Review and digitization of the Quality Management System and continuous improvement

Rafael Almeida da Silva

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Orientador na FEUP: Prof. José António de Sousa Barros Basto

U.PORTO
FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

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To my family.

Abstract

The work developed in this dissertation had as an objective the revision and digitalization of the Quality Management System according to the NP EN ISO 9001:2015 Standard and the application of continuous improvement actions. The company where the work was developed was FELINO SA, which is an organization engaged in metalworking and iron foundry.

All the processes of the company were analysed, in order to have an overview of the functioning of the organization. Then, there were ongoing meetings with the people responsible for each process in order to get a clearer idea of the activities of the company, what had to be changed, what was no longer used and the possible improvements.

The procedures related to the processes also had to undergo an in-depth analysis, due to the changes that arised over time.

The process related to technical assistance was not documented, so this process was created.

The review of the risk assessment, the inspection and testing plan, the review by management and the restructuring of all annexes necessary for the organization should also be highlighted.

In the scope of the continuous improvement, besides all the documents related to the continuous improvement having been inserted in the quality management system, two actions of continuous improvement were done in two sectors of the organization, one in maintenance and the other in the foundry molds sector.

The accomplishment of this work allowed to have an overview of the functioning of the industry and the quality area. Several theoretical concepts studied throughout the course were put into practice.

Revisão e digitalização do Sistema de Gestão da Qualidade e melhoria contínua

Resumo

O trabalho desenvolvido na presente dissertação teve como objetivo a revisão e digitalização do Sistema de Gestão da Qualidade segundo a Norma NP EN ISO 9001:2015 e aplicação de ações de melhoria contínua. A empresa onde foi desenvolvido o trabalho é a FELINO SA, que é uma organização que se dedica à metalomecânica e à fundição de ferro.

Foram analisados todos os processos da empresa, para ter uma visão geral do funcionamento da organização. De seguida, houveram reuniões constantes com os responsáveis de cada processo de modo a ficar com uma ideia mais clara do funcionamento, o que tinha de ser alterado, o que já não era usado e possíveis melhorias.

Os procedimentos relacionados com os processos, também tiveram que sofrer uma análise profunda, devido às alterações que surgem com o tempo.

O processo relativo à assistência técnica não estava documentado, por isso estruturou-se esse processo.

Realça-se também a revisão da avaliação de riscos, do plano de inspeção e ensaio, a revisão pela gestão e a reestruturação de todos os anexos necessários para a organização.

No âmbito da melhoria contínua, para além de todos os documentos relacionados com a melhoria contínua terem sido inseridos no sistema de gestão da qualidade, foram feitas duas ações de melhoria contínua em dois setores da organização, uma na manutenção e outra no setor de moldes da fundição.

A realização deste trabalho permitiu obter uma visão geral do funcionamento da indústria e relativamente à área da qualidade. Vários conceitos teóricos estudados ao longo do curso foram postos em prática.

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I thank all my family and friends for the support given along this journey, especially my parents and my girlfriend.

General index

Abreviation list

CM – *Construções Mecânicas*

FF – *Fundição de Ferro*

IF – Iron Foundry

MC – Mechanical Constructions

QMS – Quality Management System

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1 Introduction

This report was carried out within the scope of the curricular unit dissertation, inserted in the Master's in Mechanical Engineering from the Faculty of Engineering of the University of Porto. This curricular unit was developed in a business environment at the company Felino S.A..

1.1 Company presentation

The company was originated from a foundry and metalwork founded in 1932 by Manuel Ferreira Lino. Later, in 1964, a remodelling of the company's facilities and equipment began, with a view to expansion. In 1988, it was transformed into a limited company with the name of "FELINO - Fundição e Construções Mecânicas, S.A.". The company has two facilities in Portugal: one in Ermesinde, Valongo, which includes the head office, the mechanical construction sector, commercial and administrative services, and another in Sobrado, Valongo, which includes the iron foundry sector.

FELINO is dedicated to the provision of subcontracting services (pieces rough and/or machined castings) and to the design, manufacture and sale of bakery and pastry machines. FELINO also has a subdivision called FAB, which is dedicated to the sale of pellet stoves and outdoor fireplaces.

Two units:

- Mechanical constructions - The mechanical constructions unit focuses mainly on the provision of services in the areas of machining metallic and non-metallic materials, assembling, and testing of mechanical components. There are several traditional machines and numerically controlled machines for this.
- Iron foundry - The iron foundry began in 1994 and is intended for the production of gray and nodular cast iron pieces. It has an automatic molding line for medium/large series in green sand, an auto-drying molding section for unit/small series production and a manual molding sector.

The company has a quality policy, which must be followed, thus obtaining more and better benefits for everyone. And as it says on the company website "Quality must be present in all activities and daily functions" and "always seek to prevent errors and seek ways to, each time, improve performance".
FELINO has a quality certification of compliance with the standard ISO 9001:2015.
Some examples of the bakery and pastry machines produced, and a pallet stove are presented:

Figure 1 – Fork mixer (fixed bowl) in “https://www.felino.pt/amassadeira-garfo-fixa.html, accessed at 2022/05/12, 12:10”

Figure 2 – Planetary mixer in “https://www.felino.pt/batedeira.html, accessed at 2022/05/12, 12:12”

Figure 3 – Pellet stove in “https://ecofab.pt/aquecimento.html, accessed at 2022/05/12, 12:15”

1.2 Motivation of the project and objectives

The project was created by the company's quality manager and the administration, which main objective is the absolute review of the company's quality management system and the digitization of it, both at a documental and procedural level. Another objective is to simultaneously focus on continuous improvement, procedures, processes, standards and include this in the quality management system.

1.3 Method followed throughout the project

In the work carried out with the objective of updating and reformulating the quality management system, it is necessary to ensure that the requirements of the ISO 9001:2015 standard are satisfied. It is also necessary to always take into account the culture and objectives of the organization. The first step was to understand the reality of the company and how it worked, its activities and the organizational structure. Next, we tried to standardize the documents as much as possible between the two units of the company and their digitization. In parallel, small continuous improvement actions were carried out in certain activities.

1.4 Dissertation structure

The first chapter presents the project and its objectives, the company in which the project took place and the methodology used in its development.

The second chapter is dedicated to the presentation of theoretical foundations that served as the basis for the present dissertation.

Chapter three is where the functioning of the company and the situation found are presented.

In chapter four the methodology followed throughout the work is indicated and the most important changes to the quality management system are explained in detail.

In chapter five, the conclusions of the work developed and suggestions for future work are presented.

2 State of art

On this chapter will be presented the state of art of this dissertation, defining some concepts and methodologies that will be important throughout the project.

2.1 Quality

Quality is a concept that is very important for the success of the company to face strong market competition.

Quality is concerned with needs and expectations (voice) of the customer, whether it is internal (between divisions of the company) or external. It is not just compliance with product specifications (absence of defects), the companies need to develop a quality control program that ensures compliance with these requirements, implied or mandatory requirements. The term quality can then be used as an adjective – weak, good or excellent – or as an attribute – indicating a characteristic intrinsic to the product/service.

2.1.1 History of quality

In the United States, Frederick Winslow Taylor, in the early twentieth century, formulated a new approach to factory management, which he called scientific management. Were created inspection departments to keep defective products from reaching costumers, the process of manufacturing did not matter, only the result was given importance. And thus the evaluation of manufacturing processes entered in the American System.

Later appeared the statistical methods in Germany and America for analysing and controlling quality variations in the product manufacturing process. Statistical quality control is an approach developed by Walter A. Shewhart. With H.F. Dodge and H.G. Romig, they abandoned the idea of total product quality inspection and started using sample acceptance. At the beginning of World War II, William Edwars Deming, the most known proponent of statistical quality control and quality management, began teaching courses at people that worked at companies in wartime production. In 1946, The American Society Quality Control was created with Deming´s contribution. (Hoover 2012)

Due to the war, Japan lost a lot of quality and “Made in Japan” stamped, was a synonym for junk. In the 1970s and 1980s, Philip Crosby, a quality professional started talking about the concept of "zero defect”", in which quality is defined as conformance to requirements.

To this new principle in Japan, America answered with Total Quality Management (TQM) and in 1987 there was a great advance for the evolution of the concept of quality all over the world, the first International Organization for Standardization (ISO) 9000 quality management standards were published.

The ISO 9000 standards have been expanded to include industry sector – specific versions for quality management. (Hoover 2012)

2.1.2 Cost of quality

As a starting point, according to Crosby of Crosby and Associates, cost of quality is: “Quality is free; it´s non-conformance that costs!” (Campbell 1995)

Quality cost for a company is all the costs that result from poor quality and efforts to have good quality. Is the sum of four categories:

- Prevention - costs to prevent quality problems so that they do not occur. Examples: quality planning, quality control systems, among others.
- Appraisal - costs that the company has to guarantee that its products or services meet quality standards. Examples: calibrations, materials inspections, testing, among others.
- Internal Failure - are defective products that were discovered before leaving the factory. Examples: rework, bottlenecking, scrap, downtime.
- External Failure - products that are not accepted, but that the defects were not discovered until they left the factory. Examples: claims, warranty (replacement and repairs), loss of customers and lawsuits.

Companies should follow the following strategy:

Try to reduce failures to zero;

Preventive activities for improvement;

Reduce appraisal costs according to the results;

Always aim to improve. (Campbell 1995)

2.2 Quality Management System (QMS)

A Quality Management System (QMS) is a set of internal rules that guarantee that the processes are followed. For this companies must follow the standard ISO 9001:2015.

There are many reasons to implement quality management system:

- All procedures should be documented in a simple and effective way so that all employees can follow them and do all things right at first time;
- Quality must be constantly controlled in companies to detect non-conformities and deviations from mean;
- When defects occur, the procedures must have corrective actions to be followed by the company, analysing the causes and preventive actions. The cause and effect diagram (Ishikawa) can be used here;
- If the company discovers its problems and adopts a correct preventive policy, following this line, it can reduce the defect rates. If defects are found early, less costs will be incurred;
- Decreasing non-conformities, overall costs decrease and this is where the concept of cost of quality is introduced, this is where companies can reduce costs. (Priede 2012)

2.3 ISO standard

The ISO family of standards provides a guideline for the implementation of a System of Quality Management in an organization.

ISO standard is the international standard for quality management systems.

Some of the documents that are part of this family are:

ISO 9000 – fundamentals and vocabulary;

ISO 9001 - which specifies requirements.

This family was published in 1987 by the International Organization for Standardization.

According to the standard "conformity" is satisfaction of a requirement and "non-conformity" is non-fulfilment of a requirement.

Preventive action: action to eliminate the cause of a potential nonconformity or another potentially undesirable situation (used to prevent occurrences);

Corrective action: “action to eliminate the cause of a detected nonconformity or another undesirable situation” (applied with the aim of preventing recurrences)

The current version of ISO 9001:2015 was released in September 2015.

Organizations implement requirements of the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements. This standard demands companies to document and implement systems of quality management and, later, verify through audits, carried out by external entities accredited for this purpose, compliance with the requirements.

The basic principles of quality management:

- Costumer focus;
- Leadership;
- People commitment;
- Process approach;
- Improvement;
- Evidence-based decision making;
- Relationship management.

The changes in the last version of 2015 are more significant than those produced during 2008 revision. The main changes in understanding quality which include context of organizations, risk-based thinking, knowledge as resource and leadership.

The main changes are:

Context of the organization – The combination of internal and external factors that can be effect on organization´s approach to its products, services and investments. As a result, implementation of an organization´s Quality Management System will be influenced by its context.

Risk based thinking – it was been incorporate in its requirements for the establishment, implementation, maintenance and continual improvement of the quality management system. Risk is related to potential events, and that it´s typically expressed as a result of the likelihood and consequence of such an event.

Knowledge like a resource – knowledge has become key element and crucial resource to successful projects and business development. The knowledge necessary to carry out the activity in compliance with the QMS. Knowledge must be maintained, protected and made available where necessary and knowledge needs and manage the risk of failing to acquire knowledge in due time.

Leadership – It requires greater involvement by top managers and business leaders in controlling the quality management system. The goal is to encourage integration and harmonization with business processes and business strategies. (Srđan Medić 2016)

2.3.1 Certification

The certification of ISO 9001 is the methodology that a certification company independent to the organization and accredited for this purpose, validates the certificate according to the standard.

2.3.2 Concepts

According to the ISO 9000 standard:

Conformity product: When a requirement is satisfied;

Non-conformity product: When a requirement is not satisfied;

Preventive action: Action to eliminate the cause of a detected non-conformity or another undesirable situation (applied with the aim of preventing recurrences);

Corrective action: Action to eliminate a detected non-conformity" (can be carried out in parallel with a preventive action). (Freitas 2016)

2.4 Industrial Quality

There are two types of problems that can influence the quality of products, The first type is sporadic and the second is chronic. The sporadic is something that happens from one moment to the next and action is needed to get back to the initial state. The chronic is an adverse situation that lasts over time.

For this, controls are carried out throughout the processes.

Ideally, quality planning should put the worker in a state of self-control and self-inspection. The concept of self-control concerns the process to performing a task, while self-inspection corresponds to the act of examining the product.

One of the oldest ways of assuring quality involves inspecting and deciding on of products based on sampling plans. Sampling simply accepts or rejects lots (which can even lead to differences for the same quality level of the lots presented), not being a direct instrument used in the control and systematic improvement of quality. Three actions can be distinguished to control the quality of products: inspection of 100% of the batch, removing defective products, collecting and analysing a sample only or acceptance of the lot without any inspection being carried out. (Freitas 2016)

2.5 Continuous Improvement

Continuous improvement is the constant pursuit of perfection, that is, never being satisfied with what has already been achieved and always seeking to do better. The concept of continuous improvement originated from the Japanese word Kaizen and was spread by Masaaki Imai. The word Kaizen came from the terms Kai (change) and Zen (to improve). Over the years, several definitions for continuous improvement have emerged, then some are presented: (Blanco 2014)

"Improve constantly and forever the system of production and service." (Deming 1982)

"A company-wide process of focused and continuous incremental innovation." (Bessant, Caffyn et al. 1994)

"Improvement initiatives that increase successes and reduce failures." (Juergensen 2000)

"Culture of sustained improvement aimed at eliminating waste in all organizational systems and processes, and involving all organizational participants." (Bhuiyan, Baghel et al. 2006)

Continuous improvement is intended to be a systematic and tireless way of solving problems that will make the organization better and better, and the more complex problems should be approached in a systematic and structured way. (Carvalho 2021)

There is a strong idea that should be kept alive in organizations with continuous improvement systems: everyone should continually look for changes that can make work easier or more enjoyable. Employees should be encouraged to suggest improvements that are often overlooked, such as:

Put tools and materials a little more "at hand";

Move the equipment a little closer together to reduce travel;

Simplify the forms of communication with colours, lights and other types of signs;

Clarify and standardise operations;

Improve lighting and cleanliness in work areas;

Increase task diversity to avoid overload and repetitive operations;

Improve, as far as possible, comfort in the work space. (Carvalho 2021)

2.5.1 Continuous improvement tools

There are several tools associated with continuous improvement. Is based on small changes, reducing waste, increasing safety and productivity and reducing costs

Continuous improvement covers many strategies, including TPM, TQM, JIT, 5S…among others. (Singh 2013)

- TPM – Total productive maintenance (Singh 2013)

It is a preventive and productive maintenance system and encompasses all company employees. The principle used in this strategy is that if everything is properly maintained, there will be less downtime, more safety and fewer quality problems.

TPM principles:

Total employee involvement;

Autonomous maintenance by operators;

Small group activities to improve equipment reliability, maintainability, productivity;

Continuous improvement (kaizen).

- TQM – Total quality management

The main objective is to improve products, processes, services to meet customer expectations. It is necessary the participation of all its members. Quality is customer satisfaction and the main focus is the customer. (Singh 2013)

- Just-In-Time (JIT)

In the 1970s JIT was introduced by Taiichi Ohno, Executive Vice-President of the Toyota Motor Company. This philosophy has the objective for improving productivity and eliminating waste, where waste is everything that produces costs and does not add value to the product. (Singh 2013)

2.5.2 PDCA cycle

The PDCA cycle can be applied to all processes and the quality management system as a whole. The PDCA cycle allows for improvements in several areas, such as quality, morale, safety and other critical business objectives. Can be described as follows:

- Plan - establish the objectives of the system and its processes, as well as the resources necessary to obtain results in accordance with customer requirements and the organization's policies and identify and address risks and opportunities;
- Do - implement what was planned;
- Check - monitor and measure the processes and the resulting products and services in accordance with policy, objectives, goals, requirements and planned activities and report the results;
- Act - take actions to improve performance as needed.

The purpose of the PDCA cycle is process improvement. In the improvement of the process, there must be a planning, thus resulting in corrective and preventive actions leading to an improvement in the process. For the proper functioning of the PDCA cycle, the seven basic quality tools are used and the correlation between them is represented in the table 1. (Soković et all, 2009, Qualidade 2015)

Table 1 - Seven basic quality tools in correlation with PDCA-cycle steps (Soković et all, 2009)

Seven basic quality tools (7QC tools)	Steps of PDCA-cycle				
	Plan	Do	Plan, Check	Plan, Act	Check
	Problem identification	Implement solutions	Process analysis	Solutions development	Result evaluation
Flow chart	✓			✓	
Cause- and-effect diagram	✓		✓		
Check sheet	✓		✓		✓
Pareto diagram	✓		✓		✓
Histogram	✓				✓
Scatter plot			✓	✓	✓
Control charts	✓		✓		✓

2.5.3 5s

The first steps taken by the company on the LEAN path, is the implementation of the 5s (workstation organization technique). Implementing the 5s results in visible changes in the work areas, while at the same time generating benefits in the organization at the workplace and in the work itself. Spaces become more organised, materials are easier to find, safety and quality of work increases. The start of a 5s project is motivating for the employee and managers, but the real challenge is to keep the 5s alive within the organization, as it is a long distance test, which requires a lot of discipline. (Carvalho 2021)

5s is a methodology and has its origin in Japan and whose main objective is to improve the workspace in several aspects. The 5s includes 5 Japanese words:

1. Seiri (sorting) - organize the workspace and eliminate what is not needed, thus reducing the hazard;
2. Seiton (set in order) - there must be a space for everything, and everything must be in its place;
3. Seiso (shine) - clean the workspace and remove the waste;
4. Seiketsu (standardize) - procedures must be documented and everyone must know what their role is;
5. Shitsuke (sustain) - control working methods and integrate the 5s into the employees' culture. The main objective is to keep the standards and everything flowing.

These five words together, provide a methodology for organizing, cleaning, developing and sustaining a productive work environment. (Michalska 2007, Al-Aomar 2011)

Advantages of using the 5s:

Reduced cycle times and setup times, clean workplace, increased floor space, transparent process flow, lower accident rate, among others.

The mentioned advantages serve as a basis for implementing other methods, such as TPM, cellular manufacturing and just-in-time production. It also allows you to facilitate six sigma projects. (Michalska 2007, Al-Aomar 2011)

3 FELINO activity and analysis of the initial situation

3.1 Structure of the organization

The different hierarchical levels and the functional relations between them are presented below (figure 4):

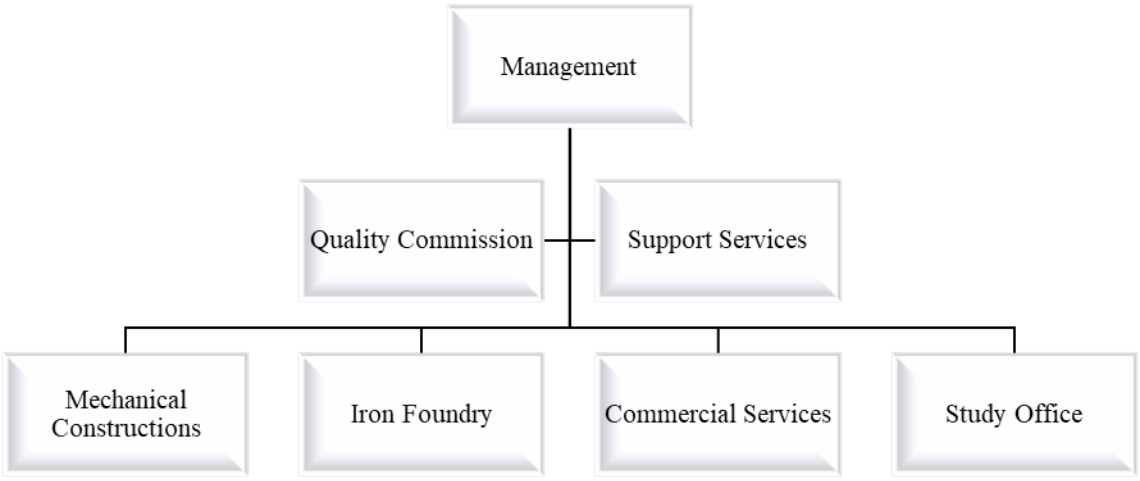


Figure 4 - Structure of the organization

- Support services are the services provided by the company and which are transversal, such as purchases, personnel service, hygiene, safety and environment services, administrative services, information systems, among others.
- Quality commission is a group of people who deal with the quality problems of the organization.
- The organization has two distinct units, the mechanical constructions, and the iron foundry.
- Commercial services are also transversal to the organization and are divided into two parts: the part dedicated to machines and the part dedicated to subcontracting parts (general mechanics).
- The study office is dedicated to the design and development of machines.

3.1.1 Departments

The two units (MC and IF) are divided into departments, each of which has its own head.

Departments at local level:

- Quality

To define the quality control process of the parts guaranteeing the fulfilment of the specifications and requirements defined by the clients; The parts shall be produced in accordance with the defined drawings and specifications, making use of measurements and tests to support and control the process; The measuring and monitoring equipment must be identified, calibrated or verified at specified intervals and protected from damage and deterioration in order to ensure that the characteristics of the inspected products conform to the specified requirements.

- Production planning / provisioning

Define applicable process for production planning and provisioning; Establish delivery deadlines for ordered items according to production capacity and customer requirements; Maintain the organization with no stock-outs and minimum stock material.

- Production

For Iron Foundry: Define process applicable to finishing, storing and shipping of castings according to customer drawings and specifications, which includes abrasive blasting, deburring, heat treatment, painting, storage and shipping; Carry out furnace charging and enforce chemical composition and pouring temperature according to the cast iron grade and characteristics of the casting. Production of sand with specified characteristics; Production of sand castings according to customer specifications.

For Mechanical Constructions: To define the process applicable to the machining of metal parts.

- Methods

Define with the customer the method of production of the piece, the molding equipment, the manufacturing parameters, in particular the work instructions for iron casting. For mechanical constructions, defining the respective manufacturing parameters, in particular, drawing up the instruction sheets. In both units, the execution of samples for customer approval is also included in this department.

Defining the process applicable to maintenance operations. It includes maintenance requests from the various sectors, preventive maintenance plans, interventions carried out and maintenance reports.

Departments common to the units:

- Shares Commercial Services

Commercial services have two areas, subcontracting and bakery and pastry machines; Define process applicable to the organization's operations of consultation and contract analysis; Customer orders.

- Studies Office

Define sub-process applicable to the design and development of new products according to customer needs. To ensure an effective and efficient response to customer needs and expectations taking into account all factors that affect product performance and functions. Main objectives: Product specifications, including acceptance criteria; Process specifications; Validated final product.

- Human Resources / Training

Define process applicable to the management of human resources and training in the organization. Main functions: Work contracts; Individual employee file; Training plan; Qualified employees and aware of the importance of the activities; Absenteeism.

- Evaluation and improvement

It is part of the organization's strategy for continuous improvement, in order to increase the performance of the organization and benefit its stakeholders. This action follows the strategic planning of the organization that together with the Quality Policy provides a framework for the establishment of the Quality Objectives. Main objectives: Improvement actions within the scope of the QMS review; General performance; Resources for improvement actions; Determining and adapting the infrastructure; Determining and managing the work environment.

3.2 Quality Management System

In general, the quality management system needs to be revised, since there are many outdated documents, documents that are used but are not documented and there is the possibility of creating documents and making them transversal to the organization. In each of the departments there are areas for improvement.

The quality management system consists of:

Quality Manual;

Quality policy;

Process approach;

Procedures;

Annexes;

Risks;

Inspection and testing plan.

- Structure of the Quality Manual

Its main objective is to harmonise, in a coherent and understandable way, the documents that contribute to the achievement and implementation of the Quality Policy, as well as to describe the FELINO's Quality Management System (QMS).

This Manual describes and explains the operation of the QMS and the interaction between its processes. It also defines the responsibilities of all the personnel involved, directly or indirectly, in the achievement of quality, working as a basic text for training, disclosure and promotion of the Company's Quality Policy.

Divided into five chapters, the Quality Manual aims at presenting the company and describing its activity, addressing issues related to the presentation of this manual and, essentially, highlighting the entire Quality Management System put into practice at FELINO.

Organizational charts are also presented, as well as reference to the procedures necessary to ensure the effective planning, operation and control of the activity in accordance with the requirements of the Reference Standard.

Preparation is conducted by the person responsible for the overall QMS. Approval is the responsibility of the Administration.

- Quality policy

The policy of a quality management system places great emphasis on control, and on the corresponding documentation of what has happened, because it is this process that makes it possible to measure the organization's quality performance, to quantify the associated costs and to correct recurrent problems or problems with significant impact. In fact, it is from the complete, objective and valuable information record that adequate corrective action and

improvement plans can be drawn up, which will allow significant and tangible benefits to be achieved for the organization.

To implement the Quality Policy, the Company adopts a process approach that is controlled and monitored in order to verify the adequacy and efficiency of the QMS.

- Process aproach

The company's process approach consists of 8 processes and one sub-process. PR01, PR02, PR2.1, PR06 are common to both units, while the others are local in scope, as shown in figure 5.

PR01 – Evaluation and Improvement

PR02 – Commercial Services Actions

PR2.1 – Studies Office (sub-process)

PR03 – Production Planning / Provisioning

PR04 - Production

PR05 – Quality Control

PR06 – Human Resources / Training

PR07 - Methods

PR08 - Maintenance

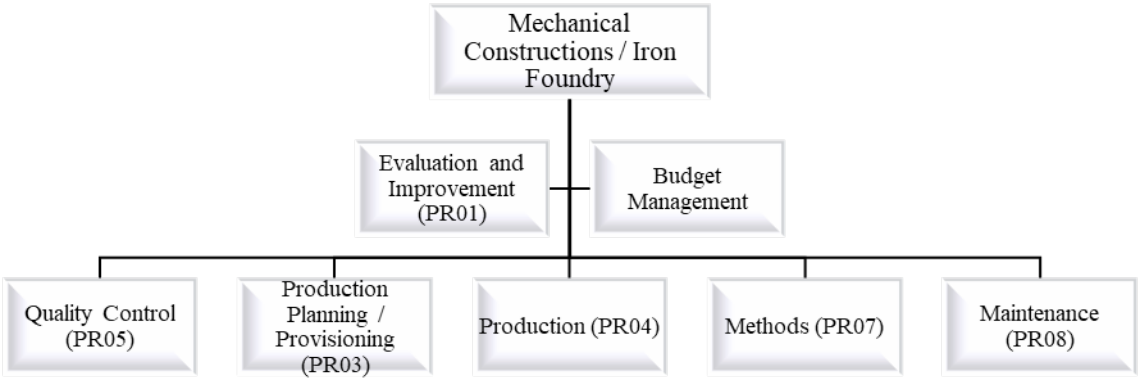


Figure 5 - Process aproach

- Procedures

There are 3 families of procedures:

PN - Procedures of eminently organizational scope and which are applied to FELINO as a whole;

PL - Procedures regarding eminently productive actions;

PP - Procedures concerning highly laboratory-based actions, regardless of the place where they are carried out.

PL and PP are addressed at the local level, as PLF and PPF for Iron Foundry and PLM and PPM for Mechanical Construction.

- Annexes

The annexes are referenced in the processes and procedures, with the main objective of keeping the information documented according to the standard.

- Risks and opportunities

Address risks and opportunities associated with its context and objectives. Risk-based thinking is essential to achieving an effective quality management system. To comply with the Standard, an organization must plan and implement actions to address risks and opportunities. This establishes a basis for increasing the effectiveness of the quality management system, achieving better results and preventing negative effects.

Opportunities may arise as a result of a favourable situation for achieving an intended result, for example, a set of circumstances that enables the organization to attract customers, develop new products and services, reduce waste or improve productivity.

3.3 Initial state of the organization

Following this, a survey of the initial state of the quality management system was carried out with the various people responsible and some objectives and possible changes were defined:

- Eliminate what is not used;
- Top Management Meeting;
- Review and reformulate the structure of processes, procedures and annexes;
- Add the technical assistance process;
- Review risks and opportunities;
- Review Inspection and Testing Plan;
- Insert continuous improvement in the QMS;
- Add a new codification of continuous improvement procedures;
- Analyse possible places to apply continuous improvement actions;
- Create a document where the acronyms of the employees and where these acronyms are present, in case of changes;
- Put everything according to the ISO 9001:2015 Standard;
- Place all this information on the local server, with the document bases (original documents) only being able to be edited by the QMS manager and the other managers can only transfer the documents to fill out and archive them properly;
- Renumbering of the annexes.

4 Project development

4.1 Work methodology

The first stage of the work developed was to read the organization's quality manual in order to have a general perception of the company's operations, analysing all the documentation, processes and procedures.

Then, the information was organised, meetings were caried out with all the people responsible for each process, from the MC, to the IF and the common processes, in order to analyse the corresponding processes and procedures. We looked at which documents were documented and no longer used, which are used but not documented and the possible improvements. We also tried to encourage employees to fill in documents in digital format whenever possible, to make it easier to file and to access information.

Throughout the work developed, there was a constant dialogue with that responsible as new information also emerged, in order to process this information and make reading simpler and more effective.

In April there was the opportunity to follow the external audit of the company, which helped a lot in the work developed, either with the dialogues with the auditors and the experience transmitted by them, or through the external audit report provided by them. The non-conformities and opportunities for improvement were encompassed in the development of the dissertation.

As for the continuous improvement, it was suggested by engineer João Carvalho, to carry out two quick actions of 5s, which will be explained in detail later on the dissertation.

4.2 Amendments

All the documentation of the quality manual was reviewed, changed as necessary, reformulated, added, deleted and replaced.

4.2.1 Uniformisation

All official documents were given a defined structure. Whenever the need arises to create a new document, the rules that are present in the document created - "Standard Rules for the Preparation of Official Documents" must be followed. Where it stands out:

- Font type and size;
- Headers and footers;
- Line spacing;
- Title;
- Logo and position in the document;

- Images;
- Captions;
- Detailed structure of:
  - Processes;
  - Procedures;
  - Annexes;
  - Quality manual.

4.2.2 Transversal documents

Some documents are now common to both units:

- Dimensional report - It was an annex used only by the Methods of the iron foundry and it was adapted to be used by the Quality and Methods of both units, where it is highlighted, the identification of the client, if it is a sample or a serial production part, the dimensions and tolerances, total amount of parts and amount of non-conforming parts. It is an attachment where the several fields are in Portuguese and English. (Annex A)
- Calibration Plan - This used to be an annex used only by mechanical constructions. It is now transversal.
- Maintenance - The preventive maintenance plans had a different structure in both units. In addition, it also became transversal the way maintenance worked, so that they worked in the same way, since some things were not carried out as they were documented. Whenever curative maintenance is needed in any section of the unit, a "maintenance request" is filled out and sent to the person in charge. Whether curative maintenance resulting from the maintenance request or preventive maintenance resulting from the annual maintenance plan (in this case, the maintenance planning can be filled in, indicating who will do it and pertinent observations), it is necessary to fill in the "intervention record", where the indication of who does the maintenance and the date are highlighted. Each one of these types of maintenance, whenever necessary, should result in filled report.

4.2.3 Reformulations

Several annexes have been reworded, with minor adjustments either because they were necessary or because of suggestions for improvement. A list of the recast annexes can be found in the Annex B.

Stands out:

- The joining of two annexes into one, the training plan and the training that is given. The training plan is made and as the training is given, the date and the average classification is placed.
- Regarding internal audits, there was an annex where internal audits were registered and there was an audit plan. A general annex was created, with the first tab being the audit plan, where the planned auditor is placed, the dates of the audits and the requirements of the standard that must be evaluated. Then there are the audit attachments, where a tab is filled in each time there is an audit. In the final tab, there is the summary table, where the information is automatically saved in a summarised form for later presentation in the external audit (this table was previously done manually) in an easy and quick manner with the general conclusions. The internal audit annex has also undergone a change, as it now

has a table with all the processes and requirements of the standard, where the requirements that will be assessed in the internal audit will be indicated (Annex C).

- Supplier Evaluation - There used to be several annexes, which were filled in repetitively, and now are no longer necessary. Throughout the year, the quality of the supplies is registered in the company's ERP by those responsible for that. Subsequently, at the end of the year, the global quality representative, with the information taken from the ERP, fills in this annex for the annual supplier evaluation.
- Start-up map - due to market conditions, silicon carbide, SiC, began to be used by the company along with graphite to add to the furnace. It was information that was not yet documented.

There were also changes in the company's procedures, where we highlight:

- In the records control PN, the archive places and the people who archive were updated. The list of items existing in that same procedure, became an annex, so that it is easier to change it, whenever necessary.
- In the supply PN, the steps that are currently carried out by computer were detailed, highlighting the internal requisitions for the purchase of materials and raw materials. The evaluation of suppliers by batches supplied has also been restructured, setting out the steps to be followed in order to insert supplier non-conformity reports into the ERP.
- In the PN of the control of non-conforming products, the steps to be followed to enter information on products that are returned by the customer into the ERP by Quality were also placed.
- In the PPM and PPF referring to the execution and sending of samples by the mechanical constructions and iron foundry, the introduction of filling out the annex "Sample Map", which is an annex with a part to be filled out by the Commercial Services, the Methods and Quality of the iron foundry and the Methods and Quality of the mechanical constructions stands out. This document allows the control of samples within the organization.

4.2.4 Eliminations

Several annexes were deleted, either because they were no longer used or because they were replaced by another one. The list of annexes deleted is Annex D.

There were documents that had the same name but different numbering, one for each unit, as is the case of "Sending Prototypes" and "Record of Measurements". Both annexes "Sending prototypes" were replaced by the "Sample Map", previously discussed in the reformulations section. The annexes "Registration of Measurements" were replaced by the transversal annex "Dimensional Report".

The following annexes no longer exist, as they are currently done in the company's ERP:

- Supplier registration sheet;
- Supplier information reception control;
- Suppliers efficiency record sheet;
- Return of goods - root cause analysis/corrective action – MC;
- Cause analysis/corrective action – IF;
- Nonconformity report – IF;
- Rejects Sheet – IF;

- Purchases order.

Executability and verifiability analysis - this analysis is done by email and the information is sent by this way to whom it is necessary.

"Production record-visual control" and "Supplier efficiency index" have been replaced by new documents, with the "Supplier efficiency index" being replaced by the "Supplier Evaluation" referred to in the reformulations section.

The annex "Technical file" has been replaced by "Instruction sheet" in MC and by "Work instructions" in IF.

These annexes have become the laboratory procedures of the iron foundry, i.e., PLF:

- Sample analysis in the spectrometer;
- Spectrometer maintenance.

4.2.5 New documents

The annexes provided by the responsible persons are in Annex E. They have undergone only minor changes and reformulations in terms of structure.

From scratch:

- Annual Maintenance Plan - A plan has been created to be used in both units (Annex F).
- PLM for bottom end gauges calibration - There was no procedure for strip back calibration.
- PLM for standard rings - There was no procedure for calibrating standard rings.
- PPM Change/replacement of design on machine - The information on this procedure was created as part of a response to an external audit from the previous year, so this documented procedure was created with that information.
- PLF to ensure the correct analysis of samples in the Spectro MAXx LMF17 optical emission spectrometer, as the spectrometer was replaced.

4.2.6 Changes continuous improvement

The existing list of continuous improvement standards has been revised. The existing codification is shown in Annex G. According to this codification, there are Standards and Procedures, and these procedures, in order to have an identical structure to the others, a new codification was created for them, PMC, Continuous Improvement Procedures. The following PMCs were created:

- Reception of Material Warehouse - Accounting;
- Invoice Validation;
- Inventory Counting;
- Control of Material Reception;
- Distribution of Tasks - Purchasing;
- Rules for Supplier Price Inquiries;
- Internal Requisition;
- Creation of New Items;
- Production, Alteration, Repair and Later Invoice Control of Molding Equipment;

- Budgets Control Meeting;
- Number of Samples to Produce Casting / Machining;
- Dissemination of Samples;
- Rules for Commercial Services to analyse the Budget Consultation;
- Preparation of Work in Machining Centres.

In the Annex H is the Invoice Validation PMC, where you can see the typical structure of a PMC.

4.2.7 Risk analysis

Regarding risk analysis, there is a global matrix of risk assessment, where some changes were made, through the opportunities for improvement suggested in external audits.

A section with columns was added for all processes, where an "x" is placed when the process is directly affected and an "O" when the process is indirectly affected (figure 6). Regarding risk assessment, the scale 1 for low, 2 for medium and 3 for high is used for the probability of the risk occurring and for the impact of this risk. The risk index is then calculated through the product of these two previously mentioned columns. The results of the risk index have a colour that characterises them, as shown in table 2:

Table 2 - Risk Index

	Risk Index	Colour
Low	1;2	Green
Medium	3;4	Yellow
High	6;9	Red

Every year, a new evaluation should be done following the same reasoning. At the end, a column was added to compare the initial evaluation with the final one, with 3 parameters (figure 7):

- Not reassessed, if no final assessment is made;
- Improved, final assessment better than initial;
- Not improved, final assessment lower than initial.

Item	Unidade Fabril	Responsável	Evento / Risco	Consequência	Processo relacionado									Avaliação inicial		
					PR01	PR02	PR2.1	PR2.2	PR03	PR04	PR05	PR06	PR07	PR08	Probabilidade	Impacto	Índice de risco
40	FF	VA	Diminuição substancial encomendas	Ocupçaõ de pessoas e máquinas					X	X					2	3	6
41	FF	JC/DT	Rotura de molde durante fabrico	Paragem de produção para reparação interna ou externa									X		2	2	4
42	FF	JC/DT/VA	Prazo excessivo de entrega de protótipos	Clientes insatisfeito					X				X		2	2	4
43	FF	JC/DT	Gitagem insuficiente	Peça sai não conforme									X		1	3	3
44	FF	JC/DT/VA	Falta de espaço devido ao elevado número de peças NOVAS a entrar (Protótipos)	Moldes e caixas de machos espalhadas pela fábrica, em locais propícios à sua degradação					X				X		2	3	6
45	FF	JC/DT	Degradação da identificação de moldes	Com o tempo e a area existente no processo fabril a identificação tende a desaparecer									X		2	1	2

Figure 6 - Matrix of risks

Reavaliação				
Data:	Probabilidade	Impacto	Índice de risco	Comparação
abr/20	2	2	4	Melhorou
abr/20	2	2	4	Não melhorou
abr/20	2	2	4	Não melhorou
abr/20	1	3	3	Não melhorou
			0	Não reavaliado
abr/20	2	1	2	Não melhorou

Figure 7 - Revaluation

4.2.8 Inspection and testing plan

The inspection and test plans of the two units were reviewed and analysed with no major changes other than the structure.

4.2.9 Management review

From the audit that was followed up, one of the non-conformities detected regarding the management review, so a restructuring was made.

In January, a meeting to review the Quality Management System is promoted by the person in charge of the global QMS and with the mandatory presence of a Company Administrator and all the persons in charge of the QMS, among others considered important for this purpose. From September to November, three follow-up meetings will be held, each with the heads of various departments, the head of the global QMS and with the compulsory presence of a Company Director, in order to monitor the level of compliance and, if so desired, redefine some of the objectives in more detail.

- Annual meeting (January)

Meeting at the beginning of the year, where the whole of the previous year is reviewed and its noted if the objectives have been met as well as prospects for the new year. The purpose of this meeting is to address global problems of the company and also to analyse the map of process indicators. Below is a more detailed list of the matters to be dealt with.

Matters to be dealt with:

- Definition of the Quality Objectives for that year;
- Checking the status of actions resulting from previous management reviews;
- Changes in external and internal issues that are relevant to the quality management system (stakeholders);
- Performance and effectiveness of the QMS including trends (present graphs):
    1) Customer satisfaction and feedback from relevant stakeholders;
    2) Extent to which quality objectives have been met;
    3) Process performance and product and service conformity;
    4) Non-conformity and corrective actions;
    5) Monitoring and measurement results;
    6) Results of audits;
    7) Performance of external suppliers;
- Adequacy of resources;
- Effectiveness of actions taken to address risks and opportunities;
- Opportunities for improvement.
- Review the proposals for the following annual plans:

    Internal audit plan;

    Training plan;

    Calibrations plan;

    Maintenance plan.

From this Meeting there have to be several outputs, including decisions and actions related to:

- Opportunities for improvement;
- Needs for changes to the QMS;
- Resource needs;
- Documented information as evidence of the results of management reviews - minutes, action plans and corrective actions.

  Minutes are taken after the meeting and approved by the participants.

- Follow-up meetings (September, October, November)

Follow-up meetings are meetings where several departments meet. The order of business is followed as shown in the following item, where there are compulsory and optional matters.

Matters to be discussed at follow-up meetings:

- Mandatory:

  Analysis of indicators;

  Explain the reasons for the results;

  Comparisons with previous years;

  Causes of problems;

  Possible improvements.

- Optional / extra:

  Suggestions;

  Personnel / resources / machines / tools;

  New projects.

The composition of the follow-up meetings is not fixed, and departments may swap, being the duty to organize and coordinate the meeting the one in charge of "Evaluation and Improvement":

1. **Mechanical constructions (September)**

   Evaluation and Improvement;

   Quality Control;

   Production Planning;

   Production;

   Methods;

   Maintenance.

2. **Mechanical Constructions (October)**

   Evaluation and Improvement;

   Commercial Services;

Human Resources / Training;

Research Office;

Technical Assistance (is referred to in the following section).

3. **Iron Foundry (November)**

   Evaluation and Improvement;

   Methods;

   Production Planning;

   Production;

   Quality Control;

   Maintenance.

After each of the follow-up meetings, minutes are drawn up and approved by the participants.

4.2.10 New procedure - Technical assistance FELINO - STAF

There was a sector in the company that was not formally documented, which is the STAF - Feline Technical Assistance Service. A new process was then created, which turns out to be a ramification of the process of "Actions of Commercial Services".

The scope of this process is that it applies to all requests for assistance whether under warranty or not for bakery and pastry machines.

It has as input the request for service and as output the resolution and conclusion of the service.

The request for assistance comes to the organization from the customer, which can be a national request or from an international customer. In the case of an international customer, technical support and materials are provided to FELINO agents abroad. If it is a national customer, this service may be performed by FELINO technicians or subcontracted companies when necessary. There are two types of services, curative and preventive, where it is necessary to make an analysis and planning of the needs. If there is material in stock, the service can be scheduled, depending on the availability of technicians and customers, otherwise, it is necessary to wait for the materials to perform the assistance. Sometimes more material is needed and the process has to be restarted based on the needs planning. Finally, the assistance service is completed. For a better understanding of how it works, the process flowchart is in figure 8.

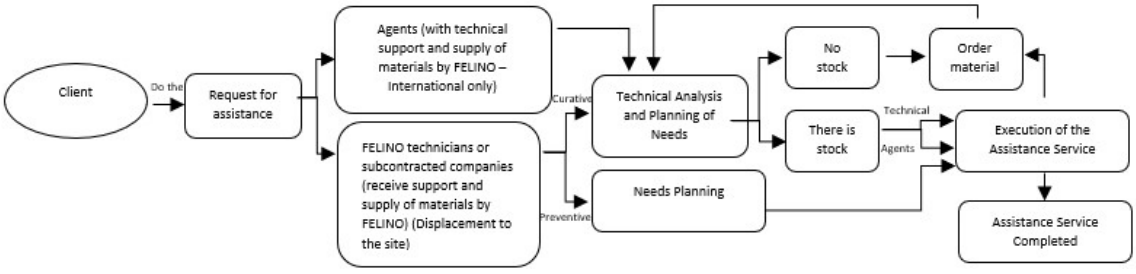


Figure 8 - Process flowchart

Whenever an assistance service takes place, the intervention report must be completed.

4.3 Continuous improvement

Two quick 5s actions were performed. One in the mechanical constructions unit and the other in the iron foundry. In the mechanical constructions unit, the continuous improvement action was carried out in the maintenance department, centered on the space that is aimed for maintenance that is located in the factory's nave. The continuous improvement action implemented in the iron foundry was performed on the methods department, specifically on the molds section.

4.3.1 Maintenance space

Initially, a 5s audit was performed by the section manager and the people who were going to perform the 5s action with a company document, which is divided into 5 subsections, which correspond to the methodology of 5s, for each one of them there are several points, where a classification from 0 to 4 was given for each one. The 5s analysed are:

1. Sorting
2. Ordination
3. Cleaning
4. Normalization
5. Subject

The rating obtained in this initial 5s audit was 56/100.

The space where the 5s methodology was applied initially had the following appearance as can be seen in figure 9.

Figure 9 – Maintenance space

The space consists of a workbench, a mobile tool carriage and a pallet.

Starting the 5s process, a sorting was carried out, where unnecessary items and garbage were removed (figure 10). Tools were separated. tags have been placed to identify tools and containers for certain objects, such as sandpaper, tape and cleaning cloths (some examples on figures 11 and 12). The tools were organized with labels and ribbons to separate them. One part of the stand was defined to store the machines (grinder and drill). Bolts, nuts and washers, eyebolts and compressed air parts were grouped in containers separately. Everything was properly labelled.

Figure 10 – Waste and unnecessary items

Figure 11 – Mobile tool carriage

Figure 12 - Workbench

Was also included in the continuous improvement action, the maintenance pallet. Where the parts that were no longer needed were removed, and the necessary parts were organized and cleaned. The harness and the safety equipment for heights, was placed inside a box. The parts that are needed to help with certain functions are in another box. There is also a box for forklift accessories and a hose that is just resting on the pallet in its proper place. In the figure 13 we can have a general perspective of the space where the continuous improvement action was applied. At the end, a new audit was carried out with the same document as the initial audit, obtaining a score of 84/100.

Figure 13 – Maintenance space after 5s action

4.3.2 Molds section

The same document used in the other improvement action was used to assess the initial state of this section, obtaining a score of 26/100. The space where the 5s methodology was applied is shown in the figure 14.

Figure 14 – Molds section

The space consists of a stand and two shelves.

The process started with a sorting process, everything that was on the shelves was removed for sorting (figures 15 and 16), which what was garbage and what was not needed was removed (Annex I).

Figure 15 – Sorting process

Figure 16 – Sorting process

Everything has been identified, highlighting the separation of the various types of screws, the taps, liquids, glues, machines and drills. The final appearance of the two shelves in more detail in annexes J and K.

After applying the 5s action, the general appearance of the space is as follows on the figure 17. At the end, a new audit was carried out with the same document as the initial audit, obtaining a score of 60/100.

Figure 17 – Molds section after 5s action

5 Conclusions and perspectives for future work

Quality is an area that plays a very important role in organizations and having an effective and up-to-date quality management system is indispensable to enable the smooth running and control of the necessary information of the organization.

The quality management system is a task that is the responsibility of the top management.

Throughout the dissertation, the most important and outstanding points of the review of the quality management system of the organization are presented. The main objective of this revision was to update, in a general way, the quality management system according to the ISO 9001:2015 Standard, improving its effectiveness and efficiency.

The quality management system having a large amount of information and covering the entire organization, certain chapters were analysed more deeply than others, highlighting the review of the processes, procedures and annexes used.

Continuous improvement, which was at a very early stage, was added to the quality management system. Continuous improvement procedures were also created.

Two continuous improvement quick actions were carried out, which allowed a reorganization in two different sections of the organization, enabling a better appearance and easier to find materials and tools.

The Felino technical assistance process was documented, which already existed in practice, but in theory there were no records.

In the external audit that was followed up, suggestions were made for improvement opportunities, most of which were taken advantage of:

Changes in risk analysis;

Internal audit changes;

Top management meetings.

In general, all topics of the quality management system have been reviewed, analysed, documented and the necessary changes were made.

All information of the quality management system will be accessible to the top management and the global head of the quality management system and can be edited by them with an access code. The managers and employees will have access via the local network to the documents that are necessary for the development of their work.

In general, the employees have always been helpful and receptive to change, always ready to listen and to help.

Any organization should base its processes around customer demands and requirements. Due to competition and the quest to be better, it is necessary to have records with quality information, as decision making must be based on facts to ensure effectiveness.

In relation to perspectives of future work, a more profound analysis of risks and opportunities could be made. Although there is no requirement in ISO 9001:2015 for formal risk management methods, organizations could develop a more extensive risk management methodology, such as creating a documented risk management process. Also, a scanning of past documents could be done in order to have them accessible from the local network.

References

Al-Aomar, R. A. (2011). "Applying 5S Lean Technology: An Infrastructure for Continuous Process Improvement."

Bessant, J., S. Caffyn, J. Gilbert, R. Harding and S. Webb (1994). "Rediscovering continuous improvement." Technovation **14**(1): 17-29.

Bhuiyan, N., A. Baghel and J. Wilson (2006). "A sustainable continuous improvement methodology at an aerospace company." International Journal of Productivity and Performance Management **55**: 671-687.

Carvalho, J. D., & Sousa, R. M. (2021). Melhoria Contínua nas Organizações. *Lisboa: Lidel-Edições Técnicas, Lda*

Deming, W. E. (2018). Out of the Crisis, reissue. MIT press.

Freitas, E. M. S. (2016). Desenvolvimento e implementação de um sistema de gestão de não conformidades numa indústria metalomecânica, FEUP.

Gupta, M., & Campbell, V. S. (1995). "The Cost of Quality." Production and Inventory Management Journal, 36, 43-43

Hoover, R. R. K. & Hoover, M. (2012). "The History of Quality in Industry." Sandia Natl. Lab, 1-17.

Juergensen, T. (2000). "Continuous Improvement: Mindsets, Capability, Process, Tools and Results" The Juergensen Consulting Group Inc., Indianapolis.

Medić, S., Karlović, B., & Cindrić, Z. (2016). "NEW STANDARD ISO 9001:2015 AND ITS EFFECT ON ORGANISATIONS." Interdisciplinary Description of Complex Systems: INDECS, 14(2), 188-193.

Michalska, J., & Szewieczek, D. (2007). "The 5S methodology as a tool for improving the organisation." Journal Of Achievements in Materials and Manufacturing Engineering, **24**(2), 211-214.

Priede, J. (2012). "Implementation of Quality Management System ISO 9001 in the World and its Strategic Necessity ". Procedia-Social and Behavioral Sciences, 58, 1466-1475.

Qualidade, I. P. d. (2015). Quality Management Systems Requirements (ISO 9001:2015).

Sanchez, L., & Blanco, B. (2014). "Three decades of continuous improvement." Total Quality Management & Business Excellence, 25(9-10), 986-1001.

Singh, J., & Singh, H. (2013). "Continuous Improvement Strategies: An Overview." IUP Journal of Operations Management, 12(1).

Soković, M., Jovanović, J., Krivokapić, Z., & Vujović, A. (2009). "Basic Quality Tools in Continuous Improvement Process." Journal of Mechanical Engineering, 55(5), 1-9.

ANNEX A: Dimensional Report

Relatório Dimensional / Dimensional Report

Relatório / Report Nº

Cliente / Customer: _____ Código do Artigo / Article Code: _____

Número de Desenho / Drawing Number: _____

Designação / Designation: _____ Amostra / Sample: Sim / Yes ☐

Data / Date: _____ Não / No ☐

Identificação / Identification	Dimensões e Tol. / Dimensions and Tol.	Peça/Piece Nº	NC	Peça/Piece Nº	NC	Peça/Piece Nº	NC	Peça/Piece Nº	NC

Observações / Remarks

Nas linhas com um X, na coluna NC (não conforme), a medida está fora da especificação. Para as amostras da fundição de ferro todas as tolerâncias lineares estão de acordo com DCTG 10 (BMD) e DCTG 13 (AS). Para as construções mecânicas é usada a ISO 2768-mk.
On the lines with an X, on the column NC, the measurement is out of specification. For iron foundry samples all linear tolerances according DCTG 10 (BMD) or DCTG 13 (AS). Mechanical constructions uses ISO 2768-mk.

Elaborado por / elaborated by: _____

Aprovado por /verified by: _____ Data / Date: _____

Manual da Qualidade v7.0 Pág. 1 de 1 - A10 - Relatório Dimensional/Dimensional Report

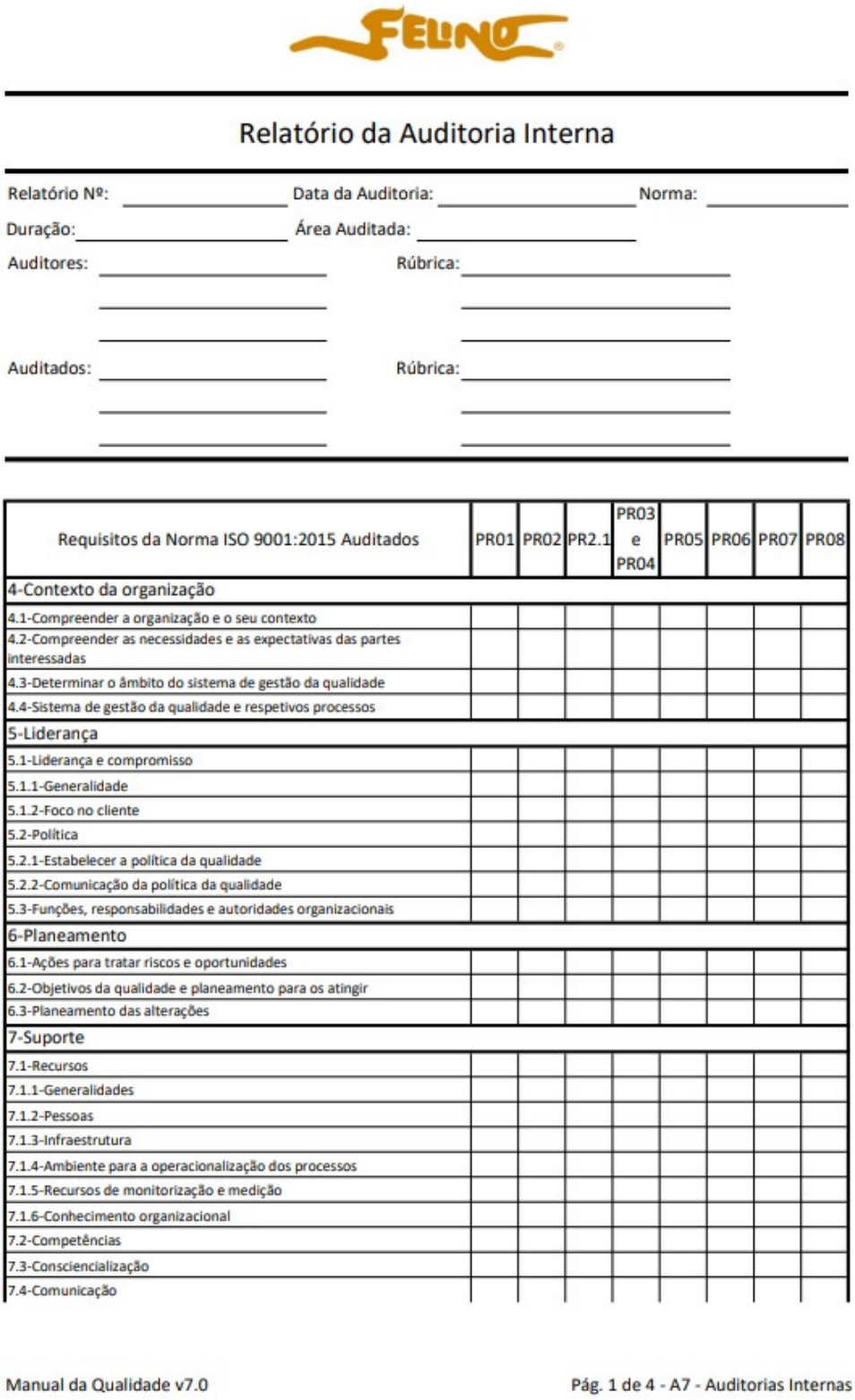
Figure A.1 - Dimensional report

ANNEX B: List of recast documents

	In Portuguese
Registration of Copies	Registo de Cópias
Registration of Instruments and Standards	Registo de Instrumentos e Padrões
List of Homologated Products	Lista de Produtos Homologados
Training Plan / Given Training	Plano de Formação / Formação Dada
Internal Audits	Auditorias Internas
Annual Calibration Plan	Plano de Calibrações Anual
Suppliers Evaluation	Avaliação de Fornecedores
Internal Calibration Results Register	Registo Resultados Calibrações Internas
Maintenance Order	Pedido de Manutenção
Intervention Record	Registo da Intervenção
Maintenance Report	Relatório de Manutenção
Maintenance Planning	Planeamento de Manutenção
Material Characteristics	Caraterísticas dos Materiais
Record of Sand Characteristics	Registo das Caraterísticas da Areia
Control Charts	Cartas de Controlo
Fusion Programme - Daily	Programa de Fusão - Diário
Load Map (Fusion)	Mapa de Cargas (Fusão)
Average Chemical Composition of Manufactured Products	Composição Química Média dos Produtos Fabricados
Start-up Map / Change of Composition	Mapa de Arranques / Mudança de Composição
Correction Sheet for the Furnace	Ficha de Correções para o Forno
Register of Analyses and Tests Results	Registo de Resultados de Análises e Ensaios
Scrap (Quantity of Pieces) - Deburring	Refugo (Quantidade de Peças) - Rebarbagem
Change in Mill Load Composition Form	Ficha de Alteração da Composição da Carga da Galga
Change Specification Sheet for Mixture of Self-drying Sand	Ficha de Alteração da Mistura da Areia Auto Secativa
Brinnel Hardness	Dureza de Brinnel
Automatic Line Plate Mounting	Montagem de Placas na Linha Automática
Heat Treatment Cycles	Ciclos de Tratamento Térmico
Green Sand Properties	Propriedades da Areia Verde
Record of Green Sand Characteristics	Registo das Caraterísticas da Areia Verde
Record of Flexion Test Results of Core Sands	Registo de Resultados de Ensaios à Flexão de Areia de Machos
Core Identification	Identificação de Machos
Requisition	Requisição
Record of Raw Material Consumption	Registo do Consumo de Matérias-Primas
Know-how and Personal Experience	Saber Fazer e Experiência Pessoal

Figure B.1 - List of recast documents

ANNEX C: Internal audit report



FELINO

Relatório da Auditoria Interna

Relatório Nº: _____ Data da Auditoria: _____ Norma: _____

Duração: _____ Área Auditada: _____

Auditores: _____ Rúbrica: _____

_____ _____

_____ _____

Auditados: _____ Rúbrica: _____

_____ _____

_____ _____

Requisitos da Norma ISO 9001:2015 Auditados	PR01	PR02	PR2.1	PR03 e PR04	PR05	PR06	PR07	PR08
4-Contexto da organização								
4.1-Compreender a organização e o seu contexto								
4.2-Compreender as necessidades e as expectativas das partes interessadas								
4.3-Determinar o âmbito do sistema de gestão da qualidade								
4.4-Sistema de gestão da qualidade e respetivos processos								
5-Liderança								
5.1-Liderança e compromisso								
5.1.1-Generalidade								
5.1.2-Foco no cliente								
5.2-Política								
5.2.1-Estabelecer a política da qualidade								
5.2.2-Comunicação da política da qualidade								
5.3-Funções, responsabilidades e autoridades organizacionais								
6-Planeamento								
6.1-Ações para tratar riscos e oportunidades								
6.2-Objetivos da qualidade e planeamento para os atingir								
6.3-Planeamento das alterações								
7-Suporte								
7.1-Recursos								
7.1.1-Generalidades								
7.1.2-Pessoas								
7.1.3-Infraestrutura								
7.1.4-Ambiente para a operacionalização dos processos								
7.1.5-Recursos de monitorização e medição								
7.1.6-Conhecimento organizacional								
7.2-Competências								
7.3-Consciencialização								
7.4-Comunicação								

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Figure C.1 - Internal audit report

ANNEX D: List of discarded documents

	In Portuguese
Suppliers' Registration Sheet	Folha de Registo de Fornecedores
Supplier information reception control	Controlo receção informação a fornecedores
Supplier efficiency record sheet	Folha registo eficiencia de fornecedores
Executability and verifiability analysis	Análise executabilidade e verificabilidade
Measurements register - MC	Registo de medições - CM
Returns analysis of causes/corrective actions	Devoluções análise de causas/ações corretivas
Sending prototypes - MC	Envio de protótipos - CM
Production recording - visual control - IF	Registo de produção - controlo visual - FF
Spectrometer sample analysis - IF	Análise de amostras no espectrómetro - FF
Spectrometer maintenance - IF	Manutenção do espectrómetro - FF
Purchases order	Pedido de compras
Suppliers efficiency index	Índice eficiência fornecedores
Technical File	Ficha técnica
Measurements Registration - IF	Registo de medições - FF
Rejects Sheet - IF	Ficha de rejeições - FF
Sending prototypes - IF	Envio de protótipos - FF
Cause Analysis / Corrective Action - IF	Análise de causas /ação corretiva - FF
Non Conformity Report - IF	Relatório não conformidade - FF

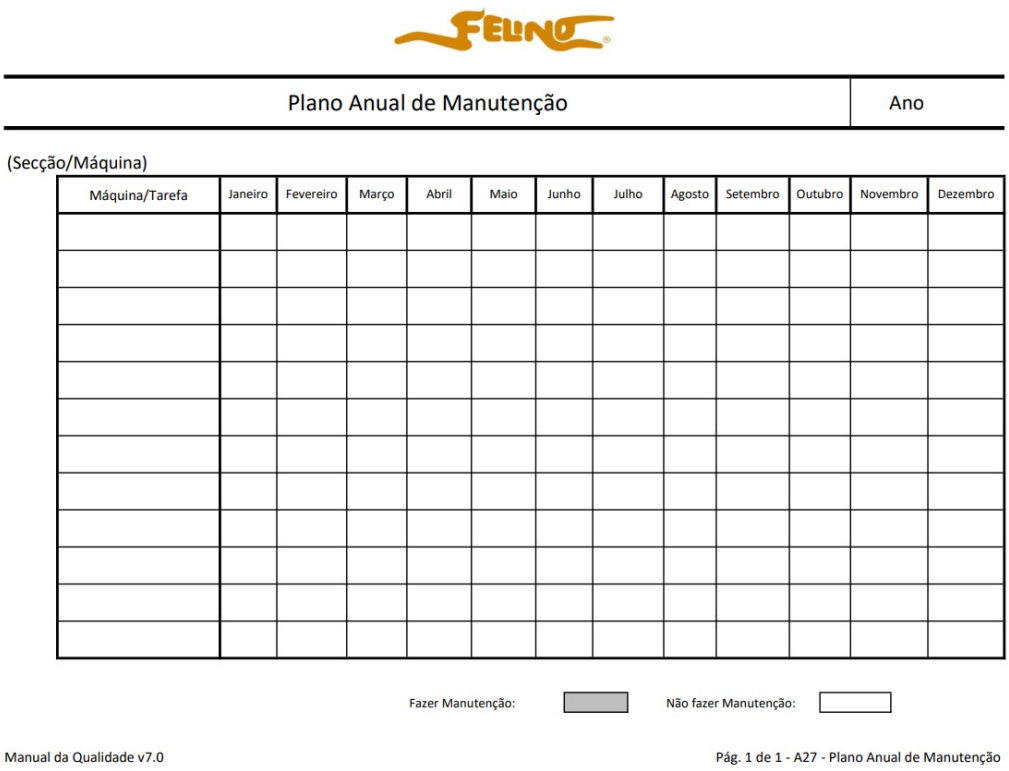
Figure D.1 - List of discarded documents

ANNEX E: List of new documents provided by those responsible

	In Portuguese
Training Record	Registo de Formação
Dimensional Report	Relatório Dimensional / Dimensional Report
Sample Map	Mapa Amostra
Budgets Control	Controlo de Orçamentos
Machine Registration of Alterations	Registo de Alterações em Máquinas
Instruction Sheet - CNC Centres and Multifunctions	Ficha de Instruções - Centros e Multifunções
Instruction Sheet - CNC Lathe	Ficha de Instruções - Torno CNC
Work Preparation Sheet	Folha de Preparação de Trabalho
Sample Control	Controlo da Amostra
Final Inspection	Controlo Final
Sample Control Sheet	Ficha da Amostra
RCI - Calipers	RCI - Paquímetros
RCI - Micrometers	RCI - Micrómetros
RCI - Comparators	RCI - Comparadores
RCI - Bottom End Gauges	RCI - Tira Fundos
RCI - Flat Buffer Gauges	RCI - Calibres Tampão Liso
RCI - Standard Rings	RCI - Anéis Padrão
Work Instructions	Instruções de Trabalho
Shaping Programming - BMD	Programação Moldação - BMD
Shift Pass Sheet - Deburring	Folha de Passagem de Turno - Rebarbagem
Weekly Production Planning	Planeamento Produção Semanal
Recommended HB Hardness	Dureza HB Recomendada
Abrasive blasting Times	Tempos de Decapagem
Temperature Measuring Rods Check	Verificação das Canas de Medição de Temperatura

Figure E.1 - List of new documents provided by those responsible

ANNEX F: Annual maintenance plan



FELINO

Plano Anual de Manutenção	Ano

(Secção/Máquina)

Máquina/Tarefa	Janeiro	Fevereiro	Março	Abril	Maio	Junho	Julho	Agosto	Setembro	Outubro	Novembro	Dezembro

Fazer Manutenção: Não fazer Manutenção:

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Figure F.1 - Annual maintenance plan

ANNEX G: Codification continuous improvement

	Code	In Portuguese
CONTINUOUS IMPROVEMENT	MC	MELHORIA CONTÍNUA
STANDARD	N	NORMA
PROCEDURE	PR	PROCEDIMENTO
ARTICLES	AR	ARTIGOS
INTERNAL REQUISITIONS	RI	REQUISIÇÕES INTERNAS
BILLINGS	FT	FATURAS
MEETING	RE	REUNIÃO
SUPPLIERS	FR	FORNECEDORES
FUNCTIONS	FU	FUNÇÕES
CLEANING	L	LIMPEZA
ORDERING	O	ORDENAÇÃO
OILS	OL	ÓLEOS
PREPARATION	P	PREPARAÇÃO
RECEPTION	R	RECEÇÃO
ELECTRICITY	E	ELETRIFICAÇÃO
DOCUMENT	DO	DOCUMENTO
INVENTORY	IV	INVENTÁRIO
MF + TOCN	01	MF + TOCN
ST1	02	ST1
METROLOGY LABORATORY	03	LABORATÓRIO DE METROLOGIA
MACHINING CENTRES	04	CENTROS DE MAQUINAGEM
PREPARATION STATION	05	POSTO DE PREPARAÇÕES
LOGISTICS	06	LOGÍSTICA
PURCHASES	07	COMPRAS
WAREHOUSE	08	ARMAZÉM
ACCOUNTING	09	CONTABILIDADE
COMMERCIAL SERVICES	10	SERVIÇOS COMERCIAIS
BMD	11	BMD
SEQUENTIAL Nº	001	Nº SEQUENCIAL

Figure G.1 - Codification continuous improvement

ANNEX H: PMC – example

Código: MCPRFT07001
Versão: 1.0
Data: 15/10/2021

PMC02 – Validação de Faturas

Posto

Diversos

Setor

Compras

Objetivo

Garantir a correta validação de faturas.

Âmbito

Aplica-se a todas as faturas.

Procedimento

Todos os dias às 08h30 são distribuídas pela Contabilidade as faturas pelos diversos departamentos.

- Faturas FSE (sem movimento STOCK)

Todos os colegas que requisitaram estes fornecimentos e serviços externos devem validar os documentos e devolver num prazo de 24 horas.

- Faturas Compras (com movimento STOCK)

Armazém/Entrada em Sistema
Cada armazém que receciona artigos até às 11 horas de cada dia, deve conferir o material rececionado até ao final desse dia e dar entrada no sistema no limite nas próximas 24 horas.
Todo o material que seja rececionado após as 11 horas deve ser conferido no limite até às 11 horas do dia seguinte e dar entrada no sistema no limite nas próximas 24 horas.

Encerrar Receções

a) Após a entrega da fatura têm 24 horas para encerrar receção e entregar a fatura na Contabilidade;
b) Ao dia 15 de cada mês se a receção não estiver encerrada deve-se questionar o fornecedor sobre o motivo de não ter enviado a fatura.

Registos

Não há registos.

Distribuído

)COM.

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Figure H.1 - PMC - example

ANNEX I: Waste

Figure I.1 - Waste

ANNEX J: Final appearance of shelf 1

Figure J.1 - Final appearance of shelf 1

ANNEX K: Final appearance of shelf 2

Figure K.1 - Final appearance of shelf 2