Project Management Best Practices in the Implementation of a Quality Management System (QMS) in an Environmental Analysis Laboratory

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This article proposes a study on the best project management practices for implementing a Quality Management System (QMS) in a Laboratory of Environmental Analysis in a shorter period and with the expected quality. In 2020 it was established as a guideline for the self-sustainability of the laboratory, obtained through revenues generated from the provision of services. For its insertion in the market of analysis, implementing a QMS was essential. This study is a case report of an exploratory, bibliographical nature. Tools and project management techniques were applied for its development, such as using PMCanvas, which corroborated fulfilling the established deadline with the expected quality.
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Introduction

The intersection of particular attributes with the degree of conformity to an established standard characterizes quality. The junction of globalization and technology causes these standards to be constantly changed, and to adhere to this scenario, organizations continually seek improvement through a Quality System.

A Quality Management System (QMS) is composed of activities that determine processes and resources necessary to achieve objectives, add value to stakeholders through the interaction of these processes and resources, enable optimization of resources, and determine the means to plan actions that address intended or unintended consequences in the provision of products and services [1].

A QMS, besides providing quality improvement in processes and products, by meeting the specifications required in the certification standards, also generates credibility for the organization and helps fulfill objectives [2].

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For laboratories, the expectation of QMS implementation is the improvements in processes for diagnostic testing [3], which ensures high levels of efficiency in reproducible and accurate results.

Implementing a Quality Management System (QMS) is temporary and has a specific result, indicating its project nature. The PMBOK (2018, 6ª ed., p. 10) elucidates project management as "*the application of knowledge, skills, tools, and techniques to project activities to meet project requirements* [...]". The guide clusters 47 management processes into 5 groups: Initiation, Planning, Execution, Monitoring and Control, and Closing [4].

A study conducted by Helgi (2015) [5] analyzed project management practices in implementing quality management: the degree to which project management was applied, what tools and techniques were used, and the most crucial success factors in its implementation were considered.

Quality managers from 21 different types of ISO 9001-certified organizations in Iceland were interviewed during the survey. However, of the 21 organizations analyzed, only 5 applied essential project management tools, such as initial and closing meetings, formal project description, Work Breakdown Structure (WBS), scope definition, and performed internal costing, as time spent by employees for implementation. As a result, the average implementation time for these organizations was 13 months as planned, unlike

the other 16, which had an average time above the expected 24 months [5].

The research concluded that the direct participation of management and employees and including time and spending on these resources in the plan are critical factors for project success. Therefore, implementing a QMS as a project can reduce essential resources such as time and costs.

Research Question

The Laboratory of Environmental Analysis (LAA), allocated at the University of Salvador, originated as a place of research and university extension, aiming to assist in undergraduate and graduate education investigations. However, in 2020 the direction of the university established new guidelines for the laboratory, the main one being its self-sustainability obtained through revenues developed from service provision.

The educational institution's market research in Salvador and the Metropolitan Region indicated that the central environmental analysis laboratories have the Quality Management System (QMS). Furthermore, the research results contributed to the elaboration of the LAA's Strategic Planning (SP), which indicated the need to implement a QMS to make the laboratory competitive in the analysis market and establish a deadline for the implementation (Table 1).

The period of 180 days, 6 months, set in the SP, is below the average in his study in Iceland. He presented the average period of 13 months for companies that implemented QMS using project management tools [5].

In the article, we will answer the following question: How can a Quality Management System implementation project in an environmental analysis laboratory be best managed to achieve compliance in a shorter period with expected quality?

Research Objective

The principal objective of this work was to propose the best project management practices for implementing a Quality Management System in an environmental analysis laboratory in a shorter-than-average timeframe.

The specific objective was to analyze the Project Plan for implementing the QMS in the environmental analysis laboratory, which was used as the basis for developing this work, and to identify the optimum management practices that meet the specificity of the project.

Table 1. Strategic planning mapped activities for LAA.

Mapped Activities	Actions	Deadline
Plankton Analysis	Hiring a mid-level technician	Immediate
Developing research in Biology and Chemistry (1st Environmental Monitoring)	Atomic Absorption equipment in operation	45 days after the operation
Commercialization of environmental analyses	Implementation of the Quality Management System	180 days
Support for physicochemical assay certifications	Hiring a consultant (financial resources); Laboratory structure	240 days
Partnership with the Bahia Network of Atlantic Forest Seeds.	Refrigerated Chamber in Operation	Immediate
Research development - water analysis (physicochemical)	Spectrophotometer in operation and a scientific initiation student	30 days
Analysis of organic compounds.	Gas Chromatography equipment in operation and 20h contract	Immediate

Source: Authors, 2022.

Expected Results

We expected to elucidate best practices of project management in 180 days that meet the project's specificity, QMS implementation in a small environmental analysis laboratory, originally constituted to meet academic demands.

Materials and Methods

This study is characterized as an exploratory case study of a bibliographical nature, applying project management best practices.

Aiming to reactivate the competitiveness of the environmental analysis laboratory for the external market, the Rectory of the University where the laboratory is located established new guidelines. Based on market research, it was defined that implementing the Quality Management System (QMS) is fundamental for the commercialization of the analyses.

In 2021 began, the preparation of the Project Plan; the plan had the Project Management Body of Knowledge (PMBOK Guide) as a reference, built-in detail with 10 knowledge areas.

This case study was developed from February to June 2021 at a university in Salvador – Bahia – Brazil, where we collected the data. This data comprised the project documents for the laboratory's implementation, the laboratory's internal quality policy, and the university's strategic plan. In addition, we did local visits accompanied by the team responsible for the laboratory. After the document analysis, we identified many points of project management practices' application. A new project plan proposal was elaborated based on the QMS structuring phase and the standards, and the PMBOK Guide. In this international pattern of project management, tools and techniques used in the knowledge areas were analyzed and compared with other case studies, which generated the mapping of best management practices that helped to comply with the guideline. Besides these standards, the Project Model Canvas method was also used to structure a systemic vision of the project. Finally, the new proposal was presented to the university chancellor along with the benefits to be gained.

Results and Discussion

Based on the demand indicated by the Environmental Analysis Laboratory's Strategic Planning, we prepared a complete Project Plan with the 10 knowledge areas (Integration, Scope, Time, Costs, Quality, Human Resources, Communication, Risks, Procurement, and Stakeholders) listed by the PMBOK Guide.

In the integration area, the Project Model Canvas methodology was used (Figure 1), which allowed collaborative planning, with the participation of the main stakeholders (Sponsor, LAA Employees, Potential Customers, and Project Manager and Team)6. Essential project information, such as the objective, requirements, assumptions, constraints, team, delivery group, risks, and cost, was grouped and consolidated.

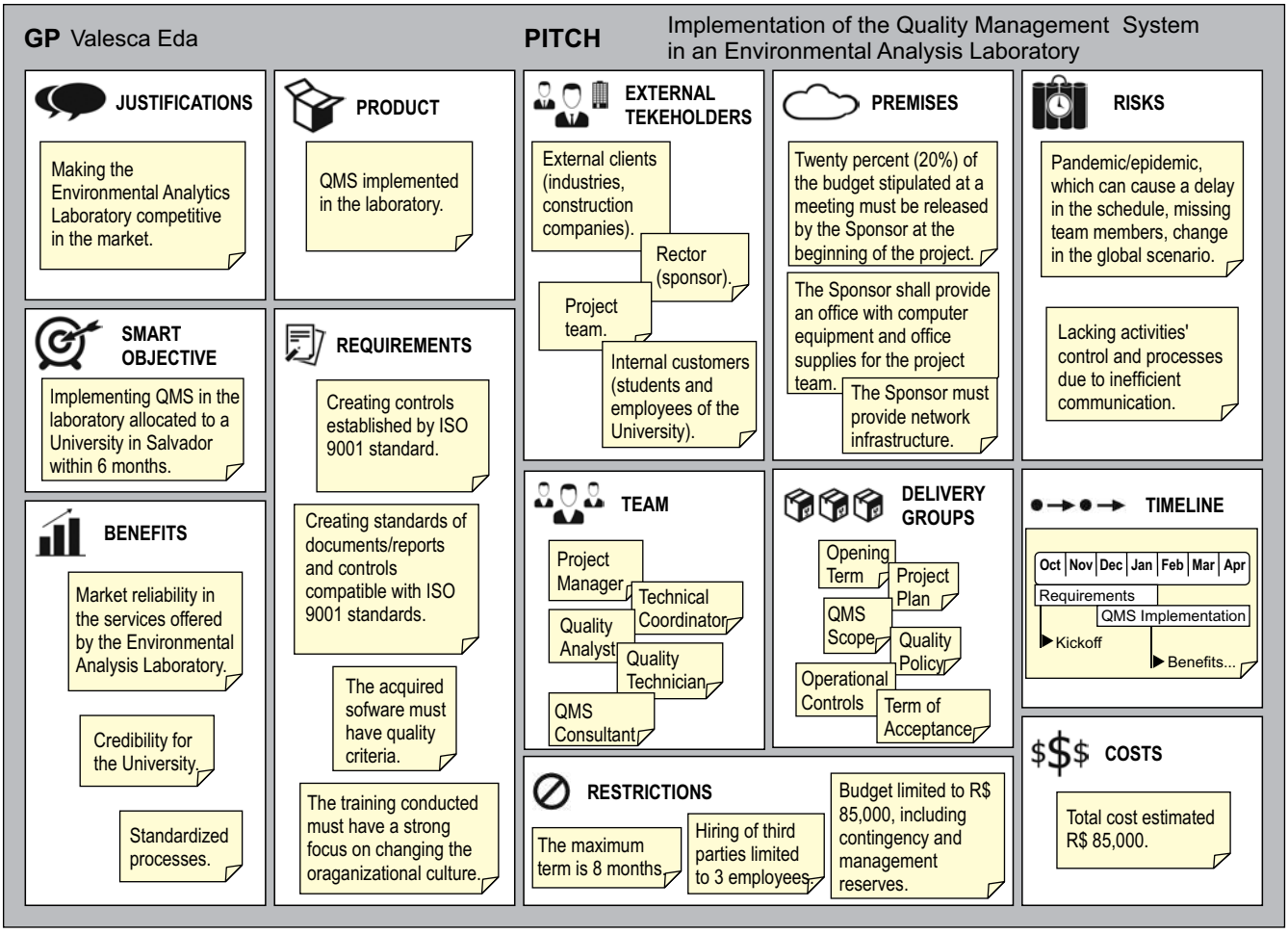
The PM Canvas enabled the project team to take ownership of the plan because it was easy to visualize and understand. In addition, it is a tool that strengthens communication.

The project's initial references defined in the PM Canvas brought an overview of the project that served as the basis for the construction of the scope, which creates 7 phases, 2 managerial (Project Management and Closing) and 5 operational (Hiring, Informational Project, QMS Structuring, Assisted Operation, and Improvement) (Figure 2).

The definition of the packages in the scope of the QMS implementation was based on the ISO 9001 Quality Management System - requirements and ISO 9000 - fundamentals and vocabulary, in case the laboratory was interested in obtaining the certification later. In addition, these packages provided the basis for estimating costs, human resources, and time and making results specific and measurable.

During the project, 11 key deliverables were defined, constituting the milestones, which go from the managerial to the operational packages, and

Figure 1.PM Canvas.



Source: Authors, 2022.

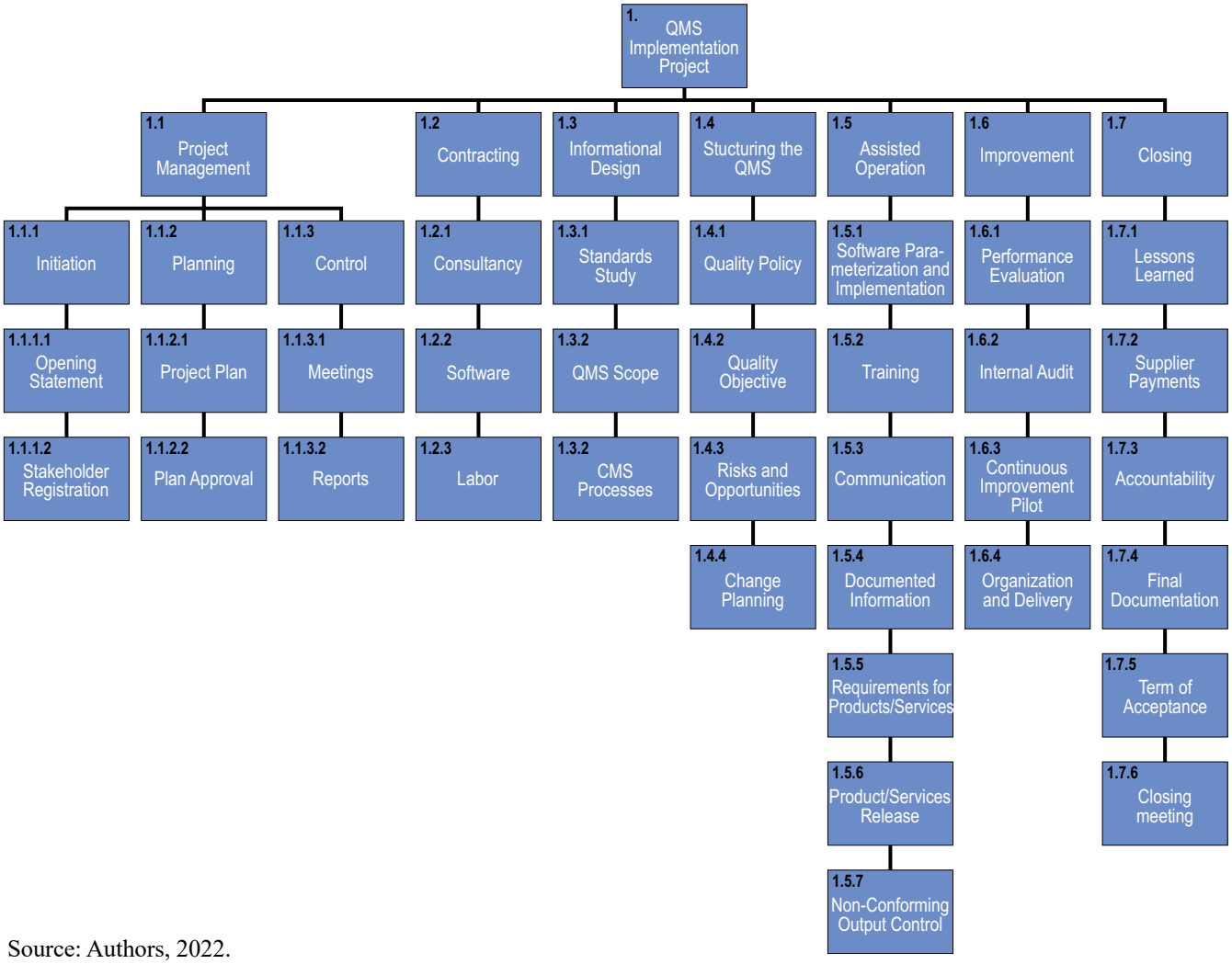
conclude with the implementation of the Quality Management System:

1. Approved opening term;
2. Approved plan;
3. Quality Policy Developed;
4. Document with the objectives and actions elaborated;
5. Change document validated;
6. Software installed;
7. Employees trained;
8. Standards for Updating/Control of Documented Information developed;
9. Manual for Communication with the Client and Control of Requirements Related to Internal and External Products and Services developed;
10. Continuous Improvement Pilot Completed;
11. SGQ Implanted.

The quality management of the project was based on the internal quality policy of the laboratory, elaborated from the QMS Structuring phase and the standards:

a. ABNT NBR ISO 9000:2015 - QMS - fundamentals and vocabulary;
b. ABNT NBR ISO 9001:2015 - QMS - requirements;
c. ABNT NBR ISO/IEC 17025:2017 - General requirements for the competence of testing and calibration laboratories;
d. PMBOK® Guide 6th edition.

Figure 2. Graphical WBS.



Source: Authors, 2022.

We associate the quality standards with the products/services and list their requirements to make the project's quality management more efficient (Table 2).

The project's risk management was formatted by the following processes: planning, identification, qualitative and quantitative analysis, response planning, and risk control. For each risk pointed out, a response and the person responsible for meeting the demand were defined. Verify evaluation details in Table 3.

The risk response plan enabled the project's strategic vision by planning to diminish or mitigate threats and visualize opportunities.

Conclusion

The PM Canvas methodology generated a framework of easy understanding and visualization, with the consolidation of the essential information for the development of the plan and consequently of the project, which enabled not only the participation of stakeholders in the first moment and the monitoring of the elements throughout the project.

If PM Canvas serves as a guide for the project, the Work Breakdown Structure (WBS) is the map that guided us throughout the process. The detailing and logical grouping of the phases, such

Table 2. Quality requirements and minimum criteria.

Product/ Service or Aspect Evaluated	Requirement	Standard / Acceptance Criterion	Verification Method
Project Management	Control of the project management plan.	Follow 100% of the requirements of NBR ISO 9001 and NBR ISO 9000 and 90% of the PMBOK® Guide.	Perform inspection on the execution of the plan.
Quality Management System	All processes are in quality standard.	Follow 100% of the requirements of NBR ISO 9001, NBR ISO 9000, and 60% of NBR ISO/IEC 17025.	Inspection with Checklist.
Training	Laboratory personnel qualified in quality.	Follow 100% of the requirements of NBR ISO 9001, NBR ISO 9000, and the laboratory's quality policy.	Perform internal audit after implementation.
Software	Software for Quality Management System.	Follow 100% of the requirements of NBR ISO 9001, NBR ISO 9000, and the laboratory's quality policy.	Performance evaluation.
Continuous Improvement Pilot	Critical analysis of the Quality Management System	Follow 100% of the requirements of the standards NBR ISO 9001 and NBR ISO 9000 and 40% of the standard NBR ISO/IEC 17025.	Simulation of system use and Checklist.

Source: Authors, 2022.

as the hiring phase being operationally first, made it possible for us to reduce time with bureaucratic processes and allocate human resources when needed, reducing financial resources.

The definition of milestones in the project schedule was created based on the main deliverables that could compromise the project's progress.

To maintain the quality of the project, we also follow international quality standards, besides providing guidelines, aligning our expectations with the market, and generating the possibility for the laboratory to obtain certification later on.

The mapping of risks was one of the main factors in „controlling" future situations, identifying possible factors that could intervene in the project, and establishing and directing actions. In this way, the project plan was followed as planned.

The fulfillment of the 180-day deadline set by the University Rector's Office, the implementation of the QMS in the Environmental Analysis Laboratory was only possible due to the planning, the involvement of the interested parties, including the top management, and the understanding of tools that would have a significant impact on the project.

The limitations of the research are, at the same time, opportunities for future development. The research was limited to a small environmental analysis laboratory. The tools and techniques used in this study, PM Canvas, WBS, Milestone, Quality Requirements, Minimum Criteria, and Planned Risk Responses, would have to be validated in other laboratory profiles. Comparative studies of the performance of projects implemented with and without these are also recommended to demonstrate best project management practices.

Table 3. Planned responses to risks

Item	Risk	Probability	Gravity Index	Exposure	Answer	Description
1.1	A pandemic/epidemic can cause a delay in the schedule, missing team members, and change in the global scenario.	Low	High	High	Acceptance	Establish remote work strategies and maintain all project documentation in the cloud.
2.1	Lack of control of activities and processes due to inefficient communication.	Medium	Medium	Medium	Attenuation	Follow the communication techniques provided in the plan and hold all scheduled events/ meetings.
3.1	Hiring qualified employees due to bureaucratic processes generates delays and additional costs.	Medium	Medium	Medium	Mitigation	Conduct the selection process in advance and maintain an updated vacancy database.
4.1	Wrong mapping of the laboratory operational processes may cause distortions in the QMS.	Medium	High	High	Mitigation	Involve a consultant with QMS experience in laboratories and the Project Manager to analyze the mapping of the processes before implementing the QMS.
4.2	Lack of technical mastery of the Quality Management Software by the laboratory staff may cause delays and quality problems in the standards created.	Medium	Medium	Medium	Attenuation	Require software training (basic and advanced) for all employees.

Source: Authors, 2022.

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