businesses

MDPI

Article

Updating a Quality Management System for a Mexican Industrial Organization: Case Study

Julio César López-Figueroa *, Ernesto A. Lagarda-Leyva *, René Daniel Fornés-Rivera and Alfredo Bueno-Solano

Department of Industrial Engineering, Instituto Tecnológico de Sonora, Ciudad Obregón Sonora 85000, Mexico; rene.fornes@itson.edu.mx (R.D.F.-R.); alfredo.buenos@itson.edu.mx (A.B.-S.)
* Correspondence: julio.lopez@itson.edu.mx (J.C.L.-F.); ernesto.lagarda@itson.edu.mx (E.A.L.-L.)

Abstract: The need to update an enterprise quality management system (QMS) seems to be more urgent each time. Without adequate updating, the system may not be capable of responding to market changes, generating delivery delays and increasing customer costs and losses instead of allowing industries to improve product quality and services, reduce costs, and increase customer satisfaction. Thus, the present research deals with a case study of a Mexican metal mechanics industry certified to ISO 9001:2015 with the need to update its operating QMS. Due to reasons for growth, the industry has added new activities to the processes and modified others, working in the integration area to improve efficiency and efficacy. Therefore, an analysis of strengths, opportunities, weaknesses, and threats (SWOT) was performed. The status of the processes was evaluated, creating a document with new activities and updating those that showed non-compliance. The results of this investigation have the purpose of contributing to the importance of QMS empirical evidence in emerging countries and increasing quality studies in Mexican industries.

Keywords: management systems; quality management system; organizational efficiency

Citation: López-Figueroa, J.C.; Lagarda-Leyva, E.A.; Fornés-Rivera, R.D.; Bueno-Solano, A. Updating a Quality Management System for a Mexican Industrial Organization: Case Study. *Businesses* **2024**, *4*, 39–52. https://doi.org/10.3390/businesses4010003

Academic Editor: Lester Johnson

Received: 13 November 2023
Revised: 12 January 2024
Accepted: 24 January 2024
Published: 31 January 2024

1. Introduction

Enterprises currently carry out their operations in a world characterized by global and competitive markets where clients demand better products and services. Due to this situation, organizations resort to implementing quality management systems (QMSs) with the purpose of increasing organizational performance and efficiency in processes and operations [1]. Thus, a QMS allows the organization to promote a culture oriented to quality and favor obtaining such results as behaviors, attitudes, activities, and processes that provide value by means of achieving the needs and expectations of the clients and stakeholders [2].

As part of the diverse standardized norms that establish the requirements and guidelines to implement a QMS, the ISO 9001:2015 norm is among the most widely recognized at the world level and applicable to any type of organization, regardless of its size and nature. This norm provides the infrastructure, procedures, processes, and necessary resources to help the organizations control and improve their yield and direct them towards efficiency, customer service, and product excellence [3]. The requirements for ISO 9001:2015 are generic and may be applied to any organization, regardless of its size, economic sector, products, and/or services provided [4].

Within the industrial economic sector, the metal mechanics industry is dedicated to manufacturing and transforming metals, machinery, and industrial equipment. According to México Industry [5], this manufacturing industry contributes close to 14% of the gross domestic product (GDP) in Mexico, where 305 metal mechanics economic units exist. The federal Mexican states that stand out with the largest number of metal mechanics manufacturing companies are Nuevo León (43), Mexico State (42), and Jalisco (32), while Sonora has six units. An important fact is that Sonora, jointly with Mexico City (CDMX) and Sinaloa, represents the greatest opportunity for developing this industry [6].

Additionally, Mexico Industry [7] points out that the negotiations established in the United States-Mexico-Canada Agreement (T-MEC, for its abbreviation in Spanish, Tratado Mexico-Estados Unidos-Canada) represent a great opportunity to develop the required technology in this country to perform the processes demanded by the metal mechanics industry. Consequently, tariffs, costs, and other competitive advantages are considered, which have an influence on increasing the capacities of Mexican industries.

It is important to mention that a Mexican metal mechanics enterprise established in the state of Sonora was selected as the object of study for this investigation and certified to the ISO 9001:2015 norm. However, a negotiation started with an international high-profile client who requested the production and delivery of new products—some of which form part of the enterprise integration area—that have experienced changes in their activities to comply with the specifications of the parts and components requested by the clients. Therefore, differences have been found between the documentation already performed and current processes; likewise, the need exists to establish markers that allow evaluation of the performance of the modified processes.

Due to the previous situation, updating the QMS was set up in the integration area of the organization in November 2021 with the purpose of identifying the processes that had added or modified activities. The documentation of such activities was performed by updating the organization chart of the integration area and assigning the responsible persons for the current processes as well as their markers to evaluate their performance. Updating the QMS facilitates improving process control, which also leads to reduced waste, decreased costs, and increased client satisfaction with their expectations, generating an increase in organization efficiency. National executives should be aware of the importance of quality management in processes, besides the fact that studies such as this one facilitate understanding the advantages generated by implementing QMS in the organizations of emerging countries.

2. Updating Empirical Quality Management Systems

In the search for client satisfaction and other parties of interest, the companies implement quality management with the purpose of guaranteeing the adequate processes and quality improvement of the products or services offered [8]. Quality management is established as a key and essential element for institutional success since it allows satisfaction and maintains competitiveness in the environment where the organization develops [9].

Escutia [10] explains that in quality management, the environment and security are aspects that play a fundamental role in organizational success and reputation since they affect client satisfaction, legal compliance, and operational efficiency. On the one hand, Díaz [11] indicates that the QMS is the interaction between the parties to the organization focused on achieving quality objectives to satisfy the needs, expectations, and requirements of the interested parties.

On the other hand, León et al. [2] consider the QMS as a set of policies, objectives, processes, documents, and resources that lead to ensuring the organization's quality as a whole, searching to comply with client needs and requirements. Murrieta et al. [12] explain that implementing a QMS allows companies in any business sector to go in depth to improve processes, including environmental and social aspects, to strengthen the organizational structure and trust perceived by the client when quality products are acquired.

Empirical studies that have implemented a QMS and have had the need to update it later on are available in specialized literature, such as Peña [13] in Colombia. This author demonstrated that the QMS evaluation of the current state of a laboratory evidenced the need for attending five procedures (effective communication, information security, risk identification, supplier selection and evaluation, and validation and testing method confirmation), which showed the need for creating and/or updating their documentation. The established markers were also evaluated, with the greatest fault located in the marker evaluating client continuity in sales.

The need for unifying institutional documents was pointed out by Zarama [14] in a work performed at a Colombian university, which conveyed optimizing the QMS and dealt with the requirements of the collaborators involved in the organization. New formats and registries were made and used to perform new documentation of the affected processes. Likewise, internal auditing quality was identified as the appropriate instrument to verify the correct functioning of the QMS.

Fernández [15] set out reviewing and updating the processes in a Colombian hospital due to the existence of problems, such as loss of documents and difficulties sharing information with other members or clients of the company, generating bad service. An initial diagnosis pointed out the need for updating 10 processes and identifying the documents that needed to be created or modified. Internal audits were recommended to detect failure modes and create a high level of conscience in the leaders of the processes for maintaining the QMS documents.

A study by Acosta et al. [16] showed a Colombian construction corporation that implemented a QMS according to ISO 9001:2008 [17] and set out updating ISO 9001:2015 [4] with the interest of being more competitive and obtaining adequate risk management and continuous improvement. An initial diagnosis was carried out with the intention of identifying the processes that needed to be updated and the documentation that had to be created or modified. This author recommended the participation of an external advisor as an active part of the QMS updating process.

Vizueta [18] analyzed a container company in Ecuador with the objective of improving the QMS yield of the administrative department. Firstly, the processes that should be updated were identified, which were internal control, human resources, accounting, import, and industrial security. Secondly, a training plan for the staff was recommended for socialization and integration of these new processes.

Zamorano [19] performed a study on a Mexican enterprise in the aerospace industry that had accelerated growth generated by an increment in sales. The company saw the need for implementing a QMS to have a formal process to verify their operations, fabrication processes, and documental procedures, facilitating follow-up on corrective actions for possible quality problems.

The studies previously mentioned set up the conditions favoring updating the QMS in an organization. For example, those that could be mentioned are the desire to achieve reaccreditation in a norm, obtain improvement in the processes and unify documents, have the intention of increasing enterprise competitiveness, and take advantage of its growth, among others.

3. Methods: Case study

The method used in the present research is a case study, in which Yin [20] points out that the capacity of studying cases in depth allows the possibility of investigating the causal complexity where various relevant factors may exist but with few observations. For Bernal [21], the objective of a case study is to analyze in depth or in detail a specific analysis, which may be a person, an institution or enterprise, a group, and so on. Likewise, Hernández et al. [22] set out that case studies "analyze a unit in depth to respond to a problem-solving approach, prove the hypothesis, and develop a theory".

Therefore, the purpose of the present research is to analyze the case of a manufacturing company that has required updating its QMS as a consequence of taking advantage of growth opportunities in the market. In this manner, the company improves the processes, minimizing waste of any type (waiting, transport, rework, defects, among others) and, in consequence, increasing organizational efficiency.

Study Objectives and Procedures

The present case study was performed in a metal mechanics manufacturing company located in Northwestern Mexico and focused particularly on the integration area since it is the last link in the production process. Additionally, the area is in charge of performing deliveries to the clients. The directors expressed that the request for new pieces and compo-

nents provoked the addition and modification of activities in some processes. Therefore, the project has as its objective to update the QMS within this area to enable consistency in improving processes and greater organizational efficiency.

The steps performed for developing the company QMS update were the following: (1) identifying the processes that constitute the integration area; (2) evaluating the current status of the QMS of the integration area; (3) evaluating the current processes against the QMS current documentation; (4) updating the documentation of the processes and defining the markers for the processes, which are described as follows:

Firstly, the processes and activities that impact the integration area were defined by elaborating on the proposal of an updated organization chart. A SWOT (strengths, weaknesses, opportunities, and threats, FODA in Spanish) analysis was performed to establish the current state of the area, since the ISO 9001:2015 norm indicates that the organization should determine the internal and external matters that are pertinent for its purpose and strategic direction, which affect its capacity to achieve the results foreseen by the QMS.

The QMS degree of compliance within the integration area was identified with respect to that established in the ISO norm, comparing the content of the current documentation with the verification list that determines the compliance of the ISO 9001:2015 norm numbers. Subsequently, the status of the current processes was evaluated against the previous documentation within the QMS, highlighting two possible results of the evaluation: new activity or lack of updating.

The documentation of the activities added to the processes was also performed by updating those that resulted in incompliance; key opportunity areas were identified for the marker allocation proposal to know the level of efficiency in the integration area. A traffic light scheme was proposed to detect promptly when the expected results are not obtained.

4. Results and Discussion

4.1. Identifying Processes and SWOT Analyses

The processes and their activities—currently constituting the integration area—were determined; and the responsible persons for each process were identified (see Table 1):

Table 1. Processes and activities of the integration area.

Process	Activities	Responsible
Assembling	• Receive the necessary inputs for the process, along with the design route to follow; • Inspect the dimensions and quantities according to the design; • Prepare the necessary nuts and bolts for the assembly process; • Perform the assembly process according to the design; • Verify the mechanical functioning of the project;	Integration Area Supervisor
Control	• Receive the inputs needed to carry out the control process; • Perform the project routing; • Integrate the components into the control cabinet and perform the pertinent connections; • Receive and install tags in the wiring; • Check electronic and pneumatic connections; • Install electronic components in the performed assemblage;	Integration Area Manager
Programming	• Receive project specifications; • Define the scheduled test type; • Design and develop the project sequence; • Install the program; • "Debug" the program; • Design visual screens; • Verify that the program is functioning;	Programming Supervisor
Management	• Request the list of requirements, design, and date of the project; • Verify the alignment of the lists with the project design; • Ask internal providers for parts and components; • Verify the corresponding amounts with the requirement list; • Send project inputs and specifications to their process; • Request nuts and bolts from the warehouse; • Carry out the process for reworks.	Integration Area Supervisor

Note: Table 1 identifies four processes, 25 activities, and the corresponding responsible persons. This identification allows a better location of the activities performed in the integration area and the subsequent documentation of the processes. Source: Authors' own production.

An organization chart of the area was proposed since it was operating with a non-official hierarchy, generating conflicts occasionally at the moment of decision-making (see Figure 1).

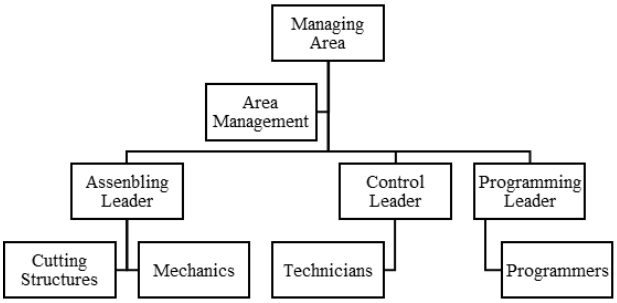

Figure 1. An organization chart proposed for the Integration Area.

The organization chart should allow assigning new responsibilities and tasks to the staff area with the objective of involving the flow of information and decision-making in the new processes to update and execute them in an optimum manner. Source: Authors' own production.

Table 2 deals with the results of the SWOT analysis developed for the integration area.

Table 2. Analysis of strengths, weaknesses, opportunities, and threats (SWOT).

Strengths	Opportunities
• Has an integration area of 80% of diversification in its products • Offers rapid reaction to demand with a little time-lapse delivery • Has a high technological level in its components • Counts on values such as teamwork, disposition, and commitment • Counts on a QMS	• Updating QMS • Aligning the area's objectives with the organizational strategy • Measuring client satisfaction • Measuring the performance of other areas • Increasing product quality
Weaknesses	**Threats**
• The area of QMS is obsolete with outdated information and incomplete processes • Lack of strategic direction • No indicators are available to evaluate processes • Lack of process standardization • Material waste • Lack of staff initiative • Space limitations within the area	• Client dissatisfaction • Late client service delivery • Increase in operation costs due to waste within the area • Low-quality products • By not implementing performance markers, the area is exposed to not knowing the status of its processes

Note: As a result of the analysis of strengths, weaknesses, opportunities, and threats (SWOT), a solid work team is identified due to continuous staff training and the trust placed in each worker; however, incorrect adjustments are detected in the organizational strategy, despite having a quality management system (QMS), since the new and modified processes developed are not taken into account in this company area. Source: Authors'own production.

The previous SWOT shows similarities with the research performed by Castro et al. [23], Freire [24], and Alva et al. [25] in metal mechanics companies, who found that this type of company has a high technical capacity and commitment to their working teams. However, they also point out that in these companies, areas of opportunity are identified due to deficiencies in quality management.

Jointly with the previous SWOT results, the need for updating the QMS is established since the company was asked to produce new parts that required modifying the activities of the processes in the integration area. This situation represented an incorrect adjustment in the current QMS with respect to its respective documentation and markers for the processes, thus placing them at risk both in complying with the requirements of the demanded products and the expected satisfaction of the client.

4.2. Evaluation of the Current QMS Status within the Integration Area

An assessment was made with the minimum requirements from Chapter 4 to 10 of the norm ISO 9001:2015 with the purpose of evaluating the current integration area QMS status. This instrument was made taking as reference the one used by Ruiz [26] and sent by electronic mail to the integration area manager and the responsible persons for assembling, control, programming, and management processes; one week was considered for their response, and they were asked to send it back by electronic mail (see Table 3):

Table 3. Instrument used to evaluate the current quality management system (QMS).

QUALITY MANAGEMENT SYSTEM DIAGNOSTIC ASSESSMENT ISO 9001- 2015 INTERNATIONAL QUALITY NORM					
GRADING CRITERIA: **A**. Complete compliance (5 points: Established, Implemented, and Maintained); **B**. Partial compliance (3 points: Established, Implemented, Not maintained); **C**. Minimal compliance (1 point: Established, Not implemented, Not maintained; Corresponds to identification and system planning stages); **D**. Noncompliance (0 points: Not established, Not implemented, Not maintained N/S).					
No.	**NUMERALS**	**GRADING CRITERIA**			
		A	**B**	**C**	**N/S**
4. AREA CONTEXT 4.1 UNDERSTANDING THE ORGANIZATION AND ITS CONTEXT					
1	Pertinent external and internal matters are determined by the purpose and strategic direction of the area.			1	
2	A follow-up and information review are performed on the external and internal matters.				0
4.2 UNDERSTANDING THE NEEDS AND EXPECTATIONS OF THE PARTIES INTERESTED					
3	The parties interested and their requirements for the QMS have been determined.			1	
4	The follow-up and information revision of the parties interested and their requirements were performed.				0
4.3 DETERMINING THE SCOPE OF THE QUALITY MANAGEMENT SYSTEM WITHIN THE AREA					
5	The QMS scope has been determined according to operational processes, products and services, physical installations, and geographical location.		3		
6	Has the QMS scope been determined taking into account the external and internal problems, parties interested, and their production and services?		3		
7	The QMS system has documentation available and within reach.	5			
8	The requirements (exclusions or not applicable) are justified and/or documented as non-applicable for the QMS.		3		
4.4 QUALITY MANAGEMENT SYSTEM AND ITS PROCESSES					
9	The necessary processes are identified for the organizational QMS.		3		
10	The process management criteria are established for their management, taking into account the responsibilities, procedures, control measurements, and necessary performance markers that allow their effective control and operations.			1	
11	Documented data that supports the operations of these processes are kept and maintained.		3		
	SUBTOTAL	5	15	3	0
	Structure Value: % Obtained ((A+B+C)/100)		42%		

Note: To perform the evaluation, each point of the following criteria was applied: A. Complete compliance with the criteria stated (5 points: Established, Implemented, and Maintained); B. Partial compliance with the criteria stated (3 points: Established, Implemented, Not maintained); C. Minimal compliance with the criteria stated (1 point: Established, Not implemented, Not maintained); N/S. Noncompliance with the stated criteria (0 points: Non-established, non-implemented, non-maintained N/S). Source: Authors' own production.

For the headings considered not applicable within the area, "N.A." was applied and not contemplated for evaluation. Table 4 points out the results of each chapter of the norm evaluated.

Table 4. Current quality management system requires diagnostic evaluation.

Norm Number		Compliance Percentage
4	Area context	42%
5	Leadership	50%
6	Planification	10%
8	Operation	55%
9	Performance evaluation	27%
10	Improvement	18%
Total		34%

Note: Table 4 indicates that the diagnosis revealed a result of 34% in the current QMS compliance within the area, taking into account the minimal requirements of the 9001:2015 norm. The value obtained was considered low, thus establishing that the current QMS is not the desired one. Source: Authors elaboration.

The QMS evaluation studies of the metal mechanics industry were performed by Torres and Carriel [27], Arce [28], and Fernández [29]. The low compliance levels in headings such as planning, performance evaluation, improvement, organization, and leadership context are derived from QMS organization incompliance. This incompliance urged the industries to update the QMS to improve process and product performance, besides complying with quality objectives.

4.3. Evaluation of the Current Processes in the Area Against the Existing QMS Documentation

The processes that are currently developed in the integration area were evaluated to collate them against the existing QMS initial documentation and identify the changes suffered by the processes and activities since the initial documentation for the ISO 9001:2015 certification. Three criteria were applied here: updated, lack of updating, or new process (see Table 5).

Table 5. Evaluation of the current processes against the current quality management system (QMS) documentation.

Process or Activity	Status within the QMS	Cause
1. Assembling	Not updated	The process suffered changes due to the working method's evolution
• Reworks	New activity	Already performed without formality and has never been documented
• Request of consumables to the warehouse	New activity	Performed, but without formality, and has never been documented
2. Control	Lack of updating	The process suffered changes due to the working method's evolution
• Electrical diagrams	New activity	Already performed without formality and has never been documented
• Manuals	New activity	Already performed without formality and has never been documented

Table 5. *Cont.*

Process or Activity	Status within the QMS	Cause
• Request of consumables to the warehouse	New activity	Already performed without formality and has never been documented
3. Programming	Lack of updating	The process suffered changes due to the working method's evolution
• Project support and release	New activity	Already performed but without formality and has never been documented
4. Management	Updated process	The process has not been documented
• Request for screws	New activity	Already performed, but with no formality, and has never been documented

Note: Table 5 points out that three existing processes should be updated, and one is identified as a new one, whereas eight sub-processes are determined to be new ones. The results shown serve as a guide for updating and documenting the processes found in the current QMS. Source: Authors elaboration.

The studies of Millán and Lache [30] and Duarte [31] show the convenience of reviewing the documentation of the processes to verify the needs of using and/or possible opportunities for improving and thus debugging the QMS documentation. Furthermore, the documentation allows defining the scope and a clear definition of the posts within the organization, which allows better identification of the responsible persons and authorities of the processes developed.

4.4. Updating the Process Documentation That Impacts the Integration Area

Table 6 lists the processes and working instructions that suffered modifications or were documented as new processes. Additionally, the identification code was added according to the QMS currently used by the investigated organization.

Table 6. Quality management system (QMS) currently updated.

Process or Working Instruction	Code	Result
Assembling process	PRI-PR-10	Updating process
Working instructions for reworks	SOP-10-02	New document
Working instructions to request consumables from the warehouse	SOP-10-03	New document
Control process	PRI-PR-09	Updated
Working instructions for electric diagrams	SOP-09-01	New document
Working instructions for manuals	SOP-09-02	New document
Programming process	PRI-PR-11	Process updated
Management process	PRI-PR-12	New document
Flow management of electronic components	PRI-PR-12-01	New document
Flow management of machined parts	PRI-PR-12-02	New document
Working instructions for screws	SOP-12-01	New document
Working instructions for project support and release	SOP-12-02	New document

Note: As Table 6 shows, 12 processes were performed, among which 75% (9 of 12) were completely new documentation; that is, the process was taking place, but no reference existed to back up its activity. Source: Authors elaboration.

Table 7 shows the current processes in the integration area and their corresponding activities.

Table 7. Updated processes in the integration area.

Process	Activities
Assembling	• Receive the necessary inputs for the processes by means of the PRI-PR-10 format; • Inspect the dimensions and quantities of the parts according to the project design; • Prepare the necessary nuts and bolts for the assembling process; in case of a shortfall, make the application to the bolt section area by means of the SOP-12-01 format; • Perform the assembly process according to the project design. If any part does not match correctly, make an application to rework using the SOP-10-02 format; • Make the application of the consumables required at any assembling point by means of the SOP-10-03 format; • Verify the mechanical functioning of the project; • When the assemblage process is finished, release the project and prepare the shipment using the SOP-12-02 format; • Recycle the non-used metallic parts using the corresponding containers.
Control	• Receive the list of the project components and route (use the PRI-PR-09 format); • Make the project address, specifying the controller connections and the components that integrate the control cabinet, and print the tags for wiring; • Integrate the components into the control cabinet and make the pertinent connections. Use the SOP-09-01 format; • Receive and install the wiring tags; • Receive the product on which the installation of the input and output devises (sensors and actuators) is performed for their calibration; • Finish all the process tasks and verify the correct functioning based on the client's requirements; • In the event that the project does not comply with the expected requirements, the nonconforming product procedure is applied; • Finish the control process (use the SOP-09-02 format), free the project, and prepare for shipment using the SOP-12-02 format; • Deposit the leftover scrap in the corresponding containers.
Programming	• Receive the project specification; • Define the type of the scheduled test (use the PRI-PR-11 format); • Design and develop the sequence for the process developed by the project; • Install the program on the computer/controller; • Debug the program to find and correct any possible fault within the installed program; • Design visual screens; • Verify that the program is functioning; • Finish the programming process, free the project, and prepare shipping using the SOP-12-02 format. • If the project does not comply with the requirements requested, inform the programming supervisor and apply the nonconforming project procedure.
Management	• Request lists of requirements, project design, and date using the PRI-PR-21 format for follow-up; • Request the project route, analyzing the complexity and identifying the key points; • For managing machined parts: ○ Request the project cut sheet using the PRI-PR-12-02 format; ○ Verify the quantity alignment of the machined parts and the cut sheet; in case of differences, directly inform the integration area supervisor; ○ Carry out delivery of the parts, performing quality inspections on critical parts; • For managing the electronic components: ○ Request the list of the project components and analyze the list's alignment with the project control requirements; ○ Receive the status of the available material from the warehouse and request the quantities of the components using the PRI-PR-12-01 format; ○ Receive the material from the warehouse and perform a quality inspection of the critical components; ○ Send the delivered list of the components received and the project route to the leader of the control team to start the process.

Note: Table 7 points out the assembling process with the addition of three activities to the control process, two activities to the programming process, and two activities to the management process. The added activities have the purpose of improving efficiency in the processes, reducing rework, and increasing client satisfaction. Source: Authors' own production.

As an example, Table 8 shows part of the format used for updating the assembly process documentation.

Table 8. Format for assembling documentation.

	ASSEMBLING PROCEDURE			Page: 3 of 4
				Revision: 8
	Norm ISO 9001:2015: 8.5.1 Reference			Code: PRI-PR-10
ACTIVITY	NAME	POST	SIGNATURE	DATE
Made by:		Assembler		28-nov-20xx
Authorized		Manager		28-nov-20xx

CHANGE CONTROL			
Number of revisions affected	Date when the change was proposed	Chapter or subindex modified	Change description
0	07-febrero-20xx	NA	Document made
1	15-August-20xx	5.1	5.1 Caption added: "This activity allows validating the design authorized by the client".
		4.2	4.2 The PRI-PR-02 was added as a reference document.
		6	6. The order format and finished assemblage (PRI-PR:10F01) were modified.
2	15-February-20xx	NA	Xxxx is assigned as the Responsible person for the procedure.
3	19-June-20xx	NA	Documented information was restructured by transitioning to the 2015 version, and xxxx is in charge of procedures.
4	20-June-20xx	NA	xxxx is assigned to be in charge of procedures.
		5.3	Mail is added as a purchase requisition option.
		5.4	Mail is added as a purchase requisition option.
5	16-July-20xx	4	Point 4.3 of SOP-IT-02 is added as a reference.
		NA	Procedure xxxx is assigned to the person in charge.
		5	Point 5. Policies are restructured as a whole.
6	30-July-20xx	5.6	Institutional mail is now the official communication medium in the Projects in Integration Process folder.
7	28-Nov-20xx	5.8	Waste instructions for residuals are added.
8	21-Nov-20xx	5.3	Documentation process is updated in general.

Note: Table 8 sets up partially updating the corresponding activities to the assemblage process; additionally, each process has the indicated objective, scope, glossary of terminology and abbreviations, documents of reference, and policies. Source: Authors' own production.

4.5. Definition of Markers for the Integration Area Processes

The following markers were proposed to evaluate if the integration area is efficiently developing its activities:

- Client satisfaction: The integration area is in charge of delivering the product to the client and, thus, has an optimum position to evaluate the project developed.
- Adding components to the project: This marker intends to evaluate the purchasing area and warehouse, which have the responsible staff to provide all the supplies (components) to carry out the project. Commonly, many components exceed or, even worse, are lacking; thus, in both cases, waste happens.
- Parts received with late delivery: This marker intends to evaluate delivery dates from the machining area to the integration area compared to the date met for the total delivery of the parts per project. Thus, delays in the final delivery date are evident.

- Reworks: Allows identifying the percentage of reworks performed per project and also its responsible process.

Table 9 shows the design of the integration area markers, including the name of the marker, the formula to calculate it, and the evaluation metrics.

Table 9. Markers for the integration area.

Marker Name	Metrics	Formula	Evaluation Ranges		
Client satisfaction per project	Requirement satisfaction	$\frac{\Sigma Grade\ of\ requirement}{Total\ requirements}$	Comply	Partially comply	Non-compliant
	Delivery date satisfaction	$\frac{\Sigma Grade\ of\ delivery}{Total\ deliveries}$	Comply	Partially comply	Non-compliant
	Satisfaction with the attention offered	$\frac{\Sigma Grade\ of\ attention}{Total\ attentions}$	Comply	Partially comply	Non-compliant
Components added to the project	Total components added	$\Sigma Added\ component$	>1 <3	> 3 < 5	> 5
Parts received with late delivery	Percentage of parts with late delivery	$\frac{Total\ parts\ received\ with\ late\ delivery}{Total\ parts\ received} \times 100$	<3%	> 3% < 10%	> 10%
Reworks	Percentage of reworked parts	$\frac{Total\ reworked\ parts}{Total\ parts\ received} \times 100$	<3%	> 3% < 10%	> 10%

Note: Table 9 shows the four markers proposed, their metrics, formula, and evaluation ranges in traffic-light ratings to monitor client satisfaction behavior, added components, and parts received with late delivery: green means that the target is met or exceeded, yellow means that the target is partially met and red means that the target is not met. Source: Authors.

Some research works on proposals for metal mechanics industry markers are those performed by Castelblanco [32], Fuentes and Pinto [33], and Sánchez et al. [34], which show similarities in proposing markers such as client satisfaction, non-conformance products, and delivery time compliance, which denotes the importance for the enterprise of monitoring and evaluating these factors to reach optimum organization quality management.

4.6. Discussion

Updating the QMS of the company of interest provides formality to the changes performed in the affected processes due to the request to make new products. In the same manner, in the study by Zamorano [19], updating is performed because the company needs a formal medium to verify the processes and their activities and write the corresponding documentation to avoid problems in quality management that could generate increments in costs and decrease client satisfaction.

The results obtained in the present study also contribute to facilitating the possibility of renewing the ISO 9001:2015 norm certification that the company currently owns. For example, in the studies of Peña [13] and Acosta et al. [16], updating the QMS was performed with the purpose of obtaining the recertification of the NTC-ISO/IEC 17025 and ISO 9001:2015 norms, respectively.

The selection of the proposed markers was the result of working jointly with the senior management staff of the integration area and the respective responsible persons for the assembly, control, programming, and management processes. In this manner, the staff, from their own experience in their duties, expressed that evaluating the client is the means by which the areas needing improvement are identified. Furthermore, the components added to the project can be evaluated to avoid or decrease waste; the parts received out of time allow for delays in deliveries, and assessing reworks provides evidence on the corrections needed to be performed and avoids low productivity.

5. Conclusions

Today, world trends urge quality management in organizations of all commercial sectors and sizes to increase their possibilities of competing successfully in the market. However, few Mexican companies have had the capacity to confront first-level organiza-

tions. One of the roots of this problem has its origin in a lack of quality discipline and culture, which delays efficient improvement of processes, products, and services.

Therefore, the organizations should focus their efforts on adequate quality management—an essential task to survive in the current global markets. For this purpose, implementing a QMS reinforces the organization structure and allows the staff to understand the quality implications for the optimum compliance of client requirements and those of other interested parties. Nevertheless, the QMS are not static; in other words, they may not have the need to be updated as a consequence of factors such as the application of new requirements by the clients or performing improvements to the organization's processes, among others.

The present research analyzes the case of a Mexican metal mechanics industry that exploited growth opportunities and the consequent need to increase its product supply. For this purpose, new activities were added to the processes and others were modified, which started to operate without documental reference or indicators assigned, causing reworks and delays in the organization's integration.

To solve this situation, the proposal to update the QMS was accepted in the area to avoid implementing empirical measurements that could generate resource waste for the company. Initially, a new organization chart was made to determine lines of authority in the area, working with four processes. The assembling process was updated, adding three activities; the control process was updated, and three activities were added; the programming process was updated, and two activities were added. On the one hand, the management process required new documentation. Additionally, four markers were proposed to evaluate the efficiency of the integration area operation: (1) Client satisfaction; (2) Added components; (3) Parts received out of time; and (4) Number of reworks; these markers facilitate identifying the areas that may improve, as well as avoiding waste, delays in deliveries, the number of reworks, and low productivity.

It is convenient to mention that for updating the QMS, the work was conducted jointly with the manager of the integration area and the responsible persons from the assembly, control, programming, and management processes, who checked every added or modified process and activity and provided their authorization and validation according to their experience and what is expected by the corresponding norm.

The results obtained show similarities with diverse studies discussed in this research study, since our intention is to assist the organization (objective of the study) in performing the production of the new products requested to comply with the client's requirements. Likewise, the intentions are to encourage quality management in Mexican enterprises of any sector that has the need to update their QMS. In this manner, the companies may obtain reaccreditation of any norm or deal or increment their capabilities to comply with the clients, who are each time more demanding in quality, time delivery of the products, and high-performance services.

The present research study showed that, as a limiting factor, working only with the integration area processes, future works should update the QMS of the other areas that conform to the studied metal mechanics company since a global evaluation of the level of compliance of such systems could be performed, and consequently, the areas of opportunity that may arise could be addressed.

Author Contributions: Conceptualization, J.C.L.-F. and E.A.L.-L.; methodology, J.C.L.-F. and E.A.L.-L.; formal analysis, J.C.L.-F. and A.B.-S.; writing—original draft preparation, J.C.L.-F. and R.D.F.-R.; writing—review and editing, J.C.L.-F., E.A.L.-L., R.D.F.-R. and A.B.-S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable

Informed Consent Statement: Not applicable

Data Availability Statement: Data is contained within the article.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Sansalvador, M.; Brotons, J. Quality Cost Analysis: A Case Study of a Spanish Organization. *Total Qual. Manag. Bus. Excell.* **2013**, *24*, 378–396. [CrossRef]
2. León, C.; Menéndez, A.; Rodríguez, I.; López, B.; García, M.; Fernández, S. Importancia de un sistema de gestión de la calidad en la Universidad de Ciencias Médicas. *Rev. Arch. Méd. Camagüey* **2018**, *22*, 843–857.
3. Parra, G.; de la Ossa, J.; del Carmen, S. Diagnóstico de la Situación Actual de una Empresa de Servicios de Alimentación con Respecto al Cumplimiento de los Requisitos de la Norma ISO 9001:2015 para un Sistema de Gestión de la Calidad. SIGNOS, Investigación en Sistemas de Gestión. 2019. Available online: https://revistas.usantotomas.edu.co/index.php/signos/article/view/4937/pdf (accessed on 1 November 2023).
4. *ISO 9001:2015*; Sistemas de Gestión de Calidad: Requisitos. ISO Publishing: Geneve, Switzerland, 2015. Available online: https://www.iso.org/obp/ui/#iso:std:iso:9001:ed-5:v1:es (accessed on 29 October 2023).
5. Mexico Industry. Metalmecánica, Eje de la Cadena Productiva. 2022. Available online: https://mexicoindustry.com/noticia/metalmecanica-eje-de-la-cadena-productiva (accessed on 1 October 2023).
6. Gobierno de México. Fabricación de Maquinaria y Equipo para la Industria Metalmecánica. 2023. Available online: https://www.economia.gob.mx/datamexico/es/profile/industry/metalworking-machinery-manufacturing?optionsSelector1=Economic%20Unit (accessed on 23 September 2023).
7. México Industry. El T-MEC, Gran Oportunidad para la Industria Metalmecánica en México. 2021. Available online: https://mexicoindustry.com/noticia/el-t-mec-gran-oportunidad-para-la-industria-metalmecanica-en-mexico (accessed on 1 October 2023).
8. Meza, E. Gestión de Calidad de los Servicios de Salud Ofertados por el Centro de Salud Tipo a Cotacachi del Instituto Ecuatoriano de Seguridad Social (IESS). 2022. Available online: https://repositorio.pucese.edu.ec/bitstream/123456789/3273/1/Meza%20Echeverr%C3%ADa%20Eduardo%20Sebasti%C3%A1n.pdf (accessed on 20 September 2023).
9. Naranjo, R. La Calidad del Servicio y Satisfacción de los Usuarios en el Instituto Ecuatoriano de Seguridad Social IESS. 2020. Available online: https://repositorio.uta.edu.ec/jspui/bitstream/123456789/31521/1/04%20ADP.pdf (accessed on 22 September 2023).
10. Escutia, L. Diseño e Implementación del Sistema de Gestión de Calidad, Medio Ambiente y Seguridad y Salud Conforme a las Normas ISO 9.001, ISO 14.001 e ISO 45.001 en una Empresa Especializada en Instalaciones de Telecomunicaciones. 2023. Available online: https://riunet.upv.es/bitstream/handle/10251/196608/Escutia%20-%20Diseno%20e%20implementacion%20del%20sistema%20de%20gestion%20de%20calidad%20medio%20ambiente%20y%20seguridad%20y%20....pdf?sequence=1&isAllowed=y (accessed on 20 September 2023).
11. Díaz, J. El Primer Libro: Guía Para Implementar un Sistema de Gestión de Calidad. Gandhi Pública. 2018. Available online: https://books.google.com.ec/books?id=PGhRDwAAQBAJ&printsec=frontcover&source#v=onepage&q&f=false (accessed on 2 October 2023).
12. Murrieta, Y.; Ochoa, E.; Carballo, B. Reflexión Crítica de los Sistemas de Gestión de Calidad: Ventajas y Desventajas. *Rev. En-Contexto* **2020**, *8*, 115–132. [CrossRef]
13. Peña, P. Actualización del Sistema de Gestión de Calidad en MASCOLAB SAS Sede Medellín Conforme a los Requisitos de la NTC-ISO/IEC 17025: 2017. 2019. Available online: https://repositorio.ucundinamarca.edu.co/bitstream/handle/20.500.12558/2839/ACTUALIZACI%C3%93N%20DEL%20SISTEMA%20DE%20GESTI%C3%93N%20DE%20CALIDAD%20EN%20MASCOLAB%20S.A.S%20SEDE%20MEDELL%C3%ADN%20CONFORME%20A%20LOS%20REQUISIT.pdf?sequence=1 (accessed on 11 September 2023).
14. Zarama, O. Propuesta para la Unificación de Documentos Institucionales: Estrategia Clave para Optimizar, Actualizar y Asegurar el Sistema de Gestión de Calidad Nacional (SGC) SIAC en Línea-USTA Colombia, Universidad Santo Tomás. 2019. Available online: https://repository.usta.edu.co/bitstream/handle/11634/19224/2019OscarZarama.pdf?sequence=11&isAllowed=y (accessed on 13 September 2023).
15. Fernández, S. Ajuste de la Documentación del SGC en los Procesos Misionales del Hospital Nuestra Señora de los Santos de la Victoria Valle de Acuerdo a la Norma ISO 9001: 2015. 2019. Available online: https://bibliotecadigital.univalle.edu.co/server/api/core/bitstreams/cfa7aaaa-6a24-450a-a1fa-ee4e08b1e5c3/content (accessed on 19 September 2023).
16. Acosta, Á.; Cerón, J.; Morales, C.; Torres, D. Formulación de un Plan Para la Actualización del Sistema de Gestión de la Concepción Pacifico Tres SAS, Según la Norma ISO 9001: 2015. 2020. Available online: https://repositorio.ucm.edu.co/bitstream/10839/3065/1/%C3%81NGELA%20MAR%C3%8DA%20ACOSTA%20CASTRO.pdf (accessed on 19 September 2023).
17. *ISO 9001:2008*; Sistemas de Gestión de Calidad: Requisitos. ISO Publishing: Geneve, Switzerland, 2008. Available online: https://www.iso.org/obp/ui/#iso:std:iso:9001:ed-4:v2:es (accessed on 29 January 2024).

18. Vizueta, A. Actualización del Sistema de Gestión de Calidad Basado en la Norma ISO 9001: 2015 de una Empresa de Servicio de Mantenimiento y Reparación de Contenedores para la Mejora del Desempeño Laboral del Área Administrativa en la Ciudad de Guayaquil. 2021. Available online: https://dspace.ups.edu.ec/bitstream/123456789/20756/1/UPS-GT003340.pdf (accessed on 14 September 2023).
19. Zamorano, M.; Anaya, M. Desarrollo de una Metodología para un Sistema de Gestión de Calidad en Base a la Norma ISO 9001 en los Procesos Clave de la Empresa SELLUS PRECISION. 2023. Available online: https://investigadores.unison.mx/es/studentTheses/desarrollo-de-una-metodolog%C3%ADa-para-un-sistema-de-gesti%C3%B3n-de-calid (accessed on 12 September 2023).
20. Yin, R. *Case Study Research: Design and Methods*, 4th ed.; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2009.
21. Bernal, C. *Metodología de la Investigación*, 4th ed.; PEARSON: Bogotá, Colombia, 2016.
22. Hernández, R.; Fernández, C.; Baptista, P. *Metodología de la Investigación*, 5th ed.; McGraw-Hill/Interamericana Editores, S.A. de C.V.: Ciudad de México, Mexico, 2010.
23. Castro, C.; Gamarra, J.; Rojas, A.; Villena, L. Planeamiento Estratégico Agregado Para la Empresa: Corporación Comercial Jerusalén. 2015. Available online: https://tesis.pucp.edu.pe/repositorio/bitstream/handle/20.500.12404/14312/CASTRO_GAMARRA_PLANEAMIENTO_JERUSALEN.pdf?sequence=1&isAllowed=y (accessed on 16 October 2023).
24. Freire, J. La Competitividad de la Industria Metalmecánica de la Provincia del Guayas y su Incidencia en las Exportaciones del Ecuador Hacia la Comunidad Andina de Naciones (CAN): Una Propuesta de Gestión de Desarrollo Estratégico del Sector. 2019. Available online: https://cybertesis.unmsm.edu.pe/bitstream/handle/20.500.12672/10699/Freire_mj.pdf?sequence=1&isAllowed=y (accessed on 15 October 2023).
25. Alva, R.; Durán, D.; Guzmán, G. Plan Estratégico de la Empresa Corporación de Ingeniería Metálica S.R.L. 2017. Available online: https://repositorio.up.edu.pe/bitstream/handle/11354/2062/Rocio_Tesis_Maestria_2017.pdf?sequence=1&isAllowed=y (accessed on 12 September 2023).
26. Ruiz, N. Diagnóstico Inicial para la Implementación de la Norma ISO 9001:2015 en Remarq S.A.S. 2017. Available online: http://hdl.handle.net/10654/17269 (accessed on 27 December 2023).
27. Torres, C.; Carriel, J. Propuesta de Mejora Continua para la Calidad del Servicio en una Empresa Metalmecánica de la Ciudad de Guayaquil Basada en la Norma ISO 9001:2015. 2023. Available online: https://dspace.ups.edu.ec/bitstream/123456789/24848/4/UPS-GT004333.pdf (accessed on 22 September 2023).
28. Arce, C. Diseño del Sistema Integrado de Gestión en una Empresa Metalmecánica y de Servicios de Salud. 2018. Available online: https://red.uao.edu.co/bitstream/handle/10614/10466/T08134.pdf;jsessionid=A234BD22B9A63E4C41676E9CA7573165?sequence=5 (accessed on 25 September 2023).
29. Fernández, N. Migración de un Sistema de Gestión de Calidad Basado en la Norma ISO 9001:2008 a la Norma ISO 9001:2015 en una Empresa Metalmecánica. 2020. Available online: https://cybertesis.unmsm.edu.pe/bitstream/handle/20.500.12672/11621/Fernandez_tn.pdf?sequence=1&isAllowed=y (accessed on 23 September 2023).
30. Millán, J.; Lache, A. Rediseño del Sistema de Gestión de la Calidad a Través de Metodologías de Mejora de Procesos para Incrementar la Productividad en una Empresa Metalmecánica de Bogotá. 2018. Available online: https://repository.usergioarboleda.edu.co/bitstream/handle/11232/1164/Redise%C3%B1o%20del%20Sistema%20de%20Gesti%C3%B3n%20de%20la%20Calidad%20a%20trav%C3%A9s%20de%20metodolog%C3%ADas%20de%20mejora.%20Metalmec%C3%A1nica%20de%20Bogot%C3%A1.pdf?sequence=1&isAllowed=y (accessed on 22 September 2023).
31. Duarte, P. Propuesta de Desarrollo de un Sistema de Gestión de Calidad para una Empresa Metalmecánica Pequeña, Basado en la Norma ISO 9001:2015. 2019. Available online: https://repositorio.uchile.cl/bitstream/handle/2250/170637/Propuesta-de-desarrollo-de-un-sistema-de-gesti%C3%B3n-de-calidad-para-una-empresa.pdf (accessed on 19 September 2023).
32. Castelblanco, K. Indicadores de Gestión de Calidad en Empresas del Sector Manufactura. 2016. Available online: https://repository.uamerica.edu.co/bitstream/20.500.11839/6999/1/07061509389-2016-II-GC.pdf (accessed on 25 September 2023).
33. Fuentes, T.; Pinto, E. Diseño de un Sistema de Indicadores de Gestión en una Empresa Metalmecánica. 2009. Available online: https://laccei.org/LACCEI2009-Venezuela/p145.pdf (accessed on 23 September 2023).
34. Sánchez, N.; Velosa, J.; Ramírez, J. Planificación y Estructuración de Sistema de Gestión de Calidad para la Empresa Diseño e Ingeniería Metalmecánica S.A.S. bajo los Lineamientos de la Norma NTC ISO 9001:2015. 2018. Available online: https://repository.usta.edu.co/bitstream/handle/11634/15379/2018javiervelosa.pdf?sequence=8 (accessed on 17 September 2023).