Polo del Conocimiento

Pol. Con. (Edición núm. 92) Vol. 9, No 3
Marzo 2024, pp. 2250-2279
ISSN: 2550 - 682X
DOI: 10.23857/pc.v9i3.6787

Characterization of small metalworking industries and diagnosis of the management of physical assets in the company induhorst cía ltda of quevedo canton, year 2022

Caracterización de las pequeñas industrias metalmecánicas y diagnóstico de la gestión de activos físicos en la empresa induhorst cía ltda del cantón quevedo, año 2022

Caracterização de pequenas indústrias metalúrgicas e diagnóstico da gestão de ativos físicos na empresa induhorst cía ltda no cantão de quevedo, ano 2022

Miguel Angel Briones Espinoza [I]
mbriones3206@utm.edu.ec
https://orcid.org/0009-0009-3090-2762

Kelvin Diego Moposita Ortega [II]
kmopositao@uteq.edu.ec
https://orcid.org/0000-0002-1032-8558

Walter Joffred Jácome Veléz [III]
wjacomev@uteq.edu.ec
https://orcid.org/0000-0002-5722-9899

Jeyson Patricio Egas Garcia [IV]
jegasg@uteq.edu.ec
https://orcid.org/0000-0002-0064-8638

Correspondencia: mbriones3206@utm.edu.ec

Ciencias Técnicas y Aplicadas
Artículo de Investigación

*** Recibido:** 30 de enero de 2024 ***Aceptado:** 22 de febrero de 2024 *** Publicado:** 15 de marzo de 2024

I. Universidad Técnica de Manabí, Portoviejo, Ecuador.
II. Universidad Técnica Estatal de Quevedo, Quevedo, Ecuador.
III. Universidad Técnica Estatal de Quevedo, Quevedo, Ecuador.
IV. Universidad Técnica Estatal de Quevedo, Quevedo, Ecuador.

Resumen

Este proyecto de investigación se enfoca en la identificación y caracterización de pequeñas empresas metalmecánicas, centrándose específicamente en la empresa INDUHORT CÍA LTDA ubicada en el Cantón Quevedo. El objetivo primordial es realizar un diagnóstico de la gestión de activos físicos (GAF) en dicha empresa y proponer mejoras congruentes con la familia de normas ISO 55XXX (000, 001, 002) (Sanchez, 2010). La identificación de las pequeñas empresas metalmecánicas en Quevedo se llevó a cabo mediante investigación de campo, tomando en consideración el número de trabajadores según la resolución de la Comunidad Andina de Naciones. Se identificaron tres empresas que cumplen con los criterios establecidos y están reguladas por la Superintendencia de Compañías. La caracterización de estas empresas se realizó mediante entrevistas con gerentes generales, revelando que INDUHORST CÍA LTDA presenta una gestión de mantenimiento más organizada. El diagnóstico aplicado mediante entrevistas en esta empresa indica que actualmente solo se está gestionando la etapa de mantenimiento, lo que lleva a proponer mejoras basadas en las normas ISO 55xxx (000, 001 y 002) (Sola R & Crespo M, 2016). Se sugiere fortalecer la gestión de mantenimiento antes de implementar la gestión de activos físicos desde la generación hasta el final de la vida del activo, conforme a la norma ISO 55000. Además, se recomienda que INDUHORST CÍA LTDA desarrolle un proyecto de "mejoramiento de la gestión de los activos físicos" mediante la contratación a terceros, después de fortalecer la gestión de mantenimiento.

Palabras Clave: activos; gestión de activos; pequeña empresa.

Abstract

This research project focuses on the identification and characterization of small metalworking companies, specifically focusing on the company INDUHORT CÍA LTDA located in the Quevedo Canton. The primary objective is to carry out a diagnosis of physical asset management (GAF) in said company and propose improvements consistent with the ISO 55XXX (000, 001, 002) family of standards (Sanchez, 2010). The identification of small metalworking companies in Quevedo was carried out through field research, taking into consideration the number of workers according to the resolution of the Andean Community of Nations. Three companies were identified that meet the established criteria and are regulated by the Superintendence of Companies. The characterization of these companies was carried out through interviews with general managers,

revealing that INDUHORST CÍA LTDA presents a more organized maintenance management. The diagnosis applied through interviews in this company indicates that currently only the maintenance stage is being managed, which leads to proposing improvements based on ISO 55xxx standards (000, 001 and 002) (Sola R & Crespo M, 2016). It is suggested to strengthen maintenance management before implementing the management of physical assets from generation to the end of the asset's life, in accordance with the ISO 55000 standard. In addition, it is recommended that INDUHORST CÍA LTDA develop a "improvement of the management of physical assets" by contracting out third parties, after strengthening maintenance management.

Keywords: assets; asset Management; small company.

Resumo

Este projeto de pesquisa tem como foco a identificação e caracterização de pequenas empresas metalmecânicas, com foco específico na empresa INDUHORT CÍA LTDA localizada no Cantão de Quevedo. O objetivo principal é realizar um diagnóstico da gestão de ativos físicos (GAF) na referida empresa e propor melhorias consistentes com a família de normas ISO 55XXX (000, 001, 002) (Sanchez, 2010). A identificação das pequenas empresas metalmecânicas em Quevedo foi realizada através de pesquisa de campo, levando em consideração o número de trabalhadores conforme resolução da Comunidade Andina de Nações. Foram identificadas três empresas que atendem aos critérios estabelecidos e são regulamentadas pela Superintendência de Empresas. A caracterização destas empresas foi realizada através de entrevistas com gerentes gerais, revelando que a INDUHORST CÍA LTDA apresenta uma gestão de manutenção mais organizada. O diagnóstico aplicado por meio de entrevistas nesta empresa indica que atualmente apenas a etapa de manutenção está sendo gerenciada, o que leva a propor melhorias com base nas normas ISO 55xxx (000, 001 e 002) (Sola R & Crespo M, 2016). Sugere-se fortalecer a gestão da manutenção antes de implementar a gestão dos ativos físicos desde a geração até o fim da vida útil do ativo, de acordo com a norma ISO 55000. Além disso, recomenda-se que a INDUHORST CÍA LTDA desenvolva uma "melhoria da gestão de ativos físicos" através da contratação de terceiros, após fortalecer a gestão da manutenção.

Palavras-chave: ativos; gestão de ativos; pequena empresa.

INTRODUCCION

This research focuses on the meticulous identification and characterization of small metal-mechanical companies, concentrating its analysis efforts on the company INDUHORT CÍA LTDA, strategically located in the Quevedo Canton. The main purpose is to carry out an exhaustive diagnosis of the management of physical assets (GAF) in this entity and to propose improvements that are rigorously aligned with the standards of the ISO 55XXX family (000, 001, 002) (Torres, 2015). The process of identifying these companies was developed through field research, meticulously adjusted to the parameters established by the Andean Community of Nations. This approach resulted in the identification of three companies that meet the defined criteria and are regulated by the Superintendency of Companies.

The detailed characterization of these companies was carried out through interviews with general managers, revealing with precision that INDUHORST CÍA LTDA exhibits a particularly well-organized maintenance management. The application of diagnostics through additional interviews in this company yielded conclusive results: the current management addresses only the maintenance stage. In response to this finding, it is suggested to implement improvements based on ISO 55xxx standards (000, 001 and 002). The specific proposal is to strengthen maintenance management before introducing physical asset management, in strict accordance with the principles established by ISO 55000 (Novillo, 2013).

In addition, it is recommended that INDUHORST CÍA LTDA develop a specific "physical asset management improvement" project through outsourcing, a strategy that would be implemented after consolidating maintenance management. This approach seeks to maximize effectiveness and efficiency in the management of physical assets through a robust methodology.

In a broader temporal context, asset management has become a crucial discipline to optimize the management of physical assets in Quevedo's small metalworking industries. This process seeks to improve the relationship between risks, costs and performance throughout the asset life cycle. In asset-intensive operations, asset reliability, availability, efficiency, maintenance and safety play a key role in achieving sustainable profitability.

This work not only aims to obtain a detailed characterization of the small metalworking companies in Quevedo and a comprehensive diagnosis of the management of physical assets in INDUHORST CIA LTDA, but also to establish an auditable reference framework according to ISO 55000. The implementation of this framework will not only allow to evaluate the current status, but will also

guide each evaluation towards an analysis focused on preventing and improving the existing system, thus promoting continuous improvement in the management of physical assets.

Ultimately, physical assets, which include basic and specialized technological systems that support the operations of these companies, play a critical role. Their detailed attention throughout the life cycle is essential to determine and contribute to the long-term competitiveness and sustainability of these companies in the metal-mechanic sector (Vera, 2020).

METHODOLOGY

Type of research

This is a diagnostic research to perform a characterization of the small metal-mechanic industries and to make a diagnosis of the management of physical assets in the company INDUHORST CÍA LTDA.

Field research

This research was conducted through the interview technique applied by means of the interview guide instrument in which situations that could be observed were recorded by capturing relevant data provided by primary sources such as general managers of small metalworking companies in the canton of Quevedo and the head of maintenance of the company INDUHORST CIA LTDA, in order to obtain data and documents to develop the research.

Research methods

Deductive method

This method was used in the study of the theoretical underpinnings at the global and local levels to argue the development of the research.

Analytical method

It consisted of the analysis of each of the results obtained in the interviews that allowed obtaining conclusive data for the development of the research proposal.

Synthetic method

This method was applied to synthesize the summary of the document, conclusions and recommendations.

Sources of information gathering

Primary sources

The primary source was used since it allowed the collection of information through the research, to obtain data from the general managers and maintenance chief of the small metal-mechanic industries, since they contribute with valuable information for the research.

Secondary sources

Secondary source was used for this research work since already existing information such as scientific articles were used in order to reveal research results in a clear and concise manner and similar theses on asset management.

Research design

Non-experimental design

This design was used in the development of this research because the research is based on theoretical support taken from undergraduate and graduate theses, scientific articles and journals. The improvement approach is based on the general aspects for asset management and asset management systems provided by the ISO 55000 standard; also the ISO 55001 standard specifies the requirements to establish, implement, maintain and improve asset management and the ISO 55002 standard provides the guidelines for asset management according to the requirements specified in 55001 (Tholana & Neingo, 2016).

Research instruments

Interview

The interview technique was used by means of the instrument "interview guide" applied to the general managers of the small metal-mechanic companies identified to know the maturity level of their companies and to the maintenance manager of INDUHORST CÍA LTDA, so questions were elaborated to know if maintenance is managed.

RESULTS

Identification of small companies in the metal-mechanic sector in the canton of Quevedo

To begin with the development of the research we will start with the identification of the small metal-mechanical companies in the canton of Quevedo, for which we classified the companies that belong to this sector:

Classification of small metal-mechanical companies

According to the characteristics of small metalworking companies in the canton of Quevedo there are three entities that belong to this sector which are detailed below:

Table 1. Classification of small metalworking companies

N.	NAME	ADDRESS	ACTIVITY
1	INDUHORST CÍA. LTDA.	Km. 2 ½ Via Valencia, in front of tropifrutas	Manufacture, maintenance of machinery used to prepare soils and plants
2	MAQGRO CÍA. LTDA	Km 1 ½ Via Buena Fe, next to the Eloy Alfaro school	Manufacture of agro-industrial machinery
3	JATARIG CÍA. LTDA	Km. 7 Via Mocache, at the foot of the main road	Manufacture of agro-industrial machinery

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

To obtain this information and classify the small companies that belong to this sector, the size of the company, number of workers and consequently they are not artisanal micro-companies must be taken into account. One of the parameters to be measured is the level of maturity of the small metal-mechanical companies, for which 4 levels were determined:

- Level 1 vulnerable; this level is obtained when the company is very sensitive to changes.
- Level 2 stable; this level remains unchanged, its purpose is to be present and to comply.
- Level 3 growth; characterized by applying new trends, seeking knowledge to make better use of resources and have less organizational waste.
- Level 4 continuous improvement; characterized by having a strong organizational culture attached to leadership, values and strategies.

For the collection of information on the maturity level in small metalworking industries, we started with the information established by (Montaño, Corona, & Gomez, 2018), which identifies the

various requirements and factors to be considered for each of them, as detailed in the following table:

Table 2. Maturity levels of small companies

	Maturity Level			
Requirement (R)	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Generally the interest of senior management is to go from little by little as the company the company grows, adopt policies, regulations, regulations and instructions into accordance and the constitution, your Will constitution, do you consider that this is done this is done to improve your company the following: (R1)	Customer satisfaction and satisfaction and to meet the requirements of control control	Individuals and certain other interested parties (business organizations, governmental agencies, etc.).	For the improvement balanced improvement of needs of stakeholders stakeholders already identified	To improve or innovate your machines and the satisfaction of a few customers
What is the focus of leadership (R2)	It is reactive and is based on top-down instructions	It is reactive and base don the decisions of managers at different levels of management.	It is proactive and relies on delegation of decisión-making authority.	It is proactive with a high participation of the people of the organization in decisión making.

Decisions made on what situations are based (R3)	Decisions are based on informal inputs from the marketplace and other sources	Decisions are based on customers' needs and expectations	Decisions are based on strategy and are linked to stakeholder needs and expectations	Decisions are based on the deployment of the strategy in the operational needs and processes.
What resources are needed to achieve results? (R4)	Resources are managed on a case-by-case basis	Resources are managed efficiently	Resources are managed efficiently	Resources are managed efficiently and taking into account their individual scarcity
How are the activities organized (R5)?	There is a system to organize the activities (software, instructions, manual, guide, internal regulations, etc.).	Activities are organized by function	Activities are organized in an asset management system based on effective processes that allow for flexibility.	Any physical asset that is within the company has some software that manages input and output.
How are the results of customer satisfaction, of innovation studies,	The results are obtained randomly.	Certain expected results are achieved, among	There are especially for identified stakeholders	expected, positive and consistent

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

others, achieved? (R6)			results, with sustainable trend
What are the priorities for improvement based on? (R7)	Based on errors, complaints or customer satisfaction data or on corrective and preventive actions	Based on the needs and expectations of stakeholders, as well as those of the company's people.	They are based on trends and input elements, as well as on the analysis of social and environmental changes.

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Characterization of the small metal-mechanical company MAQGRO CÍA LTDA

MAQGRO CÍA LTDA is an industrial company created to manufacture and commercialize agricultural, wood, food and construction machinery. It was created on January 1, 2006 with the purpose of keeping in permanent evolution and development in the competitive markets becoming one of the best companies in terms of machinery production, which has allowed the company to constantly renew its technology in such a way that it achieves the highest standards of quality and efficiency with the products it manufactures.

Objectives

General Objective

- To manufacture machinery that allows day by day to innovate the technology to visualize its better development in diverse areas that can be used in related situations and that allow to maintain the growth in the market.

Specific Objectives

- Quantify the company's investments and profits.
- To always train the personnel so that they can perform better in their functions.
- Constantly innovate technology

Mission

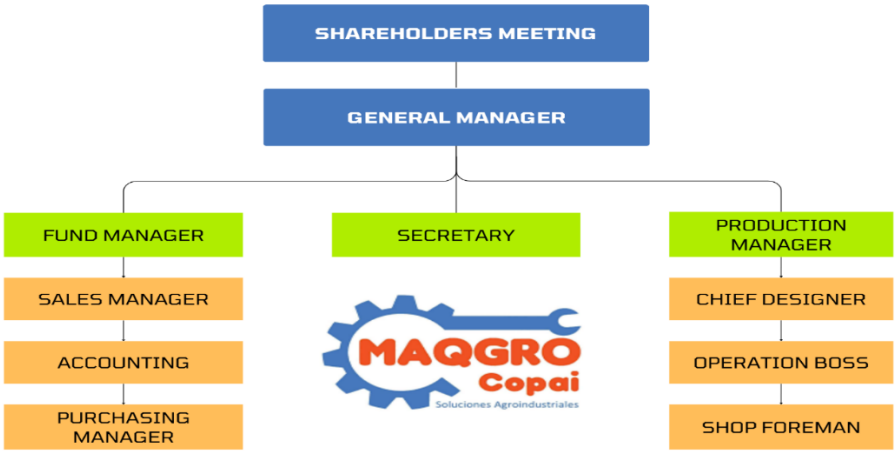
To manufacture and commercialize machinery for agribusiness in order to satisfy the countless needs of farmers, improving quality and efficiency, as well as the innovation of the personnel involved in production.

Vision

It is aimed at satisfying the internal demand for small, medium and large farmers, implementing high standards of quality and innovation in its products in order to compete with the foreign market.

Organizational Structure

Figure 1. Organizational structure of MAQGRO CÍA LTDA.



SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Results of the interview technique applied to Mr. Marco Gilberto García Sangoquiza, general manager of the small company MAQGRO CÍA LTDA.

Deduction of the maturity level

Table 3. Analysis of maturity levels MAQGRO CÍA LTDA

Requirement (R)	Level 1	Level 2	Level 3	Level 4
R1			x	
R2				x
R3		x		
R4	x			
R5		x		

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

R6	x
R7	x

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Analysis: The behavior of the maturity levels of the requirements can be evaluated as low, if we consider that 71% reach levels lower or equal to 2, four of them are classified in level 2 and one requirement in level 1. Requirement R4 of resource management reaches the lowest level, which results in a disadvantage in asset management. On the other hand, R5 linked to the organization of the company is at level 2, an essential element for good asset management. The results displayed are close to a "stable" rating for the company, with the consideration that two requirements of importance reach very low values.

Maintenance organization

- **Factor: technical documentation**

Analysis: As indicated above, there is no maintenance plan and therefore no technical documentation is managed.

- **Factor: Equipment history**

Analysis: Although there is no maintenance plan, the interviewee states that there is an equipment history and that it is generally updated every 3 months; however, from the answers to the questions it is clear that most of the equipment and machinery involved in the production process do not have a maintenance history (preventive and corrective); in other words, only a few pieces of equipment such as compressors, plasmas and drills are monitored and their maintenance service is outsourced.

- **Factor: Follow-up of work orders**

Analysis: The lack of a maintenance plan results in the non-existence of the maintenance work order and consequently there is no way to manage it.

- **Factor: Budget distribution**

Analysis: It was mentioned earlier that certain equipment and machines are taken to another company for maintenance (outsourcing), so there is a maintenance budget.

- **Factor: Planning and scheduling of maintenance activities.**

Analysis: This factor is directly related to maintenance planning; therefore, this factor is not met in the small company.

- **Factor: control of materials and spare parts**

Analysis: This factor is met because there is a software and an official (warehouse manager) who carries out this control, but above all, the raw material to be used is controlled.

- **Factor: Control of maintenance costs**

Analysis: There is only a budget to cover the costs of outsourced maintenance.

- **Factor: Management index**

Analysis: Since there is no maintenance planning, this factor is not applied in the small company; therefore, there is a lack of knowledge of maintenance management.

- **Factor: Contracting policies**

Analysis: In the case of this factor, there is only a contracting policy "by mutual agreement with the outsourcing company".

- **Factor: Contractor selection**

Analysis: As in the previous factor, only the contractor is selected in the case of outsourced maintenance according to experience and maintenance needs; generally these outsourcing companies are from Quito and Guayaquil.

- **Factor: Control at reception**

Analysis: For this factor, the equipment is tested by the operator who is a specialist in handling the equipment.

- **Factor: Warranty**

Analysis: In terms of warranty, the companies generally guarantee the work performed in accordance with the cost, brand, and time of acquisition of the equipment.

Characterization of the small metal-mechanical company INDUHORST CÍA LTDA

INDUHORST CÍA LTDA, develops and supplies complete equipment for grain treatment from harvesting to dry and clean storage, including all loading and unloading, drying and cleaning equipment. It is also dedicated to the commercialization of equipment and spare parts that are designed and produced in the facilities of the producers Jatun Huayra, Mephisto and M.C.M. The materials used are of first quality under the brands of recognized worldwide prestige.

Objectives

- Fulfill customer requirements ensuring a high level of customer satisfaction.

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

- Implement technological innovations for the benefit of the customer and the company.
- Seek continuous improvement through ongoing staff training.
- Maintain a process management system certified by the ISO 9001 standard.

Mission

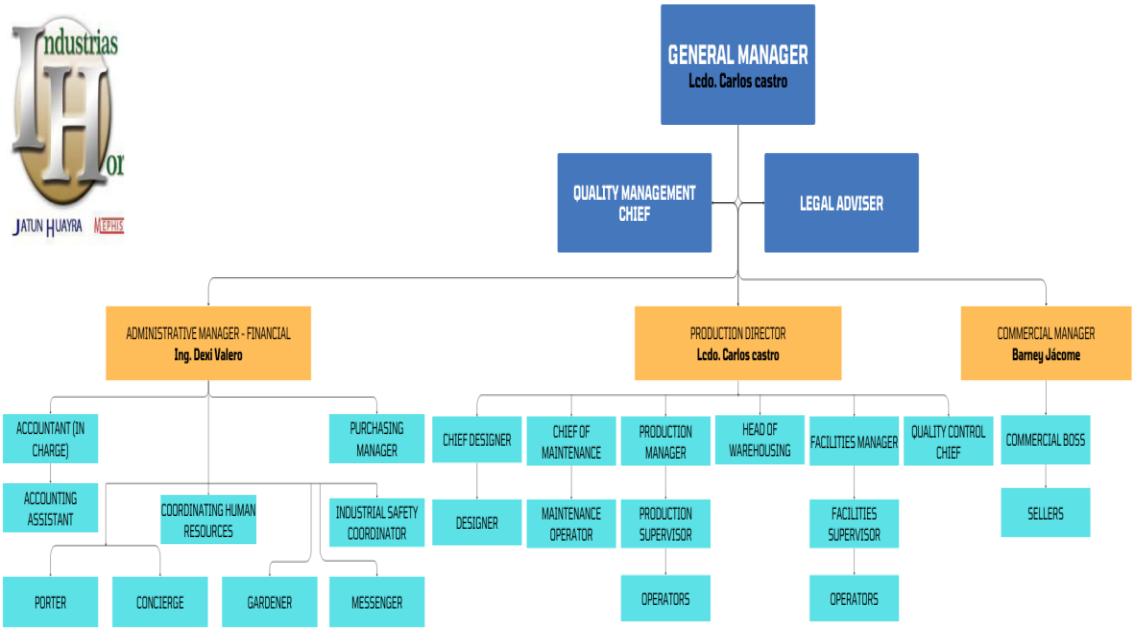
To deliver innovative products that meet the needs of our Agribusiness customers, and generate for the company the results required to support growth and development.

Vision

To be the first company in Ecuador for its technology generation and innovative product offer, both in the local and international market.

Organizational Structure

Figure 3. Organizational structure of INDUHORST CÍA LTDA.



SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Result of the interview technique applied to Mr. Carlos Castro, general manager of the small company INDUHORST CÍA LTDA.

Deduction of the maturity level

Table 4. Analysis of maturity levels INDUHORST CÍA LTDA

Requirement (R)	Level 1	Level 2	Level 3	Level 4
R1			x	
R2			x	
R3		x		
R4				x
R5		x		
R6		x		
R7		x		

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Analysis: All the maturity levels of the requirements are equal or higher than the second level, four reach level 2, two reach level 3 and one reaches level 4. In this company 57% of the requirements reach level 2, while the remaining one is higher than this level. It should be added that none of the requirements is rated at the lowest level. Unlike the previous company, requirement R4 is at the highest level, which favors asset management, while R5, linked to the organization, is placed at level 2. Although the company could be evaluated at level 2, it would be fair to accept that it is an advantageous level 2 or close to level 3.

Maintenance organization

Factor: technical documentation

Analysis: If there is a maintenance plan, but there is no work order document, what exists is a technical sheet.

Factor: Equipment history

Analysis: The interviewee stated that there is no equipment history, there is only an equipment file, but there is a systematic investigation of the most frequent breakdowns.

Factor: Work order follow-up

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

Analysis: There is a maintenance plan, but there is no maintenance work order document, so there is no way to manage it.

Factor: Budget distribution

Analysis: The interviewee mentioned that certain equipment and machines are taken to another company for maintenance, so there is a maintenance budget.

Factor: Planning and scheduling of maintenance activities.

Analysis: There is a lubrication and maintenance plan for the equipment, and it is also established who prepares and executes the maintenance plans.

Factor: Control of materials and spare parts

Analysis: This factor is complied with because there are personnel who carry out the control and, above all, control the raw materials to be handled.

Factor: Control of maintenance costs

Analysis: There is only one budget to cover outsourced maintenance costs.

Factor: Management index

Analysis: The interviewee stated that there is knowledge of management indicators within the maintenance area and that they are used for decision making.

Factor: Contracting policies

Analysis: For this factor there is only the policy of contracting outsourcing companies.

Factor: Contractor selection

Analysis: In the case of outsourced maintenance, the contractor is selected based on suppliers and experience, and when this cannot be done within the small company, these outsourcing companies are generally located in Quito and Guayaquil.

Factor: Control of reception

Analysis: As for this factor, the equipment and machinery are inspected by the specialist operator, but there is no documentation.

Factor: Warranty

Analysis: In terms of warranty, the companies generally guarantee the work performed, but compliance with the warranty is verified.

Characterization of the small metal-mechanic company JATARIG CÍA LTDA.

Quevedeña industry with the highest international quality standards, we are JATARIG CÍA LTDA, your main ally in the processes with your agro-industrial machines always looking for the highest productivity in the shortest possible time, for that reason we are located in a strategic place in the south of the city, km 7 via Mocache at the foot of the main road.

We make available to you and your companies the most sophisticated agro-industrial machinery manufactured with high quality standards, seeking to solve and facilitate your agricultural activities.

Mission

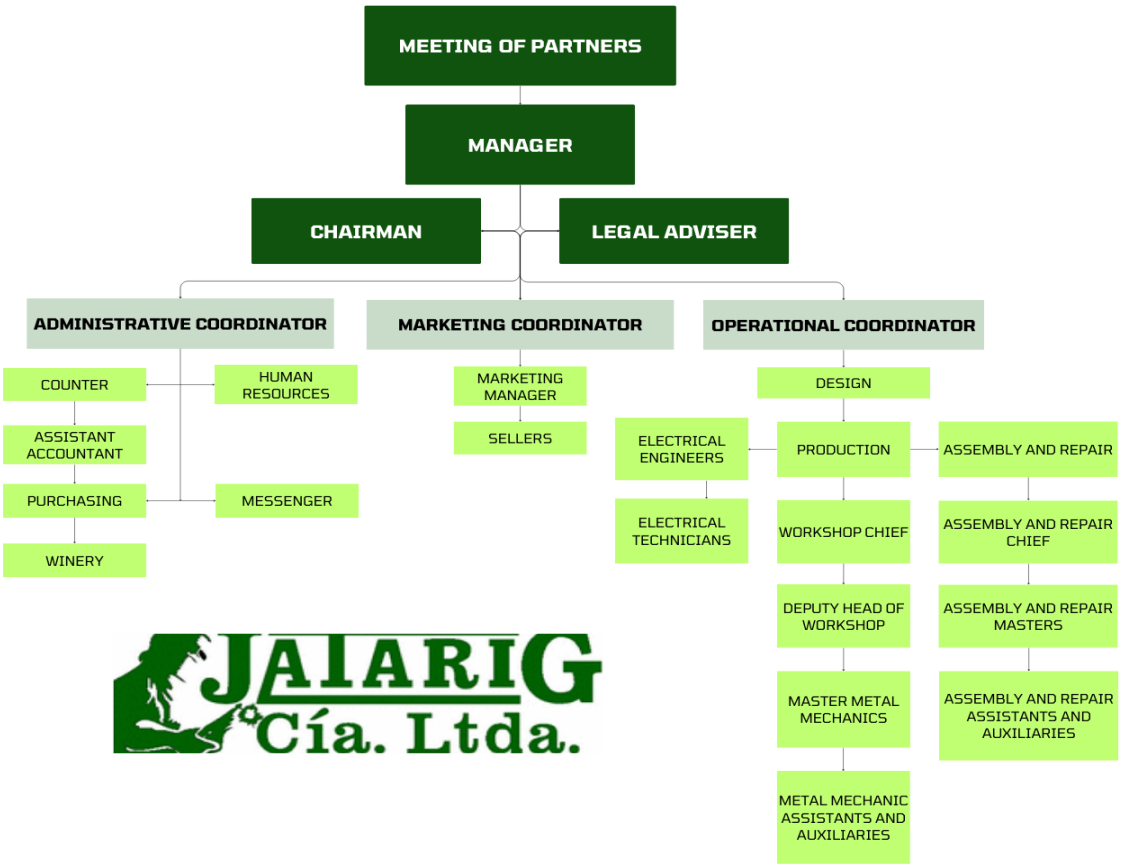
To produce the best equipment and machinery meeting the highest quality standards, with a highly qualified human and professional team, satisfying the needs and demands of the customer.

Vision

To offer to the province and the country a complete and efficient consultancy with the best products in the market, simplifying their work, optimizing their resources and improving their productivity, thus contributing to the growth of the country.

Organizational structure

Figure 4. Organizational Structure JATARIG CIA LTDA



SOURCE: LCDA. RAQUEL REYES (2017)

PREPARED BY: AUTHORS (2017)

Results of the interview technique applied to Mrs. Raquel Reyes, general manager of the small company JARATIG CÍA LTDA.

Deduction of maturity level

Table 5. Analysis of maturity levels JARATIG CÍA LTDA

Requirement (R)	Level 1	Level 2	Level 3	Level 4
R1			x	
R2			x	
R3		x		
R4		x		
R5		x		

R6	x
R7	x

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Analysis: In the company JATARIG CIA LTDA five of the requirements reach levels equal or higher than 2, while the other requirements reach level 3. 71% of the requirements are rated at level 2, but it differs from MAQGRO CIA LTDA in that none of its requirements is rated with the minimum level. In this case, R4 and R5 are rated at level 2, which does not favor a good asset management, if we talk about the management of resources and the organization of the company, respectively.

Maintenance organization

Factor: technical documentation

Analysis: Initially it was indicated that there is no maintenance plan and therefore no technical documentation is managed.

Factor: Equipment history

Analysis: Since there is no maintenance plan, the interviewee stated that there is no equipment history and that generally when the lathe breaks down, production is paralyzed because there is no replacement.

Factor: Work order follow-up

Analysis: The lack of a maintenance plan results in the non-existence of the maintenance work order and subsequently there is no way to manage it.

Factor: Budget distribution

Analysis: Some equipment and machines are taken to another company for maintenance (outsourcing), so there is a maintenance budget.

Factor: Planning and scheduling of maintenance activities.

Analysis: This factor is directly related to maintenance planning; therefore, this factor is not met in the small company.

Factor: Control of materials and spare parts

Analysis: This factor is not met because there is no official in charge of the control of materials and spare parts.

Factor: Cost control of materials

Analysis: There is a budget to cover only outsourced maintenance costs.

Factor: Management index

Analysis: Since there is no maintenance planning, this factor is not applied in small companies, therefore there is a lack of knowledge of maintenance management.

Factor: Contracting policies

Analysis: In the case of this factor, there is only a contracting policy with mutual agreement with the outsourcing company.

Factor: Contractor selection

Analysis: For this factor, only outsourced maintenance is selected according to experience and maintenance needs; these outsourcing companies are usually from Guayaquil and Quito.

Factor: control at reception

Analysis: For this factor, a diagnosis of the operation of the equipment is made by the operator specialized in the handling of the equipment.

Factor: Warranty

Analysis: Regarding the warranty, companies usually guarantee the work performed according to the cost, brand and time of acquisition of the equipment.

Summary of results issued by the respective instruments on the maintenance management of small companies in the canton of Quevedo.

Table 6. Summary of maintenance management results

COMPANY	VARIABLES	FACTORS	CONCLUSION
MAQGRO CÍA LTDA	Maintenance plan	Does not exist	There is no maintenance plan.
	Maintenance area	Does not exist	There is no maintenance area
	Maintenance organization	Does not exist	There is no maintenance organization maintenance
INDUHORST CÍA LTDA	Maintenance plan	If it exists	It exists, but it is partially partially
	Maintenance area	If it exists	If there is a maintenance area

	Maintenance organization	Technical documentation	There is a technical data sheet, annual calendar plan, critical machines.
		Equipment history	There is a history file of the technical characteristics of the equipment (there is no maintenance history).
		Follow-up of work orders.	The work order document does not exist.
		Budget distribution.	If there is a budget distribution.
		Planning and scheduling	If there is planning and programming.
		Material controls	If there is material control
		Maintenance cost control maintenance	Yes, but only for outsourced maintenance costs.
		Management index	If met.
		Hiring policies	Only for outsourcing companies.
		Contractor selection	Through suppliers
		Reception control	If there is a reception control
		Warranty	If compliance with the warranty is verified.

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

JATARIG CÍA LTDA	Maintenance plan	Does not exist	There is no maintenance plan.
	Maintenance area	Does not exist	There is no maintenance area.
	Maintenance organization	There is no organization	There is no maintenance organization organization.

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Conclusion

According to the summary of results on maintenance management inscribed in (table 1), the company that presents a maintenance management with greater evidence of organization according to the documents that is carried, is the small company INDUHORST CÍA LTDA; that is to say that it can develop and then implement the project of "improvement of the management of physical assets" because this industry has implemented its production process from the design; therefore both internally and to its customers can offer in the future the Asset Management from the generation to the end of its life as proposed by the ISO 55000 standard.

Diagnosis of the management of physical assets of the small metal-mechanic company INDUHORST CÍA LTDA.

Determination of the documents to be handled in a maintenance plan

- In accordance with the provisions of, (Garcia M, Gonzales S, & Cortés M, 2009), there are documents that are being executed in the company: technical data sheet, critical machines (paralyzes production process), schedule plan.
- According to the authors, (Garcia M, Gonzales S, & Cortés M, 2009), Another additional instrument required for a maintenance plan is the work order that the company must implement.
- Develop a training plan that involves all operators, managers and administrators in production, maintenance, quality control, design, storage and facilities activities.

Complementary areas of the administrative organization chart

- It is considered that the transcendental and complementary areas of maintenance are: production, design, facilities, quality, health and safety area, which the company considers in the established organization chart.

Machines and equipment offered by the company INDUHORST CÍA LTDA

Table 7. Machinery and equipment offered by INDUHORST CÍA LTDA

Machines and equipment offered by the company INDUHORST CÍA LTDA		Machines and equipment offered by the company INDUHORST CÍA LTDA
➢ Rice aging machine ➢ Shed dryer ➢ Centrifugal fan ➢ Poultry fans ➢ Grain sheller and sorter ➢ Starter pulley ➢ Mobile aerator ➢ Double ear fan ➢ Axial fan ➢ Horizontal mixer ➢ Conveyor belt ➢ Pneumatic conveying ➢ Bazooka	➢ Compact bean and cocoa dryer ➢ Sorting cleaner ➢ Gas burner ➢ Stainless steel bean roaster ➢ Moving flat belt ➢ Shell kiln with double-ear fan ➢ Vibrating conveyor ➢ Continuous flow vertical dryer ➢ Bucket elevator ➢ Hammer mill ➢ Grass harvester ➢ Grain pre-cleaner ➢ Shed construction	

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Machines and equipment for the food agroindustry

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

Table 8. Machinery and equipment for the food agroindustry

Machines and equipment for the food agroindustry	
➢ Polyfrut roller extractor ➢ Juice recovery machine - passion fruit ➢ Juice refiner - mango ➢ Finisher - seed separator ➢ Sorting table 1 ➢ Juice Reclaimer - pineapple ➢ Juice refiner - passion fruit ➢ Vacuum pump ➢ Sorting table 2 ➢ Disc extractor	➢ Fruit conveyor ➢ Centrifugal pump ➢ Brush washer ➢ Passionfruit refining ➢ Inclined fruit conveyor ➢ Rotary washing machine ➢ Finisher - fruit crusher ➢ Tubular cooler ➢ Seed washing machine ➢ Vat - washing machine ➢ Mango refining ➢ Pineapple refiner

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Proposed improvements in maintenance management

As indicated by, (Ormaza M, Féliz L, Real P, & Parra F, 2015). The proposal is based on the analyses carried out in the previous stages and then defines the main shortcomings, determines measures, establishes actions and those responsible for them.

Table 9. Improvement proposal based on the maintenance management diagnosis

MAIN SHORTCOMINGS	**MEASUREMENTS**	**IMPLEMENTATION EXECUTION**	**RESPONSIBLE**
Work order	Maintenance work order processing	Prepare maintenance work order	General Manager, Production Manager and Maintenance Manager.
Training plan	Reaction, learning, behavior and results	Develop, implement and evaluate the annual training plan.	Financial administrative manager and head of maintenance.

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Table 10. Proposals based on the diagnosis of OTM maintenance management

<table>
<tr><td colspan="4">MAINTENANCE WORK ORDER</td></tr>
<tr><td colspan="4">Responsibilities</td></tr>
<tr><td colspan="2">The issuer of the work order shall be the maintenance manager.</td><td colspan="2">The issuer of the work order will have the main control over the progress of the work.</td></tr>
<tr><td colspan="4">Development</td></tr>
<tr><td>Detection of the need for it by any of the members of the sector, who will communicate it to the maintenance manager.</td><td>Designation of those responsible for its preparation by the maintenance manager as appropriate.</td><td>The maintenance manager will give the necessary explanations or clarifications to facilitate and guarantee the executions, before starting the maintenance.</td><td>Approval of the work order will be issued by the maintenance manager.</td></tr>
<tr><td colspan="4">Registrations</td></tr>
<tr><td colspan="4">The records shall be filed in a folder, in the office of the maintenance manager, arranged numerically in increasing order according to the work order number.</td></tr>
<tr><td colspan="3">Training Plan</td><td>Estimated Time (hours)</td></tr>
<tr><td>TOPICS</td><td colspan="2">MAINTENANCE AREA
How to strengthen this department.
Detection and analysis of mechanical failures in machines and systems.</td><td>15</td></tr>
</table>

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

	• Use and repair of static machines.	
	INDUSTRIAL SAFETY • Preventive industrial safety measures	15
	PRODUCTION • Operations planning. • Operations planning methods. • Production line operations scheduling. • Process capability measurement.	30
	PERSONAL TRAINING PLAN • Factors to take into account. • The importance of keeping personnel updated. • How to elaborate a good personnel training plan.	20
	TOTAL HOURS	80

SOURCE: FIELD RESEARCH

PREPARED BY: AUTHORS (2017)

Analysis: Once the imperfections have been overcome, the implementation of physical asset management based on the ISO 55000 standard will begin (Minnaar, Basson, & Vlok, 2013), as proposed in the following table.

Table 11. Improvement approach based on ISO 55xxx family of standards (000, 001 and 002)

MAJOR SHORTCOMINGS	MEASUREMENTS	PERFORMANCE ACTIONS	RESPONSIBLE

Maintenance management	Management of physical assets management (NTE INEN- ISO 55000)	Senior Management Meeting Resolution	The 4 management
Asset management after installation	Manage the asset from generation to the end of its life (NTE INEN-ISO 55000).	Project "Improvement of physical asset management".	General Manager, third party contracting (project development and development and execution of the project).
Individual asset management	Manage your assets as a type group (portfolio of physical assets).	Project "Improvement of physical asset management".	General Manager, third party contracting (specialist in project development and execution).
Disconnect between organizational management and physical asset management	Relate the key terms of asset management.	Relate physical asset portfolio - asset management system - asset management - organization management.	General Manager, third party contracting (specialist in project development and execution).
Asset management system requirements	Align the requirements of the asset management system	Align with: organizational context, leadership, planning, support, operation, performance evaluation,	General Manager, third party contracting (specialist in project

Pol. Con. (Edición núm. 92) Vol. 9, No 3, Marzo 2024, pp. 2250-2279, ISSN: 2550 - 682X

	with the company's objectives.	improvement (ISO 55001:2014:chapter 4,5,6,7,8,9,10).	development and execution).
Implementation	Implement the project "Improvement of physical asset management".	of the project "improvement of physical asset management" provided by the ISO 55002 standard.	Resolution of the top management board (the 4 managements), head of maintenance.

SOURCE: NTE INEN-ISO 55000

PREPARED BY: AUTHORS (2017)

CONCLUSIONS

Until the completion of this research in Quevedo there are three companies with the legal denomination of small, because they meet the number of servers, according to resolution of the CAN (Andean Community of Nations), ie the size of the companies in this category must have between 10 to 49 people and consequently are not artisanal microenterprises.

Once the small metal-mechanical companies in the canton of Quevedo were identified, we proceeded to characterize each of them, using the technique of interviewing the general managers of MAQGRO CÍA LTDA, JATARIG CÍA LTDA and INDUHORST CÍA LTDA, the head of maintenance, proving that most of them do not efficiently manage the maintenance of the physical assets involved in the production processes.

The diagnosis of the management of physical assets in the small metal-mechanic industry INDUHORST CÍA LTDA determines that the maintenance of the machines involved in the production processes is managed and not all the stages of the physical assets of these processes, because in reality according to (León G, Valero Y, & Vera M, 2020) , "Asset management is a way

of integrating all areas of the organization so that the asset life cycle is managed during the stages of design, construction, utilization, maintenance, and decommissioning or repowering.".

The diagnosis carried out in the selected small company shows that only one stage of asset management, maintenance, is being managed. This situation allows the development of the improvement proposal based on maintenance management and improvements based on the NTE INEN - ISO 55000, ISO 55001 and ISO 55002 family of standards.

Referencias

Garcia M, G., Gonzales S, H., & Cortés M, E. (2009). METODOLOGÍA DE MANTENIMIENTO CON POSIBLE APLICACIÓN EN EL SECTOR. CES Medicina Veterinaria y Zootecnia, 4(2), 137-150.

León G, M., Valero Y, L., & Vera M, S. (2020). Diseño del sistema de gestión de activos físicos según norma ISO 55001:2014. InGenio, 3(1), 81-88.

Minnaar, J., Basson, W., & Vlok, P. (2013). Métodos cuantitativos necesarios para la implementación de PAS 55 o la serie ISO 55000 para la gestión de activos. Revista Sudafricana de Ingeniería Industrial, 24(3), 98-111.

Montaño, O., Corona, J., & Gomez, H. (2018). Modelo de madurez para la valoración de las mejores prácticas de las PyMES manufactureras. Mercados y Negocios, 27-48.

Novillo, A. (Agosto de 2013). Repositorio Institucional de la Universidad Politécnica Salesiana. Obtenido de Repositorio Institucional de la Universidad Politécnica Salesiana: http://dspace.ups.edu.ec/handle/123456789/6401

Ormaza M, M., Féliz L, M., Real P, G., & Parra F, C. (2015). Procedimiento para el diagnóstico del diseño físico de los puestos de trabajo. Ingeniería Industrial, 36(3), 253-262.

Sanchez, A. P. (2010). La gestión de los activos físicos en la función mantenimiento. Ingeniería Mecánica, 13(2), 72-78.

Sola R, A., & Crespo M, A. (2016). Principios y marcos de referencia. AENOR.

Tholana, T., & Neingo, P. (2016). Ampliación de la aplicación de la norma PAS 55/ ISO 55 000 a la gestión de activos minerales. Revista del Instituto Sudafricano de Minería y Metalurgia, 116(11).

Torres, L. (2015). Gestión Integral de Activos Físicos y mantenimiento. Buenos Aires: Alfaomega.

Vera, S. (2020). Repositotio Universidad Técnica Estatal de Quevedo. Obtenido de Repositotio Universidad Técnica Estatal de Quevedo.