mesa, Ortiz and Pinzón (2006) present reliability as the probability that a failure does not occur within the production process, with a given confidence level for a given model. Likewise, reliability identifies the availability of the company to determine interrelation standards, norms, guidelines and a regulation in the organization in order to achieve the objectives of operational reliability engineering.

Reliability-centered maintenance makes it possible to use the methodology for a systematic analysis applicable to any type of industrial facility in the development or optimization of an efficient preventive maintenance plan that is based on a vertical fault tree analysis or an essential principle, with an organizational advantage, with a simple and easy to understand structure that facilitates the implementation and stability of the activities that are directly and indirectly related to the objectives of the company (Diaz et al., 2016).

METHODOLOGY

This work is an exploratory study with a methodological approach, which collects data from different aspects of the reliability engineering system of the company. Thus, through this design, it is possible to perform a measurement analysis of improvements with the implementation and description of the behavior of the variables under study since this design allows to expose in detail the knowledge from the point of view of operational reliability engineering for business development. It is intended to have an impact on decision making through research

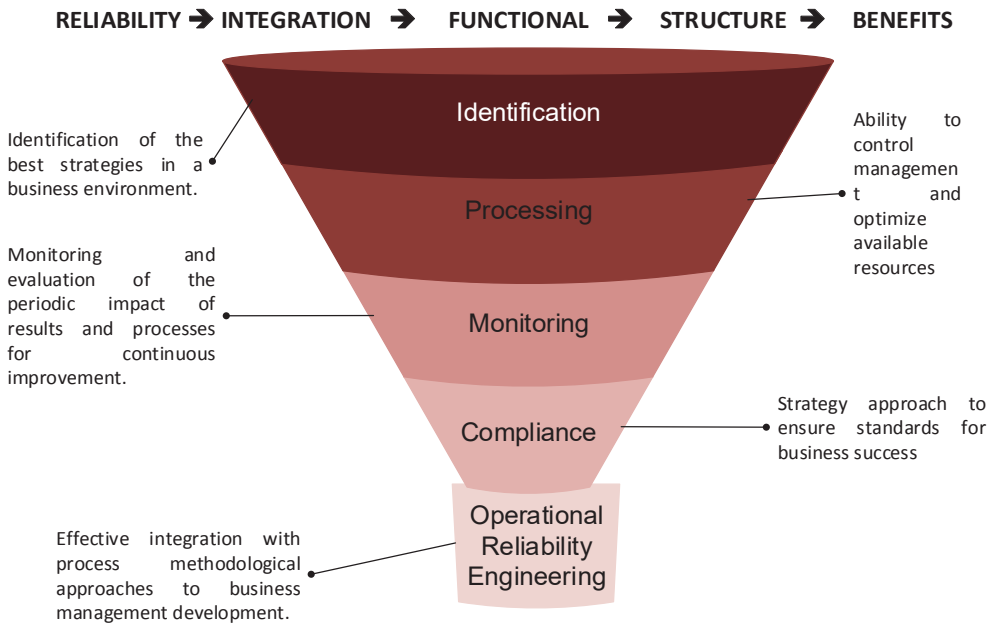

Figure 3. Operational Reliability Engineering Funnel Chart.

Source: Prepared by the author.

that allows building elements that help to identify the analysis and diagnosis characteristics of all the vehicles of the company under study.

The research presents a quantitative and non-experimental approach to collect data and information from the company, which allows for an analysis and diagnosis focused on the vehicles of the company. The units of analysis are determined in the diagnostic systems; thus, through a prioritization analysis, immediate solutions are proposed to help fulfill the functions for which the vehicles have been acquired.

During the research process, the redesign of the reliability process should be considered for continuous improvement through sustainable business development, since it enables the determination and establishment of control parameters that optimize available resources and incorporate tools for the adequate performance of the assets, which enables the effective and efficient use of the operational system.

Considering the actions of maintenance personnel to determine the risk of vehicles in operations allows maintenance management to expand and optimize company productivity and sustainable development. The research proposed in this paper makes it possible to make optimal decisions to expand capabilities in the development of operational reliability engineering, which in turn makes it possible to evaluate business management in a comprehensive, systematic way and to take advantage of opportunities that arise in the company.

The degree of competitiveness of the company is a key factor in its development. Efficient and timely business decision making allows the evaluation in different areas of the company for the development of the proposed management model. The key importance of the evaluation of the company's situation lies in the fact that it facilitates the detection of existing problems and the establishment of priorities to understand strengths and weaknesses that allow for the measurement of the productive performance of its economic activity.

RESULTS

The probability per kilometer of all vehicles proposed by the model of a processing information system to be considered as the reference point of any analysis in the risk assessment of operational reliability engineering for business development was detailed. This model was very useful and served as a support to business management by facilitating the achievement of the objectives obtained in this study to develop a pilot test with the purpose of evaluating the operational reliability engineering model of the maintenance area.

Table 1 shows that the statistical model of the research consisted of the cost of internal and external maintenance according to the function of service hours or mileage, depending on the vehicles.

Table 1. *Costs of Internal and External Vehicle Maintenance Work Orders per 5000 Kilometers Using the Data System.*

Vehicles	Internal	External
1	S/ 865	S/ 1085
2	S/ 915	S/ 1125
3	S/ 985	S/ 1140
4	S/ 995	S/ 1390
5	S/ 1005	S/ 1405

Source: Prepared by the author.

Figure 4 shows the variability of the central 50% of the internal and external maintenance cost. It is observed that external maintenance is higher than internal maintenance, that the distribution of maintenance costs is asymmetric and that there is no presence of outliers considering external maintenance. They differ in the characteristics of specialization, calibration, time, immediate results, quality, and safety.

Hypothesis Testing

The internal and external maintenance of the company are compared using Student's *t*-test for independent samples.

$$H_0: \mu_1=\mu_2$$

$$H_1: \mu_1\neq\mu_2$$

Before reviewing the comparison of averages of both maintenance varieties, the normal distribution and homogeneity of variances were calculated.

RStudio 4.1.0 software was used to perform an analysis of the commands, which is detailed below:

Normality of the Data

H_0: El costo de mantenimiento Interno se ajusta en una distribucion normal

H_1: El costo de mantenimiento Interno no se ajusta en una distribucion normal

H_0: El costo de mantenimiento Externo se ajusta en una distribucion normal

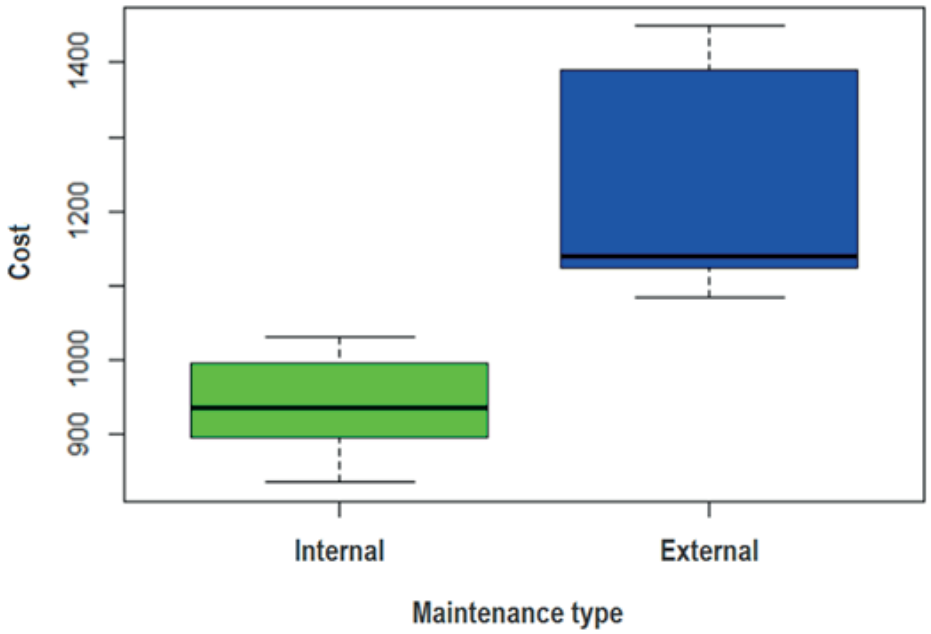

Figure 4. **Boxplot**.

Source: Prepared by the author with data taken from RStudio 4.1.0.

H_1: El costo de mantenimiento Externo no se ajusta en una distribucion normal

Table 2. *Verification of Normality.*

Verification of Normality
Shapiro-Wilk normality test
data: Internal
W = 0.9785, *p*-value = 0.9264
data: External
W = 0.82507, *p*-value = 0.1277

Source: Prepared by the author, data taken from RStudio 4.1.0.

As shown in Table 2, the p-value in both maintenance is greater than the reliability level (=0.05). Therefore, the cost of internal and external maintenance conforms to a normal distribution.

Homogeneity of Variances

$$Ho: \frac{\sigma_1^2}{\sigma_2^2} = 1$$

$$H_1: \frac{\sigma_1^2}{\sigma_2^2} \neq 1$$

Table 3. *Homogeneity of Variances.*

```
F test to compare two variances
Data: Interno and Externo
F=0.21484, num df=4, denom df=4,
p-value=0.1655
Alternative hypothesis: true ratio
of variances is not equal to 1
95 percent confidence interval:
0.02236906 2.06347811
Sample estimates: ratio of variances
0.2148443
```

Source: Prepared by the author, data taken from RStudio 4.1.0.

Table 3 shows the decision criterion: H_0 is rejected if *p*-value < 0.05. Since *p*-value = 0.1655, greater than = 0.05, H_0 is not rejected. Therefore, it is concluded that there is homogeneity of variances in the cost of internal and external maintenance.

Student's T-Test for Independent Samples

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S_p^2 * (\frac{1}{n_1} + \frac{1}{n_2})}}$$

Comparison of Internal and External Maintenance

$H_0: \mu_1=\mu_2$

$H_1: \mu_1\neq\mu_2$

Table 4. *Maintenance Comparison.*

```
Two Sample t-test
Data: Interno and Externo
t=-3.6097, df=8, p-value=0.006884
alternative hypothesis: true differ-
ence in means is not equal to 0
95 percent confidence interval:
-490.9925 -108.2075
Sample estimates:
mean of x mean of y 938.2 1237.8
```

Source: Prepared by the author, data taken from RStudio 4.1.0.

Table 4 shows the decision criterion: H_0 is rejected if *p*-value < 0.05. Since *p*-value = 0.0006884, lower than α = 0.05, H_0 is rejected. Therefore, it is concluded that there are significant differences between internal and external maintenance costs. It was observed that the average external maintenance cost of S/. 938.20 soles were lower than the internal maintenance cost of S/. 1238 soles.

DISCUSSION

This model of reliability failure rates of maintenance engineering has the execution processes as its main structure, whose failures were caused by the lack of controls and indicators and inadequate management. In most cases, the failure of maintenance management is attributed to the factor of lack of knowledge of the defects during the processes (Valdivieso, 2010). For Moubray (2004), the designation of evaluation criteria in the maintenance processes that focus on the guarantee of operation of the organizational structure will establish the number of resources required to be able to carry out the functions of each area or process more effectively and efficiently, fulfilling the objectives for reliability engineering.

A series of improvements were identified in the development of a reliability management system that make it possible to mitigate failures in the maintenance processes with a higher frequency of training in the maintenance areas. Thus, it was possible to generate a continuous improvement plan and optimize operational processes to analyze and visualize the strategy and objectives that are linked to market needs or to the change of the structural model for new needs in compliance with the organizational strategy. The growth factors are favorable for the company because it can offer a lower price than the market, which will allow it to attract more customers without affecting its profit margin (Villegas, 2016).

CONCLUSIONS

It can be concluded that today's entrepreneurs need an operational reliability model for economic growth and sustainable development. This has been demonstrated by Student's t-test on an independent sample, over a period of 6 months, in the comparison of internal and external maintenance, considering specific operating conditions of temperature, oil viscosity, speed, air filter, engine filter, oil filter and vibration level.

There are significant differences in internal and external maintenance costs taking into consideration a systematic diagnosis of the data.

It is concluded that the external maintenance costs were higher than the internal maintenance costs, so it is necessary to take action and implement an operational reliability system.

A systematic analysis should be carried out to reduce maintenance costs in the operational processes.

It is concluded that an organizational structure is required to establish optimal levels with special emphasis on operational reliability, and thus optimize time to ensure product quality.

RECOMENDATIONS

Establish updated information for operational reliability policies and procedures.

Avoid gaps in processes to ensure quality, time, and confidence.

Establish autonomous training according to the responsibilities and obligations of the members of the company.

Implement objectives and goals to generate a proactive attitude of objectives and results.

Actively anticipate planned activities to meet goals and achieve accomplishments.

Formulate the organizational structure for business success.

Implement the change of new factors within the environment variable approach.

Determine a strategic structure for preventive maintenance.

Implement a matrix structure to facilitate the coordination of information exchange within the hierarchical line.

REFERENCES

[1] Acuña J. (2003). *Ingeniería de confiabilidad*. Cartago, Costa Rica: Editorial Tecnológica de Costa Rica.

[2] Aguilar O., Torres, R., & Magaña D. (2010) Análisis de modos de falla, efecto y criticidad (AMFEC) para la planeación del mantenimiento empleando criterios de riesgo y confiabilidad. *Revista Tecnología, Ciencia, Educación,* 25(1), 15-26.

[3] Berman, S. (2012). Digital transformation: opportunities to create new business models. *Strategy & Leadership, 40*(2), 16-24. https://doi.org/10.1108/10878571211209314

[4] Cameron, K., & Quinn, R. (2011). *Diagnosing and Changing Organizational Culture*. San Francisco, CA, EE. UU.: Jossey Bass.

[5] Chiavenato, I. (2004). *Comportamiento Organizacional. La dinámica del éxito en las organizaciones*. México D. F., México: Mcgraw-Hill/Interamericana Editores, S.A. de C.V.

[6] Cohen, D., & Asín, E. (2004*). Sistemas de información para los negocios: Un enfoque para la toma de decisiones* (3ª ed.). México D. F., Mexico: McGraw-Hill/Interamericana Editores, S.A. de C.V.

[7] Cutipa, E., Mera, M., Pimentel, M., & Varillas, A. (2018) *Servicio de mantenimiento preventivo de vehículos por plataforma digital: "Car Xpress"*. (Undergraduate thesis). Universidad Peruana de Ciencias Aplicadas, Lima.

[8] David, F. (2013). *Conceptos de administración estratégica (14a ed.)*. Naucalpán de Juárez, Mexico: Editorial Pearson.

[9] Delfín, L., & Acosta, M. (2016). Importancia y análisis de desarrollo empresarial. *Pensamiento & Gestión*, (40), 184-202.

[10] Diaz, A., Villar, L., Cabrera, G., Gil A., Mata R., & Rodríguez A. (2016) *Implementación del mantenimiento centrado en la confiabilidad en empresas de trasmisión eléctrica, 19*(3), 137-142.

[11] Espinosa J., De la Paz, E., Pérez, R., & Acosta, I. (2020) Contribución del mantenimiento centrado en la confiabilidad para el estudio de fallos a equipo consumidores de energía eléctrica. *Revista Centro Azúcar*, *47*(1),22-32.

[12] Lascurain, M. (2017). Challenges of Economic Globalization. *Revista de Relaciones Internacionales, Estrategia y Seguridad, 12*(1), 23-50. http://dx.doi.org/10.18359/ries.2462

[13] Girón, J. (2007). *Propuesta de un plan de mantenimiento para los vehículos repartidores de gas único, S.A. (DAGAS, S.A.)*. (Trabajo de graduación). Universidad de San Carlos Guatemala, Guatemala.

[14] Grueso, M., & Toca, C. (2012). *Área funcional para la reflexión marketing y recursos humanos*. Bogotá, Colombia: Editorial Universidad del Rosario.

[15] Heredero, C., Agius, J., Romero, S., & Salgado, S. (2012). *Organización y transformación de los sistemas de información en la empresa*. Madrid, Spain: ESIC Editorial.

[16] Jacobs, F. (2007). Enterprise resource planning (ERP) A brief history. *Journal of Operations Management, 25*(2), 357-363. https://doi.org/DOI:10.1016/j.jom.2006.11.005

[17] Mesa, D., Ortiz Y., & Pinzón M. (2006). La confiabilidad, la disponibilidad y la mantenibilidad, disciplinas modernas aplicadas al mantenimiento. *Scientia Et Technica*, *12*(30), 155-160.

[18] Mielgo, N., Montes, J. & Vázquez, C. (2007). *Cómo gestionar la innovación en las Pymes*. La Coruña, España: Netbiblo.

[19] Mintzberg, H. (2004). Directivos, no MBA's: *Una visión crítica de la dirección de empresas y la formación empresarial.* Barcelona, Spain: Ediciones Deusto.

[20] Montilla C., Arroyave J., & Silva, C. (2007). Caso de aplicación de mantenimiento centrado en la confiabilidad RCM, previa existencia de mantenimiento preventivo. *Scientia et Technica, 1*(37), 273-278.

[21] Moscoso, R. (2017) *Programa de control del mantenimiento proactivo y correctivo en equipos mecánicos del transporte de hidrocarburos en el Ecuador.* (Tesis doctoral). Universidad Nacional Mayor de San Marcos, Lima.

[22] Moubray, J. (2004). *Mantenimiento centrado en la confiabilidad* (2ª ed.). Spain: Aladon Ltd.

[23] Padilla, C. (2012). *Plan de gestión del mantenimiento para la flota vehicular del gobierno autónomo descentralizado intercultural de la ciudad de Cañar*. (Undergraduate thesis). Universidad Politécnica Salesiana Sede Cuenca, Cuenca.

[24] Palomo, M. (2014). *Liderazgo y motivación de equipos de trabajo* (8ª ed.). Madrid, Spain: ESIC.

[25] Quispe, J. (2017) *Propuesta de un modelo de gestión de mantenimiento para un establecimiento de venta al público de GNV*. (Undergraduate thesis). Universidad Nacional Mayor de San Marcos, Lima.

[26] Schroeder, R., Meyer, S. y Rungtusanatham, M. (2013) *Administración de operaciones: Conceptos y casos contemporáneos (5ª ed.)*. México, D. F., México: Editorial Mc Graw Hill.

[27] Schwertner, K. (2017). Digital transformation of business. *Trakia Journal of Sciences*, *15*(1), 388-393. https://doi.org/10.15547/tjs.2017.s.01.065

[28] Socconini, L. (2014) *Lean company: Mas allá de la manufactura*. Ciudad de México, México: Norma Ediciones.

[29] Tanta, R. (2017). *Implementación de un sistema de gestión de mantenimiento preventivo aplicado a los vehículos Hyundai Acent, en la empresa AUTOTAN Ingeniería E. I. R. L., Distrito de Ate-Vitarte, ciudad Metropolitana de Lima, 2016*. (Informe de suficiencia profesional). Universidad Tecnológica del Perú, Lima.

[30] Valdivieso, J. (2010) *Diseño de un plan de mantenimiento preventivo para la empresa EXTRUPLAS S.A.* (Undergraduate thesis). Universidad Politécnica Salesiana Sede Cuenca, Cuenca.

[31] Villegas, J. (2016). *Propuesta de mejora en la gestión del área de mantenimiento, para la optimización del desempeño de la empresa Manfer S.R.L. Contratistas Generales, Arequipa 2016*. (Undergraduate thesis). Universidad Católica San Pablo, Arequipa.

[32] Zapata, C. (2011). *Confiabilidad en ingeniería*. Pereira, Colombia: Universidad Tecnológica de Pereira.

[33] Ziyadin, S., Suieubyeva S., & Utegenova A. (2020). Digital Transformation in business. En Ashmarina, S., Vochozka, M., Mantulenko, V. (Eds.), *Digital Age: Chances, Challenges and Future* (pp. 408-415). Cham, Switzerland: Springer. https://doi.org/10.1007/978-3-030-27015-5_49