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Proposal for structuring the quality manual of the SENAI Innovation Institute for Biomass in accordance with ISO 9001.
Proposta de estruturação do manual da qualidade do Instituto SENAI de Inovação em Biomassa em conformidade com a ISO 9001.
Propuesta de estructuración del manual de calidad del Instituto SENAI de Innovación en Biomasa conforme a la ISO 9001.

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Abstract:
This study proposes the structure of a Quality Manual for the SENAI Institute of Innovation in Biomass (ISI Biomassa), based on ABNT NBR ISO 9001:2015, at an institute in the early stage of implementing the standard. In an exploratory, qualitative single-case study, the research combined observation and exploratory conversations, a general meeting, a questionnaire answered by 31 employees and an analysis of the quality manuals of four organizations. The diagnosis pointed to favorable aspects, such as defined responsibilities and access to training, and to gaps typical of the early implementation stage, such as perceived insufficiency of resources, limited dissemination of the quality policy and limited familiarity with indicators and internal audits. Based on these results and on benchmarking, an eight-section manual is proposed as a starting point for implementing the Quality Management System.

Keywords:
Quality Manual. ISO 9001:2015. Quality management. Benchmarking. Case study.

Resumo:
Este trabalho propõe a estrutura de um Manual da Qualidade para o Instituto SENAI de Inovação em Biomassa (ISI Biomassa), com base na ABNT NBR ISO 9001:2015, em um instituto na fase inicial de implantação da norma. Em um estudo de caso único, exploratório e qualitativo, combinaram-se observação e conversas exploratórias, reunião geral, questionário respondido por 31 colaboradores e análise de manuais da qualidade de quatro organizações. O diagnóstico apontou pontos favoráveis, como a definição de responsabilidades e o acesso a treinamentos, e lacunas próprias da fase inicial de implantação, como a percepção de insuficiência de recursos, a baixa difusão da política da qualidade e a pouca familiaridade com indicadores e auditorias internas. Com base nesses resultados e no benchmarking, propõe-se um manual de oito seções, ponto de partida para a implantação do Sistema de Gestão da Qualidade.

Palavras-chave:
Manual da Qualidade. ISO 9001:2015. Gestão da qualidade. Benchmarking. Estudo de caso.

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Resumen:
Este trabajo propone la estructura de un Manual de Calidad para el Instituto SENAI de Innovación en Biomasa (ISI Biomassa), basado en la ABNT NBR ISO 9001:2015, en un instituto que se encuentra en la fase inicial de implantación de la norma. En un estudio de caso único, exploratorio y cualitativo, se combinaron la observación y las conversaciones exploratorias, una reunión general, un cuestionario respondido por 31 colaboradores y el análisis de los manuales de calidad de cuatro organizaciones. El diagnóstico señaló aspectos favorables, como la definición de responsabilidades y el acceso a formación, y brechas propias de la fase inicial de implantación, como la percepción de insuficiencia de recursos, la escasa difusión de la política de calidad y la poca familiaridad con los indicadores y las auditorías internas. A partir de estos resultados y del benchmarking, se propone un manual de ocho secciones como punto de partida para implantar el Sistema de Gestión de la Calidad.

Palabras clave:
Manual de calidad. ISO 9001:2015. Gestión de la calidad. Benchmarking. Estudio de caso.

1. introduction

Quality management is a set of systematized practices that guide and control the activities of an organization, regardless of its size or sector. This strategic approach establishes parameters for the planning, execution and monitoring of processes, with the objective of ensuring operational efficiency, standardization and greater satisfaction of stakeholders. In this context, the adoption of certified Quality Management Systems (QMS) according to ISO 9001 has been consolidated as a competitive differential. This is because the adoption of this standard consolidates and demonstrates the commitment of organizations to continuous improvement, compliance and reliability of processes (Carvalho, 2015). In addition, ISO 9001 certification also contributes to strengthening institutional credibility, reducing risks in commercial transactions and greater trust between companies and customers, especially in supply chains and procurement processes (Valls, 2005).

According to Soares, Oliveira and Menelau (2020), the evolution of ISO 9001 is associated with the advancement of international trade and the need for standardization of quality, especially from globalization and the organizational search for competitiveness. After the creation of the International Organization for Standardization (ISO) in 1946, the institution consolidated the development of international standards aimed at the standardization of products, services, processes, social responsibility and environmental issues. To consider specifically the standards linked to Quality Management, there is the ISO 9000 series, which was structured based on the BS 5750, originating the first version of ISO 9001 in 1987, becoming a global reference for the prevention of non-compliance and quality assurance. Since then, the standard has undergone revisions in 1994, 2000, 2008 and 2015, motivated by changes in the global environment, market requirements and users' needs, promoting a transition from a documentary and prescriptive approach to a strategic approach oriented to management, organizational performance, risk analysis and continuous improvement.

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According to Carpinetti (2017), a fundamental action for the implementation of ISO 9001 is the development of a quality manual. This document can be defined as a management instrument that describes the quality system of an organization, structuring policies, responsibilities and processes in a clear and accessible way. Thus, it is necessary that the function of the manual is to guide employees and managers, serving as a reference to ensure the standardization of activities and compliance with normative requirements.

One point to highlight is that, although in this latest update of ISO 9001, the quality manual is no longer a mandatory item, several authors emphasize its importance (Barçante, 1998; Juran; Godfrey, 1999; Mello et al., 2023; Paladini, 2019). Mello et al. (2023) point out that the manual remains a strategic resource, as it helps in the clear definition of responsibilities, in the registration of exclusions and in the consolidation of the practices of the quality management system, functioning as guidance guide for employees and managers. Similarly, Barçante (1998) emphasizes that standardization and formalization of processes are essential elements to sustain the culture of quality and reduce costs arising from failures, which makes the manual an effective instrument of organizational integration. In addition to these authors, Juran and Godfrey (1999) and Paladini (2019) reinforce that structured documentation and clarity of processes are fundamental for the sustainability of the quality management system, allowing the maintenance of organizational knowledge and continuous improvement. Thus, even though it is not mandatory, the manual remains recognized as a tool of support relevant to the effectiveness and maturity of the quality management system.

The need for this manual is even more evident in institutions dedicated to applied research, since quality directly affects scientific reliability, the traceability of experiments and the reproducibility of results. In this context, the SENAI Innovation Institute for Biomass (ISI Biomassa) stands out as a reference center for research, development and technological innovation aimed at the sustainable use of resources. The activities of ISI Biomassa require rigorous technical standards and reliable results, reinforcing the need for standardized and monitored processes. Thus, implementing a structured and effective Quality Management System aligned with ISO 9001:2015 is essential to ensure excellence in the services provided, process conformity and fulfillment of stakeholders' expectations.

Given this scenario, and considering that ISI Biomassa is in the early stage of implementing ABNT NBR ISO 9001:2015, the main objective of this article is to propose a structure for a Quality Manual to support the future implementation and application of the standard. The article is organized as follows. First, the theoretical framework presents the main concepts and guidelines related to quality management and ISO 9001. The methods section then describes the procedures used to develop the manual. Next, the results present the proposed Quality Manual as a strategic tool to support the QMS. Finally, the conclusions highlight the study's contributions and practical implications.

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2. theoretical framework

2.1 ISO 9001

The search for excellence and competitiveness in the global scenario has driven the creation of international management standards. In this context, the International Organization for Standardization (ISO), an international non-governmental organization based in Geneva and founded in 1946, plays a key role. ISO is responsible for the development of technical standards of global application, possessing great representativeness in the establishment of international standards for management (Maekawa; Carvalho; Oliveira, 2013). These standards are internationally accepted by experts and describe how a product should be designed or a service delivered, with the aim of reducing failures and inefficiencies (Ribeiro et al., 2024).

Among the vast set of standards developed by the organization, the ISO 9000 series or family of standards stands out for establishing the foundations for Quality Management Systems (QMS) (Maekawa; Carvalho; Oliveira, 2013). The ISO 9000 family is composed of a group of standards applicable to different segments such as products, processes, inputs and services and is in constant review (Mariquito et al., 2017).

The ISO 9000 family comprises complementary standards, each with specific functions within Quality Management Systems. The main standards in this family and their respective purposes are presented in Table 1.

Table 1 - Standards

Standard	**Concept and function**
ISO 9000	Introductory standard for the QMS. It presents the system's fundamentals and vocabulary, serving as a guide to its principles, concepts and common terminology (Maekawa; Carvalho; Oliveira, 2013; Mariquito et al., 2017).
ISO 9001	Contains the essential requirements for effective QMS implementation. It is the certifiable standard in the series and guides the company's actions toward certification (Maekawa; Carvalho; Oliveira, 2013; Mariquito et al., 2017).
ISO 9004	Provides guidance for improving QMS performance, focusing on competence development and resource optimization to achieve excellence and long-term sustainability (Maekawa; Carvalho; Oliveira, 2013; Mariquito et al., 2017).
ISO 19011	Provides guidelines for auditing Quality and/or Environmental Management Systems, establishing principles, management of audit programs and auditor competence criteria (Mariquito et al., 2017).

Source: Prepared by the author based on Maekawa, Carvalho and Oliveira (2013) and Mariquito et al. (2017).

This study focuses on ISO 9001, the certifiable and best-known standard in the series, because it is the standard that most concerns companies seeking competitiveness, profitability and market prominence (Mariquito et al., 2017). ISO 9001 establishes the basic requirements for a QMS and applies to all organizations, regardless of their type, size or the products or

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services they offer (Maekawa; Carvalho; Oliveira, 2013; Ribeiro et al., 2024). ISO 9001 certification attests that the organization has implemented, maintains and controls processes, resources and personnel to meet customers' quality requirements (Mariquito et al., 2017).

The relevance of ISO 9001 extends beyond obtaining a certificate, positioning it as a management model focused on continual improvement and a risk-based approach. ISO 9001:2015 emphasizes the need for organizations to understand their internal and external context and the expectations of interested parties for the Quality Management System (QMS) to be effective (Ribeiro et al., 2024). This perspective, based on risk and top-management leadership, enables companies to anticipate failures, optimize resources and ensure that quality is a strategic as well as an operational concern. ISO 9001 therefore standardizes processes and instills a proactive management culture, essential for institutions seeking excellence and reliable results, such as ISI Biomassa.

2.2 QMS

The Quality Management System (QMS), in accordance with ISO 9001, is a set of interrelated elements that act systematically to establish policies, objectives and processes that allow the organization to achieve its quality purposes (Ribeiro et al., 2024; Moura et al., 2016). The QMS is fundamental for the continuous improvement of processes, products and services, always aiming at customer satisfaction and meeting the requirements of stakeholders (Moura et al., 2016).

According to ISO 9001:2015, the QMS should be seen as a holistic approach that integrates customer focus, leadership, engagement of people, process approach, improvement, evidence-based decision-making and relationship management (Ribeiro et al., 2024; Adame, 2018). The adoption of a QMS based on ISO 9001 is a strategy that contributes to competitive viability in the market, allowing organizations to standardize their procedures, reduce the complexity of operations, costs and failures (Moura et al., 2016).

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2.2.1. essential requirements of QMS (ISO 9001:2015)

The ISO 9001:2015 standard is structured in ten clauses. Clauses 1, 2 and 3 correspond, respectively, to the scope, to normative references and to terms and definitions, performing an introductory and conceptual function for the understanding of the standard. On the other hand, clauses 4 to 10 present the essential requirements for the implementation and maintenance of the Quality Management System, covering aspects such as organizational context, leadership, planning, support, operation, performance evaluation and continuous improvement. In addition, the standard requires the organization to demonstrate its ability to consistently provide products and services that meet the customer's requirements and applicable statutory and regulatory requirements, also seeking to increase customer satisfaction (Moura et al., 2016).

The main requirements established by ISO 9001:2015 for the implementation process can therefore be summarized as shown in Table 2.

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Table 2 – Main clauses

Clause	Title	Description and main focus
4	Context of the organization	Determine relevant internal and external issues, interested parties' needs and expectations, and the QMS scope. This is the starting point for strategic quality planning (Adame, 2018).
5	Leadership	Emphasizes top management's role in demonstrating leadership and commitment to the QMS, establishing the quality policy and ensuring that responsibilities and authorities are assigned (Ribeiro et al., 2024; Adame, 2018).
6	Planning	Focuses on establishing quality objectives and planning to achieve them. The main feature of this clause is risk-based thinking, which requires identifying and addressing risks and opportunities that may affect the QMS's ability to achieve its intended results (Adame, 2018; Ribeiro et al., 2024).
7	Support	Addresses the resources needed for the QMS, including infrastructure, the environment for process operation, monitoring and measurement resources and, crucially, people's competence and awareness, as well as management of documented information (Adame, 2018).
8	Operation	Addresses operational planning and control, including product and service requirements, design and development, control of production and service provision, preservation and post-delivery activities, with control of conforming and nonconforming outputs. The 2015 version reinforces control of externally provided processes, products and services, such as those of outsourced suppliers, and identification and traceability (Oliveira et al., 2020; Vasconcelos; Nunes, 2020).
9	Performance evaluation	Requires monitoring, measurement, analysis and evaluation of QMS performance. It includes internal audits and management review and is essential for checking system effectiveness (Adame, 2018).
10	Improvement	Focuses on continual QMS improvement, linked to organizational performance and effectiveness and customer satisfaction. The organization must respond to nonconformities by taking corrective action and eliminating their causes to prevent recurrence. In the 2015 version, preventive action is expressed through risk-based thinking (Oliveira et al., 2020; Vasconcelos; Nunes, 2020).

Source: Prepared by the author based on Adame (2018), Oliveira et al. (2020), Ribeiro et al. (2024) and Vasconcelos and Nunes (2020).

As already noted, the essential requirements for the implementation of ISO 9001:2015 are organized in clauses 4 to 10 of the standard, which guide the structuring and functioning of the Quality Management System in organizations. These clauses address aspects such as the context of the organization, leadership, planning, support, operation, performance evaluation and continuous improvement, constituting the basis for the effective implementation of the QMS (Carpinetti, 2017; Moura et al., 2016).

Each of clauses 4 to 10 is further divided into subclauses that detail the requirements to be met by the organization, totaling 28 subclauses (ABNT, 2015). Clause 4 has four subclauses (4.1 to 4.4); clauses 5, 6, 9 and 10 have three each; clause 7 has five (7.1 to 7.5); and clause 8

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has seven (8.1 to 8.7). Some subclauses are further subdivided, and this numbering makes it possible to reference specific requirements of the standard.

Among the elements introduced in the 2015 version of the standard, we highlight the integration of Risk-Based Thinking, especially in clause 6. This approach replaces the need for explicit preventive actions, requiring the organization to identify and proactively treat risks and opportunities in their processes, in order to prevent failures and enhance positive results (Adame, 2018).

Finally, the literature reviewed indicates that ISO 9001 certification attests that the organization has implemented and maintains structured processes, adequate resources and qualified personnel to meet customers' quality requirements. Certification thus becomes a competitive advantage and an institutional strategy, demonstrating process effectiveness and the qualifications of the personnel involved to interested parties (Unido, 2016; Ribeiro et al., 2024).

2.3 quality manual

Documentation is a key pillar for the operation and maintenance of an effective Quality Management System (QMS). Historically, the Quality Manual has been the central document describing the QMS of an organization. Although the ISO 9001:2015 version has made the Quality Manual a non-compulsory document, its elaboration and maintenance are still considered a good management practice and a strategic tool for the communication and coherence of the system (Mostafa; Farahmand, 2019; Oliveira; Araujo Junior; Barros, 2020).

2.3.1 the quality manual in the context of ISO 9001:2015

The revision of ISO 9001 in 2015 brought a significant change by removing the obligation of a formal Quality Manual. This change reflects the search for the norm for being less prescriptive and more focused on flexibility and process approach (Bravi et al., 2019; Oliveira et al., 2020). The objective was to allow organizations to adapt the QMS documentation to its reality, size and complexity, rather than following a rigid model, making a document more adaptable to the company's reality.

However, the removal of the obligation did not diminish the relevance of the manual. It remains a high-level document that consolidates the philosophy and structure of the QMS, contributing to the communication of the quality guidelines, the guidance of employees and the demonstration of compliance in audits. Thus, the manual remains a strategic tool for the organization and standardization of the quality management system.

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2.3.2 concept, purpose and importance

The Quality Manual describes an organization's Quality Management System and explains how it meets the requirements of a reference standard such as ABNT NBR ISO 9001 (Embrapa Meio Ambiente, 2025; INPI, 2025). Its primary purpose is to communicate how the organization manages quality, both internally and externally. The manual is the main reference for the QMS, providing an overview of the organization, its context, its policy and the interaction between its processes. It also guides and supports employee training and the demonstration of conformity during audits, reinforcing the system's standardization and reliability.

To facilitate understanding, Table 3 summarizes the main purposes of the Quality Manual and its importance within the QMS, organized into five aspects: communication and transparency, guidance and standardization, structure and responsibilities, conformity and auditing, and project management.

Table 3 – Purpose and importance of the quality manual

Aspect	**Detailed purpose and importance**
Communication and transparency	Provides customers, partners and employees with an overview of the organization, strengthening reliability and transparency. It is a means of communicating the QMS and is often publicly available (INPI, 2025).
Guidance and standardization	Serves as a guide for QMS implementation and maintenance, ensuring that activities are standardized and aligned with the quality policy. It transforms informal "ways of doing things" into a documented, replicable method (Herrmann & Copello Junior, 2014).
Structure and responsibility	Defines the organizational structure, roles, responsibilities and process interactions, providing an essential means of control and organization for managing projects and processes (Nemer et al., 2024).
Conformity and auditing	Demonstrates fulfillment of ISO 9001 requirements and serves as a reference document in internal and external audits. It helps define the QMS scope and exclusions (Mostafa & Farahmand, 2019; Oliveira et al., 2020).
Project management	Acts as a technical manual that helps teams complete all essential stages when implementing new projects, ensuring quality and predictable results (Nemer et al., 2024).

Source: Prepared by the author based on Embrapa Meio Ambiente (2025), INPI (2025), Herrmann and Copello Junior (2014), Nemer et al. (2024), Mostafa and Farahmand (2019) and Oliveira et al. (2020).

The aspects presented in Table 3 reinforce the relevance of the Quality Manual to the consolidation and organization of a Quality Management System. In addition to documenting policies, responsibilities and processes, the manual contributes to standardized practices and internal communication within the system. Its preparation can therefore be an important step toward structuring and strengthening the QMS, especially in institutions implementing or formalizing their quality management practices.

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2.3.3 control of documented quality manual information

Document management, as noted by Mendes and Silva (2024), is aligned with quality management, and "documented information" is a common and fundamental term in ISO management system standards. As a QMS reference document, the Quality Manual must itself be subject to rigorous control, as required by subclause 7.5 of ISO 9001:2015. This subclause is part of clause 7 (Support) and addresses documented information, establishing requirements for creating, updating and controlling QMS documents and records. It comprises three items: 7.5.1 (General), 7.5.2 (Creating and updating) and 7.5.3 (Control of documented information) (ABNT, 2015).

The mandatory elements for controlling the Quality Manual include the following (INPI, 2025):

a) **Preparation, approval and review:** responsibility for creating the manual (e.g., the QMS manager) and approving it (e.g., the governing board or top management) must be clearly defined. The review process must be triggered by audits, strategic changes, changes to the standard or the creation of new processes.
b) **Change control:** maintaining a revision table is essential to record the version, date and description of changes, ensuring traceability and use of the correct version.
c) **Distribution:** the channels and processes used to make the manual available (e.g., intranet, website and controlled copies) must ensure that all interested parties have access to the current version and that obsolete copies are removed or identified.

Thus, as highlighted in section 2.3.1, although the Quality Manual is optional, once adopted by the organization it must be treated as documented information and subject to these controls.

2.3.4 essential structure and content

ISO 9001:2015 does not require the documented information of the QMS to follow the structure of sections or the terminology of the standard, because this structure intends to present the requirements in a coherent manner, rather than serve as a model for documenting the policies, objectives and processes of the organization (ABNT, 2015). Thus, the organization is free to define the structure of its Quality Manual, provided it is concise and communicates clearly how the QMS meets the requirements of the standard.

In practice, however, it is common for manuals to be organized into chapters that accompany the clauses of the norm (Embrapa Meio Ambiente, 2025). In this organization, clauses 1 to 3, of an introductory nature as presented in section 2.2.1, usually comprise the introduction of the manual (scope, normative references, terms and definitions), while clauses 4 to 10, which concentrate the requirements of the QMS (Table 2), give rise to the other

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chapters. This logic facilitates the consultation by auditors and collaborators and allows the direct relationship of each requirement of the norm to the corresponding content of the manual.

3. material and method

According to Gil (2002), research is a rational and systematic procedure that seeks answers to the proposed problems, through the careful use of methods, techniques and other scientific procedures.

3.1 research classification

As for the purpose, the research is exploratory, because it aims to provide greater familiarity with the problem, in order to make it more explicit (Gil, 2002), which is manifested in the initial investigation of the ISI Biomassa processes and the team's knowledge about ISO 9001:2015. As for nature, it is applied, because it seeks to know in order to do something more efficiently or effectively (Gil, 2002): in this case, face the absence of a Quality Management System (QMS) formalized in the institute.

As for the approach, the research is qualitative. According to Berto and Nakano (1999), qualitative research seeks to approximate the theory and facts through the description and interpretation of isolated or unique episodes, favoring the relationship between context and action, and the case study is one of the most frequent types in this approach. Although the questionnaire (likert scale) is structured, the emphasis is on the understanding of the reality of the ISI Biomassa in its context, and not on statistical generalization; therefore, its results are treated descriptively and interpretatively.

Finally, the research was conducted through a case study, empirical investigation of a contemporary phenomenon in its context of real life, indicated for questions such as “how” and “why” when the researcher has little control over the events (Yin, 2001). These conditions apply to the present study, which follows the implementation of ISO 9001:2015 in ISI Biomassa while it occurs, without control over organizational events.

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3.2 methodological procedures

3.2.1 planning of the case study

This is a single case study, concentrated exclusively on ISI Biomassa. According to Yin (2001), the single case is justified, among other situations, when it is revealing, that is, when the researcher can observe and analyze a phenomenon previously inaccessible to scientific research, which occurs here, because the study accompanies, from the inside of the organization, the initial phase of implementation of ISO 9001:2015 in an applied research institute. The case is contemporary: the data were collected at the institute itself, as the process occurred. As a single case, analytical generalization is sought, and not statistics (Yin, 2001).

3.2.2 data collection

Following Yin (2001)'s recommendation to use several sources of evidence that converge for the same set of facts, the collection combined four sources:

a) **Initial observation and exploratory discussions:** informal meetings with the unit director, coordinators and employees involved in the main activities, together with observation of daily work, to understand the institute's processes, infrastructure and overall operation, and staff knowledge of quality management and ISO 9001:2015.
b) **General presentation meeting:** led by the person responsible for quality and attended by all employees, this meeting presented the planned progress toward implementing ISO 9001:2015, the main changes expected in processes and procedures, the work already started and an explanation of the standard itself. The meeting also provided an opportunity for observation.
c) **Structured questionnaire:** the Diagnostic Questionnaire on the Implementation of ISO 9001:2015 at ISI Biomassa was administered through Google Forms, with anonymous responses. It contains 28 closed-ended questions: four respondent-profile questions (role, length of service, previous participation in quality management and area of work), 23 statements on a five-point Likert scale (Q5 to Q27), with an "I don't know" option in some items, distributed across clauses 4 to 10 of ISO 9001:2015 (three or four per clause), and an overall assessment of the institute's readiness for the standard (Q28, ranging from "very low" to "very high"). The questionnaire was made available to all employees (about 60, including scholarship holders, interns and employees hired under Brazil's CLT labor regime) and received 31 responses, approximately half the workforce: 10 analysts, 10 scholarship holders, 5 researchers, 4 technicians and 2 interns. Of these, 23 worked in Processes/Laboratory, 4 in the Project Management Office (PMO) and 4 in Administration.

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d) **Document analysis:** ABNT NBR ISO 9001:2015 and the publicly available quality manuals of four organizations were analyzed as references for structural benchmarking: Portugal's Instituto Nacional da Propriedade Industrial – INPI (2025), Embrapa Meio Ambiente (2025), Sistema FIEG – SESI and SENAI Goiás (2023), and GreyLogix Brasil Máquinas Ltda (2023). The first three are ISO 9001 certified, while the GreyLogix manual describes a proposed QMS designed to meet the standard. The set includes public organizations, a SENAI System entity and a private company. The Sistema FIEG manual is the closest reference to the institutional context of ISI Biomassa.

3.2.3 data analysis

Observations, exploratory discussions and the general meeting did not generate systematic records. They provided qualitative context for interpreting the questionnaire results in light of ISO 9001:2015. For each questionnaire item, percentages were calculated from the 31 responses. "Partially agree" and "strongly agree" were grouped as agreement, and "partially disagree" and "strongly disagree" as disagreement, while "neither agree nor disagree" and "I don't know" remained separate categories. The purpose of this assessment corresponds to the pre-implementation assessment suggested by Carpinetti and Gerolamo (2016) to determine how well practices meet the standard's requirements.

Next, a comparative analysis (benchmarking) was carried out between the diagnostic gaps and the organization of reference manuals, identifying practices applicable to the ISI Biomassa, which supported the structural proposal of the manual. The study does not cover the implementation of the QMS or the organization's certification.

4. results and discussion

4.1 diagnosis of the current situation of ISI Biomassa

From the observations, from the general meeting and the questionnaire, the situation of ISI Biomassa is characterized in relation to clauses 4 to 10 of ISO 9001:2015. The percentages refer to the 31 answers, and Q indicates the question of the instrument. In the general evaluation of the preparation for the standard (Q28), 54.8% answered "intermediate", 32.3% "low" or "very low" and 12.9% "high"; nobody chose "very high".

Clause 4 – Context of the Organization. Exploratory observations and conversations indicated that the institute has a consolidated understanding of its mission as an applied research center, still without systematization from the perspective of quality management, and that employees generally have some notion of ISO 9001:2015, some with little knowledge and

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others with a lot. In the questionnaire, 67.7% agreed to have clear knowledge of what the institute proposes to do in quality management (Q5), 58.1% to know who are the main partners, customers or suppliers (Q6) and 64.5% that the team discusses the internal and external factors that affect the results (Q7); the disagreement ranged from 19.4% to 29.0%, which indicates moderate knowledge, not yet discussed in a structured way with the entire team.

Clause 5 – Leadership. At the general meeting, top management was observed to be formally engaged in implementing the standard. Staff perceptions, however, were divided: 41.9% agreed that the leadership was committed to implementing ISO 9001 (Q8), 29.0% were neutral and 29.0% disagreed. This indicates an opportunity to communicate management's actions more widely to operational teams. Regarding the quality policy, 35.5% answered "I don't know" and 25.8% agreed that a formal document had already been communicated (Q9), indicating that the policy was still not widely disseminated among employees. The definition of responsibilities was the most highly rated aspect: 80.6% knew who was responsible for each quality-related activity (Q10).

Clause 6 – Planning. The items on risks and changes had divided answers, with no predominance of agreement: in the identification of risks that may impair quality, 32.3% agreed, 35.5% disagreed and 32.3% were neutral (Q11); in the previous planning of changes in processes, 32.3% agreed, 32.3% disagreed and 35.5% were neutral (Q13). The quality goals known by the team were recognized by 58.1% (Q12), with 25.8% disagreement.

Clause 7 – Support. Perceptions of the sufficiency of resources (equipment, personnel and infrastructure) were the aspect requiring the most attention in the assessment: 58.1% of respondents disagreed that resources were sufficient and 29.0% agreed (Q14), the only item with a majority expressing disagreement. Communication of changes to procedures also showed room for improvement: 29.0% agreed that the information was communicated clearly, 35.5% disagreed and 35.5% were neutral (Q17). Conversely, 71.0% reported having received or having access to quality-related training (Q15), and 54.8% considered their department's documents and records organized and easy to find, although 35.5% disagreed (Q16).

Clause 8 - Operation. Standardization of the activities of the sectors was recognized by 58.1% (Q18) and the existence of criteria to verify whether a process is well executed by 41.9% (Q19), with 25.8% of disagreement in each item. Identification and correction of errors in products or services had the best evaluation of the block (71.0%; Q20), which suggests reactive practices of quality control, not yet necessarily formalized. In the evaluation of suppliers and external materials, 48.4% agreed that it occurs, 19.4% disagreed and 16.1% do not know it (Q21).

Clause 9 – Performance evaluation. Monitoring of work or departmental results was recognized by 61.3% (Q22). However, institutional indicators were not widely known: 32.3% agreed that they existed, 32.3% were neutral and 19.4% answered "I don't know" (Q23).

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Regarding internal audits or management reviews of processes, 32.3% reported having heard of them, 35.5% disagreed and 16.1% answered “I don’t know” (Q24), which is consistent with the early implementation stage.

Clause 10 – Improvement. For 61.3%, in the face of errors or problems, one usually acts to correct them and prevent them from being repeated (Q25); 48.4% feel encouraged to suggest improvements, with 35.5% of neutral responses (Q26); and 64.5% realize that the institution evolves to better quality processes, against 12.9% disagreement (Q27).

In summary, the diagnosis shows favorable points (defined responsibilities, training, correction of errors and perception of evolution, which indicate culture favorable to improvement) and gaps in resources, quality policy, risks and changes, communication of changes in procedures, indicators and internal audits. This framework is compatible with the literature: Bravi, Murmura and Santos (2019) include the lack of resources and changes in organizational culture between the barriers to the implementation of ISO 9001, and Maekawa, Carvalho and Oliveira (2013) highlight the greater awareness of employees among the main benefits of certification, which reinforces the importance of communicating the policy and empowering the team. The favorable points, added to the formal engagement of top management, form a consistent basis for the implementation of the QMS, and the gaps are typical of the initial phase in which the institute is located; they guide the proposal of section 4.3.

4.2 comparative analysis (benchmarking)

To support the structural proposal of the Quality Manual, the diagnostic gaps (section 4.1) were compared with the practices of four organizations whose manuals are based on ISO 9001:2015: INPI (2025), Embrapa Meio Ambiente (2025), Sistema FIEG – SESI and SENAI Goiás (2023) and GreyLogix (2023). As each manual meets its own reality, its practices serve as a reference structure, and not as a model to be replicated. Next, we present the good practices applicable to ISI Biomassa, by normative clause:

a) **Organizational context.** Embrapa Meio Ambiente (2025) details its focus of activity, business model, interested parties and QMS scope. Sistema FIEG (2023) links the context to its mission, vision, values and quality policy. GreyLogix (2023) separately addresses internal and external issues, interested parties, scope and exclusions. Since the assessment indicated moderate knowledge of the institutional purpose (Q5 to Q7), a clearly structured and widely communicated context section could reduce this gap.

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b) **Leadership.** Embrapa Meio Ambiente (2025) dedicates a subsection to communicating the quality policy. Sistema FIEG (2023) lists top-management responsibilities and describes channels for communicating strategies (meetings, intranet, website, emails and banners). INPI (2025) communicates its policy through its website and notices in both institute buildings. These examples address the main gap in this dimension, the limited dissemination of the policy (Q9), and show that communicating it requires explicit mechanisms.

c) **Planning.** Sistema FIEG (2023) links risk management to the SESI and SENAI strategy through its own policy and a risk matrix reviewed annually, and describes change planning with leadership involvement. Embrapa Meio Ambiente (2025) and GreyLogix (2023) devote specific sections to risks and change planning. These models provide a reference for the most prominent gap in this dimension: the need to formalize and communicate a process for risks and changes (Q11 and Q13).

d) **Support.** In its Operational Support chapter, Embrapa Meio Ambiente (2025) distinguishes resources (people, infrastructure and environment) and addresses communication and documented information separately. Sistema FIEG (2023), which also uses the term Support, links resource allocation to strategy implementation and groups competence, awareness and communication. Since perceptions of resource sufficiency were the aspect requiring the most attention in the assessment (Q14), the proposed manual should explain how resources are identified, allocated and communicated.

e) **Operation.** Sistema FIEG (2023) covers operational planning and control, product and service requirements, project management and procurement. Embrapa Meio Ambiente (2025) has a similar structure, including interaction with external providers. GreyLogix (2023) addresses design and development, procurement and nonconforming outputs. These models reinforce the relevance of addressing the standardization of laboratory activities and supplier evaluation criteria separately, since knowledge of these matters varies across the team (Q18, Q19 and Q21).

f) **Performance evaluation.** Embrapa Meio Ambiente (2025) presents a table of quality objectives with indicators and targets. Sistema FIEG (2023) describes strategic, tactical and operational indicators and review bodies with defined intervals (a monthly committee and an annual management review). INPI (2025) provides for an annual management review of the QMS. GreyLogix (2023) associates each process with an objective, indicator, measurement and review intervals, and a responsible person. These examples provide references for addressing the gap in knowledge of indicators and internal audits (Q23 and Q24).

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g) **Improvement.** Sistema FIEG (2023) dedicates a separate chapter to improvement, bringing together improvement opportunities, corrective actions, audit and management-review results, and complaint handling. GreyLogix (2023) addresses nonconformity, corrective action and improvement in one section. Embrapa Meio Ambiente (2025) addresses improvement under planning, without a dedicated chapter. INPI (2025) links requirements 10.1 to 10.3 to processes through a matrix. This diversity is consistent with the structural flexibility allowed by the standard (section 2.3.4). Since the assessment revealed a favorable perception of the improvement culture (Q25 to Q27), formalizing this clause tends to consolidate an existing practice rather than introduce a new one.

4.3 structural proposal of the ISI Biomassa quality manual

Based on ABNT NBR ISO 9001:2015, the assessment (section 4.1) and the comparative analysis (section 4.2), the proposed Quality Manual for ISI Biomassa has eight sections: an introduction covering clauses 1 to 3, followed by seven sections corresponding to clauses 4 to 10 (Table 2). This organization follows the rationale discussed in section 2.3.4. For each section, the proposed content and the assessment gaps it addresses are indicated.

4.3.1 introduction

It is proposed that the ISI Biomassa Quality Manual be initiated by an introductory section, containing:

1) **Objective of the manual:** describe the purpose of the document as the central reference for the Quality Management System (QMS) of ISI Biomassa and set out the guidelines the institute follows to meet the requirements of ABNT NBR ISO 9001:2015.
2) **Scope:** define the scope of the proposed QMS by specifying the institute's areas and processes covered by the manual.
3) **Normative references:** identify ABNT NBR ISO 9001:2015 as the standard on which the structure of the document is based.
4) **Terms, definitions and acronyms:** compile the main concepts and abbreviations used throughout the manual to standardize terminology across the institute's departments.
5) **Revision control:** provide a version-control table recording the drafting, approval and amendment history so that updates to the manual can be traced over time, in line with established practice at other units in the reference system examined.

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4.3.2 organisation context

Based on requirement 4 of the standard, it is proposed that this section present:

1) **Institutional overview:** ISI Biomassa was inaugurated in 2017 in Três Lagoas, Mato Grosso do Sul, to conduct applied research aimed at developing new products, services and innovative processes through biomass conversion, contributing to the competitiveness of Brazilian industry.
2) **Mission, vision and values:** the institute's mission is to promote the competitiveness of Brazilian industry through knowledge transfer, research and applied innovation. Its vision is to establish itself as an international reference in applied research on the development of products, services and processes for biomass conversion. Its institutional values of customer focus, commitment, results orientation, quality of life, transparency, proactivity, trust and ethics should guide the Quality Policy to be set out in the next section of the manual.
3) **Understanding the organization and its context:** systematically identify internal and external issues relevant to the strategic purpose of ISI Biomassa, considering its role as a research institute within the SENAI System, its relationship with industry and its links to organizations that promote innovation.
4) **Interested parties:** formally identify the parties relevant to the QMS and their requirements, including employees, industrial partners, funding bodies and the SENAI System itself.
5) **Scope of the QMS:** clearly define and document the scope of the quality management system, specifying the processes, products and services it covers.
6) **Organizational structure:** include the institute's organizational chart, showing its governance structure, technical areas (processes and laboratories) and support areas (PMO and administration), so that hierarchical and functional relationships between departments are clear.

This structure directly meets one of the gaps identified in the diagnosis (section 4.1), related to the team's still moderate knowledge of the institutional purpose from the perspective of quality management.

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4.3.3 leadership

Based on requirement 5 of the norm, it is proposed that this section contemplates:

1) **Commitment of top management:** formalize the commitment of ISI Biomassa's leadership to QMS effectiveness, demonstrated by appointing a person responsible for quality, promoting a quality culture and engaging in implementation of the standard, as observed at the general meeting led by that person. The manual should also record management's commitment to ensuring the resources needed for the QMS, the aspect identified in the assessment as requiring the most attention.
2) **Quality policy:** formalize the Quality Policy of ISI Biomassa based on its existing institutional values, including commitments to interested-party satisfaction, continual process improvement and fulfillment of applicable requirements. Effective mechanisms should also be defined for communicating and disseminating this policy to all employees, addressing the gap identified in the assessment regarding staff awareness of its formal existence.
3) **Organizational roles, responsibilities and authorities:** clearly define and communicate quality-related responsibilities for each role within the institute, based on the existing organizational structure. According to the assessment, the team already perceives this practice relatively positively, and the proposal should reinforce and formalize it within ISO 9001:2015.

4.3.4 planning

Based on requirement 6 of the standard, this section is proposed to include:

1) **Actions to address risks and opportunities:** establish a systematic process to identify, analyze and address risks and opportunities that could affect process conformity and the institute's ability to achieve its objectives, with formal records and periodic reviews.
2) **Quality objectives and planning to achieve them:** define measurable quality objectives aligned with the Quality Policy, supported by action plans specifying responsible persons, deadlines and the resources required.
3) **Planning of changes:** formalize a process for reviewing proposed changes to processes, products or the QMS structure, assessing their impacts before implementation.

This subsection addresses one of the gaps identified in the assessment: the need to formalize and disseminate risk-management and change-planning processes.

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4.3.5 support

Based on requirement 7 of the standard, this section is proposed to include:

1) **Resources:** identify and provide the personnel, infrastructure and environmental resources needed to operate and control the institute's processes. According to the assessment, this was the aspect requiring the most attention in staff perceptions and should be addressed as a priority in future implementation of the standard.
2) **Competence:** formalize competence requirements for each role within the institute, drawing on the existing training structure, including access to professional development programs, an aspect already perceived positively by employees in the assessment.
3) **Awareness:** ensure that all employees understand the Quality Policy, institutional objectives and their contribution to QMS effectiveness.
4) **Communication:** define formal internal communication processes, particularly for changes to procedures, a significant gap identified in the assessment.
5) **Documented information:** establish a process for controlling QMS documents and records, covering their preparation, approval, distribution, review and retention, to ensure traceability and up-to-date information within the system.

4.3.6 operation

Based on requirement 8 of the norm, it is proposed that this section includes:

1) **Operational planning and control:** standardize activities routinely performed by the institute's departments, especially in processes and laboratories, establishing clear criteria for performing and verifying processes.
2) **Requirements for products and services:** formalize criteria for reviewing requests and research projects undertaken by the institute, ensuring that interested-party requirements are properly understood before activities begin.
3) **Control of externally provided processes, products and services:** formalize criteria for evaluating and monitoring external suppliers, an aspect that the assessment showed was unevenly understood across the institute's departments.
4) **Control of nonconforming outputs:** establish a formal process for identifying, handling and recording nonconformities in products, services or research results.

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4.3.7 performance assessment

Based on requirement 9 of the standard, this section is proposed to include:

1) **Monitoring, measurement, analysis and evaluation:** define institutional performance indicators for each organizational area, with clearly established measurement and review intervals, using a model inspired by the indicator matrix identified in the comparative analysis (section 4.2), to address the gap in staff knowledge of institutional indicators identified in the assessment.
2) **Internal audit:** establish a program of periodic internal audits, with defined criteria, scope and responsible persons, to consolidate this practice, which the assessment showed was still not widely known among the team.
3) **Management review:** formalize periodic reviews of the QMS by top management, covering process performance, audit results and identified opportunities for improvement.

4.3.8 improvement

Based on requirement 10 of the standard, this section is proposed to include:

1) **Nonconformity and corrective action:** formalize a process for handling nonconformities, including cause analysis and implementation of corrective actions, to consolidate a practice that staff already rated relatively positively in the assessment.
2) **Continual improvement:** establish formal mechanisms to encourage and record suggestions from employees, sustaining the organizational culture supportive of continual improvement that the assessment identified as one of the institute's strengths.

4.4 considerations on the applicability of the proposal

The proposal translates assessment gaps and good practices from the comparative analysis into a documentary structure. Preparing an initial version of the manual before implementing all processes is consistent with the guidance of Carpinetti and Gerolamo (2016), who state that the document helps plan the quality system, provided it is updated throughout implementation.

Regarding the effort required, the institute is estimated to be able to approve the first version of the manual within three to four months. This would require a three-person group (the person responsible for quality and representatives of the technical and support areas) working approximately two hours per working day, with coordinators and top management participating at specific stages of review and approval.

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There are, however, limitations to consider. The proposed structure is a documentary outline, rather than a completed, implemented or certified manual. Detailing procedures, assigning responsibilities and obtaining top-management validation are subsequent stages that depend on internal decisions. The assessment also derives from a single case study and reflects the perceptions of 31 employees, approximately half the workforce, at a specific point in implementation. The percentages describe this sample and should not be generalized statistically.

Final considerations

This study proposed the structure of a Quality Manual for ISI Biomassa, based on ABNT NBR ISO 9001:2015, to support the institute in the initial phase of implementation of the norm. The case study allowed diagnosing the situation of the institute in relation to clauses 4 to 10 and, with support in comparison with reference manuals, elaborate the proposal, which meets the defined objective.

The assessment revealed favorable aspects, including defined responsibilities (80.6%), access to training (71.0%) and error correction (71.0%), and gaps typical of the early stage, including perceived insufficiency of resources (58.1% disagreed that they were sufficient), limited dissemination of the quality policy (35.5% answered “I don’t know”) and limited knowledge of indicators and internal audits. For 54.8%, the institute’s readiness was intermediate. These gaps informed the proposal, which translates them into an eight-section documentary structure.

The main contribution is to provide the institute with an initial manual structure supported by internal data and practices from reference organizations. Academically, the study applies ISO 9001:2015 to an applied research institute, a context that remains little explored. As a single case with 31 responses and a proposal still awaiting detailed procedures and top-management validation, the results should not be generalized. Future studies should validate the proposal with top management, develop the procedures, apply the assessment at other SENAI System units and reassess the institute’s maturity after an implementation cycle.

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