

**UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)**

**DEVELOPMENT OF A PROJECT MANAGEMENT METHODOLOGY FOR
AUTOMATION PROJECTS ACCORDING TO PMBOK GUIDE 6 EDITION**

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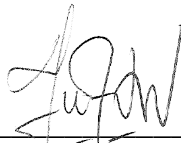
UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

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DEDICATION

This project is dedicated to my son, Juan Daniel Wandurraga, for being my day to day engine to grow and become a better person for him.

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ABBREVIATIONS AND ACRONYMS

- **AC** - Actual Cost
- **BAC** - Budget at Completion
- **COP** - Colombian Peso currency code
- **CPI** - Cost Performance Index
- **CV** - Cost Variance
- **DCS** - Distributed Control Systems
- **EAC** - Estimate at Completion
- **ETC** - Estimate to Complete
- **EV** - Earned Value
- **FAT** - Factory Acceptance Test
- **FGP** - Final Graduation Project
- **HMI** - Human Machine Interface
- **HSEQ** - Health, Safety, Environment and Quality
- **IIoT** - Industrial Internet of Things
- **IoT** - Internet of Things
- **IT** - Information Technology
- **M2M** - Machine-to-machine communication
- **MS Project** - Microsoft Project
- **OT** - Operational Technology
- **PLC** - Programmable logic controller
- **PMBOK** - Project Management Body of Knowledge
- **PMI** - Project Management Institute
- **PV** - Planned Value
- **SAT** - Site Acceptance Test
- **SCADA** - Supervisory Control and Data Acquisition
- **SPI** - Schedule Performance Index
- **SV** - Schedule Variance
- **TCPI** - To Complete Performance Index
- **VAC** - Variance at completion
- **WBS** - Work Breakdown Structure

EXECUTIVE SUMMARY (ABSTRACT)

The automation of processes has become a necessity to survive in the competitive world of the industrial sector, where the quest to increase the quality of products and carry out processes quickly with a lesser environmental impact and total safety to people has become paramount worldwide. Additionally, the arrival of Industry 4.0 with the IoT and IIoT, and the monitoring of process information in real time have become increasingly important in management decision making.

The execution of automation projects without an appropriate or unified methodology generally ends in deviations of scope, cost, schedule, quality, and others, subsequently generating dissatisfaction in the client, the company, and other stakeholders.

Therefore, this Final Graduation Project (FGP) proposes a unified methodology to manage industrial automation projects in order to mitigate said problems and obtain additional benefits, such as the maximization of company profits, client satisfaction, increased productivity and the operability of the company.

The general objective of this paper is to define a project management methodology for the development of automation projects to improve the satisfaction of all stakeholders. In order to achieve this goal, the following specific objectives were stated: to evaluate the organization's needs regarding project management to establish the main components of the project management methodology; to develop frameworks, templates and techniques to apply to the management of future projects; to describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation; and to apply the methodology to a typical process automation project.

For the development of this methodology, primary sources of information were used, such as interviews with colleagues who work in project management in other companies. The information acquired allowed to understand how projects in different companies are controlled, which in turn helped to improve the proposed methodology. Additionally, secondary sources such as the PMBOK (6th ed.) and the Best Practices and Benchmarks Manual developed by the CSIA were used to define the appropriate guidelines regarding the applied methodology and to reference the corresponding parameters.

Throughout the research, it became evident that there are companies that do not use a defined methodology for the management of their projects, which can lead to more risks and unexpected events. The analysis of the specifics is carried out at project post-mortem. Thus, one of the present document main objectives is to establish a reference framework to plan and evaluate automation projects in an objective and concrete way, while adjusting the correct planning for this type of project.

Hence, the proposed methodology contains a step-by-step guide to its application, indicating when each process must be carried out depending on the phase of the project, which activity must be executed, what aspect is to be controlled, and what actions must be carried out during the execution. In the same way, a sample project has been developed to serve as a reference in the application or formulation of automation projects, in such a way that the application of the methodology is simplified. Additionally, an analysis of the project's earned value was conducted on a random date to determine how the project indicators behave and to facilitate decision-making.

The main recommendation is to integrate this methodology into the company's comprehensive management system, so that the formats and procedures become part of the company's culture when executing automation projects. This methodology will allow proper planning of projects by thinking exclusively about what should be done for the project itself rather than for the sake of mere documenting. Additionally, it is recommended to analyze earned value periodically to evaluate the progress of the project, instead of settling for the simple satisfaction that the percentage of progress is similar to what was planned.

It is also recommended to review the content of the management plans for each project and adjust if necessary, in order to ensure compliance with the project in terms of knowledge areas of PMBOK. This will guarantee successful projects, and increased client satisfaction and profits for the company. The plans presented here are a guide that can be used, rather than a compulsory step. Therefore, the scope, schedule, cost, quality, risks, resources, acquisitions, stakeholders, and communication management plans must be understood, adjusted, and applied according to the characteristics of the particular project.

1 INTRODUCTION

Beforehand, it is important to define what elements encompass an automation project, while reflecting about some other components where the main aspect is automation as a way to frame the following project in this specific area. In the same way, the problems that are generally found in an automation project without a methodology that allows to better carry out the project planning and the monitor and control phases to avoid deviations, thus achieving client satisfaction with profits for the company will be discussed.

The general objective and the specific objectives that will be developed throughout the project are detailed: the aforementioned objectives will be the cornerstone for the development of the following chapters, focused on providing solutions to the problems posed by them.

This project will be generally applicable for any automation project. However, it is a proposal for the execution of projects at WAN SAS Company, which currently does not have an established methodology for project planning, monitoring and control.

1.1 Background

The development of automation projects implies satisfying the industry needs to improve processes in speed, quality, safety, and costs, among others. For this purpose, a set of computerized, mechanical, and electromechanical elements or processes are used to optimize them according to the project requirements.

Automation companies develop different projects for different industries, including the Oil & Gas sector, the energy sector, the water sector, the food and beverage sector, the industrial sector and so on; all of them have the particularity of requiring automated processes by using DCS, PLC, SCADA, information management systems and other technology components.

Today, the development of automation projects includes the adoption of the Fourth Industrial Revolution (also called Industry 4.0), which involves the use of new emerging technologies such as IoT, IIoT, cloud computing, machine learning, data science, among others; this increases the industries production capacity, making them more competitive.

In general, this type of project involves the development of engineering, the supply and installation of instrumentation, control panels, computer equipment, software licenses, the programming of PLC or DCS, the configuration of the HMI, and the configuration of the information management systems, as well as communication network configuration, the performance of FATs, SATs, training and commissioning.

1.2 Problem Statement

Automation projects entail the development of a scope within a specific time and with estimated costs, currently worked without any defined methodology, leaving the monitoring and control of the project empirically in the control engineer's expertise. This way of executing projects can develop different deviations:

- **Scope:** When the scope is not monitored and controlled, it is difficult to measure it in percentages or to determine if the full scope has already been developed. When additional deviations occur within reach, the client cannot collect them.
- **Cost:** Costs tend to deviate and only deviations are known at the end of the project when the utility is evaluated.
- **Time:** Sometimes projects take longer than estimated, generating cost overruns, client dissatisfaction, and occasionally leading to fines.
- **Stakeholders:** Sometimes the interested parties are not analyzed correctly. While discussing the execution, stakeholders may not agree with what has been implemented, and request changes of scope, generating reprocesses.
- **Purchases:** Sometimes equipment ordered does not arrive at the expected time, and it is only known weeks before it is delivered to the client.
- **Communication:** The improper handling of communication leads to disorder throughout the development and the lack of knowledge of stakeholders on the project status.

1.3 Purpose

The purpose of this paper is to define a methodology adjusted to the process of project automation, which can be used to properly plan, control and monitor the company's projects, thus preventing deviations in scope, time or costs.

This methodology is of vital importance for the development of projects, since it is necessary to standardize the planning, monitoring and control processes. In

this fashion, the judgment of project managers or technical leaders does not affect the implementation of processes or procedures within the projects.

Although the proactivity of each person involved is valuable to the organization, all proposals should be included in the methodology for the sake of uniformity within project information. Likewise, analyzing key factors during or at the end of the execution may become a problem since the information will be different or non-existent.

This methodology intends to obtain the following benefits:

- **Maximize the profitability of the company:** Applying this methodology correctly will prevent cost overruns due to deviations in time, the addition of resources not included in the planning, non-compliance fines, and cost overruns for non-conforming products, among others.
- **Increase client satisfaction:** The suggested methodology will prove useful when maintaining appropriate communication channels, involving all stakeholders, and meeting delivery milestones, among others.
- **Increase the productivity of human resources:** A unified methodology will facilitate the monitoring of the project development and the organization of work packages, while avoiding the generation of reprocesses not recognized by the client, among other problems.
- **Increase the operability of the company:** It is recommended to apply the present methodology to guarantee the on-time project delivery, the proper

planning of resources, and the possibility of planning new projects at a macro perspective to facilitate their development.

1.4 General Objective

To define a project management methodology for the development of automation projects to improve the satisfaction of all stakeholders.

1.5 Specific Objectives

- To evaluate the organization's needs regarding project management to establish the main components of the project management methodology.
- To develop frameworks, templates and techniques to apply to the management of future projects.
- To describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation.
- To apply the methodology to a typical process automation project to have a general application format applicable to future projects.

2 THEORETICAL FRAMEWORK

This chapter goes over WAN SAS mission, vision, and main business in a thoroughly fashion. Considering that this company delves into automation projects, its background provides a better understanding of the topic as it facilitates the application of the methodology here supported within a real context.

Moreover, the concepts of project management that will be applied in this paper are discussed using PMBOK (PMI, 2017) as the main source. Other important concepts in process automation and the Fourth Industrial Revolution or Industry 4.0 will be detailed as well.

2.1 Company Framework

Companies dedicated to process automation serve projects in multiple industries, such as: Oil & Gas, Mining, Manufacturing, Food and Beverages, Energy, Water, among others. These industries possess different needs that can be resolved with automation projects.

This paper focuses specifically on WAN SAS Company, a newly established company, that currently does not have a project management methodology. This work will serve as the cornerstone for the execution of future projects.

2.2 Company Background

WAN SAS company was created to provide added value as well as contribute to the industry with sustainable automation projects. For this reason, it is necessary to describe the background of automation, this being the focus of WAN SAS.

This term was explored by Groover (n.d.), who stated that “automation was coined in the automotive industry around 1946 to describe the increasing use of automatic devices and controls on mechanized production lines [...] The term is widely used in a manufacturing context.” However, automation can be applied to different processes originated by human labor and intelligence, who in turn involve a significant substitution of mechanical, electrical, or computerized actions.

This concept of automation was shaped during the Industrial Revolution around 1784, when it became necessary to have energy sources to carry out certain processes regarding mechanics, steam generation, and looms, among others. Later, with the widespread use of electrical energy in the 1870s, additional processes were automated with wired logic to speed and improve mass production, assembly lines, and others.

Due to the increasingly common use of transistors and electronics in the 1960's, automation became an important part of the industry as computers gained popularity. The Programmable Logic Controllers (PLCs) that were developed as a result increased process productivity and enhanced control in such manner that it made avoiding deviations easier, thus reducing the impact on both humans and the environment by reducing the resulting footprint.

Today, these automation projects involve the concept of the Fourth Industrial Revolution, which includes using the Internet of Things (IoT) to connect teams, thus creating new needs for cybersecurity. This involves the creation and maintenance of networks to make information from processes available at all times

to aid decision-making through the use of real-time information and advanced analytical methods.

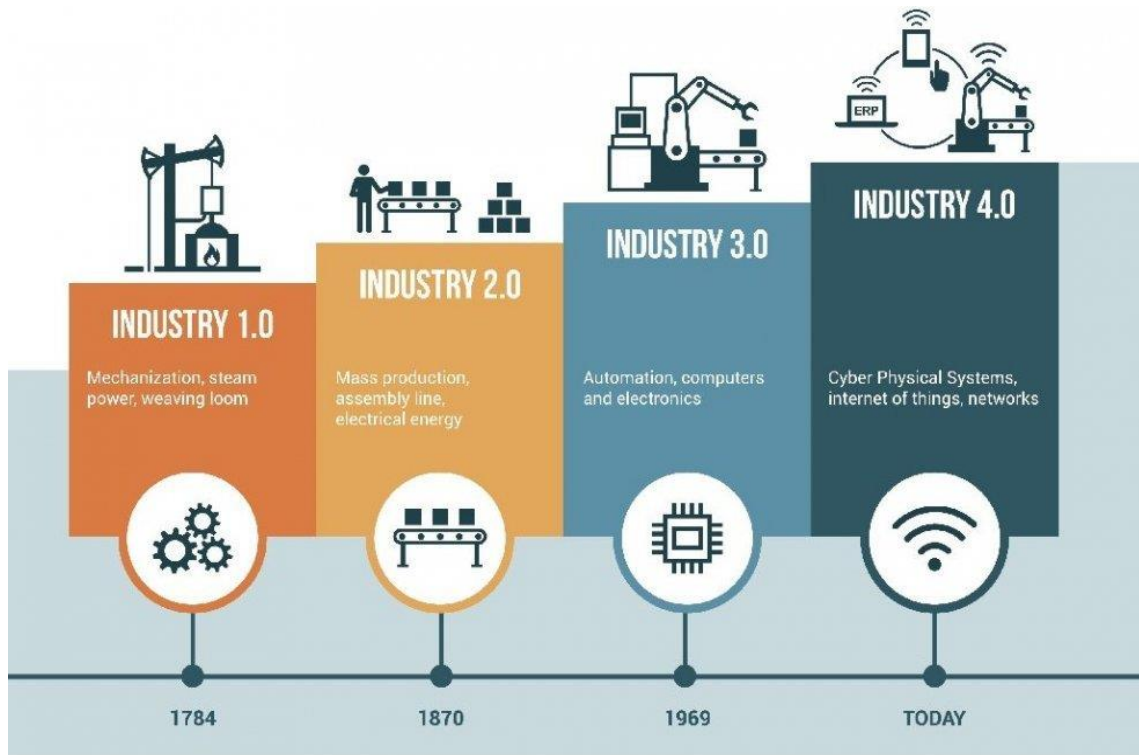


Figure 1 Industrial Revolution infographic (2019)

2.2.1 Mission and vision statements.

The mission and vision shown below come from the business presentation of WAN SAS, translated from Spanish into English.

2.2.1.1 Mission Statement.

We support our clients in the realization of their automation projects through consulting, management, and project execution.

2.2.1.2 Vision Statement.

To be a company recognized within the industry for achieving client satisfaction in carrying out its projects.

2.2.2 Organizational structure.

Even though many companies may have a more complex organization that allows for more detailed control of all the processes of the different projects, this minimal organizational structure works well as an initial proposal for WAN SAS due to the client being the highest authority within any project, since the organization revolves around the fulfillment of the client objectives as stated in the aforementioned mission and vision statements.

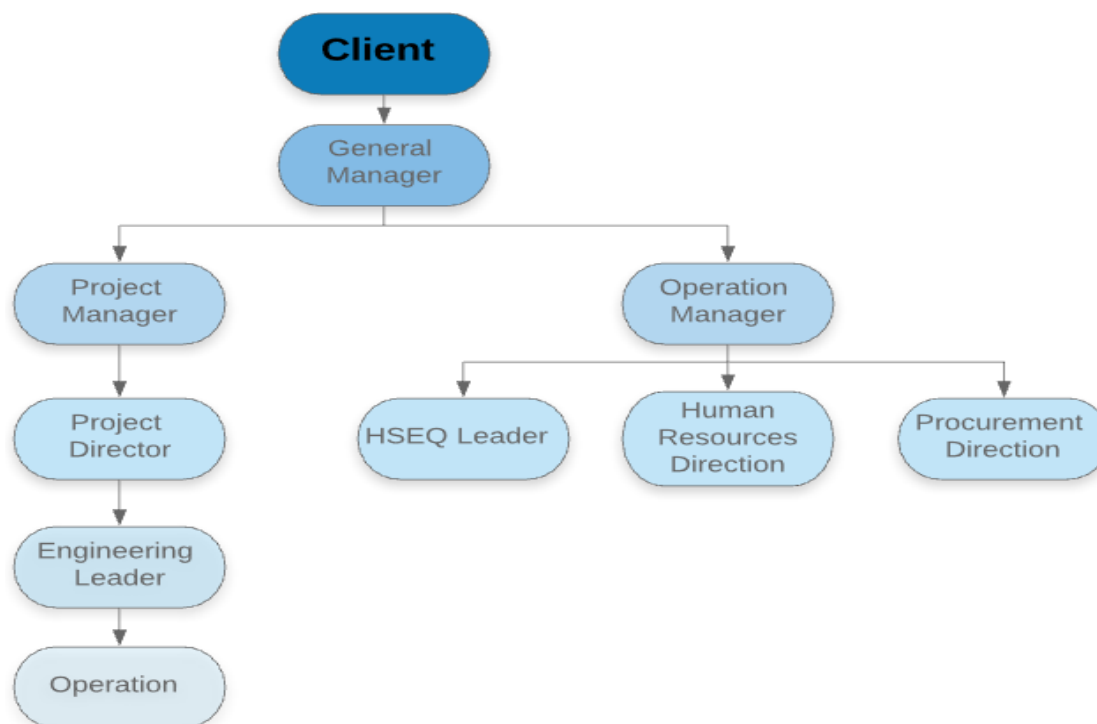


Figure 2 Organizational structure

(Own elaboration)

The general manager is the one in charge of the company and its direction by establishing strategic alliances, gaining customer and client loyalty, and creating new opportunities for the company. Both the project manager and the operation manager are directly under the general manager's authority. The project manager directs the execution of the projects assisted by the work team, which will vary depending on the size of the project; nevertheless, the unchanging positions will always include a project manager, an engineering leader and the operation as a whole. The operation manager oversees and supports the operation areas which comprises the Health, Safety, Environment and Quality Area leader (HSEQ leader), human resources and procurement.

2.2.3 Offered products.

WAN SAS and akin companies offer the following products:

- **Process automation projects:** These projects range from the development of control panels and the corresponding configuration of their components, PLCs, and HMIs, to the implementation of a SCADA system in the already existing industrial networks.
- **Information management projects:** These projects range from the configuration of a historical server, the mapping of all the signals to be historized, the logical organization of the plant within the information system, the generation of automatic reports based on the time series data, and the configuration of notifications to e-mails, to the configuration of data visualization tools or reports.

- **Augmented reality projects:** These projects include the use of new technologies and especially of augmented reality and mixed reality to facilitate the industry operation and maintenance.
- **Industrial 4.0 projects:** These projects include the use of new technological tools such as IoT, IloT, data science, machine learning, and cloud computing, among others.

2.3 Project Management Concepts

Here, the most important concepts in project management to be used in this project will be defined.

2.3.1 Project.

As per PMBOK, *“a project is a temporary endeavor undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end.”* (PMI, 2017, p. 542); this is to say that a project is designed to create a unique product, service, or result. It is important to highlight this definition, so that a project is not confused with the normal operation of a company. Likewise, a project has a start date and an end date, making it a temporary effort to achieve a goal.

2.3.2 Project management.

According to PMBOK, *“the project manager is the person assigned by the performing organization to lead the team that is responsible for achieving the project objectives.”* (PMI, 2017, p. 552)

Project managers work through the project team and other stakeholders. Said project managers must have different soft skills, including leadership, teamwork, being motivating, having communication skills, influencing, decision making, and political and cultural awareness. His roles may vary between negotiator, facilitator, conflict manager or coach, among others.

2.3.3 Project life cycle.

According to PMBOK, *“A project life cycle is the series of phases that a project passes through from its start to its completion. A project phase is a collection of logically related project activities that culminates in the completion of one or more deliverables.”* (PMI, 2017, p. 547)

Hence, the phases of a project can be sequential, iterative, or overlapping according to the needs of the project. As well as the names, the quantity and the duration of the project phases are also determined by the management and control needs of the organizations involved in the project, the nature of the project itself and its area of application.

However, the PMBOK (PMI, 2017) proposes that a typical project can be mapped to the project life cycle structure below, with the following phases:

- Starting the project,
- Organizing and preparing,
- Carrying out the work, and
- Closing the project.

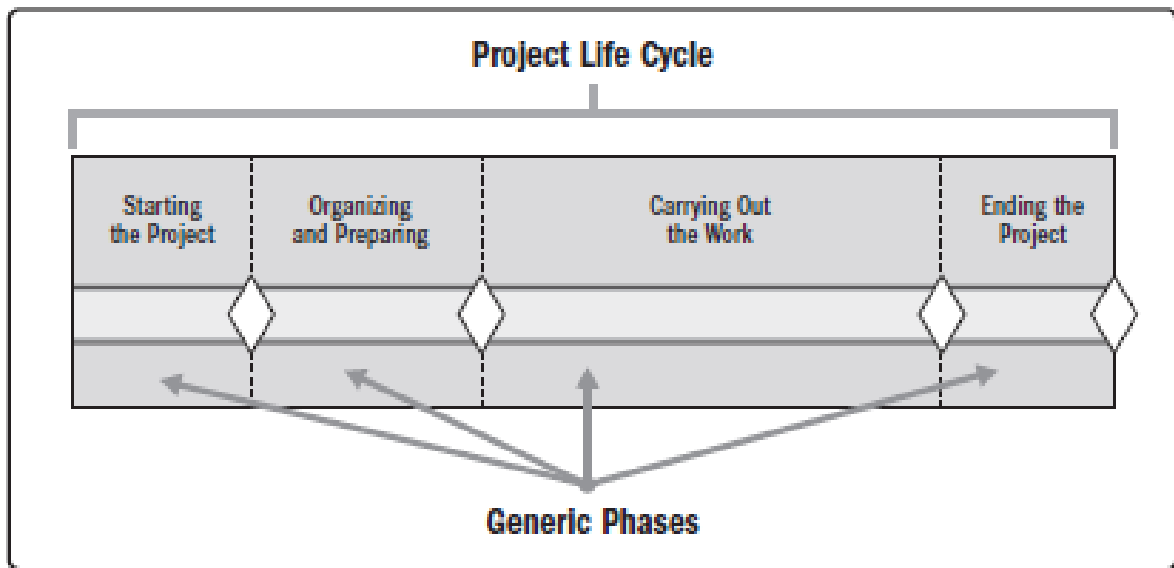


Figure 3 Generic description of a project life cycle

(PMI, 2017, p. 548)

It also mentions that, generally, a project has the following characteristics in its life cycle:

- Costs are low at the start, increase as work is done, and decrease rapidly as the project comes to an end.
- The risk is greatest at the beginning of the project and decreases during the project life cycle as decisions are reached and deliverables are accepted.
- The impact of the changes is less at the beginning of the project and increases substantially as the project approaches completion.

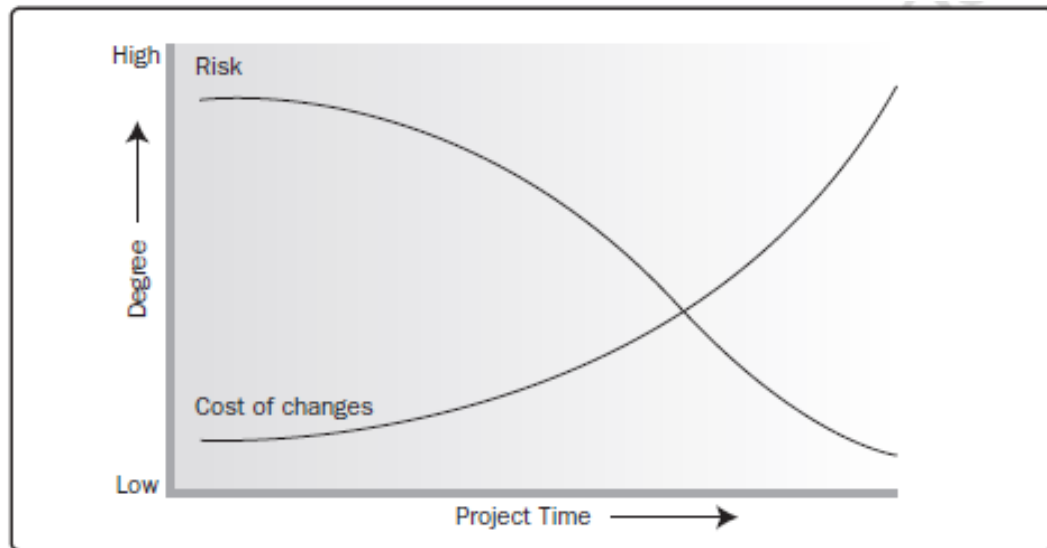


Figure 4 Impact of variables over time

(PMI, 2017, p. 549)

2.3.4 Project management processes.

The PMBOK (PMI, 2017, p. 554) describes the project management processes used to meet project objectives as classified in the following five project management process groups:

- **Initiating Process Group.** The processes performed to define a new project or a new phase of an existing project.
- **Planning Process Group.** The processes required to establish the scope of the project, refine the objectives, and define the course of action required to attain the objectives that the project was undertaken to achieve.
- **Executing Process Group.** The processes performed to complete the work defined in the project management plan to satisfy the project requirements.

- **Monitoring and Controlling Process Group.** The processes required to track, review, and regulate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes.
- **Closing Process Group.** The processes performed to formally complete or close a project, phase, or contract.

Projects are separated into different phases such as concept development, feasibility study, design, prototype, and build or test, among others. The following figure illustrates the processes in one phase of the project.

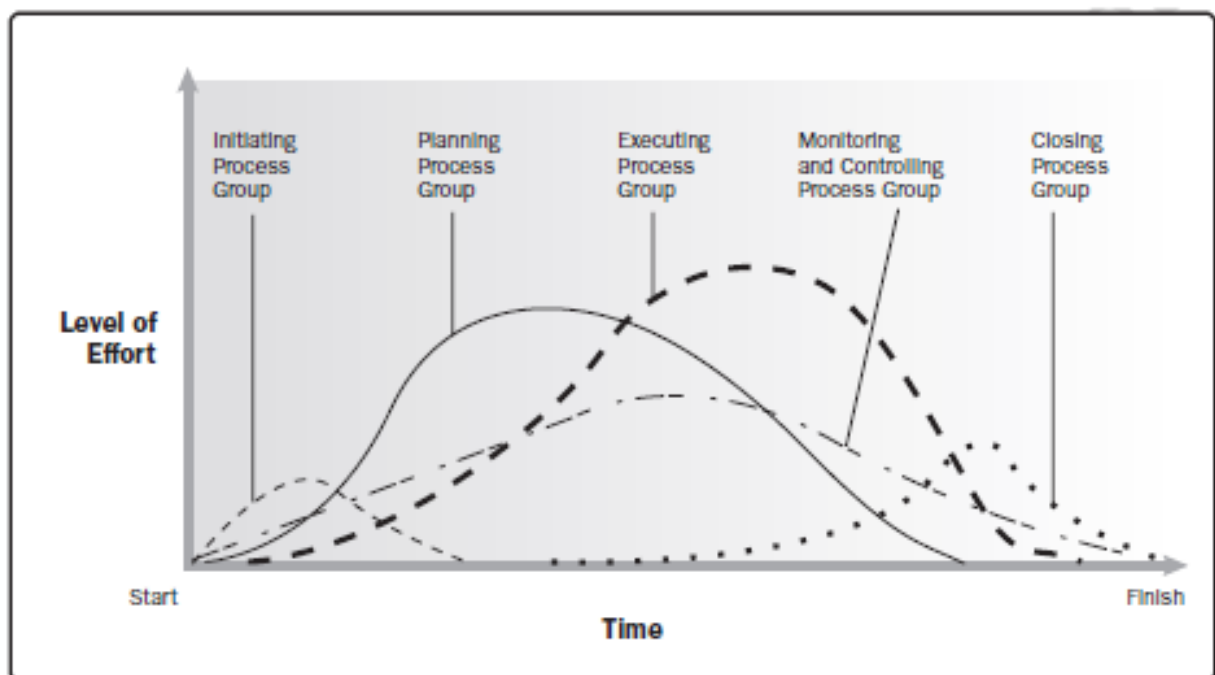


Figure 5 Example of the process group interaction within a project or phase

(PMI, 2017, p. 555)

2.3.5 Project management knowledge areas.

According to the PMBOK (PMI, 2017, p. 553), the Project Management Knowledge Areas are fields of specialization utilized when managing projects. The following ten are the most commonly used:

- **Project Integration Management.** Includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.
- **Project Scope Management.** Includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully.
- **Project Schedule Management.** Includes the processes required to manage the timely completion of the project.
- **Project Cost Management.** Includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so the project can be completed within the approved budget.
- **Project Quality Management.** Includes the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements in order to meet stakeholders' expectations.

- **Project Resource Management.** Includes the processes to identify, acquire, and manage the resources needed for the successful completion of the project.
- **Project Communication Management.** Includes the processes required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and ultimate disposition of project information.
- **Project Risk Management.** Includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project.
- **Project Procurement Management.** Includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team.
- **Project Stakeholder Management.** Includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution.

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

Figure 6 Project Management Process Group and Knowledge Area Mapping

(PMI, 2017, p. 556)

2.4 Other Concepts Related to the Project Topic

Additional concepts related to the scope of this project will be defined below:

2.4.1 Industrial automation.

Industrial automation is the use of control systems such as PLCs, DCS and computers to manage and improve different processes and machinery in an industry. These are some of its advantages:

- **Lower operating cost:** Optimizes the use of resources, effort, energy and time, among others.
- **High productivity:** It facilitates the work of the operators, thus increasing production speed.
- **High Quality:** Automation mitigates human error.
- **High flexibility:** Knowledge is easier to spread due to the fact that automated processes require less human intervention.
- **High Information Accuracy:** The automated data collection allows to gather factual key production information that can help to make the right decisions when it comes to reducing waste and improving processes. This in turn enhances data accuracy and reduces data collection costs.
- **High safety:** Industrial automation can make the production line safer for the employees by deploying robots to handle hazardous conditions.

2.4.2 Internet of Things.

According to Trend Micro, *“The IoT can be described as an extension of the internet and other network connections to different sensors and devices — or*

“things” — affording even simple objects, such as lightbulbs, locks, and vents, a higher degree of computing and analytical capabilities.” (2020)

Subsequently, the IoT is simply giving the things that are used every day the possibility of connecting. At home, for example, objects such as the TV, the fridge, the light bulb, the door, the home theater system, as well as electrical outlets, can be manipulated online or provide information via Internet. Utility meters and vehicles like cars and bicycles may also be used in the same way.

The concept of IoT has made its way to the industry, as it “refers to the extension and use of the Internet of Things (IoT) in industrial sectors and applications.” (Trend Micro, 2020). The migration of IoT to the industrial sector has generated further innovating concepts such as M2M, Big Data and machine learning.

The IIoT has brought multiple benefits to industries by taking advantage of the automation already achieved, since it allows industries and companies to become even more efficient and reliable in their operations by using derived technologies and real-time information. This permits the analytical application of data using Big Data, machine learning, and better communication between the components of the entire system via M2M.

To take advantage of the IIoT, the companies have committed to uniting two computerized worlds with different communication needs: information technology (IT) and operational technology (OT). IT refers to the communication within the administrative part of the company (i.e., from managers, production engineers,

etc.) whereas OT refers to the networking of operating processes and control systems such as HMI, SCADA, DCS and PLC.

3 METHODOLOGICAL FRAMEWORK

This chapter describes the sources of information, research methods and tools that were used in the development of the project. In the same way, the expected deliverables were defined according to the specific objectives of this project.

3.1 Information Sources

The information sources are classified into primary or secondary according to the originality and proximity of the source of origin, as described below.

3.1.1 Primary sources.

According to the University of Minnesota, primary sources are:

records of events or evidence as they are first described or actually happened without any interpretation or commentary. It is information that is shown for the first time or original materials on which another research is based. Primary sources display original thinking, report on new discoveries, or share fresh information. (2020)

As per this definition, interviews with other stakeholders and company legal documentation, among other sources were consulted as primary sources to develop this FGP.

3.1.2 Secondary sources.

According to the University of Minnesota, secondary sources “offer an analysis or restatement of primary sources. They often try to describe or explain

primary sources. They tend to be works which summarize, interpret, reorganize, or otherwise provide an added value to a primary source.” (2020)

The secondary sources used in the present document are:

- The sixth edition of PMBOK
- The fifth revision of the CSIA Best Practices and Benchmarks manual
- Related literature studies on project management methodology

An overview of the objectives and their primary and secondary sources are presented in the Chart 1 made available below.

Chart 1 Information sources (Own elaboration)

Objectives	Information sources	
	Primary	Secondary
To evaluate the organization's needs regarding project management to establish the main components of the project management methodology.	Personal interviews with partners, legal company documents	The sixth edition of PMBOK, the fifth revision of the CSIA Best Practices and Benchmarks manual, related literature studies on project management methodology
To develop frameworks, templates and techniques to apply to the management of future projects.	Personal interviews with partners, legal company documents	The sixth edition of PMBOK, the fifth revision of the CSIA Best Practices and Benchmarks manual, related literature studies on project management methodology

Objectives	Information sources	
	Primary	Secondary
To describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation.	Personal interviews with partners, legal company documents	The sixth edition of PMBOK, the fifth revision of the CSIA Best Practices and Benchmarks manual, related literature studies on project management methodology
To apply the methodology to a typical process automation project to have a general application format applicable to future projects.	Personal interviews with own company partners, legal company documents	The sixth edition of PMBOK, the fifth revision of the CSIA Best Practices and Benchmarks manual, related literature studies on project management methodology

3.1.3 Research methods.

Those are the techniques or tools used to collect research data. For the purpose of this project, two methods were applied: E-research: Internet research methods and secondary analysis and official statistic, which are going to be described below.

3.1.3.1 E-research: Internet research methods.

According to Bryman (2016), websites and web pages are potential sources of data and can be considered for potential analysis of quantitative and qualitative content. With the aim of gathering meaningful information from those sources, it is relevant to take into account the following observations:

- Search websites using keywords that contain the search criteria. It is recommended to test as many relevant keywords as possible and combinations of them.
- New websites are created continuously, while others disappear. Researchers who ground their work must recognize that their analyses may be based on websites that no longer exist, and that new ones may have appeared since the data collection ended.

In addition, it is recommended to include the date on which the websites were consulted. As stated in the second observation, some websites can be outdated or non-existent. Therefore, if subsequent researchers want to track (or even verify) their findings, they may realize that the information is no longer there, or it has changed. Quoting the date when the website was accessed can help mitigate concerns of someone who cannot find what was cited before.

3.1.3.2 Secondary analysis and official statistics.

Bryman (2016) defines secondary analysis as "*the analysis of data by researchers who will probably not have been involved in the collection of those data, for purposes that in all likelihood were not envisaged by those responsible for the data collection.*" (p. 312)

The use of secondary analysis in research is convenient for the development of this project because it allows the researcher to take advantage of the large amount of information that has been collected by scientists and other authors; this,

in turn, optimizes time and resources. The related aspects can be seen in the following chart in relation to the objectives of this project.

Chart 2 Research methods (Own elaboration)

Objectives	Research methods	
	E-research: Internet research methods	Secondary analysis and official statistics
To evaluate the organization's needs regarding project management to establish the main components of the project management methodology.	Internet research on the main needs of automation projects.	Lessons learned from automation projects will be reviewed.
To develop frameworks, templates and techniques to apply to the management of future projects.	Reference frameworks, formats and other applicable projects will be studied using the already selected Internet sources.	References taken from secondary sources will be used to determine the deliverables.
To describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation.	Internet sources will be properly referenced.	References taken from secondary sources will be used to explain the methodology.
To apply the methodology to a typical process automation project to have	Internet sources will be properly referenced.	References taken from secondary sources will be taken into account

Objectives	Research methods	
	E-research: Internet research methods	Secondary analysis and official statistics
a general application format applicable to future projects.		while applying the methodology.

3.1.4 Tools.

For the development of this project, the techniques and tools described in the PMBOK (PMI, 2017) will be used in the different areas of knowledge, including:

- **Expert judgment:** *“[it] is defined as judgment provided based upon expertise in an application area, Knowledge Area, discipline, industry, etc., as appropriate for the activity being performed.”* (p. 79)
- **Analytical techniques:** *“Various techniques used to evaluate, analyze, or forecast potential outcomes based on possible variations of project or environmental variables and their relationships with other variables.”* (p. 699)
- **Project management information system:** *“The PMIS provides access to information technology (IT) software tools, such as scheduling software tools, work authorization systems, configuration management systems, information collection and distribution systems, as well as interfaces to other online automated systems such as corporate knowledge base repositories.”* (p. 95)

- **Data gathering:** It includes different techniques for information gathering such as benchmarking, brainstorming, interviews, alternative analysis, document analysis, process analysis, root cause analysis (RCA), and checklists, among others (p. 122).

The next chart shows how the tools previously mentioned are linked to each objective.

Chart 3 Tools (Own elaboration)

Objectives	Tools
To evaluate the organization's needs regarding project management to establish the main components of the project management methodology.	Data gathering Analytical techniques Expert judgment
To develop frameworks, templates and techniques to apply to the management of future projects.	Data gathering Expert judgment Project management information system Data representation
To describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation.	Project management information system Expert judgment
To apply the methodology to a typical process automation project to have a general application format applicable to future projects.	Expert judgment Analytical techniques Project management information system

3.1.5 Assumptions and constraints.

The PMI (2017) defines assumptions as “a factor in the planning process that is considered to be true, real, or certain often without any proof or demonstration.” (p. 699); likewise, the constraints are defined as “limiting factors that affects the execution of a project, program, portfolio, or process.” (p. 701). These are explored in relation to the objectives of the present project in the following chart.

Chart 4 Assumptions and constraints (Own elaboration)

Objectives	Assumptions	Constraints
To evaluate the organization's needs regarding project management to establish the main components of the project management methodology.	The information collected is available, and a tutor from the university can provide advice on it.	The project is expected to be develop within three months, which is a short amount of time for completion.
To develop frameworks, templates and techniques to apply to the management of future projects.	The information collected is available, and a tutor from the university can provide advice on it.	The project is expected to be develop within three months, which is a short amount of time for completion.
To describe the application step by step in each of the phases of the	The information collected is available,	The project is expected to be

Objectives	Assumptions	Constraints
methodology to ensure a deep understanding and correct implementation.	and a tutor from the university can provide advice on it.	develop within three months, which is a short amount of time for completion.
To apply the methodology to a typical process automation project to have a general application format applicable to future projects.	The information collected is available, and a tutor from the university can provide advice on it.	The project is expected to be develop within three months, which is a short amount of time for completion.

3.1.6 Deliverables.

The PMI defines deliverables as products, results, or capabilities produced by a project and validated by the client or sponsors once the results meet the specified acceptance criteria (2017, p. 704). The following are the expected deliverables according to each specific objective:

Chart 5 Deliverables (Own elaboration)

Objectives	Deliverables
To evaluate the organization's needs regarding project management to establish the main	Analysis and compilation of the needs of typical automation projects.

Objectives	Deliverables
components of the project management methodology.	
To develop frameworks, templates and techniques to apply to the management of future projects.	Frameworks, templates and techniques.
To describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation.	Detailed description of the proposed methodology.
To apply the methodology to a typical process automation project to have a general application format applicable to future projects.	Automation project with the applied methodology.

4 RESULTS

This chapter documents the development of the project objectives, starting with the collection and analysis of typical automation project needs. For this purpose, two interviews with two project managers were conducted to establish the key points of this methodology.

Subsequently, the management of automation project methodology is developed by defining the formats and templates used in each of the processes recommended by the PMBOK (2017). Considering the corresponding analysis, the approach is adjusted to the automation projects in such a way that the planning and procedures serve as support for the project manager, which helps to avoid any complication in the execution.

The procedure for applying the methodology is established step by step, keeping in mind when and how each of the templates should be used. At the end of this FGP, an example of the application of this methodology for a fictitious project is shown with the aim of serving as a guide for future tasks.

4.1 Needs of the Company regarding Project Management

WAN SAS is a newly established company working on the development of automation projects, but without extensive experience in project development or applicable methodology yet. Consequently, there are no records of lessons learned or project experiences that allow for nurturing this methodology. However, for this paper, the expertise of a partner in the development of automation projects in the sector is taken as the primary source, and the CSIA Best Practices and

Benchmarks manual is used as a secondary source, given that the following project focuses specifically on stating the best practices for companies that integrate control systems as per said guidelines.

4.1.1 Interviews.

Two interviews were carried out. The first one was conducted with a colleague, who is a project manager of a similar and newly established company as well. This interviewee possesses very valuable knowledge in the development of automation projects in the Oil & Gas sector. The second interview was conducted with another colleague who works in a more experienced company in the market; said company is slightly bigger than the other and deals with automation project management.

The questions asked during the interview were focused on finding the main problems found when executing automation projects. The questions were devised taking into account the management areas stated by PMBOK in order to analyze the collected information in an organized and practical fashion.

Besides, each interviewee was asked to provide as many details as possible, and to mention any lessons learned if pertinent. The answers of each participant are available below.

4.1.1.1 Interview 1.

The interview was conducted with a colleague who works in a company with six years of incorporation, dedicated to the automation of processes mainly in the Oil & Gas sector. The interviewed engineer has twelve years of experience in

project managing, two of which within this company. The chart below shows the answers provided for each question.

Chart 6 Interview 1 (Own elaboration)

Question	Answer
Does your company have a defined methodology for project management? Do you consider it adequate? If not, do you think it is important to have a methodology?	I do not know any methodology so far, I know that there are some formats that were implemented with the ISO 9001 certification, but they are not widely used. Project management is done empirically, and the responsibility lies within the project manager. Of course, I consider that it is important to have a methodology, but at the moment it is not a priority for the company.
When beginning a project, is it formalized with a certificate of initiation? Do you consider it adequate? If not, do you consider it important to have it?	Some projects have a start certificate. Basically, it depends on the client's request, or when the project manager indicates that it is time to do it. I do not know of any format for this initial act; we generally do it in a general minute format that is found within the company's management system.
How do you plan to manage the projects scope? Are there procedures or formats for compiling requirements, compiling documentation, monitoring requirements,	As I mentioned, scope management is done empirically, or according to the experience of the project manager. Generally, there are no records of the information gathering, and in some cases, there is no schedule either. Basically, activities are executed as soon as

Question	Answer
<p>defining the scope, creating the WBS, the WBS dictionary, and creating the scope baseline, among others?</p>	<p>they are established in the project quote. There are times when we begin the project without fully knowing the scope and we have difficulties when starting, we lose time and sometimes there are disagreements with the client later as a result.</p>
<p>How do you plan time management? Are there procedures or formats to carry out schedule network diagrams, estimate resources for activities, estimate duration of activities, project scheduling, and the baseline of the schedule, among others?</p>	<p>The project times are given at the moment of the quotation; basically, the personnel stipulated in the quotation are hired. I do not remember any format for making the schedule. A report is made every time the project manager requests it.</p>
<p>How do you plan project cost management? Are there procedures or formats for estimating the costs of activities, determining the budget, and the cost baseline, among others?</p>	<p>The costs are taken into account by the company from the quote. We try to ensure the execution of the project in the estimated time, so that the project does not have cost overruns. It is the same with the materials or subcontracts: those contemplated in the quotation are purchased, and all the additional materials are generally deviations that affect the utility of the project.</p>

Question	Answer
How do you plan project communication? Are there procedures or formats for registering or managing stakeholders? Do you use any tools?	There is no planning of communication. A rule of the company is that everything must be in writing and signed or emailed otherwise.
How do you plan for the quality management of the project? Are there procedures or formats?	Generally, the company hires people with a lot of experience, and it is therefore assumed that the work is done with quality, but there is no audit to validate that this is the case.
How do you plan for the human resources management of the project? Are there formats or procedures?	The company has a contact base that generally satisfies the hiring expectations, sometimes they are recommended people by the company staff. These people are hired at the request of the project manager with the approval of the general manager.
How do you plan to manage project risks? Are there formats or procedures?	I do not know of risk management.
How do you plan the procurement management of the project? Are there formats or procedures?	The company has a purchase department, but we generally provide all the necessary data to make the purchases, such as references, quantities, prices, quotes, and suppliers.
How do you manage the integration of the project? Are there formats or procedures?	It is the responsibility of the project manager to ensure the integrity of the project.

Question	Answer
Do you want to add something?	I think that the company does not know if a project is profitable or not. In fact, I do not know what the real cost of the project is, and I have seen that this analysis is carried out at the end in most projects, and in many occasions, there are losses for the company.

4.1.1.2 Interview 2.

This interview was conducted with a colleague engineer who works in a company with 25 years of incorporation, dedicated to the automation of processes in many sectors of the industry such as Oil & Gas, Food & Beverage, utilities, chemical and others. The interviewee engineer has eight years of experience in project management, five of which are in said company.

Chart 7 Interview 2 (Own elaboration)

Question	Answer
Does your company have a defined methodology for project management? Do you consider it adequate? If not, do you think	If there is a methodology, it is called a quality plan, where all the steps required to start and finish a project are specified. Sometimes it becomes extremely difficult to complete all these steps. In addition, the company has

Question	Answer
it is important to have a methodology?	assigned a staff member from the documentation area to request the project manager to upload all the plan information to a server. On many occasions, I feel that they only care about fulfilling the required number of documents rather than the contents.
When beginning a project, is it formalized with a certificate of initiation? Do you consider it adequate? If not, do you consider it important to have it?	That is right, an internal initiation minute is made with the staff who make the quotation, and then an external initiation meeting with the client is held. There are occasions when one of these two does not take place due to the speed with which the projects start, but it is necessary to make a fictional act and upload it to the server, nevertheless.
How do you plan to manage the projects scope? Are there procedures or formats for compiling requirements, compiling documentation,	There is a base schedule format; it is, however, very complex. It is necessary to erase almost everything to adjust it to the project. For this reason, it is not often used; it is better to make a new one. The schedule is done in MS Project

Question	Answer
<p>monitoring requirements, defining the scope, creating the WBS, the WBS dictionary, and creating the scope baseline, among others?</p>	<p>and generally only activities, sequences and times are estimated.</p>
<p>How do you plan time management? Are there procedures or formats to carry out schedule network diagrams, estimate resources for activities, estimate duration of activities, project scheduling, and the baseline of the schedule, among others?</p>	<p>The time estimation for each activity and their sequence are made in the MS Project schedule. In the same way, the resources are assigned to each activity to create a baseline.</p>
<p>How do you plan project cost management? Are there procedures or formats for estimating the costs of activities, determining the</p>	<p>In the internal kick-off meeting, the quotations team explain what costs were included in the quotation; these are evaluated by the project manager and if any novelties emerge, they are reported right at the beginning and approved by</p>

Question	Answer
budget, and the cost baseline, among others?	the operation manager. Only in this way the project manager is exempt from responsibility for unforeseen deviations.
How do you plan project communication? Are there procedures or formats for registering or managing stakeholders? Do you use any tools?	There is a general report format. You have to walk with these blank formats in the suitcase in case you have to make a decision at once and request the client's signature. Communication is formalized by email.
How do you plan for the quality management of the project? Are there procedures or formats?	There is a quality team, but to tell the truth, I rarely see them review the documents content or audit the project quality. They are more interested in meeting the requirements of the company's management system for ISO 9001 certification.
How do you plan for the human resources management of the project? Are there formats or procedures?	There is an engineering coordinator. When a project manager needs resources, he must request them from the engineering coordinator, who decides whether to hire them or move

Question	Answer
	<p>them from other projects. In many occasions the projects are delayed due to lack of resources, as these are not assigned when required.</p>
<p>How do you plan to manage project risks? Are there formats or procedures?</p>	<p>There is an analysis of risks that is carried out at the beginning of the project, where it is analyzed what the risks associated to the project are and what consequence they may have in the project regarding scope, time or costs. Similarly, a mitigation plan is established.</p>
<p>How do you plan the procurement management of the project? Are there formats or procedures?</p>	<p>There is a group of people in charge of purchases. We make the requisition of materials and they are in charge of looking for quotes and selecting the supplier. This process is often delayed, and on many occasions, delivery times are not met. It seems that this group prefers to ensure its own results without taking into account the project milestones.</p>

Question	Answer
How do you manage the integration of the project? Are there formats or procedures?	The assigned project manager is responsible for complying with the quality plan. Each item must be treated, completed, and uploaded to the server; otherwise, he will have problems with the internal closure of the project thus affecting his professional evaluation. It is very complicated.
Do you want to add something?	I think that the quality plan is very complicated, especially when small projects are assigned to us, since we spend more time filling all that pile of formats than carrying out the project. In addition, closing the project is usually very tedious because there are additional formats (such as completing the lessons learned, technical data sheet, satisfaction surveys and others) that I think should be filled in by another company unit.

4.1.1.3 Analysis.

The interviews make it possible to visualize the differences in the project management between two companies: while the first one has a functional organizational structure, the other has a balanced matrix organizational structure.

The first company seems to have a poor methodology. However, it is easily observed that there is a requirement for the project manager to comply mainly with the scope and time aspects. It is also evident that the company depends on the experience of the project manager for the creation and completion of records in all areas of knowledge, as deemed necessary.

In this first company, there is a strong perception of the projects not being profitable; in fact, it is not even known for sure if they are or not until the last stage. Likewise, it is quite noticeable that the projects do not have an adequate documentation management, and the place where the information is located isn't available for further consultation; this creates a high dependency on the assigned project manager and the execution team.

The situation of this company can be considered as critical, since it is possible that innumerable problems are generated throughout the project cycle. For example, the scope management clearly indicates that they have started the project without fully understanding the scope, which can lead to having rework, cost overruns, unscheduled stops, client dissatisfaction, and dispersal of the work team, among many other problems. On the other hand, time management is better controlled, even when this control is still not adequate. The costs are not well

managed, either, as they are only evaluated at the end during the project post-mortem.

Proper planning and control are not observed in the other areas of knowledge, either. These are processes that depend mainly on the project manager, and the support from other areas is not palpable; therefore, the project manager may tend to be overloaded with tasks while trying to fulfill the objectives on his own without a defined methodology.

As for the second company, it is observed that it has a defined methodology for project management. However, based on the interviewee's comments, it seems that the methodology is rather extensive and difficult to apply, especially when the projects are small. Furthermore, it is clear that the company support areas have their own goals, which may differ from meeting milestones, commitments and client and customer satisfaction. It becomes apparent, then, that the project manager does not feel supported by these other departments, which becomes a problem for himself concerning a balanced matrix organization structure.

According to the information collected through the second interview, this company shows that they have formats and procedures for most of the areas of knowledge of the PMBOK, and that there is control when it comes to the compliance with the scope, the time and the cost originally established at the internal and external initiation minutes. The first meeting with the commercial area ensures that all the information collected in the bidding or quotation process is delivered, including assumptions and restrictions, the stakeholders, the initial

planning of the scope, time and cost of the project, among other related issues.

This precaution guarantees that the project manager will have enough information for the initial meeting with the client and thus, will be able to start the project with more assertiveness.

It is also noticeable that, although this company has created procedures and formats for most areas of knowledge, there is no technical quality review or audit of the projects. In this way, the quality assessment becomes more like a documentation review, simply ensuring that all the formats established in the quality plan have been completed at some point during the execution of the project notwithstanding their pertinence or correctness.

4.1.2 Best practices.

The research of the best practices in project management will be based on the recommendations of the CSIA fifth version of the Best Practices and Benchmarks manual, since this is a non-profit organization that seeks to advance in the industry of control system integrators through the collaboration of more than 500 companies in 35 countries to make companies safer and more successful (CSIA, 2020).

The CSIA itself declares in the fifth chapter of said manual that they closely follow the structures defined by the PMI in the PMBOK guide, thus recommending to review the PMBOK in more detail (CSIA, 2018).

The most important recommendations to take into account for the methodology to be defined for the management of automation projects, as stated by the CSIA (2018) are described below, differentiated by area of knowledge.

4.1.2.1 Project contract management.

- Ensure that the project is contractually authorized, such as a contract or purchase order, or in the worst-case scenario, via a letter of intent (LOI).
- Guarantee that the project is managed according to the contract, with procedures and policies to align the execution strategies with the requirements of the contract.

4.1.2.2 Project procurement management.

- Standard documents or templates must be available for outsourced services, such as contracting documents and bid qualification lists.
- Outsourced services must be managed throughout the project; periodic reviews with weekly reports are recommended, in order to track the authorized amount of work for the week, rests, progress, important achievements, problems found, risk management, expense lists, among others.
- The subcontracted services must be correctly closed at the end of the project. One of the recommendations is to review a checklist applicable to the contracted work, verifying that all the contracted items have been completed.

4.1.2.3 Project planning.

- A project management plan should be developed according to the complexity of the project; a grade checklist (GAC) is a practical example of such exercise.
- An internal kick-off meeting should be held with the project team prior to the external kick-off meeting, similarly with a standard agenda.
- An external kick-off meeting must be held with the client and the agenda must be standard for this type of meeting as well.
- A new initial meeting must be held after the external meeting to disclose the information, since important novelties can emerge.
- The project management plan must be followed up, monitoring performance, and taking measures accordingly.

4.1.2.4 Project risk management.

- There must be a specific risk management plan for the project, where the lessons learned from previous projects, the industry, the client, and the applied technology are considered.
- A risk register must be maintained throughout the life of the project, identifying risk triggers, risk ratings and the response plans to be followed.

4.1.2.5 Project resource management.

- There must be a clearly defined and easy way to understand organizational structure for each project, for which it is necessary to define the specific roles and responsibilities of the staff.
- Personnel with the required experience and qualities should be assigned according to their responsibility and the nature of the project.
- Personnel availability must be managed, and a common business methodology must be implemented to support the effective use of all company resources.
- There must be a resource plan, which may include a schedule and a matrix of roles and responsibilities.

4.1.2.6 Project communication management.

- Stakeholders should be identified, including contact information, role, position, requirements, and expectations as well as their impact and influence on the project.
- It must be defined how communication will be managed; these parameters must be available in the project communication plan, which has to specify who is responsible for (a) issuing and receiving information; (b) how communication will be documented; (c) how communication will be collected and stored; and (d) the approval procedure.

- It must be defined how the official approvals of the project will be given, through which means of communication, and who will be responsible.

4.1.2.7 Project scope management.

- Define the procedure to ensure that key project personnel clearly understand the scope.
- A clear statement of the scope must be kept, agreed, and signed by the client.
- A meaningful division of labor structure (i.e., WBS) should be developed, allowing for greater precision in estimating costs, duration, and resources.
- The way in which compliance with the scope for acceptance of the work will be verified must be defined.

4.1.2.8 Project schedule management.

- There must be a specific schedule for the project in accordance with the WBS, logically sequenced, with durations according to the realistic load of the resources, which has to take into account the limitations and contingencies to identify the critical path and the slack areas.
- The schedule must be managed and evaluated continuously to improve the execution of the project, and all adjustments must be done while taken into account the general planning of the company's resources.

4.1.2.9 Project budget management.

- A budget should be established during the planning stage, verifying the estimate made by the company's sales area; it is recommended to establish this budget to a consistent level based on the WBS.
- Project costs must be managed throughout the project within a defined period of time according to the project life cycle. There should be indicators for the status of the project in costs, including an estimate to completion (ETC) and an estimate at conclusion (EAC).

4.1.2.10 Project change management.

- There must be a documented change management process, detailing the history of modifications in terms of the scope, schedule, and budget; the authorities approving these changes must have been well identified, regardless of the approval of said change requests.
- There should be standard templates for requesting changes, identifying the category of the change (Adjustment to a deliverable, Corrective Action, Preventive action or Defect repair), and the description of the change, who requests it, who reviews it, and who gives the approval.
- Billable changes must be identified, differentiated, and socialized across the organization.

4.1.2.11 Project quality management.

- There must be a project quality plan which identifies the project deliverables and the person responsible for it, as well as the generation

of the work product, the confirmation that the product meets the requirements, and the technical validation.

- The compliance with the quality standards applicable to each deliverable must also be ensured.
- The project acceptance and test plans must be consistent with company procedures and the nature of the deliverable.

4.1.2.12 Project closure.

- A project closure review should be done with the client to document the completion of the project.
- A satisfaction survey should be carried out to obtain information on the client's perception of the execution of the project.
- Lessons learned, both positive and negative, should be documented.
- A review should be carried out at the end to ensure that the documentation is prepared and stored according to company policies, for which a standard checklist must be in place.

4.2 Development of the Methodology for Project Management

The templates, procedures and plans proposed for the automation project management methodology for the WAN SAS Company are presented below, divided according to the Project Management Process Groups.


4.2.1 Initiating process group.

This group of processes help define a new project or a new phase of an existing project, which is the first stage in the life cycle of a project as mentioned by the PMBOK. Its purpose is to identify the stakeholders and align their expectations with the purpose of the project, in addition to informing them about the scope of the project and making a preliminary analysis of stakeholder participation in the project.

4.2.1.1 Develop project charter.

According to PMBOK (2017), the project charter is, “a document that formally authorizes the existence of the project and provides the project manager with the authority to apply organizational resources to project activities” (p. 75), in which case the general manager of WAN SAS is who authorizes the project manager to carry out the project activities, and recognizes their existence by allocating resources for their development using the format PR-F01.

Chart 8 Project Charter (Own elaboration)

	PROJECT CHARTER	Code: PR-F01
		Version: 1
		Date: 22-Jun-2020
Date:	Client:	
(Issue date)	(Write the name of the client)	
Project ID:	Project Name:	
(Write the project ID)	(Directly related to the project main product and thus to its general objective)	
Project Start Date:	Project Finish date:	
(Same as the issue date)	(Write the date when the project is scheduled to be finished)	
Project Objectives (General and Specific):		
General Objective: (Write the general objective on this line)		
Specific Objectives: 1. (Write each specific objective on the correspondent line)		

2.		
3.		
(Include as many lines as needed)		
Project Benefits:		
(Briefly describe what the expected benefits of the project are, including savings, efficiency, process improvements, updating knowledge, etc.)		
Project Scope:		
Deliverable	Description	
(Deliverable name)	(General description of the features and components of the deliverable)	
(Include as many lines as needed)		
Assumptions:		
(Facts assumed to be true for planning purposes. Their validity must be confirmed as the project advances. Might be related to time, cost, scope, quality, resources, etc.)		
Constraints:		
(Limiting factors affecting the execution of a project. Might be related to time, cost, scope, quality, resources or others.)		
Preliminary Risks:		
(List the main risks identified at current stage. Write as follows: If (cause), might (effect), impacting (scope, time, cost, quality, etc.))		
Budget:		
(General cost estimate of main items/deliverables for project budget.)		
Milestones and dates:		
Milestone	Start date	End date
(Significant activity)		
(Include as many lines as needed)		
Relevant historical information:		
(Brief basic company information. Documentation of previous works or similar efforts related to the project.)		
Stakeholders:		
(Describe the key participants in the project as per the client as follows)		
Role	Description	
Sponsor	(who finances the project)	
PM	(Who leads the project)	
Final User	(Who benefits directly from the project)	
Other Stakeholders		
(Describe the key participants in the project as per WAN SAS as follows)		
Role	Description	
Sponsor	(who approves changes to the project)	
PM	(Who leads the project)	
Functional Boss	(Engineering Manager / Commercial Manager / Special Accounts Manager)	
Approval:		
Preparation - Project Manager:	Signature:	
Approval - Sponsor:	Signature:	


4.2.1.2 Initiation meeting minute.

Based on the recommendations by the CSIA (2018), it is necessary to make an internal kick-off meeting with the project team to list all important materials or information; this meeting also serves to synchronize the work team within the organization. After that, the external kick-off meeting will be held with the client in order to present the preliminary project management plan. The work team and the key factors will be rather agreed upon at the start, execution, and delivery of the project.

Next, the formats of the internal and external initiation minutes are defined; these must include the standard agenda to be dealt with. However, the project director is free to supplement it as he seems fit.

Each meeting must be summarized in a minute: the PR-F02 format must be used for the internal kick-off meeting, while the PR-F03 format is suited for the external kick-off meeting. It is recommended to fill out this minute in a spreadsheet such as Excel to add as many boxes as necessary to list all the assistants, include all the observations of the meeting and add the signature space according to the number of attendees easily.

Chart 9 Internal Initiation Meeting Minute (Own elaboration)


	INTERNAL INITIATION MEETING MINUTE		Code	PR-F02
			Version	1
FORMAT			Date	22-Jun-20
DATE AND LOCATION				
Date and Time	(Issue date and time)	Location	(Meeting place)	

PROJECT OVERVIEW INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		
MEETING GENERAL INFORMATION			
ATTENDEES			
Full Name	Initials	Work Position	
(Name of attendees)	(Initials of attendee's name)	(Write role or position)	
(Include as many lines as needed)			
MEETING CONCLUSIONS			
(Write down all important conclusions and notes from the meeting.)			
(Include as many lines as needed)			
STANDARD MEETING AGENDA			
1 - Definition of client requirements	11 - Purchase plan		
2 - Project justification	12 - Logistic plan		
3 - Scope and objectives of the project	13 - Risk analysis and mitigation		
4 - List of activities not included in the project	14 - Management of contractors		
5 - Project Assumptions	15 - Customer Property Management		
6 - Restrictions of time, cost, scope, engineers, etc.	16 - Progress reports		
7 - List of stakeholders	17 - Deliverables to the customer		
8 - Work Schedule	18 - Warranties		
9 - Training Needs	19 - Preliminary billing plan		
10 - Requirements of the personnel involved			
COMMITMENTS			
Description	Person Responsible	Expected date of execution	Observations
(Describe the commitment)	(Who is responsible?)	(What is the expected date of compliance?)	(Add remarks if necessary)

(Include as many lines as needed)			
-----------------------------------	--	--	--

ATTENDEES SIGNATURES			
Full Name		Full Name	
Signature		Signature	
(Include as many lines as needed)			

Chart 10 External Initiation Meeting Minute (Own elaboration)

	EXTERNAL INITIATION MEETING MINUTE		Code	PR-F03
			Version	1
	FORMAT		Date	22-Jun-20
DATE AND LOCATION				
Date and Time	(Issue date and time)	Location	(Meeting place)	
PROJECT OVERVIEW INFORMATION				
Project Name:	(Write the project name)			
Project ID:	(Write the project ID)	Order Number:	(Order number by client)	
Client:	(Name of client)			
MEETING GENERAL INFORMATION				
ATTENDEES				
Full Name	Initials	Work Position/Role	Telephone Number	Email Address
(Name of attendees)	(Initials of attendee's name)	(Write position)	(Write the phone number)	(Write the email address)
(Include as many lines as needed)				
MEETING CONCLUSIONS				
(Write down all important conclusions and notes from the meeting)				
(Include as many lines as needed)				
STANDARD MEETING AGENDA				
1 - General Project Management				
1,1 - Presentation of the company workgroup, clients, and others				
1,2 - Verification of client's requisites and deliverables scope definition				

1,3 - Work schedule and project organization
1,4 - Definition of resources and client participation
1,5 - Technical milestones
1,6 - Clarification of critical route
1,7 - Follow-up meetings
1,8 - Explanation and agreement on the methodology to treat change control in all phases of the project
1,9 - Communication: definition of channels of communication, reports, frequency and content
1,10 - Procedures for approval of deliverables
1,11 - Management of subcontractors
1,12 - Project risk and response plan
1,13 - Purchase management
1,14 - Methodology for partial surveys and final satisfaction survey
2 - Project Technical Management
2,1 - Software versions of the deliverables (deliverable software and development software)
2,2 - Definition of the programming standard for all software
2,3 - Requirements for Factory Acceptance Test (FAT)
2,4 - Requirements for Site Acceptance Test (SAT)
3 - Commercial Conditions
3,1 - Duration and scope of warranty periods on engineering service and equipment installation during the project
3,2 - Billing Plan
4 - Others
4,1 - Permission to enter facilities, and arrangement of work shifts and special work schedules
4,2 - Client terms and HSE requirements
4,3 - HSE induction and customer emergency procedure


COMMITMENTS			
Description	Person Responsible	Expected date of execution	Observations
(Describe the commitment)	(Who is responsible?)	(What is the expected date of compliance?)	(Add remarks if necessary)
(Include as many lines as needed)			

ATTENDEES SIGNATURE			
Full Name		Full Name	
Signature		Signature	
(Include as many lines as needed)			

4.2.1.3 Identify stakeholders.

According to PMBOK (2017), the Identify Stakeholder Process “enables the project team to identify the appropriate focus for engagement of each stakeholder or group of stakeholders” (PMI, 2017, p. 507). In order to develop this process, the following tools and techniques will be used: expert judgment and data gathering by going to the most experienced and influential stakeholders through meetings focused on understanding their requirements and expectations.

Chart 11 Stakeholder Management Plan (Own elaboration)

	STAKEHOLDER MANAGEMENT PLAN	Code: PR-F04
		Version: 1
	FORMAT	Date: 22-Jun-2020

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

STAKEHOLDER REGISTER MATRIX						
ID	Stakeholder	Functiona l Area	Roles - Responsibilitie s	Main Expectations	Major Requirement s	Additional Comment s
1	(List all stakeholders)	(What area do they work in?)	(What is their role or responsibility?)	(What is the main expectation?)	(What is the biggest requirement?)	(Add comments if necessary)
2						
3						
4						
5	(Include as many lines as needed)					

Note: This is the first part of the stakeholder management plan PR-F04, it continues in 4.2.2.19 Stakeholder management plan.

4.2.2 Planning process group.

This group of processes defines how the project will be executed by planning each of the areas of knowledge according to PMBOK. The development of said process group must provide all the necessary components for managing the project, as well as the formats and other documents that will be used during its development.


However, planning does not only include determining documents. It must also be focused on the development of the project, which is why each document must be adjusted according to the project; such is the case of scope planning, that involves the compilation of requirements, the definition of the scope and the creation of the WBS. It also includes: (a) schedule planning, that involves the definition, sequencing and time framing of the project activities; (b) cost planning, that involves estimating project costs and determining the budget; (c) risk management planning, that involves the identification, analysis and response plan of the project risks; and (d) other complementary plans such as the management of the interested parties, the resources, the acquisitions, and the communication, as discussed below.

4.2.2.1 Plan scope management.

Based on the information collected in this project, the basis of the scope management plan is elaborated, which generalizes the scope management of

automation projects; document PR-P01 provides a guide on how the scope should be managed. However, this document can be tailored specifically to the project at hand depending on its complexity and based on expert judgment, data analysis, or meetings.

Chart 12 Scope Management Plan (Own elaboration)

	SCOPE MANAGEMENT PLAN	Code	PR-P01
		Version	1
	PLAN	Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

PROJECT SCOPE MANAGEMENT
(Describe how will the scope of the project be managed?)

PROJECT MANAGEMENT CHANGES
(Describe how to handle changes, their frequency and impact)

INTEGRATION OF CHANGES IN THE SCOPE
(Describe how will the scope changes be integrated into the project?)


ADDITIONAL COMMENTS
(Add additional comments if necessary)

4.2.2.2 Collect requirements.

According to PMBOK (PMI, 2017), collecting the requirements is part of the scope management and refers to the process of documenting and managing the requirements of the stakeholders in order to meet the project objectives. Various tools and techniques are used in the execution of this process, such as expert judgment, data collection, data analysis, and interpersonal skills, among others. All the collected information should be organized in a requirements traceability matrix as per the PR-F05 format.

In the format, the description of the requirements must be completed, including the type of requirement it is, and whether this requirement is part of the project objective. In case a WBS item is part of the project objective, its execution must be ensured. The status of the requirement and additional comments in case the requirement date is extended must be registered as well.

Chart 13 Requirements Traceability Matrix (Own elaboration)

	REQUIREMENTS TRACEABILITY MATRIX		Code: PR-F05	
	FORMAT		Version: 1	
			Date: 22-Jun-2020	

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

REQUIREMENTS REGISTER MATRIX						
ID	Requirements Description	Business Needs, Opportunities, Goals, Objectives	Is it project objective?	Deliverable WBS	Status (Active, Cancelled, Deferred, Aggregate, Completed)	Additional Comments
1	(List all requirements)	(Requirement type)	Is it project objective? (yes / no)	(WBS code number)	(specify the status of the request)	(Add comments if necessary)


2						
3						
4						
5	(Add as many lines as necessary)					

4.2.2.3 Define project scope

This process consists on preparing the detailed description of the scope of the project or project phase. Various tools and techniques may be used to this end, such as expert judgment, data analysis, decision-making, and interpersonal and team skills. The definition of the scope will be documented in the PR-F06 format shown below (chart 14).

The scope of the project will be described in detail in said format, and the following information will be filled in to further delimit the scope regarding: (a) the list of project deliverables to specify what the client expects to receive; (b) the acceptance criteria describing how each deliverable will be measured at the time of delivery; (c) the exclusions of the project that determine everything not included in the scope; (d) the restrictions in the development of the scope; and (e) the assumptions made to support the decision-making process.

Chart 14 Project Scope Statement (Own elaboration)

	PROJECT SCOPE STATEMENT		Code	PR-F06
			Version	1
	FORMAT		Date	26-Jun-20

PROJECT INFORMATION	
Project Name:	(Write the project name)
Project ID:	(Write the project ID)
Order Number:	(Order number by client)
Client:	(Name of client)

PROJECT SCOPE DESCRIPTION
(Write in detail the scope of the project)

PROJECT DELIVERABLES
(Write in detail the project deliverables)
•
•
•

PROJECT ACCEPTANCE CRITERIA
(Write in detail the project acceptance criteria)
•
•
•

PROJECT EXCLUSIONS
(Write in detail the exclusions of the Project)
•
•
•

PROJECT CONSTRAINTS
(Write in detail the project constraints)
•
•
•

PROJECT ASSUMPTIONS
(Write in detail the assumptions of the project)
•
•
•

4.2.2.4 Create WBS.

This process consists on using the technique of decomposition to subdivide the scope of the project into deliverables, phases, specialties, subprojects and

components that are smaller and easier to manage and control. The scope should be divided to the point where the work or activity package can be tracked and controlled, but not so small that it increases the work to be done or makes the tracking hard.

For this automation project management methodology, a WBS is established with the phases and work packages that are generally executed in an automation project. Nevertheless, it is the responsibility of the project manager and the work team to define the actual packages and activities according to the scope, even if it changes completely.

The WBS is made up of three levels: level 1 has the name of the project, level 2 comprises the phases of the project, deliverables or subprojects (i.e., the main deliverables and phases that are carried out in a standard automation project), and level 3 consists of the work packages that must be specifically adjusted to the scope of the project and each deliverable. The connection between all of these is shown below:

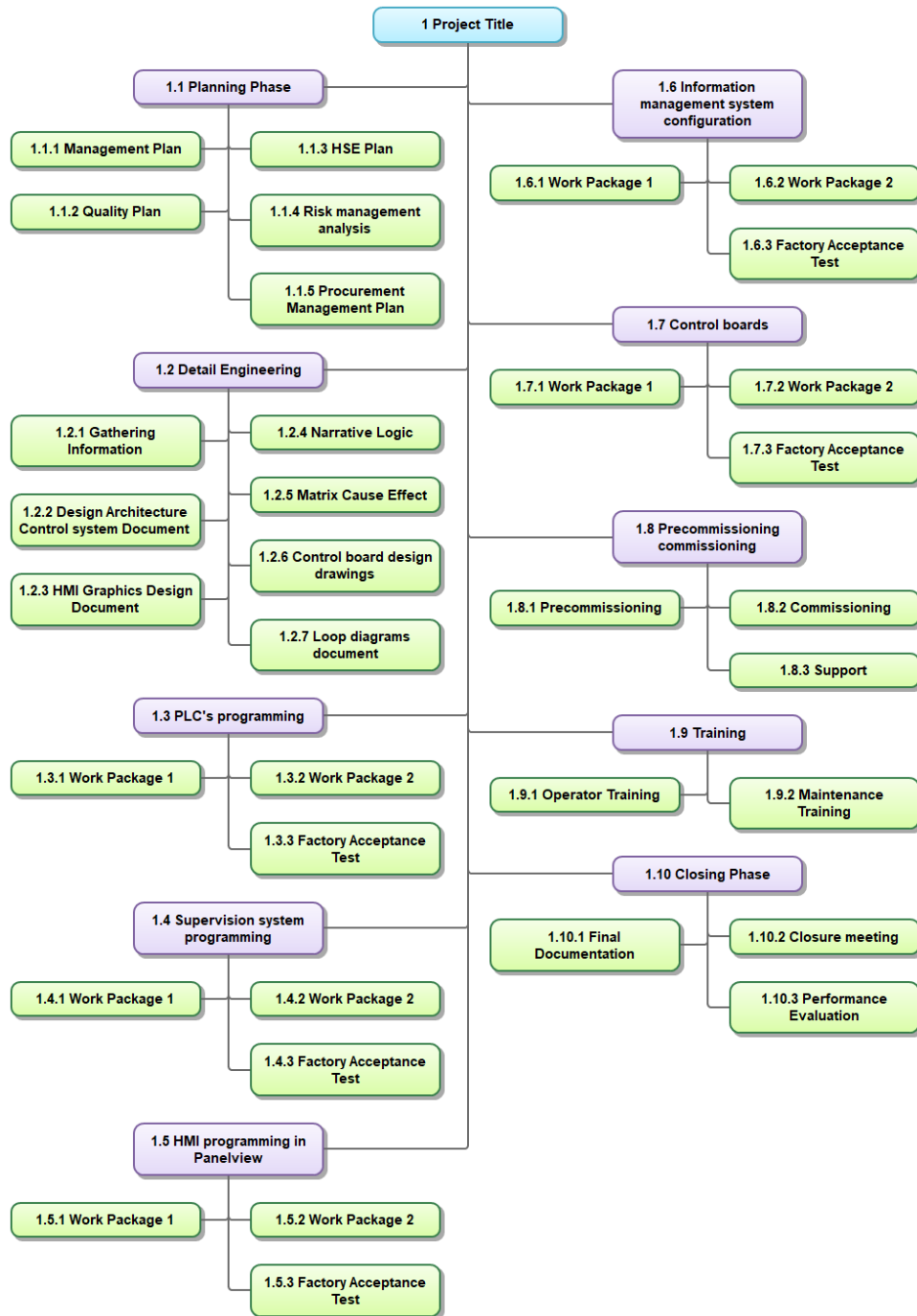


Figure 7 WBS Format


(Own elaboration)

4.2.2.5 WBS dictionary.

This document is created to provide or expand information on the activities or work packages defined in the WBS, that is provided in the PR-07 format. It represents the WBS in a tabular diagram and involves the description of what it entails to carry out the work and what the final expected result is.

It is recommended to describe each work package or activity quite explicitly due to the nature of work in automation projects, and to the fact that the WBS dictionary is reduced compared to more complex project examples. A good description of the work to be carried out will suffice, which will then be complemented in the detailed design or engineering documents.

Chart 15 WBS Dictionary (Own elaboration)

	WBS DICTIONARY		Code	PR-F07
	PLAN		Version	1
			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

PHASE / DELIVERABLE	WORK PACKAGE NAME / ACTIVITIES	WORK PACKAGE DESCRIPTION
Planning Phase	Management Plan	
	Quality Plan	
	HSE Plan	
	Risk management analysis	
	Procurement Management Plan	
Detail Engineering	Gathering Information	
	Design Architecture Control System Document	
	HMI Graphics Design Document	
	Narrative Logic	
	Cause and effect matrix	
	Control board design layouts	

Describe the work package or activities in detail.


	Loop diagrams documentation	
PLCs programming	Work Package 1	
	Work Package 2	
	Factory Acceptance Test	
Supervision system programming	Work Package 1	
	Work Package 2	
	Factory Acceptance Test	
HMI programming in Panelview	Work Package 1	
	Work Package 2	
	Factory Acceptance Test	
Information management system configuration	Work Package 1	
	Work Package 2	
	Factory Acceptance Test	
Control boards	Work Package 1	
	Work Package 2	
	Factory Acceptance Test	
Precommissioning commissioning	Precommissioning	
	Commissioning	
	Support	
Training	Operator Training	
	Maintenance Training	
Closing Phase	Final Documentation	
	Closure meeting	
	Performance Evaluation	

Describe the work package in detail.

4.2.2.6 Schedule management plan.

The basis of the schedule management plan is elaborated using the information collected in this project. This generalizes the scope management of automation projects in document PR-P02 and provides guidance on how the schedule should be managed. Nonetheless, depending on the complexity of the project, this document may be tailored specifically to the project based on expert judgment, data analysis, or meetings.

Chart 16 Schedule Management Plan (Own elaboration)

	SCHEDULE MANAGEMENT PLAN		Code	PR-P02
			Version	1
	PLAN		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

REASONS FOR CHANGES
(What are the acceptable reasons for changes in the project schedule?)

CHANGE MODALITIES
(What are the modalities of change of the schedule? and how will they be managed?)

CHANGE REPORT
(Describe how to calculate and report the impact on the project due to the change in schedule (time, cost, quality, etc.))

ADDITIONAL COMMENTS
(Add additional comments if necessary)


4.2.2.7 Define and estimate activity duration.

The process of defining the activities and estimating their duration will be carried out in the same format to simplify the process. The work packages deemed

necessary will be broken down so that their progress can be controlled and monitored without increasing the complexity of the monitoring and control areas.

Therefore, the WBD Dictionary PR-F07 format will be used as a base to estimate the allotted time for the activities or work packages in the PR-F09 format. The profiles responsible for executing the activity or work package must be determined. In automation projects the profiles that are generally used are Senior Control Engineer, Junior Control Engineer and Automation Technician, but these profiles can be renamed, or columns increased as required.

Chart 17 Definition and Estimate Durations of the Activities (Own elaboration)

	DEFINITION AND ESTIMATE DURATIONS OF THE ACTIVITIES					Code	PR-F09			
	FORMAT					Version	1			
						Date	26-Jun-20			
PROJECT INFORMATION										
Project Name:	(Write the project name)									
Project ID:	(Write the project ID)	Order Number:	(Order number by client)							
Client:	(Name of client)									
PHASE / DELIVERABLE	WORK PACKAGE NAME / ACTIVITIES	SUMMARY OF DURATIONS			CONTROL ENGINEER JUNIOR		CONTROL ENGINEER SENIOR		CONTROL TECHNICIAN	
		TOTAL	WO	WF	WO	WF	WO	WF	WO	WF
Planning Phase	Management Plan	7	7	0	5		2			
	Quality Plan	0	0	0						
	HSE Plan	0	0	0						
	Risk management analysis	0	0	0						
	Procurement Management Plan	0	0	0						
Detail Engineering	Gathering Information	0	0	0						
	Design Architecture	0	0	0						

	Control System Document									
	HMI Graphics Design Document	0	0	0						
	Narrative Logic	0	0	0						
	Cause and Effect matrix	0	0	0						
	Control board design layouts	0	0	0						
	Loop diagrams documentation	0	0	0						
PLC programming	Work Package 1	0	0	0						
	Work Package 2	0	0	0						
	Factory Acceptance Test	0	0	0						
Supervision system programming	Work Package 1	0	0	0						
	Work Package 2	0	0	0						
	Factory Acceptance Test	0	0	0						
HMI programming in Panelview	Work Package 1	0	0	0						
	Work Package 2	0	0	0						
	Factory Acceptance Test	0	0	0						
Information management system configuration	Work Package 1	0	0	0						
	Work Package 2	0	0	0						
	Factory Acceptance Test	0	0	0						
Control boards	Work Package 1	0	0	0						
	Work Package 2	0	0	0						
	Factory Acceptance Test	0	0	0						
Precommissioning commissioning	Precommissioning	0	0	0						
	Commissioning	0	0	0						
	Support	0	0	0						
Training	Operator Training	0	0	0						
	Maintenance Training	0	0	0						
Closing Phase	Final Documentation	0	0	0						
	Closure meeting	0	0	0						
	Performance Evaluation	0	0	0						
TOTAL					5	0	2	0	0	0
Notes:										
WO - Office work activities, WF - Field work activities										
The summary of durations is based on effort rather than on delivery time										

4.2.2.8 Schedule development.

The document PR-F09 - defining and estimating the duration of the activities will be the base to build the schedule in MS Project as standard software. The sequencing of activities is a logical process that must be carried out by both the project manager and the team to increase the accuracy in the estimating and sequencing of activities.

It is highly likely for new work packages or new activities to emerge during this phase to guarantee the complete execution of the project. Therefore, all the documents previously prepared should be updated as modifications take place during the planning development. The base scheme for the schedule of activities already adjusted for automation projects is shown below, adjusted to work nine hours a day from Monday to Friday.

At this time, the efforts of each activity and the resources that would execute each activity are already defined. Consequently, the schedule must already be available with the complete execution framework but without costs.

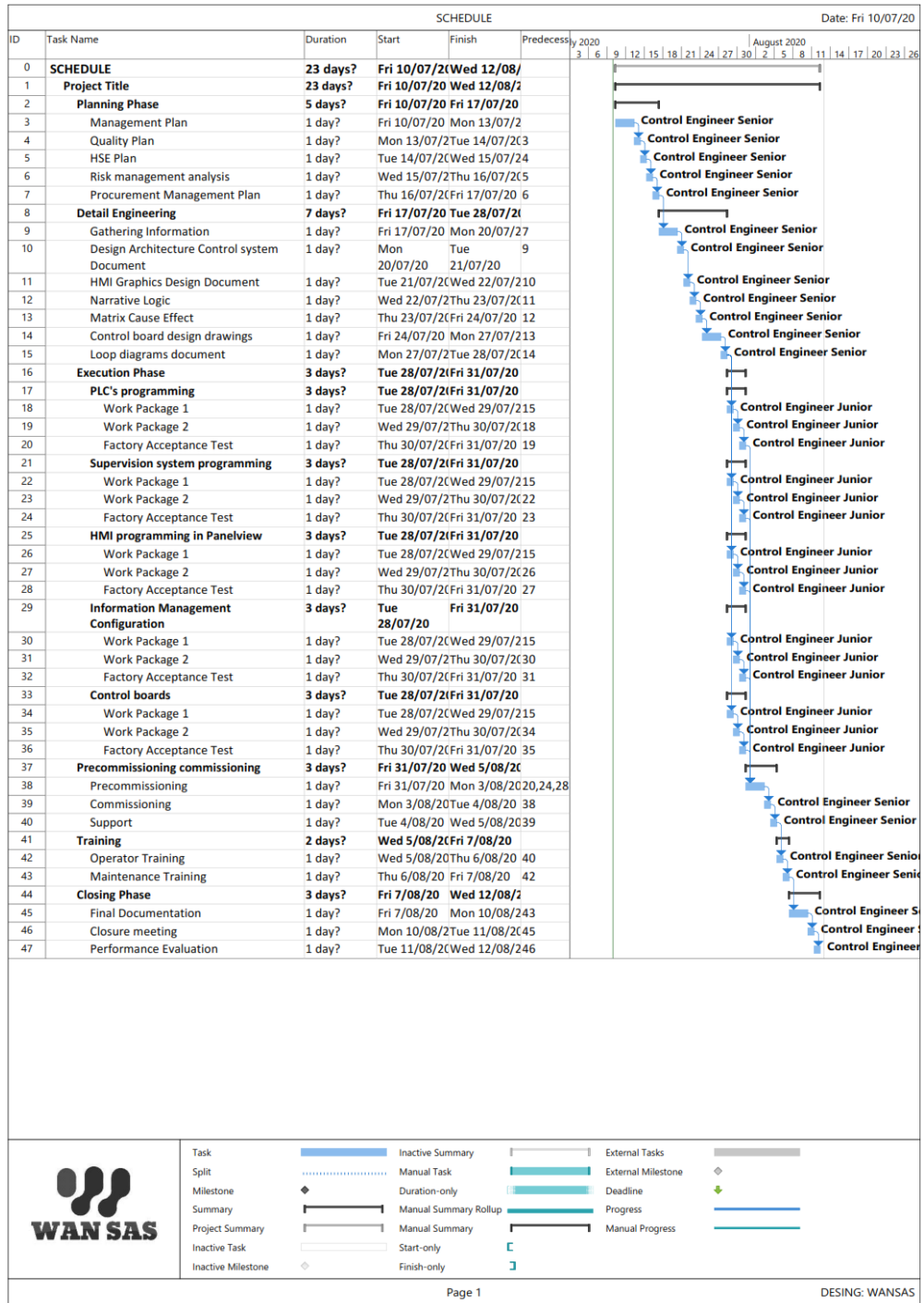



Figure 8 Schedule of Activities

(Own elaboration)

4.2.2.9 Cost management plan.

According to PMBOK, devising the project cost management plan is the process of defining how the project costs will be estimated, monitored, and controlled (PMI, 2017). This means that the project costs will be initially estimated, while the procedure to carry out cost control by managing the change for internal or external reasons will be described in the cost management plan, according to plan PR-P03.

Chart 18 Cost Management Plan Format (Own elaboration)

	COST MANAGEMENT PLAN		Code	PR-P03
	PLAN		Version	1
			Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	(Write the project name)			
Project ID:	(Write the project ID)	Order Number:	(Order number by client)	
Client:	(Name of client)			
REASONS FOR CHANGES				
(What are the acceptable Reasons for Changes in Project Cost?)				
CHANGE MODALITIES				
(What are the modalities of change of the cost? and how will they be managed?)				
CHANGE REPORT				
(Describe the procedure for reporting changes in project cost)				
ADDITIONAL COMMENTS				
(Add additional comments if necessary)				


4.2.2.10 Estimate cost and determine budget.

In this process, the project budget and the cost of each deliverable and work package will both be determined in the same PR-F10 format. It is necessary to remark that the calculations are based on the costs of the project rather than on its sale price.

To determine the cost of each work package, three aspects will be estimated: the first is the cost of labor, which includes how much the effort of human resources in each activity costs by basically multiplying the number of hours allocated to the activity for the unit cost of the hour; the second aspect is the cost of the equipment involved in the deliverable; and lastly, there are the costs associated to the work package that corresponds to mobilizing personnel, such as hotel expenses, flights, special transportation, food, etc.

At the end of the format, the percentage of the contingency reserve for each of the aspects will be determined according to the experts of the project management team. This amount plus the management reserve for the total project will thus determine the project budget.

Chart 19 Estimate Cost Format (Own elaboration)

	ESTIMATE COST AND DETERMINE BUDGET	Code	PR-F10
	FORMAT	Version	1
		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

ACTIVITY COST ESTIMATES				
WORK PACKAGE NAME / ACTIVITIES		TOTAL	COST OF LABOR	ASSOCIATED COST
Planning Phase	Management Plan	\$ 2,725,000	\$ 1,925,000	\$ 800,000
	Quality Plan	\$ -	\$ -	\$ -
	HSE Plan	\$ -	\$ -	\$ -
	Risk management analysis	\$ -	\$ -	\$ -
	Procurement Management Plan	\$ -	\$ -	\$ -
Detail Engineering	Gathering Information	\$ -	\$ -	\$ -
	Design Architecture Control System Document	\$ -	\$ -	\$ -
	HMI Graphics Design Document	\$ -	\$ -	\$ -
	Narrative Logic	\$ -	\$ -	\$ -
	Cause and Effect Matrix	\$ -	\$ -	\$ -
	Control board design layouts	\$ -	\$ -	\$ -
	Loop diagrams documentation	\$ -	\$ -	\$ -
PLC's programming	Work Package 1	\$ -	\$ -	\$ -
	Work Package 2	\$ -	\$ -	\$ -
	Factory Acceptance Test	\$ -	\$ -	\$ -
Supervision system programming	Work Package 1	\$ -	\$ -	\$ -
	Work Package 2	\$ -	\$ -	\$ -
	Factory Acceptance Test	\$ -	\$ -	\$ -
HMI programming in Panelview	Work Package 1	\$ -	\$ -	\$ -
	Work Package 2	\$ -	\$ -	\$ -
	Factory Acceptance Test	\$ -	\$ -	\$ -
Information management system configuration	Work Package 1	\$ -	\$ -	\$ -
	Work Package 2	\$ -	\$ -	\$ -
	Factory Acceptance Test	\$ -	\$ -	\$ -
Control boards	Work Package 1	\$ -	\$ -	\$ -
	Work Package 2	\$ -	\$ -	\$ -
	Factory Acceptance Test	\$ -	\$ -	\$ -
Precommissioning commissioning	Precommissioning	\$ -	\$ -	\$ -
	Commissioning	\$ -	\$ -	\$ -
	Support	\$ -	\$ -	\$ -
Training	Operator Training	\$ -	\$ -	\$ -
	Maintenance Training	\$ -	\$ -	\$ -
Closing Phase	Final Documentation	\$ -	\$ -	\$ -
	Closure meeting	\$ -	\$ -	\$ -
	Performance Evaluation	\$ -	\$ -	\$ -
TOTAL		\$ 2,725,000	\$ 1,925,000	\$ 800,000

EQUIPMENT COST			
EQUIPMENT DESCRIPTION	UNIT PRICE	QTY	SUBTOTAL
(List all equipment to supply)	\$ 1,000,000	1	\$ 1,000,000
	\$ -	1	\$ -
	\$ -	1	\$ -
	\$ -	1	\$ -
	\$ -	1	\$ -
TOTAL			\$ 1,000,000

DETERMINE BUDGET				
WORK PACKAGE NAME / ACTIVITIES	TOTAL	COST OF LABOR	EQUIPMENT COST	ASSOCIATED COST
Work Package Cost Estimates	\$ 3,725,000	\$ 1,925,000	\$ 1,000,000	\$ 800,000
Contingency Reserve Percentage		5%	2%	10%
Contingency Reserve	\$ 196,250	\$ 96,250	\$ 20,000	\$ 80,000
Cost Base Line	\$ 3,921,250			
Management Reserve	\$ 156,850			
Project Budget	\$ 4,078,100			

The daily value of each one of the resources involved in the project must be updated in the corresponding MS Project file in the same way that the associated costs were calculated for the cost estimation. This is the case for the personnel maintenance expenses, location costs and Equipment Cost.

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt.	Cost/Use	Accrue	Base
1	Project Manager	Work		PM	Cost of La	100%	30,000/day	\$ 0/hour	\$ 0	Prorated	Standard
2	Control Engineer	Work		CES	Cost of La	100%	30,000/day	\$ 0/hour	\$ 0	Prorated	Standard
3	Control Engineer	Work		CEJ	Cost of La	500%	15,000/day	\$ 0/hour	\$ 0	Prorated	Standard
4	Control Technician	Work		CT	Cost of La	100%	10,000/day	\$ 0/hour	\$ 0	Prorated	Standard
5	Personnel Maintenance	Cost		Exp	Associate					Start	
6	Location Cost	Cost		L	Associate					Prorated	
7	Equipment Cost	Material		E	Material		\$ 1,000,000		\$ 0	Start	

Figure 9 Resource Sheet Configuration

(Own elaboration)

Note: If the schedule must be shared with the client, it is highly recommended to use the sales rates in the costs of each of these resources; making two schedules will make it difficult to follow up later.

4.2.2.11 Quality management plan.

The quality management plan is defined by describing how the quality of the project deliverables will be monitored and controlled. Along with it, the inspection and test plan allows technical planning on the control issues for each deliverable, the acceptance criteria, the tests to be given to the deliverable, and the person responsible for said deliverable.

This inspection and test plan must be built according to the scope of the project, listing all the deliverables and defining the aforementioned criteria. Additionally, a control must be carried out in the same document by identifying the status of the tests carried out on each deliverable.

Chart 20 Quality Management Plan (Own elaboration)



	QUALITY MANAGEMENT PLAN		Code	PR-P04
	PLAN		Version	1
			Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	(Write the project name)			
Project ID:	(Write the project ID)	Order Number:	(Order number by client)	
Client:	(Name of client)			
PLAN FOR QUALITY				
(Describe how the quality of the project deliverables will be controlled)				
PERFORM QUALITY ASSURANCE				
(Describe how quality compliance will be ensured)				
CONTINUOUS IMPROVEMENT				
(Describe how continuous improvement will be strengthened)				
ADDITIONAL COMMENTS				
(Add additional comments if necessary)				

Chart 21 Inspection and Test Plan (Own elaboration)


	INSPECTION AND TEST PLAN		Code	PR-F10	
	FORMAT		Version	1	
			Date	26-Jun-20	
PROJECT INFORMATION					
Project Name:	(Write the project name)				
Project ID:	(Write the project ID)	Order Number:	(Order number by client)		
Client:	(Name of client)				
ACTIVITY COST ESTIMATES					
DELIVERABLES	VARIABLE TO CONTROL	ACCEPTANCE REQUIREMENTS	TEST	PERSON RESPONSIBLE	STATUS
Detail Engineering	(Indicate which variable you want to control in the deliverable)	(What are the acceptance criteria of the deliverable?)	(What kind of tests are you going to do?)	(Indicate the person responsible for WAN SAS and the client)	(In what state it is, according to the revision date)
PLC programming					
Supervision system programming					
HMI programming in Panel view					
Information management system configuration					
Control boards					

4.2.2.12 Resource management plan.

The resource management plan is based on the PR-P05 format, which helps us estimate the personnel required for the automation project. In this case, the base profiles describing the knowledge requirements and the necessary functions of each position in the work team for a typical automation project have been

included in the plan. The resource management plan must be complemented, modified or adjusted as the project requires in order to know exactly what resources will be needed regarding its scope, deliverables and delivery time.

Chart 22 Resource Management Plan (Own elaboration)

	RESOURCE MANAGEMENT PLAN		Code	PR-P05
	PLAN		Version	1
			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

SCOPE	
The resource management plan includes the definition of the personnel involved in the project according to the estimation of activities. For each profile, the knowledge required in the position and the main functions should be determined.	

RESOURCES DEFINITION		
POSITION	KNOWLEDGE	MAIN FUNCTIONS
Name of the required position	Describe the knowledge and experience required by the resource.	Describe the main functions that the resource will perform.
(Add more lines as needed)		

ADDITIONAL COMMENTS
(Add additional comments if necessary)

4.2.2.13 Estimate activity resources.


The estimation of the activity resources must be carried out along with the process of defining their duration. Both the type of resource required per task and

the time it takes to be executed must be specified. All the resources needed to complete each deliverable can be included in the PR-F09 format.

4.2.2.14 Communication management plan.

The communication management plan is presented in the PR-P06 format below. This shows how communication will be managed and formalized throughout the project in order to keep each stakeholder informed, thus meeting the needs of the project.

Chart 23 Communication Management Plan (Own elaboration)

	COMMUNICATION MANAGEMENT PLAN		Code	PR-P06
			Version	1
	PLAN		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

COMMUNICATION PLANNING
(Explain how this will handle the communications plan)


INFORMATION NEEDS
(Describe how the communication needs will be defined)

COMMUNICATION CHANNELS
(Describe which are the communication channels or how the communication channel will be defined)

ADDITIONAL COMMENTS
(Add additional comments if necessary)

Additionally, all project communication should be planned in the communication matrix. The project information needs must also be registered, identifying who delivers the information and who expects it; the means of communication, the frequency and the format in which the message will be sent must be included.

Chart 24 Communication Matrix (Own elaboration)

	COMMUNICATION MATRIX	Code: PR-F13
		Version: 1
	FORMAT	Date: 4-Ago-2020


PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

STAKEHOLDER REGISTER MATRIX							
ID	Information	Document	Level of detail	Person Responsible	Receiver	Frequency	Method of delivery
1	What type of information must be delivered?	In what format will it be delivered?	Indicate the level of detail: low, medium, high.	Who is responsible for delivering the information?	Who receives the information?	How often is the information sent?	What is the means used to deliver the information?
2							
3							
4							
5	(Add additional comments if necessary)						

4.2.2.15 Risk management plan.

The risk management plan defines how the risks of the project will be identified, classified and managed. The PR-F07 format is where the risks are identified; it includes the procedure for risk management, and how the evaluation is carried out. The necessary formats to manage said risks are also specified.


Chart 25 Risk Management Plan Format (Own elaboration)

	RISK MANAGEMENT PLAN		Code	PR-P07
			Version	1
	PLAN		Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	(Write the project name)			
Project ID:	(Write the project ID)	Order Number:	(Order number by client)	
Client:	(Name of client)			
SCOPE				
(Describe the scope of the risk management plan)				
TOOLS AND TECHNIQUES				
(Describe step by step which tools and techniques will be used, and how they will be used)				

4.2.2.16 Identify risk.

The process of identifying project risks is the initial stage defined in the risk management plan. This will be carried out in the risk identification format PR-F08 on the RISK IDENTIFICATION sheet, where all identified risks must be recorded and classified by category. Expert judgment tools and data collection using techniques such as brainstorming will be used to identify such risks.


Chart 26 Risk Identification Format (Own elaboration)

	RISK MANAGEMENT		Code	PR-F08
	RISK IDENTIFICATION FORMAT		Version	1
			Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	(Write the project name)			
Project ID:	(Write the project ID)	Order Number:	(Order number by client)	
Client:	(Name of client)			
Identify the project risks within each category:				
RISK CODE	TECHNICAL OR QUALITY RISK			
1.1	The objectives are not clear, or the information is confusing or incorrect.			
1.2	Changes in scope.			
1.3	The information provided is not enough.			
1.4				
RISK CODE	MANAGEMENT RISK			
2.1	Poor budget estimate.			
2.2	Delays in the activities proposed in the schedule.			
2.3	Poor follow-up and monitoring of the work team.			
2.4				
RISK CODE	ORGANIZATIONAL RISK			
3.1	The personnel assigned to the project do not have the required knowledge or experience.			
3.2	Change of assigned human resources.			
3.3	Safety, health and environmental protection aspects not covered.			
3.4				
RISK CODE	EXTERNAL RISK			
4.1	Failure in the supplied equipment.			
4.2	Delay in equipment delivery by suppliers.			
4.3	Delay in the delivery or approval of documents by the client.			
4.4	Natural disasters.			
4.5	Strikes or work stoppages.			
4.6				
RISK CODE	OTHER RISKS			
5.1				
5.2				
5.3				
5.4				

4.2.2.17 Risk analysis.

For the risk analysis, the instructions of the risk management plan must be followed. The data resulting from this analysis, the definitions to determine the impact, the application of the Probability x Impact matrix and the guide to propose the strategy for each identified risk according to the qualification of the probability x Impact matrix will be registered in the format PR-F08 on the RISK ANALYSIS sheet.

Chart 27 Risk Analysis Format (Own elaboration)

	RISK MANAGEMENT	Code	PR-F08
	RISK ANALYSIS FORMAT	Version	1
		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

ANALYSIS RISK						
RISK CODE	RISK DESCRIPTION	PROBABILITY	IMPACT	PXI SCORE	MAJOR ASPECT	STRATEGY
(Write the risk code of risk identification format)	(Write the risk description of risk identification format)	(Determine the probability according to the risk management plan)	(Determine the impact according to the risk management plan)	(Determine the Score according to the risk management plan)	(Determine the major aspect affected, according to the risk management plan)	(Establish a strategy to eliminate or mitigate risk)
(Add as many lines as needed)						

4.2.2.18 Procurement management plan.

This procurement management plan will be used and documented in the PR-P08 format when the Project to be developed includes the supply of equipment or the contracting of third-party services. This plan should be tailored to the needs of the project, keeping track of how acquisitions will be managed according to their nature.

Chart 28 Procurement Management Plan (Own elaboration)

	PROCUREMENT MANAGEMENT PLAN		Code	PR-P08
	PLAN		Version	1
			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

PROCUREMENT RESOURCES
(Define how purchases will be triggered, who executes them and who approves them)

PRODUCTS AND SERVICES TO HIRE
(Describe the products and services that are required to contract)

PRODUCTS AND SERVICES REQUIREMENTS
(Describe the requirements of products and services that need to be contracted)

ADDITIONAL COMMENTS
(Add additional comments if necessary)


4.2.2.19 Stakeholder management plan.

After identifying the stakeholders of the project in the planning phase, the definition of the stakeholder management plan will be carried out for which the first part of the PR-F04 format filled out in the initiation phase (the identification of the stakeholder) is required.

If the information in this format is incomplete, it must be completed at this stage in order to carry out a conscientious analysis of the interested parties, such as their Main Expectations or Major Requirements.

Then, the Power/Influence and Interest Analysis will be done; the approach to this task will depend on the location of each stakeholder in the matrix, the establishment of a strategic plan for each interested party, and the expectations of the project and its main requirements. A guide to do this for each type of stakeholder is given in the following format.

Chart 29 Stakeholder Management Plan Format (Own elaboration)

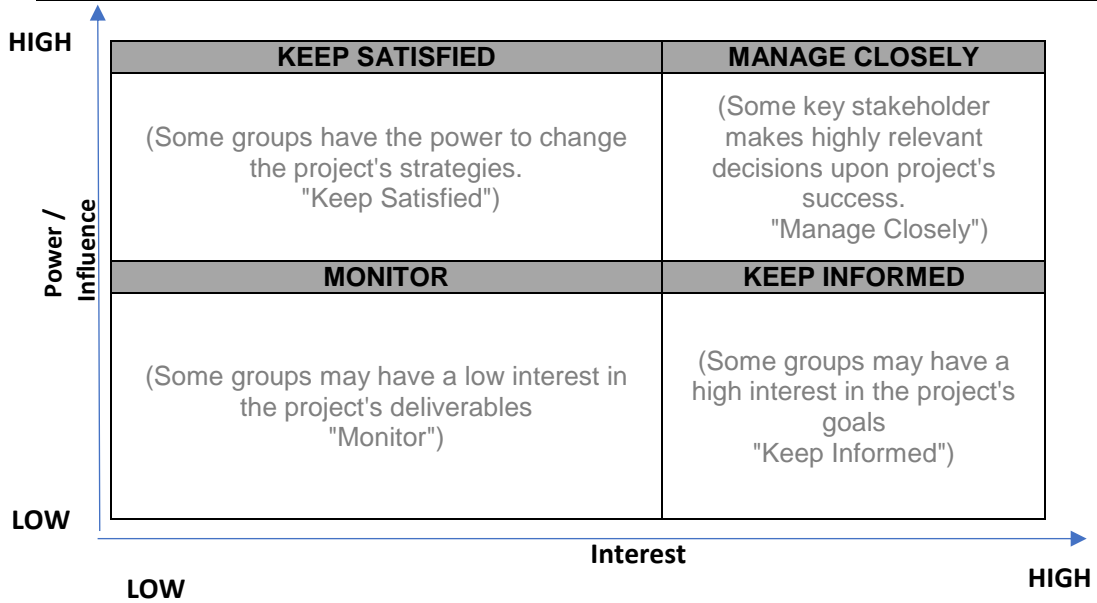
	STAKEHOLDER MANAGEMENT PLAN	Code: PR-F04
		Version: 1
	FORMAT	Date: 22-Jun-2020

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

STAKEHOLDER REGISTER MATRIX						
ID	Stakeholders	Functional Area	Roles - Responsibilities	Main Expectations	Major Requirements	Additional Comments
1	(List all stakeholders)	(In what area do)	(What is their role or responsibility?)	(What are their main)	(What are their biggest)	(Add comments if)

		they work?)		expectations ?)	requirements ?)	necessary)
2						
3						
4						
5	(Add as many lines as needed)					

POWER AND INTEREST ANALYSIS



ANALYSIS CONCLUSIONS		
ID	Stakeholders	Analysis Conclusion/Strategy
1	(List all stakeholders)	(Write the conclusions of the analysis and/or strategy.)
2		
3		
4		
5		

4.2.3 Execution process group.

During this phase of execution, the plans made in the planning phase will be used as a guide to direct and manage the project. It is the responsibility of the project manager to ensure the correct execution of activities on the planned dates, with the projected costs and the scope required. Here are some recommendations for the project manager to keep in mind:

- The project manager must ensure the acquisition of the project team as detailed in the human resources management plan, in addition to guarantee the development of the project team according to the technical and administrative needs required by the project.
- The project manager will be responsible for organizing and leading the work team for the development of the project, according to the aforementioned planning.
- A daily meeting of no more than fifteen minutes should be held with the project work team to validate progress, learn about difficulties, assess risks, and coordinate the execution of activities.
- A detailed weekly meeting should be held with the work team; this meeting should function as a general record to review the progress of the project, cost assessment and the risk assessment closely, and to coordinate new activities for the week.
- Quality assurance must be ensured according to the quality plan and the inspection and testing plan. It is necessary for the project manager to make

sure that the tests are executed and that the records are stored in the file provided for validation by the technical leader.

- The project manager has to ensure the handling of communication according to agreements of the internal kick-off meeting and the communication management plan.
- The project acquisitions must be carried out as planned.
- The strategic use of stakeholder analysis will help to adequately manage stakeholder engagement.

4.2.4 Monitoring and controlling process group.

The monitoring and control processes group focuses on the methodology for monitoring and controlling the schedule and costs. The analysis of earned value (EV) compares the baseline of the schedule and the cost with the actual performance of the project in relation to the performance described by the PMBOK in chapter 7.4.2.2 of said book. This analysis initially consists of three key dimensions:

- Planned Value (PV), which corresponds to the budgeted cost for the project as a function of time. To carry out this calculation, the project budget at completion (BAC) is multiplied by the percentage planned each week.
- Earned Value (EV), which corresponds to the budgeted cost for the work that has been completed at the time of the analysis. This value must be

calculated on a weekly basis to obtain the analysis represented in the S-curve.

- Actual Cost (AC), which corresponds to the real cost of the project in the moment of analysis; this is the cost to complete the percentage of project progress.

These three calculations (PV, EV and AC) are represented in a graph as a function of time. That by itself facilitates the measurement of the performance of the project with the trend of the three variables, allowing to verify if the project is above or below what was planned since the performance is seen as a function of time. This graph is called the S-curve of the project, as shown in the following figure:

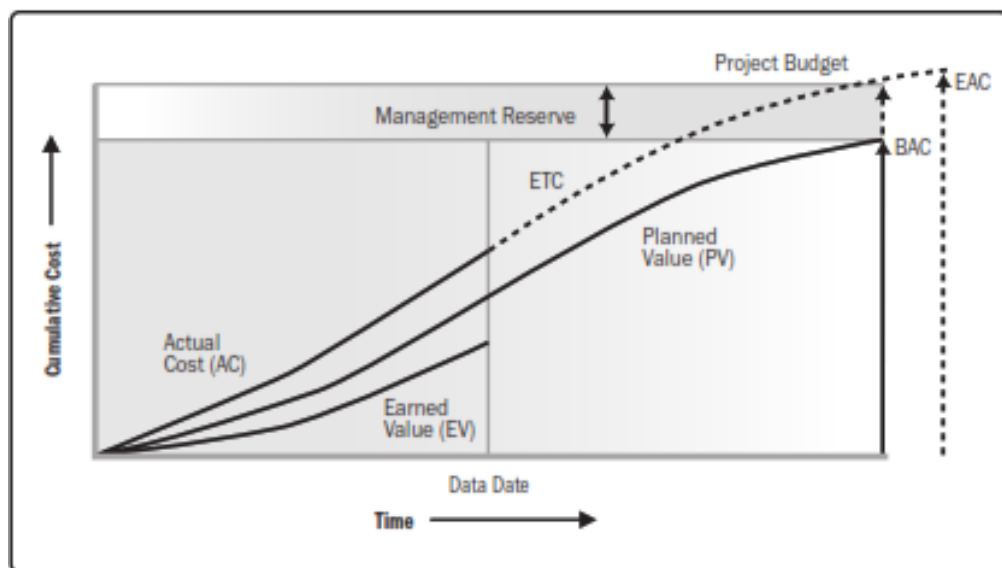


Figure 10 S-curve – Earned Value

(PMI, 2017, p. 264)

For the application of this analysis, it is essential to follow the corresponding procedure shown below in MS Project:

1. Once the initial planning is defined and approved, the baseline will be established. For this, go to "Project> Set baseline> Set Baseline" and select the baseline to update; this will allow to take a snapshot of the schedule with all its attributes for later comparison.

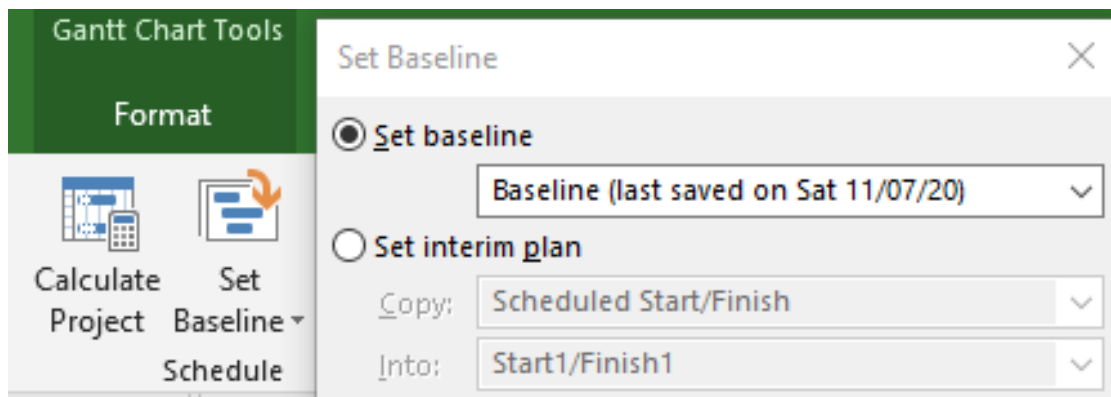


Figure 11 Setting Baseline in MS Project

(Own elaboration)

2. At a minimum, the project update must be carried out on a weekly basis in the MS Project document, verifying that the date of entry of the information is updated and that it corresponds to the date of advance in "Project> Status Date."

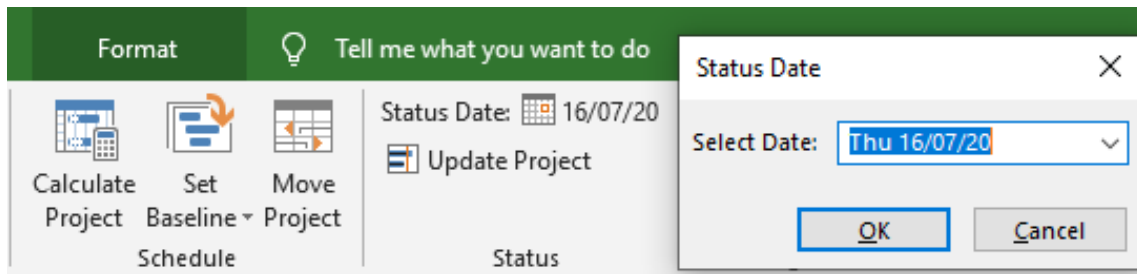


Figure 12 Update status Date in MS Project
(Own elaboration)

3. The update of the monitoring will be done in the "Tracking" view, which can be found in "View> Gantt Chart> Tracking Gantt". There, the actual execution values can be specified as each activity is executed. For example, the current amount of work, the actual start and end date, the start date and remaining time, the amount of time worked so far, and the time left for each activity can be visualized and adjusted. In short, this table brings traceability per activity to the project.

Task Name	Act. Start	Act. Finish	% Comp	Phys. % Comp.	Act. Dur.	Rem. Dur.	Act. Cost	Act. Work
0 SCHEDULE	10/07/20	NA	14%	0%	3.13 days	19.87 days	\$ 1,250,000	3.5 days
1 Project Title	10/07/20	NA	14%	0%	3.13 days	19.87 days	\$ 1,250,000	3.5 days
2 Planning Phase	10/07/20	NA	83%	0%	4.15 days	0.85 days	\$ 1,250,000	3.5 days
3 Management Plan	10/07/20	13/07/20	100%	0%	1.89 days	0 days	\$ 200,000	0.5 days
4 Quality Plan	13/07/20	13/07/20	100%	0%	0.5 days	0 days	\$ 175,000	0.5 days
5 HSE Plan	14/07/20	14/07/20	100%	0%	0.5 days	0 days	\$ 175,000	0.5 days
6 Risk management plan	15/07/20	NA	50%	0%	1 day	1 day	\$ 350,000	1 day
7 Procurement Management Plan	16/07/20	17/07/20	100%	0%	1 day	0 days	\$ 350,000	1 day

Figure 13 Tracking Gantt in MS Project
(Own elaboration)

The "Earned Value" view in MS Project gives an overview of the EV analysis. Here the PV, the EV and the AC can be found. These values can be taken to a spreadsheet for its graph and analysis as the project manager deems it convenient. For this methodology, however, the report available in MS Project is used instead.

The following figure shows how to access the earned value views, including two additional views to identify cost and schedule indicators.



Figure 14 Earned Value Views Available in MS Project
(Own elaboration)

The following definitions, with their respective abbreviations in MS Project for analysis of variation, performance indices and forecasts will be used for the EV analysis in this particular methodology.

Chart 30 Earned Value - Definitions (Own elaboration)

Initials	MS Project – (English)	Description
EV	BCWP	<p>Earned Value: Budgeted Cost of Work Performed. It is calculated up to the status date and depends on the method selected by the task, % Complete or Physical % Complete.</p> <p>Theoretically: $EV = BAC * \% \text{ Complete}$</p>
AC	ACWP	<p>Actual Cost: Actual Cost of Work Performed. Contains the cost incurred for work and is calculated up to the status date.</p> <p>Theoretically: $AC = \text{Real Cost at date Status}$</p>
PV	BCWS	<p>Planned Value: Budget Cost of Work Schedule. Contains the cumulative time cost of the phased baseline.</p> <p>Theoretically: $PV = \text{Cost at date Status in Baseline}$</p>
VARIANCE ANALYSIS		
CV	CV	<p>Cost variance: A cost performance measure. Corresponds to the deficit or surplus budgeted at date status. It allows to verify whether the progress achieved so far is costing more or less than what was budgeted. An action plan must be reviewed when the CV is negative.</p> <p>Theoretically: $CV = EV - AC$</p>
SV	SV	<p>Schedule Variance: Being a measure of schedule performance, it indicates if the project is behind or ahead the project baseline at status date status. When the SV is negative, the project is behind.</p> <p>Theoretically: $SV = EV - PV$</p>
PERFORMANCE INDEX		
CPI	CPI	<p>Cost Performance Index: A measure of cost efficiency relative to budgeted resources; measures cost efficiency for work completed at date status. When the CPI is less than 1, the project is costing more than budgeted; when it is greater than 1, the project is costing less than budgeted.</p> <p>Theoretically: $CPI = EV / AC$</p>
SPI	SPI	<p>Schedule Performance Index: It is a measure of schedule efficiency that expresses the efficiency with which work is being carried out. When the SPI is less than 1, an inefficient use of time is being made; an SPI greater than 1 means that an efficient use of time is being made.</p> <p>Theoretically: $SPI = EV / PV$</p>
TCPI	TCPI	<p>To Complete Performance Index: Assesses whether the cost performance must be improved at a certain point of</p>

		the project by taking into account the cost of the expenses already incurred in and relating them to what was budgeted in the first place. Theoretically: $TCPI = (BAC - EV) / (EAC - AC)$
FORECASTING		
BAC	BAC	Budget at completion: Corresponds to the original budget of the project. MS Project discriminates it by activities. Theoretically: $SPI = EV / PV$
EAC	EAC	Estimate at completion: Corresponds to the projection of the total cost of the project, considering that the CPI will behave the same as the rest of the project. Theoretically in MS Project: $EAC = AC + (BAC - EV) / CPI$
VAC	VAC	Variance at completion: Concerns the difference between the approximate cost of the project in relation to the initial budget. Theoretically: $VAC = BAC - EAC$
ETC	ETC	Estimate to complete: How much the project will cost from status date to finish. Theoretically: $ETC = EAC - AC$

The views to be used for the analysis of the aforementioned indicators starting with the overview of earned value are shown below.

Task Name	Planned Value - PV	Earned Value - EV (BCWP)	AC (ACWP)	CPI	SPI	SV	CV	EAC	BAC	VAC	TCPI	Remaining Cost	Remaining Duration
0 SCHEDULE	\$ 311,111	\$ 350,000	\$ 94,118	3.72	1.13	\$ 38,889	\$ 255,882	\$ 2,776,471	\$ 10,325,000	\$ 7,548,529	0.97	\$ 8,750,000	19.65 days
1 Project Title	\$ 311,111	\$ 350,000	\$ 94,118	3.72	1.13	\$ 38,889	\$ 255,882	\$ 2,776,471	\$ 10,325,000	\$ 7,548,529	0.97	\$ 8,750,000	19.65 days
2 Planning Phase	\$ 311,111	\$ 350,000	\$ 94,118	3.72	1.13	\$ 38,889	\$ 255,882	\$ 470,588	\$ 1,750,000	\$ 1,279,412	0.85	\$ 0	0 days
3 Management Plan	\$ 311,111	\$ 350,000	\$ 94,118	3.72	1.13	\$ 38,889	\$ 255,882	\$ 94,118	\$ 350,000	\$ 255,882	0	\$ 0	0 days
4 Quality Plan	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 175,000	\$ 350,000	\$ 175,000	1	\$ 0	0 days
5 HSE Plan	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 175,000	\$ 350,000	\$ 175,000	1	\$ 0	0 days
6 Risk management analysis	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 175,000	\$ 350,000	\$ 175,000	1	\$ 0	0 days
7 Procurement Management Plan	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 350,000	\$ 350,000	\$ 0	1	\$ 0	0 days
8 Detail Engineering	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 3,675,000	\$ 2,450,000	-\$ 1,225,000	1	\$ 2,625,000	6.5 days
9 Gathering Information	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 350,000	\$ 350,000	\$ 0	1	\$ 0	0 days
10 Design Architecture Control system Document	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 525,000	\$ 350,000	-\$ 175,000	1	\$ 175,000	0.5 days
11 HMI Graphics Design Document	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 1,400,000	\$ 350,000	-\$ 1,050,000	1	\$ 1,050,000	2 days
12 Narrative Logic	\$ 0	\$ 0	\$ 0	0	0	\$ 0	\$ 0	\$ 350,000	\$ 350,000	\$ 0	1	\$ 350,000	1 day

Figure 15 Earned Value View MS Project

(Own elaboration)

The following figure shows the view in the monitoring of cost with the analysis of earned value in MS Project.

	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	CV	CV%	CPI	BAC	EAC	VAC	TCPI
0	▲ SCHEDULE	\$ 311,111	\$ 350,000	\$ 255,882	73%	3.72	\$ 10,325,000	\$ 2,776,471	\$ 7,548,529	0.97
1	▲ Project Title	\$ 311,111	\$ 350,000	\$ 255,882	73%	3.72	\$ 10,325,000	\$ 2,776,471	\$ 7,548,529	0.97
2	▲ Planning Phase	\$ 311,111	\$ 350,000	\$ 255,882	73%	3.72	\$ 1,750,000	\$ 470,588	\$ 1,279,412	0.85
3	Management	\$ 311,111	\$ 350,000	\$ 255,882	73%	3.72	\$ 350,000	\$ 94,118	\$ 255,882	0
4	Quality Plan	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 175,000	\$ 175,000	1
5	HSE Plan	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 175,000	\$ 175,000	1
6	Risk manager	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 175,000	\$ 175,000	1
7	Procurement Management	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 350,000	\$ 0	1
8	▲ Detail Engineer	\$ 0	\$ 0	\$ 0	0%	0	\$ 2,450,000	\$ 3,675,000	-\$ 1,225,000	1
9	Gathering Inf	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 350,000	\$ 0	1
10	Design Architecture	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 525,000	-\$ 175,000	1
11	HMI Graphics	\$ 0	\$ 0	\$ 0	0%	0	\$ 350,000	\$ 1,400,000	-\$ 1,050,000	1

Figure 16 Earned Value Cost Indicators View in MS Project

(Own elaboration)

Here below, the view in MS Project of the monitoring of schedule with the analysis of earned value is shown.

	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	SV	SV%	SPI
0	▲ SCHEDULE	\$ 311,111	\$ 350,000	\$ 38,889	12%	1.13
1	▲ Project Title	\$ 311,111	\$ 350,000	\$ 38,889	12%	1.13
2	▲ Planning Phase	\$ 311,111	\$ 350,000	\$ 38,889	12%	1.13
3	Management	\$ 311,111	\$ 350,000	\$ 38,889	12%	1.13
4	Quality Plan	\$ 0	\$ 0	\$ 0	0%	0
5	HSE Plan	\$ 0	\$ 0	\$ 0	0%	0
6	Risk manager	\$ 0	\$ 0	\$ 0	0%	0
7	Procurement Management	\$ 0	\$ 0	\$ 0	0%	0

Figure 17 Earned Value Schedule Indicators View in MS Project

(Own elaboration)

Finally, the “Earned Value Over Time Report” is used to generate the S-curve as shown in the following figure. After this, the report will be exported to a spreadsheet, and the data of the S-curve will be updated until it reaches the status date configured in MS project for the analysis.

The screenshot shows the Microsoft Project interface. The 'Report' menu is highlighted in red. The 'Visual Reports - Create Report' dialog is open, showing a list of report templates. The 'Earned Value Over Time Report' template is selected and highlighted with a red circle. The main window displays a Gantt chart and a table of project data.

Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	SV	SV%
0 SCHEDULE	\$ 3,811,111	\$ 2,450,000	-\$ 1,361,111	-
1 Project Title	\$ 3,811,111	\$ 2,450,000	-\$ 1,361,111	-
2 Planning Phase	\$ 1,750,000	\$ 1,750,000	\$ 0	-
3 Management	\$ 350,000	\$ 350,000	\$ 0	-
4 Quality Plan	\$ 350,000	\$ 350,000	\$ 0	-
5 HSE Plan	\$ 350,000	\$ 350,000	\$ 0	-
6 Risk manager	\$ 350,000	\$ 350,000	\$ 0	-
7 Procurement Management	\$ 350,000	\$ 350,000	\$ 0	-
8 Detail Engineer	\$ 2,061,111	\$ 700,000	-\$ 1,361,111	-

Figure 18 Earned Value Report in MS Project

(Own elaboration)

The generated report has configured the S-curve, on which the analysis of trends will be performed. It is also possible to add more curves to the graph to complement the analysis.

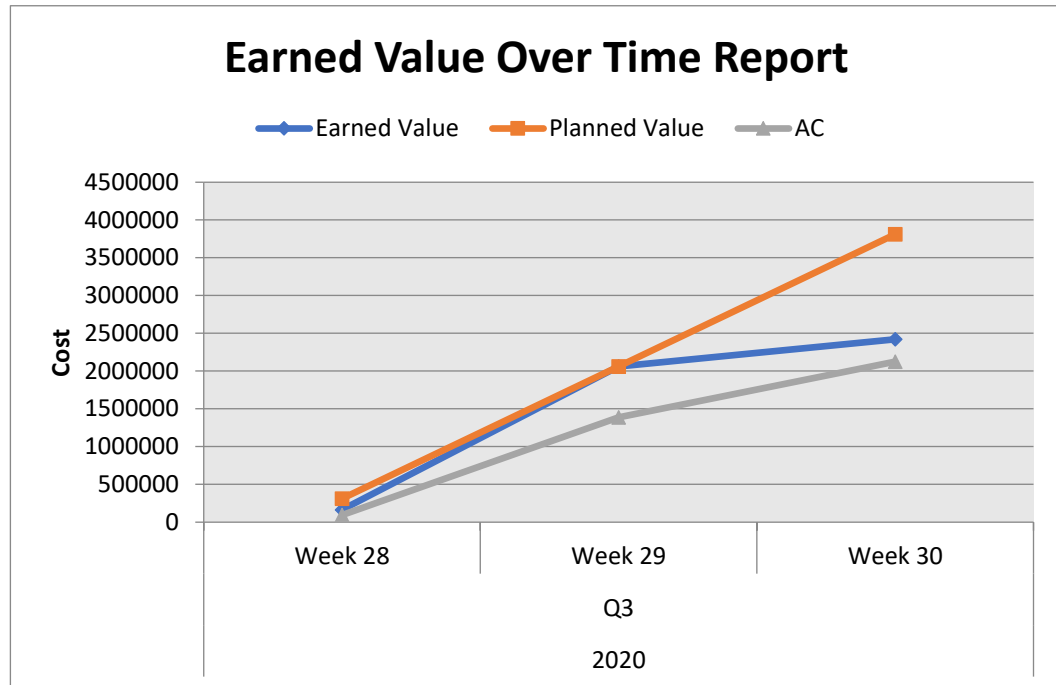



Figure 19 S-curve with MS Project

(Own elaboration)

4.2.5 Closing process group.

It is important to formally close with the client at the end of each phase or project; therefore, a closing meeting must be held with the proposed agenda in the PR-F12 minute format. During this meeting the work done is formally delivered, the project documentation is handed over, and the commercial conditions are formalized after delivery.

Chart 31 Delivery Minute (Own elaboration)

	DELIVERY MINUTE		Code	PR-F12
	FORMAT		Version	1
			Date	28-Jun-20

DATE AND LOCATION			
Date and Time	(Issue date and time)	Location	(Meeting place)

PROJECT INFORMATION			
Project Name:	(Write the project name)		
Project ID:	(Write the project ID)	Order Number:	(Order number by client)
Client:	(Name of client)		

MEETING GENERAL INFORMATION				
ATTENDEES				
Full Name	Initials	Work Position/Role	Telephone Number	Email Address
(Name of attendees)	(Initials of attendee's name)	(Write position)	(Write the phone number)	(Write the email address)
(Include as many lines as needed)				

DELIVERY CONDITIONS
(Write down all important conclusions and notes from the meeting.)
(Include as many lines as needed)

STANDARD MEETING AGENDA
1 - Project Technical Management
1,1 - Summary of Work Done
1,2 - Specify missed jobs
1,3 - Dossier delivery
1,4 - Client feedback
2 - Commercial Conditions
2,1 - Guarantee
2,2 - Billing
2,3 - Satisfaction Survey

COMMITMENTS			
Description	Person Responsible	Expected date of execution	Observations
(Describe the commitment)	(Who is responsible?)	(What is the expected date of compliance?)	(Add remarks if necessary)
(Add as many lines as needed)			

ATTENDEES SIGNATURE			
Full Name		Full Name	
Signature		Signature	
(Add as many lines as needed)			


4.3 How to Apply the Methodology for Project Management

The methodology includes the minimum formats, templates, plans, and procedures required for project management; all these documents must be adjusted to the scope of the project. The project director, who is directly responsible for the project, should develop or lead the preparation of documents related to the methodology.

A table has been created with the logical sequence for the management of automation projects to facilitate the understanding of the methodology. Although project management is usually a repetitive and iterative cycle of processes carried out in order to control all the areas of knowledge according to PMBOK (PMI, 2017), it is hoped that this document will help to better acknowledge and organize the management of the projects.

The document PR-D01 details the management activities of the initialization, planning, execution, monitoring and control phases, along with project closure. The aspect to be controlled has been made available for each activity. The corresponding registration in the documents and further actions are to be carried out by the project manager.

Chart 32 Project methodology step-by-step guide (Own elaboration)

		PROJECT METHODOLOGY			Code: PR-D01
					Version: 1
					Date: 12-07-2020
ITEM	PHASE	ACTIVITY	ASPECT TO CONTROL	REGISTER	ACTIONS
1	Initiation	Develop Project Charter	Whether the project is duly approved by the company for its execution.	PR-F01 - Project Charter	Once the project is awarded to the company, the commercial area must prepare the preliminary version of the Project Charter in order to formalize the project and authorize its execution.
2	Initiation	Assign Project Manager	Assignment of the person in charge of the direction of the project.	Email from the Engineering Director PR-F01 - Project Charter	The engineering director will assign the project director, who will be in charge of coordinating the project activities from this point onward. The Project Charter must be updated by the project manager and signed at the internal kick-off meeting.
3	Initiation	Conduct the internal project kick-off meeting	Guarantee that all areas of the company are aware of the	PR-F02 Internal Initiation Meeting Minute	The director will send an invitation to the other processes of the

			project's existence, scope, milestones, purchasing requirements, human resources, and related information.		company, including purchases, human talent, operations manager, HSE coordinator and others.
4	Initiation	Conduct the External Kick-off Meeting	Formalize the start of the project with the client, to determine important aspects and commitments between the parties.	PR-F03 External Initiation Meeting Minute	The requirements will be verified and the information available for the development of the project will be validated in this meeting. The projects team will be presented if it is already defined. Plans will also be presented, or commitments will be made to present them if there are not any.
5	Initiation	Identify stakeholders	Identify all the stakeholders that may influence the project or have an interest in the project. Know their expectations and requirements.	PR-F04 Stakeholder Management Plan	The interested parties must be identified during the internal and external kick-off meetings to subsequently interview them and find out their expectations.
6	Planning	Scope Management Plan	Establish a plan for scope management.	PR-P01 - Scope Management Plan	Review the draft preset plan for automation project management, adjust if necessary.
7	Planning	Schedule Management Plan	Establish a plan for managing the schedule.	PR-P02 - Schedule Management Plan	Review the draft preset plan for automation project management, adjust if necessary.
8	Planning	Cost Management Plan	Establish a cost management plan.	PR-P03 - Cost Management Plan	Review the draft preset plan for automation project

					management, adjust if necessary.
9	Planning	Collect Requirements	Ensure that there is complete and sufficient information for the correct estimation of resources for the project, such as time, and costs, and know the requirements of those interested.	PR-F05 - Requirements Traceability Matrix Meeting Minutes Backups Contract specifications Client Complementary Documents	Collect the information needed to complete the project and further requirements of the interested parties.
10	Planning	Define Scope	Ensure that the scope is clear and complete, and that project exclusions, restrictions, and assumptions are known.	PR-F06 - Project Scope Statement	The definition of the project scope will be drafted and formalized with the work team.
11	Planning	WBS and WBS Dictionary	Ensure that all scope requirements are planned for execution.	WBS PR-F07 - WBS Dictionary	The work decomposition tool will be used until controllable activities or work packages are found; a detail of each activity and work package will be made in the WBS Dictionary.
12	Planning	Define activities and estimate time and resources	Quantify the times and activities and ensure their adequacy for the entire scope; assign activities to profiles.	PR-F09 - Define and estimate activities duration	Define the activities of each work package if necessary, assign resources and estimate the effort to complete the activity or work package with the help of the work team.

13	Planning	Develop Schedule	Guarantee a logical order in the execution of activities.	Schedule in MS Project	Define the sequence of execution of the activities and register it in MS Project for subsequent monitoring and control.
14	Planning	Estimate cost and determine the budget	Calculate and guarantee the economic resources and the cash flow for the execution of the project.	Schedule in MS Project PR-F10- Estimate Cost and Determine Budget	Determine the cost of the project according to the required human resources, the effort required for the execution of each activity, and the associated costs and equipment.
15	Planning	Quality Management Plan	Establish a plan for quality management.	PR-P04 - Quality Management Plan PR-F10 - Inspection and Test Plan	Review the draft preset plan for automation project management, adjust if necessary. Define how the acceptance tests will be carried out for each deliverable.
16	Planning	Resource Management Plan	Establish a plan for human resources management.	PR-P05 - Resource Management Plan	Review the draft preset plan for automation project management, adjust if necessary.
17	Planning	Communication Management Plan	Establish a plan for communication management.	PR-P06 - Communication Management Plan	Review the draft preset plan for automation project management, adjust if necessary.
18	Planning	Risk Management Plan	Establish a plan to control project risks.	PR-P07 - Risk Management Plan PR-F08 - Risk Management	Review the draft preset plan for automation project management, adjust if necessary. In addition, carry out the risk identification, risk analysis and response plan accordingly.

19	Planning	Procurement Management Plan	Establish a plan for controlling project purchases.	PR-P08 - Procurement Management Plan	If there are purchases in the project, write the purchase plan according to the products or services to be contracted.
20	Planning	Stakeholder Management Plan	Establish a plan for stakeholder management.	PR-F04 - Stakeholder Management Plan	Complete the management plans as per the interested parties, analyzing them according to the plan and establish a strategy for each interested party or group of interested parties.
21	Execution	Execution: Development of activities according to plan	Verify that the execution of each activity is carried out according to the planned guidelines and specifications	Activities and deliverables according to the scope of the contract	Carry out the work planned for the development of the project.
22	Execution	Follow-up meetings of the work team	Hold meetings with the work team regularly to direct it and to ensure the proper flow of information.	Minute sent via email	Report deviations and record in the project log when necessary.
23	Execution	Complement and update project documentation	Complete and clarify documentation.	Project documentation	Keep the project documentation updated, including the entire project management documentation and the project technical documentation.
24	Monitoring and Controlling	Project monitoring	Guarantee the correct execution of the project.	Project log	Evaluate the progress of the project continuously, along with its profitability, and new developments and other actions contemplated in the

					management plans.
25	Monitoring and Controlling	Review project progress	Comply with times, quantities and progress achieved.	Earned Value Report in MS Project	Use the earned value tool to constantly evaluate the project.
26	Closing	Closure meeting	Perform formal delivery of project scope and deliverables	PR-F12 - Delivery Minute	Hold a technical and administrative closing meeting of the project (it is possible to hold separate meetings). The project will be formally delivered to the client.

4.4 Sample Methodology

The methodology was applied in an example project with the scope of an assumed automation project; therefore, the overall project, scope, budget allocated, company name, stakeholders and other data are fictional and used exclusively for the development of this degree project.

The project will consist on the implementation of a monitoring system to manage alarms according to the ISA 18-2 standard, which should provide all the reports and indicators recommended by the standard and some additional ones of interest. The project is a turnkey project with a single final cost, so additional costs must be strategically negotiated with the sponsor.


The project already has basic engineering carried out by the commercial area, where several important topics have been defined for the project, (i.e., the internal budget and the equipment and licenses to be purchased). However, it is

necessary to carry out the complete planning of the project to achieve the objectives required by the client in a real context.

The application of the methodology consisted on following the procedures and filling out the formats presented in this document, hence developing the project planning and carrying out an analysis after a time of execution to review the project as a whole at the end. The following are the sample formats filled out for this project and the analysis of the project at a random execution date.

4.4.1 Sample project charter.

Chart 33 Sample Project Charter (Own elaboration)


	PROJECT CHARTER		Code: PR-F01
			Version: 1
Date:	Client:		
30 Apr 2020	OIL COMPANY SAS		
Project ID:	Project Name:		
P001-OCS	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project Start Date:	Project End Date:		
4 May 2020	4 Sep 2020		
Project Objectives (General and Specific):			
General Objective: Implement monitoring tools to perform alarm management according to ISA 18-2 standard.			
Specific Objectives:			
1. Perform the detailed engineering of the solution to ensure that the project technically satisfies the client requirements.			
2. Install a Vantage Point server to connect to the alarm and event server database and generate reports and indicators.			
3. Perform the configuration of the reports and indicators on the platform to help the client to manage the alarms of the control system.			
Project Benefits:			
The project aims to improve the response of operators to the trip and alarms of the control system, thus enhancing its reliability and efficiency. This will be achieved by establishing key indicators of the alarm system such as average alarms within a certain period of time, alarm trip frequency, and identification of permanent, fleeting or disabled alarms, among others.			
Project Scope:			
Deliverable	Description		
Detailed engineering	Detailed engineering of the solution. It must consider at least one control architecture system with architecture specifications, technical		

	characteristics of the implementation, definition of reports and indicators, and details of configuration parameters.	
Vantage Point Server	Supply and installation of a VantagePoint server, configuration of the interface to connect to the alarm and event server, and configuration of web interface, users and reports.	
Monitoring system configuration	Configuration of the monitoring system; includes the configuration of the web interface, users and user parameters, and reports and indicators.	
Assumptions:		
<ul style="list-style-type: none"> It is assumed that the client has established a methodology for alarm management. It is assumed that the client has established the requirements of the reports and the indicators needed to check his system. It is assumed that the current system architecture is compatible with the server to be installed 		
Constraints:		
<ul style="list-style-type: none"> The client has four months to develop the project. The control system is working; hence it is critical to consider strategies so as not to stop the process. 		
Preliminary Risks:		
<ul style="list-style-type: none"> If the client does not give the approval of the detailed engineering according to the schedule, it will delay the execution of activities and therefore the delivery date. If the control system is not compatible with the system to be implemented, it will cause cost overruns for the project. If the plant does not allow the entry of personnel during quarantine, the project will have delays in execution. 		
Budget:		
The client's budget is one hundred and fifty million pesos (\$ 150,000,000 COP)		
Milestones and dates:		
Milestone	Start date	End date
Definition and purchase of equipment	4 May 2020	8 May 2020
Detailed engineering delivery	4 May 2020	22 May 2020
Detailed engineering approval	22 May 2020	29 May 2020
Project delivery	30 Jul 2020	4 Sep 2020
Relevant historical information:		
No information is available		
Stakeholders:		
Describe the key participants in the project as per the client as follows:		
Role	Description	
Sponsor	Lennyn Echeverria	
PM	Aida Santamaria	
Final User	Elcy Angulo	
Operator	Juan Daniel Sierra	
Describe the key participants in the project as per WAN SAS as follows:		
Role	Description	
Sponsor	Abelardo Gomez	
PM	Javier Wandurraga	

Approval:	
Preparation - Project Manager: Javier Augusto Wandurraga	Signature:
Approval - Sponsor: Abelardo Gomez	Signature:

4.4.2 Sample internal initiation meeting minute.

Chart 34 Sample Internal Initiation Meeting Minute (Own elaboration)

	INTERNAL INITIATION MEETING MINUTE	Code	PR-F02
	FORMAT	Version	1
		Date	22-Jun-20

DATE AND LOCATION			
Date and Time	4 May 8:00 am	Location	Meeting Room

PROJECT OVERVIEW INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order Number:	OC-32105
Client:	OIL COMPANY SAS		

MEETING GENERAL INFORMATION			
ATTENDEES			
Full Name	Initials	Work Position	
Javier Wandurraga	JW	Project Manager	
Abelardo Gomez	AG	Sponsor	
Valeria Villamizar	VV	Technical Leader	
Doris Aguirre	DA	Seller	

MEETING CONCLUSIONS
The seller presents the quotation and the technical scope sold, as well as the costs and the sale price of the project.
The seller presents the initial Project charter, which contains the client's requirements, the expected objectives, the budget, the general scope, the commitments, the assumptions, the restrictions, and the risks of the project.
The client wants to develop this project because the operators do not trust the alarms that are triggered, and hence disable them because they consider them to be very annoying. The company manager has been authorized to solve this problem before catastrophic damage occurs.
The client had been told that updating the current control system was not included at the time of the quotation.
The activities must be well planned because the project must be completed within four months.
The client requires the end user to be trained on how to consult the reports.
It is necessary to raise the requirements of the stakeholders.
The server and the license must be purchased this week so that they arrive before the project delivery date; they must be purchased in cash.
A weekly follow-up meeting will be held every Monday at 8:00 am.

STANDARD MEETING AGENDA	
1 - Definition of client requirements	11 - Purchase plan


2 - Project justification	12 - Logistic plan
3 - Scope and objectives of the project	13 - Risk analysis and mitigation
4 - List of activities not included in the project	14 - Management of contractors
5 - Project Assumptions	15 - Customer Property Management
6 - Restrictions of time, cost, scope, engineers, etc.	16 - Progress reports
7 - List of stakeholders	17 - Deliverables to the customer
8 - Work Schedule	18 - Warranties
9 - Training Needs	19 - Preliminary billing plan
10 - Requirements of the personnel involved	

COMMITMENTS			
Description	Person Responsible	Expected date of execution	Observations
Define server purchase and license	Valeria Villamizar	8 May 2020	Make the purchase as soon as possible.
Organize the work team	Javier Wandurraga	5 May 2020	1 senior engineer and 1 junior engineer have been assigned
Hold kick-off meeting with the client	Javier Wandurraga	6 May 2020	None

ATTENDEES SIGNATURE			
Full Name	Javier Wandurraga	Full Name	Abelardo Gomez
Signature		Signature	
Full Name	Valeria Villamizar	Full Name	Doris Aguirre
Signature		Signature	

4.4.3 Sample external initiation meeting minute.

Chart 35 Sample External Initiation Meeting (Own elaboration)

	EXTERNAL INITIATION MEETING MINUTE			Code	PR-F03
				Version	1
	FORMAT			Date	22-Jun-20
DATE AND SITE					
Date and Hour	6 May 8:00 am		Site	Meeting Room - Client	
PROJECT OVERVIEW INFORMATION					
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.				
Project ID:	P001-OCS	Order Number	OC-32105		
Client:	OIL COMPANY SAS				
GENERAL INFORMATION OF MEETING ASSISTANTS					
Full Name	Initials	Work Position/Role	Telephone	Email	
Javier Wandurraga	JW	Project manager	3163048403	jwandurraga@wansas.com.co	
Lennyn Echeverria	LE	General Manager	3151234567	L.echeverria@oc.com.co	
Aida Santamaria	AS	Project manager	3171234567	a.santamaria@oc.com.co	
Elcy Angulo	EA	Process leader	3181234567	e.angulo@oc.com.co	
Juan Daniel Sierra	JS	Operator	3191234567	j.sierra@oc.com.co	
MEETING CONCLUSIONS					
The team is introduced. The senior control engineer will be Jose Prada. The junior control engineer will be Julian Vargas while Javier Wandurraga will work as the project manager.					
The client's project requirements are agreed upon. The main focus is on generating reports and indicators according to the alarm management methodology that the company has already defined and committed to supply.					
The Project Charter is shown to the client to confirm that what is written there corresponds to the objective, scope and deliverables required.					
The client assigns Aida Santamaria as the project manager and Elcy Santamaria as the end user.					
The client reminds the project team that the project must be completed by September 4.					
The client is reminded of the importance of giving the approval to the engineer in a promptly manner in order to avoid delays that may prevent meeting the delivery date. The client agrees.					
Weekly follow-up meetings are agreed every Tuesday at 8:00 am.					
In case change control is needed, it must be formally approved by the client's project manager, for which a report must be provided indicating why the change is required as well as the implications and the plan to follow.					
The client requires a weekly advance every Monday at the end of the day, which will be reviewed at the meeting on Tuesday.					
All formal communication will be made by email. Any approval given via email will be handled by the client's project manager.					
The client is informed that the project risk plan is being conceptualized.					
The purchase of equipment and licenses will be made no later than May 8. The client approves the purchase.					
The client is notified that the satisfaction survey will be carried out at the end of the project.					
The client notifies that a programming standard is lacking, and it is the responsibility of WAN SAS to supply software compatible with its control system.					
The FATs will be the responsibility of WAN SAS. Once the system has been tested, the end user will witness the SAT testing.					

The client is informed that the guarantee will be 6 months once the project is delivered.
The billing will be made according to the project deliverables: 30% with the delivery of the engineering, 30% more with the delivery and installation of the equipment and licenses, and 40% with the total delivery of the project.
The client provides the format needed to list the personnel who will be allowed into the facilities and the corresponding HSE requirements.
HSE inductions are held every Tuesday at 7:00 am.


STANDARD MEETING AGENDA	
1 - General Project Management	
1,1 - Presentation of the company workgroup, clients, and others	
1,2 - Verification of client's requisites and deliverables scope definition	
1,3 - Work schedule and project organization	
1,4 - Definition of resources and client participation	
1,5 - Technical milestones	
1,6 - Clarification of critical route	
1,7 - Follow-up meetings	
1,8 - Explanation and agreement on the methodology to treat change control in all phases of the project	
1,9 - Communication: definition of channels of communication, reports, frequency and content	
1,10 - Procedures for approval of deliverables	
1,11 - Management of subcontractors	
1,12 - Project risk and response plan	
1,13 - Purchase management	
1,14 - Methodology for partial surveys and final satisfaction survey	
2 - Project Technical Management	
2,1 - Software versions of the deliverables (deliverable software and development software)	
2,2 - Definition of the programming standard for all software	
2,3 - Requirements for Factory Acceptance Test (FAT)	
2,4 - Requirements for Site Acceptance Test (SAT)	
3 - Commercial Conditions	
3,1 - Duration and scope of warranty periods on engineering service and equipment installation during the project.	
3,2 - Billing Plan	
4 - Others	
4,1 - Permission to ingress the plant, work shift and special work schedules.	
4,2 - Client Terms and HSE requirements	
4,3 - HSE Inductions and customer emergency procedure	

COMMITMENTS			
Description	Responsible	Expected date of execution	Observations
Provide the alarm management methodology document	Aida Santamaria	7 May 2020	
Placing purchase orders	Javier Wandurraga	8 May 2020	

ATTENDEES FIRM			
Full Name	Javier Wandurraga	Full Name	Lennyn Echeverria
Signature		Signature	
Full Name	Aida Santamaria	Full Name	Elcy Angulo
Signature		Signature	
Full Name	Juan Daniel Sierra	Full Name	
Signature		Signature	

4.4.4 Sample scope management plan.

Chart 36 Sample Scope Management Plan (Own elaboration)

	SCOPE MANAGEMENT PLAN		Code	PR-P01
			Version	1
	PLAN		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

PROJECT SCOPE MANAGEMENT	
How will the scope of the project be managed?	
The scope initiatives by internal or external request will be managed by the project director, who will be in charge of channeling them to the engineering team. These must be formally approved by the client.	


PROJECT MANAGEMENT CHANGES	
Assess the stability of the project scope (how to handle changes, their frequency and impact):	
Project changes must be evaluated and approved. The project manager must quantify the impact and provide alternative solutions, informing the client for the approval of said changes.	
The requested changes are to be reviewed at weekly meetings, and their status must be indicated in the meeting following the one that was requested.	

INTEGRATION OF CHANGES IN THE SCOPE	
How will the scope changes be integrated into the project?	
If the impact of the change does not modify the project baseline, it will be approved by the project manager; otherwise, it shall be approved by the factory superintendent along with the corresponding modifications to baselines and to all the related project plans.	

ADDITIONAL COMMENTS	
None	


4.4.5 Sample requirements traceability matrix.

Chart 37 Sample Requirements Traceability Matrix (Own elaboration)

	REQUIREMENTS TRACEABILITY MATRIX				Code: PR-F05	
	FORMAT				Version: 1	
Date: 22-Jun-2020						
PROJECT INFORMATION						
Project Name:		Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.				
Project ID:		P001-OCS	Order Number:		OC-32105	
Client:		OIL COMPANY SAS				
REQUIREMENTS REGISTER MATRIX						
ID	Requirement Description	Business Needs, Opportunities, Goals, Objectives	Is it project objective?	Deliverable WBS	Status (Active, Cancelled, Deferred, Aggregate, Completed)	Additional Comments
1	Enable the reports visualization in a web portal	Business Needs	Yes	1.2.3.4.	Completed	The project includes the solution to this requirement.
2	Have a report showing which alarms are disabled	Goals	Yes	1.2.1 and 1.2.4	Completed	This requirement must be included at the design phase.
3	Have a report indicating which the leaking alarms are	Goals	Yes	1.2.1 and 1.2.4	Completed	This requirement must be included at the design phase.
4	Have a report indicating the frequency of the alarms trip and prioritize the top 10	Goals	Yes	1.2.1 and 1.2.4	Active	This requirement must be included at the design phase.
5	Have reports and indicators according to the ISA 18-2 standard	Business Needs	Yes	1.2.1	Active	The design will aim to provide sufficient information for alarm management based on the ISA 18-2 standard.

4.4.6 Sample project scope statement.

Chart 38 Sample Project Scope Statement (Own elaboration)

	PROJECT SCOPE STATEMENT		Code	PR-F06
	FORMAT		Version	1
			Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.			
Project ID:	P001-OCS	Order number:	OC-32105	
Client:	OIL COMPANY SAS			
PROJECT SCOPE DESCRIPTION				
Implement monitoring tools to perform alarm management according to ISA 18-2 standard. This implementation will be made compatible with the technological tools available from the OIL COMPANY SAS plant; a new server will be used to install the Vantage Point Server software, where reports and indicators will be configured to facilitate the management of plant alarms.				
PROJECT DELIVERABLES				
<ul style="list-style-type: none"> • Perform the detailed engineering of the solution • Supply and install a Vantage Point server • Perform the configuration of the reports and indicators on the platform to help the client to manage the alarms of the control system. 				
PROJECT ACCEPTANCE CRITERIA				
<ul style="list-style-type: none"> • The reports must be viewed from any computer connected to the business network by using the credentials of authorized users to access the information. • At a minimum, the reports of alarms must be configured per period of time, frequency of alarm trip, indicator of fleeting alarms and indicator of permanent alarms. • The updated documentation must be delivered at the end of the project. 				
PROJECT EXCLUSIONS				
<ul style="list-style-type: none"> • The project does not consider updating the current system a priority. • The definition of the methodology is not included; it will be provided by the client. 				
PROJECT CONSTRAINTS				
<ul style="list-style-type: none"> • The system is critical and must work without interruptions; therefore, interventions must be well planned. 				
PROJECT ASSUMPTIONS				
<ul style="list-style-type: none"> • It is assumed that the system is compatible. It must be validated with a survey of information. • It is assumed that the alarm system works correctly, and that the desired information can be obtained. 				

4.4.7 Sample WBS.

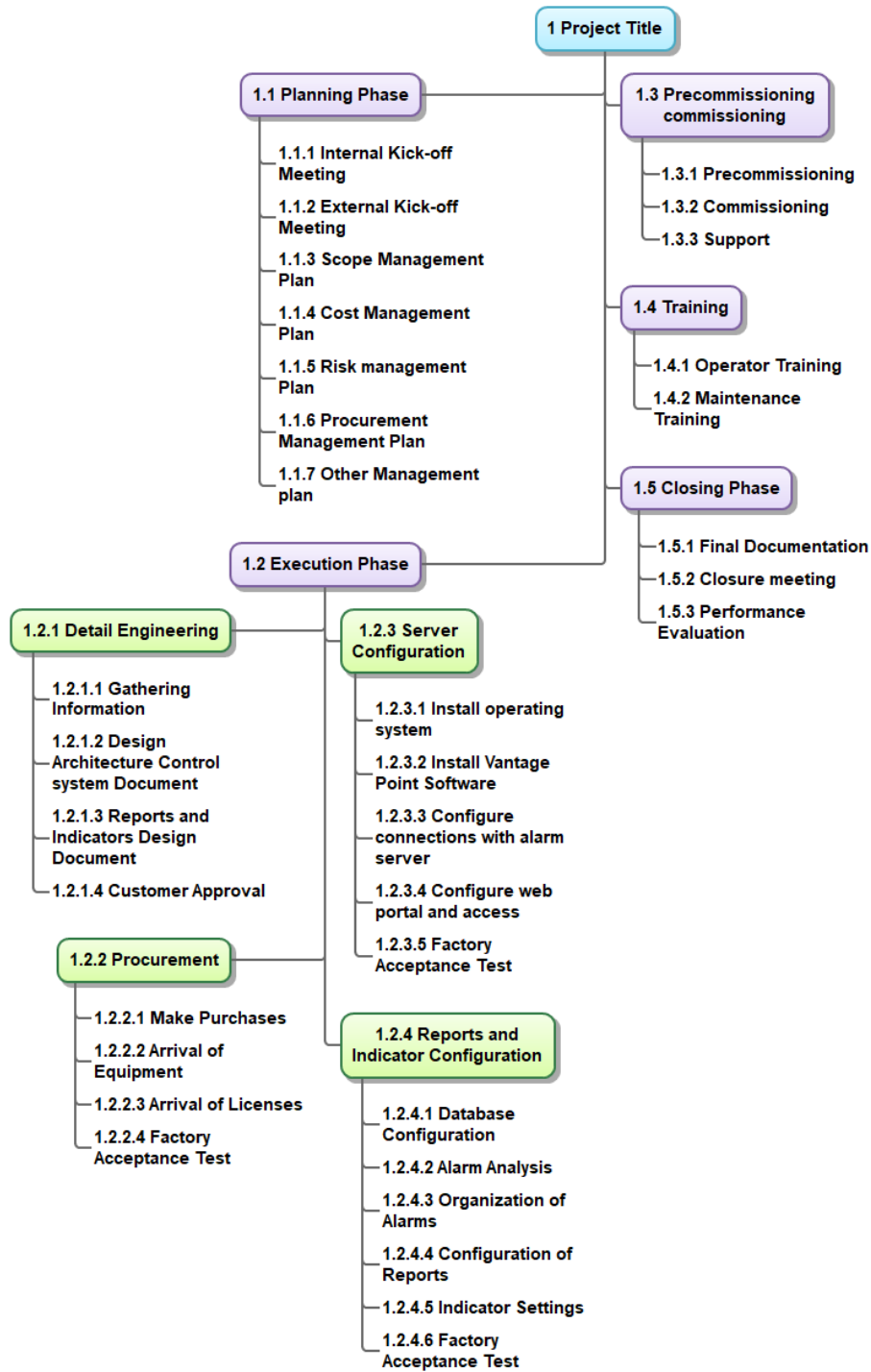



Figure 20 Sample WBS

(Own elaboration)

4.4.8 Sample WBS dictionary.

Chart 39 Sample WBS Dictionary (Own elaboration)

	WBS DICTIONARY		Code	PR-F07
			Version	1
	PLAN		Date	26-Jun-20


PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order Number:	OC-32105
Client:	OIL COMPANY SAS		

PHASE / DELIVERABLE	WORK PACKAGE NAME / ACTIVITIES	WORK PACKAGE DESCRIPTION
Planning Phase	Scope Management Plan	Define the scope of the project and plan how it will be developed.
	Cost Management Plan	Define project costs, according to input information such as project charter, scope, and kick-off meetings.
	Risk management Plan	Identify, analyze, and define the strategies for the project risks.
	Procurement Management Plan	Define the project's purchase plan according to the equipment and licenses to be supplied.
	Other Management plans	Define the other management plans according to the automation project methodology.
Detailed Engineering	Gathering Information	Carry out information gathering on site to identify stakeholder requirements, take information from the equipment that makes up the existing system, and take backups of current software configurations, such as an alarm database. Collect the alarm management methodology to be used as defined by the client.
	Design Architecture Control System Document	Carry out the design of the final control architecture for the reporting system. This architecture will be defined by a functional diagram of the control elements to be used.
	Reports and Indicators Design Document	Determine and provide the reports and indicators to be configured in the system. Additionally, the consultation policies of this information will specify where the information must be consulted, which users have permission to access it, and which users can modify or implement new reports.
	Client Approval	The client will have three (3) days to give his approval once these documents are issued. In the case that minor modifications are required, they must be made within two (2) days at most. If the required modifications are considered to be major, a change control must be made instead.
Procurement	Make Purchases	Before proceeding with purchases, they must be properly validated.
	Factory Acceptance Test	Once the equipment arrives, the factory tests will be carried out to verify that it operates correctly and corresponds to what was purchased.

Server Configuration	Install operating system	Installation of the operating system on the server, according to the specifications of the control architecture.
	Install Vantage Point Software	Installation of the Vantage Point software on the server, according to the manufacturer's instructions and the specifications of the control architecture.
	Configure connections with alarm server	Preconfiguration will be performed to connect the service with the alarm server database.
	Configure web portal and access	Configuration of the web portal including the configuration of users, portal design, logos, access address, domain and others specified in the control architecture.
	Factory Acceptance Test	Operational tests will be carried out ensuring that the server has been correctly configured.
Reports and Indicator Configuration	Database Configuration	Configuration of the database where the analyzed and calculated indicators will be stored.
	Alarm Analysis	Perform the analysis of the alarms configured in the current control system to determine how to carry out the configuration. The alarms should be classified by areas, by process, by priority, and by any other categories required, during the design stage.
	Organization of Alarms	Organization of the hierarchical tree to consult the reports according to their required design.
	Configuration of Reports	Configuration of the reports according to the report design.
	Indicator Settings	Configuration of the indicators according to the report design.
	Factory Acceptance Test	Perform factory tests to validate that the reports satisfy the list of approved requirements and function correctly.
Precommissioning commissioning	Precommissioning	In-plant activities for on-site installation of the server and connection to the network will be carried out, along with connections within the existing control system and internal operational tests.
	Commissioning	Plant activities to carry out acceptance tests with the client; the configured reports and the operation of the system in general will be validated one by one in accordance with the defined operating policies.
	Support	On-site support to ensure system stability.
Training	Operator Training	Training for system operators and end users; they will be trained on how to consult the reports and interpret them.
	Maintenance Training	Training for the administration or maintenance personnel; they will be trained on how to modify reports, how to add new reports and how to perform the necessary periodic maintenance routines.
Closing Phase	Final Documentation	Preparation of final documentation to deliver the project, including updating design documents, acceptance tests and operation and maintenance manuals.
	Closure meeting	Finalization meeting with the client
	Performance Evaluation	Carrying out performance evaluation.

4.4.9 Sample schedule management plan.

Chart 40 Sample Schedule Management Plan (Own elaboration)

	SCHEDULE MANAGEMENT PLAN		Code	PR-P02
			Version	1
	PLAN		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order Number:	OC-32105
Client:	OIL COMPANY SAS		

REASONS FOR CHANGES	
<p>Acceptable Reasons for Changes in Project Schedule</p> <ul style="list-style-type: none"> - Request for change of scope by the Client. - Natural disasters. - Popular strikes and revolts. - Arrears caused by subcontractors. - Work accidents. - Change of subcontractors due to force majeure. - Failure of supplier to deliver materials. - Poor establishment of the sequence of activities. 	


CHANGE MODALITIES	
<p>Requests made by subcontractors</p> <p>Change requests must be submitted in writing by the contractor's representative. Applications must be submitted within 5 days after the inconvenience or delay occurs in the delivery of a deliverable. Applications will be reviewed by the project manager in the first instance to assess their feasibility. The project manager and his team will evaluate the need to make a change in the schedule.</p>	
<p>Requests made by the project team</p> <p>The leaders of each specialty or scope should report to the project manager, indicating the cause of the delay in the schedule. The project manager, along with the team, will evaluate the need to make a change in the schedule.</p>	

CHANGE REPORT	
<p>Describe how to calculate and report the impact on the project due to the change in schedule (time, cost, quality, etc.)</p> <p>To report the impact due to changes in the schedule, a report must be made including the following information:</p> <ol style="list-style-type: none"> 1) Person responsible for the change and date of occurrence of the problem. 2) Description of the problem indicating the degree of urgency. 3) Impact on the project (cost, quality, time and scope). 4) Description of the possible solutions detailing the impact of each in the different areas (cost, quality, time and scope). 5) Recommendation for selecting the best solution. 6) Supporting documents. <p>Note: Any change in the schedule that affects the delivery time of the project must be presented to the client for approval.</p>	

ADDITIONAL COMMENTS	
None	

4.4.10 Sample defining and estimate activity duration.

Chart 41 Sample Defining and Estimate Activity Duration (Own elaboration)

	ESTIMATE ACTIVITY DURATION	Code	PR-F09
		Version	1
	FORMAT	Date	26-Jun-20


PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order Number:	OC-32105
Client:	OIL COMPANY SAS		

PHASE / DELIVERABLE	WORK PACKAGE NAME / ACTIVITIES	SUMMARY OF DURATIONS			CONTROL ENGINEER JUNIOR		CONTROL ENGINEER SENIOR		PROJECT MANAGER	
		TOTAL	WO	WF	WO	WF	WO	WF	WO	WF
Planning Phase	Scope management plan	2	2	0			1		1	
	Cost management Plan	2	2	0			1		1	
	Risk management Plan	2	2	0			1		1	
	Procurement Management Plan	2	2	0			1		1	
	Other Management plans	2	2	0			1		1	
Execution Phase	Project Management	30	30	0					30	
Detail Engineering	Gathering Information	0	0	6		3		3		
	Design Architecture Control System Document	10	10	0	5		5			
	Reports and Indicators Design Document	10	10	0	5		5			
Procurement	Make Purchases	0	0	0						
	Factory Acceptance Test	2	2	0	2					
Server Configuration	Install operating system	1	1	0			1			
	Install Vantage Point Software	2	2	0			2			
	Configure connections with alarm server	3	3	0			3			

	Configure web portal and access	5	5	0			5			
	Factory Acceptance Test	1	1	0			1			
Report and Indicator Configuration	Database Configuration	9	9	0	6		3			
	Alarm Analysis	18	18	0	12		6			
	Organization of Alarms	15	15	0	10		5			
	Configuration of Reports	24	24	0	16		8			
	Indicator Settings	9	9	0	6		3			
	Factory Acceptance Test	6	6	0	4		2			
Precommissioning commissioning	Precommissioning	0	0	10		5		5		
	Commissioning	0	0	12		6		6		
	Support	0	0	10		5		5		
Training	Operator Training	0	0	3		1		2		
	Maintenance Training	0	0	3		1		2		
Closing Phase	Final Documentation	16	16	0	16					
	Closure meeting	0	0	0						
	Performance Evaluation	0	0	0						
TOTAL					82	21	54	23	35	0
Notes:										
WO - Office work activities, WF - Field work activities										
The summary of durations is based on effort rather than on delivery time.										

4.4.12 Sample cost management plan.

Chart 42 Sample Cost Management Plan (Own elaboration)

	COST MANAGEMENT PLAN		Code	PR-P03
	PLAN		Version	1
			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

REASONS FOR CHANGES	
<p>Acceptable Reasons for Changes in Project Cost</p> <ul style="list-style-type: none"> - Changes in the scope of the project - Changes in the schedule of the project - Additional changes in the project scope - Increased costs of subcontractors - Changes in delivery dates - Budget restriction - Others, as long as they are supported 	


CHANGE MODALITIES	
<p>All cost changes must be analyzed by the project manager and the work team; it is important to determine if the cost change will be assumed by the client or by the company.</p>	
<p>Cost changes transferable to the client</p> <p>These cost changes generally correspond to <i>additional</i> (i.e., scope changes), or <i>novelties</i> (if under the client's responsibility). These requests for changes will be made by the project manager, and must be analyzed, quantified, and justified extensively since they impact the invoicing of the company directly. These cost changes must be analyzed in a maximum of 5 days and approved internally by the organization. These must also be properly supported and communicated to the client for approval in a swift manner that allows obtaining formal approval.</p>	
<p>Cost changes assumed by the company</p> <p>These changes are generally deviations from the budget initially allocated by the company for the execution of the project. These requests must be reported by the project manager with the initial analysis indicating how the change in cost affects the expected utility of the project. The report must be completed in a maximum of 2 days after identifying the novelty, and the analysis must be justified at the weekly meetings between the work team and the functional managers.</p>	

CHANGE REPORT	
<p>To report the impact due to changes in the schedule, a report must be made that includes at least the following information:</p> <ol style="list-style-type: none"> 1) Person requesting the change 2) Description of the novelty that triggers the change 3) Impact on the project (cost, quality, time and scope) 4) Description of the possible solutions detailing the impact on the different areas (cost, quality, time and scope) 5) Recommendation regarding the best possible solution 6) Supporting documents 7) Maximum response time 	

ADDITIONAL COMMENTS	
None	

4.4.13 Sample estimate cost and determine budget.

Chart 43 Sample Estimate Cost and Determine Budget (Own elaboration)


		ESTIMATE COST AND DETERMINE BUDGET		Code	PR-F10
		FORMAT		Version	1
				Date	26-Jun-20
PROJECT INFORMATION					
Project Name:		Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.			
Project ID:		P001-OCS	Order Number:	OC-32105	
Client:		OIL COMPANY SAS			
ACTIVITY COST ESTIMATES					
WORK PACKAGE NAME / ACTIVITIES		TOTAL	COST OF LABOR	ASSOCIATED COST	
Closing Phase	Scope Management Plan	\$ 1,085,000	\$ 1,085,000	\$ -	
	Cost Management Plan	\$ 1,085,000	\$ 1,085,000	\$ -	
	Risk management Plan	\$ 1,085,000	\$ 1,085,000	\$ -	
	Procurement Management Plan	\$ 1,085,000	\$ 1,085,000	\$ -	
	Other Management plans	\$ 1,085,000	\$ 1,085,000	\$ -	
Execution Phase	Project Management	\$ 16,800,000	\$ 16,800,000	\$ -	
Detail Engineering	Gathering Information	\$ 5,625,000	\$ 2,625,000	\$ 3,000,000	
	Design Architecture Control System Document	\$ 4,375,000	\$ 4,375,000	\$ -	
	Reports and Indicators Design Document	\$ 4,375,000	\$ 4,375,000	\$ -	
Procurement	Purchases	\$ -	\$ -	\$ -	
	Factory Acceptance Test	\$ 700,000	\$ 700,000	\$ -	
Server Configuration	Install operating system	\$ 525,000	\$ 525,000	\$ -	
	Install Vantage Point Software	\$ 1,050,000	\$ 1,050,000	\$ -	
	Configure connections with alarm server	\$ 1,575,000	\$ 1,575,000	\$ -	
	Configure web portal and access	\$ 2,625,000	\$ 2,625,000	\$ -	
	Factory Acceptance Test	\$ 525,000	\$ 525,000	\$ -	
Reports and Indicator Configuration	Database Configuration	\$ 3,675,000	\$ 3,675,000	\$ -	
	Alarm Analysis	\$ 7,350,000	\$ 7,350,000	\$ -	
	Organization of Alarms	\$ 6,125,000	\$ 6,125,000	\$ -	
	Configuration of Reports	\$ 9,800,000	\$ 9,800,000	\$ -	
	Indicator Settings	\$ 3,675,000	\$ 3,675,000	\$ -	
	Factory Acceptance Test	\$ 2,450,000	\$ 2,450,000	\$ -	
Precommissioning and commissioning	Precommissioning	\$ 7,875,000	\$ 4,375,000	\$ 3,500,000	
	Commissioning	\$ 9,450,000	\$ 5,250,000	\$ 4,200,000	
	Support	\$ 7,875,000	\$ 4,375,000	\$ 3,500,000	
Training	Operator Training	\$ 3,150,000	\$ 1,750,000	\$ 1,400,000	
	Maintenance Training	\$ 3,150,000	\$ 1,750,000	\$ 1,400,000	
Closing Phase	Final Documentation	\$ 5,600,000	\$ 5,600,000	\$ -	
	Closure meeting	\$ -	\$ -	\$ -	
	Performance Evaluation	\$ -	\$ -	\$ -	
TOTAL		\$ 113,775,000	\$ 96,775,000	\$ 17,000,000	

EQUIPMENT COST			
EQUIPMENT DESCRIPTION	UNIT PRICE	QTY	SUBTOTAL
Server	\$ 15,000,000	1	\$ 15,000,000
Licenses	\$ 10,000,000	1	\$ 10,000,000
	\$ -	1	\$ -
	\$ -	1	\$ -
	\$ -	1	\$ -
TOTAL			\$ 25,000,000

DETERMINE BUDGET				
WORK PACKAGE NAME / ACTIVITIES	TOTAL	COST OF LABOR	EQUIPMENT COST	ASSOCIATED COST
Work Package Cost Estimates	\$ 138,775,000	\$ 96,775,000	\$ 25,000,000	\$ 17,000,000
Contingency Reserve Percentage		3%	2%	10%
Contingency Reserve	\$ 5,103,250	\$ 2,903,250	\$ 500,000	\$ 1,700,000
Cost Base Line	\$ 143,878,250			
Management Reserve	\$ 5,755,130			
Project Budget	\$ 149,633,380			


4.4.14 Sample quality management plan.

Chart 44 Sample Quality Management Plan (Own elaboration)

	QUALITY MANAGEMENT PLAN		Code	PR-P04
	PLAN		Version	1
			Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.			
Project ID:	P001-OCS	Order Number:	OC-32105	
Client:	OIL COMPANY SAS			
PLAN FOR QUALITY				
<p>An inspection and test plan will be designed and adapted to the project and its deliverables in order to effectively control and manage their quality during the development of the project. The execution of this test plan will allow to devise the parameters to be inspected, the tolerance, and the frequency of the inspection and the recording of the results.</p>				
PERFORM QUALITY ASSURANCE				
<p>Quality assurance will be overseen by the project manager, who will designate the necessary resources to execute the inspection plan and tests as planned by the work team.</p>				
CONTINUOUS IMPROVEMENT				
<p>The reports of lessons learned will be made for all those activities that had difficulty preventing them from reopening in future opportunities. Likewise, reports will be made of all those activities that were successful and are therefore necessary to document to replicate them in future opportunities.</p>				
ADDITIONAL COMMENTS				
None				


4.4.15 Sample inspection and test plan.

Chart 45 Sample Inspection and Test Plan (Own elaboration)

	INSPECTION AND TEST PLAN		Code	PR-F10	
	FORMAT		Version	1	
			Date	26-Jun-20	
PROJECT INFORMATION					
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.				
Project ID:	P001-OCS	Order Number:	OC-32105		
Client:	OIL COMPANY SAS				
DELIVERABLES	VARIABLE TO CONTROL	ACCEPTANCE REQUIREMENTS	TEST	PERSON RESPONSIBLE	STATUS
Detail Engineering	Compliance with requirements	That engineering develops all the requirements of the scope.	Review using a requirement checklist.	Project Director, Senior Engineer	Full
Equipment	Equipment operation	That the equipment corresponds to what was purchased.	Validation of references and performance tests with energized equipment.	Project Director, Senior Engineer	Full
Licenses	Correct licenses	That the equipment works correctly.	Validation of references and activation with client data.	Project Director, Senior Engineer	Full
Server Configuration	Server operation	That the licenses correspond to the purchased items.	Validation regarding architecture and functional validation	Project Director, Senior Engineer	Full
Report and indicator configuration	Quantity and Quality in the reports	That the server is correctly configured.	Functional validation of counting reports regarding engineering	Project Director, Senior Engineer	Pending

4.4.16 Sample resource management plan.

Chart 46 Sample Resource Management Plan (Own elaboration)

	RESOURCE MANAGEMENT PLAN	Code	PR-P05
		Version	1
	PLAN	Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

SCOPE
The resource management plan includes the definition of the personnel involved in the project according to the estimation of activities. For each profile, the knowledge required in the position and the main functions should be determined.

RESOURCES DEFINITION		
POSITION	KNOWLEDGE	MAIN FUNCTIONS
Project Director	Electronic, automation or related engineer with more than 5 years of experience in automation project management.	<p>Properly manage project requirements, taking care of client satisfaction and company profits. Maintain effective communication with the client and the company at all times.</p> <p>Carry out the adequate management of the personnel assigned to the project.</p> <p>Detect training needs of collaborators and provide training as needed within the allotted time.</p> <p>Ensure that the collaborators in charge comply with the established methodologies and policies.</p>
Technical Leader	Electronic, automation or related engineer with more than 5 years of experience in the execution of automation projects, and design skills of control system solutions.	<p>Prepare the basic and detailed engineering of industrial control systems.</p> <p>Carry out the design of the control and instrumentation architectures.</p> <p>Design the appropriate control strategy for the process.</p> <p>Estimate engineering times, appropriate technology, required licenses and equipment.</p> <p>Select the industrial communication protocols that apply to the process.</p> <p>Create protocols, FATs, SATs, and Commissioning.</p> <p>Supervise the development and implementation of control projects according to established procedures.</p> <p>Supervise the assembly of electrical and electronic boards, instruments, and control systems in automation projects.</p> <p>Self-train and stay informed about technological evolution.</p>


Junior Control Engineer	Electronic, automation or related engineer with more than 2 years of experience in the execution of automation projects.	Carry out the programming activities of PLCs, HMIs, Information Systems and all related activities. Prepare and execute protocols, FATs, SATs, and Commissioning. Self-train and stay informed about technological evolution. Guarantee the complete and timely delivery of project documentation. Coordinate and manage resources to effectively carry out the designated activities.
Senior Control Engineer	Electronic, automation or related engineer with more than 5 years of experience in the execution of automation projects.	Carry out the design and technical documentation of all the work related to the activity. Carry out the programming activities of PLCs, HMIs, Information Systems or the activity assigned to it. Prepare and execute protocols, FATs, SATs and Commissioning. Self-train and stay informed about technological evolution. Guarantee the complete and timely delivery of project documentation. Coordinate and manage resources to effectively carry out the designated activities.
Automation Technician	Automation technician with more than 1 year of experience in the design and assembly of control panels.	Carry out the assembly of electrical panels and control systems. Prepare the plans of the mounted electrical panels. Carry out equipment tests and prepare technical notes. Self-train and stay informed about technological evolution. Guarantee the complete and timely delivery of project documentation.

ADDITIONAL COMMENTS

none


4.4.17 Sample communication management plan.

Chart 47 Sample Communication Management Plan (Own elaboration)

	COMMUNICATION MANAGEMENT PLAN		Code	PR-P06
			Version	1
	PLAN		Date	26-Jun-20
PROJECT INFORMATION				
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.			
Project ID:	P001-OCS	Order number:	OC-32105	
Client:	OIL COMPANY SAS			
COMMUNICATION PLANNING				
This communication plan is carried out to explain how the project releases and meetings will be handled, detailing where they will be recorded and what communication channels are allowed.				
INFORMATION NEEDS				
The information needs will be defined by the client, the project manager and those interested in the external kick-off meeting. The information needs of each stakeholder involved in the project must be stated in this document.				
COMMUNICATION CHANNELS				
The communication channels will be defined in the external kick-off meeting. It is necessary to clarify if the communication via email is valid for the client and if so, who should receive a copy, whose approval is needed, and what the time limit is to reply to said communication.				
ADDITIONAL COMMENTS				
none				

4.4.18 Sample communication matrix.

Chart 48 Sample Communication Matrix (Own elaboration)


	COMMUNICATION MATRIX		Code: PR-F13
			Version: 1
	FORMAT		Date: 4-Ago-2020

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order Number:	OC-32105
Client:	OIL COMPANY SAS		

STAKEHOLDER REGISTER MATRIX							
ID	Information	Document	Level of detail	Person Responsible	Receiver	Frequency	Method of delivery
1	General project information	Project Charter	medium	Project Manager	Owner of the company and functional managers	Once	PDF document by email
2	General project information	Scope Statement	High	Project Manager	Sponsor, client, project manager	Once	PDF document by email
3	Project planning	Schedule	High	Project Manager	Owner of the company and functional managers	Once	Folder compressed in .zip by email
4	Analysis of the project status	Detailed plans of scope, time, cost, and quality, including resources, communication, risks and acquisitions	High	Project Manager	Owner of the company and functional managers Client, Project Manager	Weekly, every Monday	PDF document by email
5	Minutes of weekly meetings with the team	Earned Value Report	Low	Project Manager	Workgroup	weekly	PDF document by email
6	Detail engineering	Minutes of the topics covered	High	Project Manager	Client Project Manager	Once	Printed and filed
7	Final dossier	Documents of the detail engineering	High	Project manager	Client Project Manager	Once	Printed and filed
8	Project closure	Final implementation documents	medium	Project manager	Client Project Manager	Once	Printed and signed by the parties

4.4.19 Sample risk management plan.

Chart 49 Sample Risk Management Plan (Own elaboration)

	RISK MANAGEMENT PLAN			Code	PR-P07
				Version	1
	PLAN			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

SCOPE
<ul style="list-style-type: none"> - Carry out the identification, prioritization, and monitoring of risks. - Determine the mitigation plan for the most critical risks. - The Risk Management process must be defined and known by the entire organization.

TOOLS & TECHNIQUES																								
In the elaboration of this plan, the judgment of experts will be used; the opinions of the general manager, the analysis of the data obtained and meetings with the work teams and the client will be particularly useful to identify all risks and establish the appropriate mitigation plan.																								
<p>Risk Identification: The process begins with the identification of risks by listing all the possible ones in the categories indicated in the PR-F08 - RISK MANAGEMENT format on the RISK IDENTIFICATION sheet.</p> <p>Risk analysis: The risk analysis will be carried out in the PR-F08 - RISK MANAGEMENT format on the RISK ANALYSIS sheet, according to the following criteria.</p> <p>Impact calculation: The following table will be used for calculating the impact in the scope, financial, quality and time aspects for each risk. The result will be the highest value object in the analysis of said four aspects after evaluating the possible impact in the event that the risk is triggered.</p>																								
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">ASPECT</th> <th style="text-align: center;">Very Low 1</th> <th style="text-align: center;">Low 2</th> <th style="text-align: center;">Medium 3</th> <th style="text-align: center;">High 4</th> <th style="text-align: center;">Very High 5</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Scope</td> <td>Insignificant decrease in scope</td> <td>Minor elements of the scope are affected</td> <td>Main elements of the scope are affected</td> <td>The result does not meet the expected objective</td> <td>The scope is not acceptable to the client</td> </tr> <tr> <td style="text-align: center;">Time</td> <td>Insignificant delay</td> <td>Less than 5% delay in delivery time</td> <td>Delay between 5% and 10% in delivery time</td> <td>Delay between 10% and 20% in delivery time</td> <td>Over 20% delay in delivery time</td> </tr> <tr> <td style="text-align: center;">Financial</td> <td>Decrease in profit is very low</td> <td>Decrease in profit is less than 5%</td> <td>Decrease in profit is between 5% and 10%</td> <td>Decrease in profit is between 10% and 20%</td> <td>Decrease in profit greater than 20%</td> </tr> </tbody> </table>	ASPECT	Very Low 1	Low 2	Medium 3	High 4	Very High 5	Scope	Insignificant decrease in scope	Minor elements of the scope are affected	Main elements of the scope are affected	The result does not meet the expected objective	The scope is not acceptable to the client	Time	Insignificant delay	Less than 5% delay in delivery time	Delay between 5% and 10% in delivery time	Delay between 10% and 20% in delivery time	Over 20% delay in delivery time	Financial	Decrease in profit is very low	Decrease in profit is less than 5%	Decrease in profit is between 5% and 10%	Decrease in profit is between 10% and 20%	Decrease in profit greater than 20%
ASPECT	Very Low 1	Low 2	Medium 3	High 4	Very High 5																			
Scope	Insignificant decrease in scope	Minor elements of the scope are affected	Main elements of the scope are affected	The result does not meet the expected objective	The scope is not acceptable to the client																			
Time	Insignificant delay	Less than 5% delay in delivery time	Delay between 5% and 10% in delivery time	Delay between 10% and 20% in delivery time	Over 20% delay in delivery time																			
Financial	Decrease in profit is very low	Decrease in profit is less than 5%	Decrease in profit is between 5% and 10%	Decrease in profit is between 10% and 20%	Decrease in profit greater than 20%																			

Quality	Insignificant decrease in quality	Only minor requirements are affected	Client approves quality deviation	The quality of the result does not meet the objective	The decrease in quality is not acceptable to the client
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Subsequently, the probability of the risk being presented will be evaluated, and the analysis will be carried out with the following Probability x Impact matrix, thus qualifying all the risks.


		IMPACT					
		Very Low	Low	Med.	High	Very High	
		1	2	3	4	5	
PROBABILITY	Very High	5	5	10	15	20	25
	High	4	4	8	12	16	20
	Medium	3	3	6	9	12	15
	Low	2	2	4	6	8	10
	Very Low	1	1	2	3	4	5

A strategy will be established according to the risk rating given by the Probability x Impact matrix, prioritizing Very Serious risk and Major Risk, which will make the project feasible.

	Very serious risk. Requires urgent preventive measures. The project should not be started without the application of urgent preventive measures and without solidly limiting the risk.
	Major risk. Mandatory preventive measures. The risk variables must be strongly controlled.
	Appreciable risk. Study economically if it is possible to introduce preventive measures to reduce the level of risk. If this is not possible, keep the variables controlled.
	Marginal risk. It will be monitored although it does not require preventive starting measures.

4.4.20 Sample risk management – Risk identification.

Chart 50 Sample Risk Management – Risk Identification (Own elaboration)

	RISK MANAGEMENT		Code	PR-F08
	RISK IDENTIFICATION FORMAT		Version	1
			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

Identify the project risks within each category:	
RISK CODE	TECHNICAL OR QUALITY RISK
1.1	The objectives are not clear, or the information is confusing or incorrect.
1.2	Changes in scope.
1.3	The information provided is not enough.
1.4	Control system is not compatible with the system to be implemented.

RISK CODE	MANAGEMENT RISK
2.1	Poor budget estimation.
2.2	Delays in the activities proposed in the schedule.
2.3	Poor follow-up and monitoring of the work team.
2.4	The client's requirements are not followed up.


RISK CODE	ORGANIZATIONAL RISK
3.1	The personnel assigned to the project do not have the required knowledge or experience.
3.2	Change of assigned human resources.
3.3	Safety, health and environmental protection aspects are not covered.

RISK CODE	EXTERNAL RISK
4.1	Failure in the supplied equipment.
4.2	Delay in equipment delivery by suppliers.
4.3	Delay in the delivery or approval of documents by the client.
4.4	Natural disasters.
4.5	Strikes or work stoppages.
4.6	The plant does not allow the entry of personnel due to quarantine.

RISK CODE	OTHER RISKS
	None.

4.4.21 Sample risk management – Risk analysis.

Chart 51 Sample Risk Management – Risk Analysis (Own elaboration)

	RISK MANAGEMENT		Code	PR-F08
	RISK ANALYSIS FORMAT		Version	1
			Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order Number:	OC-32105
Client:	OIL COMPANY SAS		

ANALYSIS RISK						
RISK CODE	RISK DESCRIPTION	PROBABILITY	IMPACT	PXI SCORE	MAJOR ASPECT	STRATEGY
1.1	The objectives are not clear, or the information is confusing or incorrect.	3	5	15	Scope	It is very important to carry out an exhaustive survey, and to hold a meeting with the end user for further validation. Additionally, approval from the engineering area must be given to continue the project.
1.2	Changes in scope.	4	4	16	Time	It is very important to negotiate every emerging change effectively, by invoicing it and extending the delivery date.
1.3	The information provided is not enough.	3	2	6	Scope	In case that the information is not enough, it is necessary to regather it more exhaustively.
1.4	Control system is not compatible with the system to be implemented	1	5	5	Financial	System compatibility must be validated in advance.
2.1	Poor budget estimation.	3	3	9	Financial	The times have to be validated by the technical leader to verify that the times are adjusted to reality.
2.2	Delays in the activities proposed in the schedule.	3	3	9	Time	It is necessary to carry out a daily monitoring of the activities and the progress obtained. This will allow a quick reaction to delays.
2.3	Poor follow-up and monitoring of the work team.	2	4	8	Quality	The progress in work group must be monitored daily and weekly with the operation manager.

2.4	The client's requirements are not followed up.	1	5	5	Quality	There must be a clear list of requirements to validate compliance.
3.1	The personnel assigned to the project do not have the required knowledge or experience.	3	3	9	Scope	It is important to hire trained personnel, or to train personnel in advance.
3.2	Change of assigned human resources.	4	2	8	Time	Due to the short execution time of the project, no personnel changes can be allowed. In case of staff withdrawals, at least two (2) trained engineers from the company must be kept.
3.3	Safety, health, and environmental protection aspects are not covered.	1	5	5	Financial	It is essential to be acquainted with the bare minimum necessary security aspects before sending personnel to the plant.
4.1	Failure in the supplied equipment.	2	3	6	Financial	The equipment should be tested as soon as it arrives to know its status.
4.2	Delay in equipment delivery by suppliers.	2	3	6	Time	Weekly monitoring of the teams' delivery, with penalty clauses in the contract.
4.3	Delay in the delivery or approval of documents by the client.	4	3	12	Time	In case of delay in the approval of documents by the client, the project must be suspended.
4.4	Natural disasters.	1	4	4	Time	In the event of a natural disaster that threatens the continuation of the project, it will be suspended until its viability is secured.
4.5	Strikes or work stoppages.	1	2	2	Time	In the event of strikes or work stoppages that affect the project, the project is to be suspended and an extension of the delivery date will be requested.
4.6	The plant does not allow the entry of personnel due to quarantine.	5	4	20	Time	It is necessary to either negotiate the unappealable entry of the personnel to the plant or to postpone the beginning of the project once quarantine is decreed in the plant location.

4.4.22 Sample procurement management plan.

Chart 52 Sample Procurement Management Plan (Own elaboration)

	PROCUREMENT MANAGEMENT PLAN		Code	PR-P08
			Version	1
	PLAN		Date	26-Jun-20

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

PROCUREMENT RESOURCES
The acquisitions of the project will be defined and triggered by the director of the project; he will be responsible for finalizing the quotation and technical negotiation and sending the purchase solutions to the administrative assistant, who will finish negotiating the commercial conditions.


PRODUCTS AND SERVICES TO HIRE
The products to be bought are a server with the characteristics required by the licenses to be installed and the Vantage Point license.

PRODUCTS AND SERVICES REQUIREMENTS
Server with the following minimum characteristics: Processor with a total of 4 cores, 2.2 GHz, and 12-16 GB RAM. Storage (drive) 2 TB. Network 100 Megabit Ethernet card or faster.

ADDITIONAL COMMENTS
The maximum delivery date for licenses and equipment must be June 22.

4.4.23 Sample stakeholder management plan.

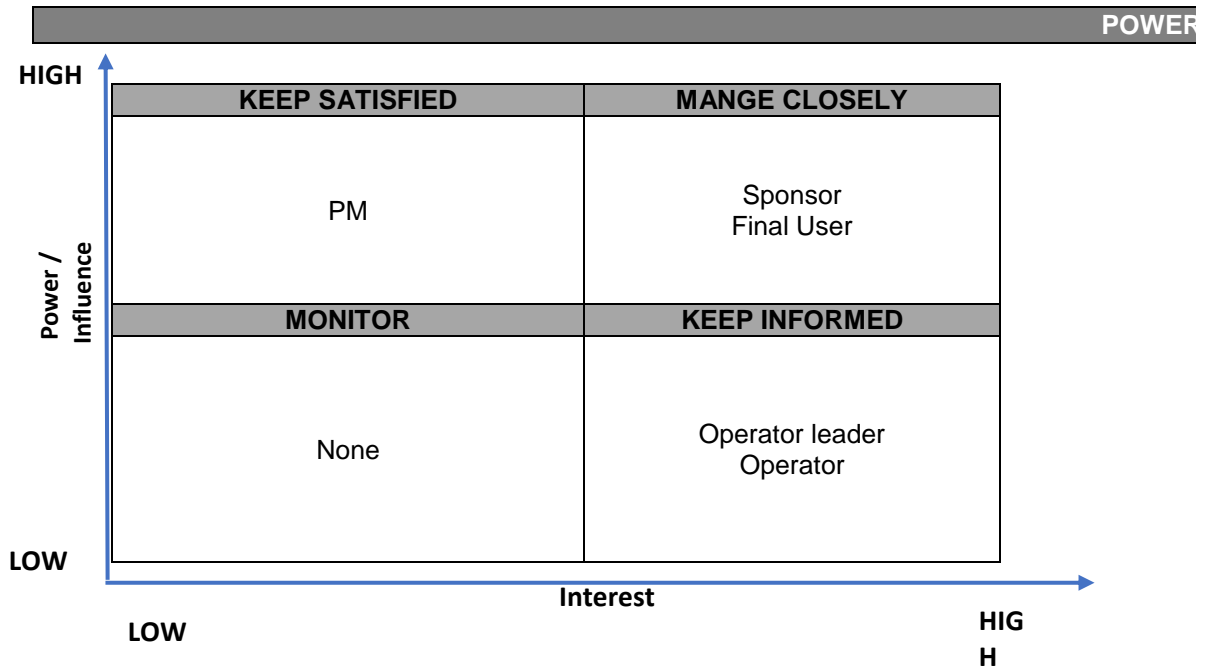
Chart 53 Sample Stakeholder Management Plan (Own elaboration)

	STAKEHOLDER MANAGEMENT PLAN	Code: PR-F04
		Version: 1
	FORMAT	Date: 22-Jun-2020

PROJECT INFORMATION			
Project Name:	Implementation of monitoring tools for alarm management of the company OIL COMPANY SAS.		
Project ID:	P001-OCS	Order number:	OC-32105
Client:	OIL COMPANY SAS		

STAKEHOLDER REGISTER MATRIX						
ID	Stakeholder	Functional Area	Roles - Responsibilities	Main Expectations	Major Requirements	Additional Comments
1	Sponsor	Strategic planning	Command the direction of the company to improve its profits without risks in the operation.	To improve the management of the Control System.	Have reports and indicators according to the ISA 18-2 standard.	The sponsor agrees with the solution and has all the power over the project.
2	Project Manager	Projects	Execute projects to achieve objectives.	To execute the project within the planned time and costs.	Execute the project in the scheduled time.	The project manager is really concerned about meeting the expectations of the project.
3	Final User	Production	Control oil production efficiently.	Have information on the control system for decision making.	Being able to view the reports in a web portal.	It aims to improve its control system.
4	Operator Leader	Operation	Operate the plant according to procedures.	Have a reliable alarm system to operate.	Have a report showing which alarms are disabled Have a report indicating the frequency of the alarms trip and indicate	In general, it shows the anguish of the operators due to the lack of reliability of the alarm system

					the top ten to be prioritized.	
5	Operator	Operation	Operate the plant according to procedures.	Have a reliable alarm system to operate.	Have a report indicating which the leaking alarms are.	



ANALYSIS CONCLUSIONS		
ID	Stakeholder	Analysis Conclusion / Strategy
1	Sponsor	The strategy consists on being close to the sponsor to keep him up to date on the detailed engineering in order to obtain his approval.
2	Project Manager	The strategy consists on keeping the project manager satisfied with the work done. Therefore, he must be informed about the project development so he can help to solve problems regarding possible delays and cost overruns.
3	Final User	The strategy consists on being close to the End Users in order to include their requirements if problems arise.
4	Operator Leader	The strategy consists on collecting his requirements and keep him informed about the given approvals.
5	Operator	The strategy consists on collecting the requirements and keep him informed about given approvals.

In this figure, the project has a 72% completion at a current cost of \$93,280,227, but there is no information about the project in terms of time. To find out this information it was necessary to carry out the Earned Value analysis. The results are shown below.

4.4.24.1 S-curve analysis.

The analysis of the S-curve shows that, even from its start, the project has been costing more than what was initially budgeted. This is easily observed in the graph as the current cost (reflected in the AC curve) is always above the PV.

The Earned Value over Time report also shows that the work has been carried out according to the plan as per the EV curve. However, something happened the week before that delayed the project; this makes it necessary to specify said unexpected event to establish at which point the schedule was not followed, as well as a subsequent plan of action to compensate for it.

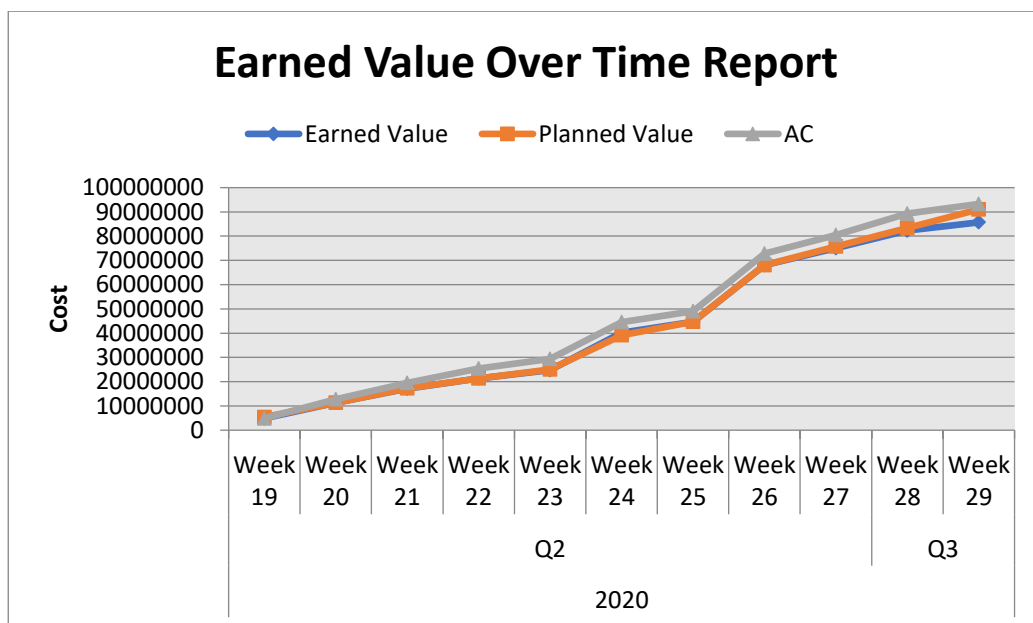


Figure 23 Sample S-curve

(Own elaboration)

4.4.24.2 Earned value cost analysis.

The analysis of figures 23 and 24 shows that the work done as of July 19, 2020 has a negative difference of \$ 4,603,037 COP, corresponding to a 9% deviation from the planned costs. Moreover, the CPI is at 0.92, thus indicating that the work executed is costing more than planned; this evidences a problem in the execution of the project.

The forecast shown in MS Project implies that if the cost performance continues in the same way the project can cost \$151,089,963, which amounts to \$12,314,963 more than the project planned budget. This means that the contingency reserves would end up being consumed, and that the project management can fail.

Additionally, the TCPI indicator in figure 24 shows the work performance index per item, in this case the TCPI is 1.17. This number implies that the remaining work must render 17% more than planned to finish the project according to the initially stipulated cost.

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	CV	CV%	CPI	BAC	EAC	VAC	TCPI
0	SCHEDULE	\$ 91,022,727	\$ 88,677,190	-\$ 4,603,037	-9%	0.92	\$ 138,775,000	\$ 151,089,963	-\$ 12,314,963	1.17
1	1 Project Title	\$ 91,022,727	\$ 88,677,190	-\$ 4,603,037	-9%	0.92	\$ 138,775,000	\$ 151,089,963	-\$ 12,314,963	1.17
2	1.1 Planning Ph	\$ 5,425,000	\$ 5,425,000	-\$ 542,500	-10%	0.91	\$ 5,425,000	\$ 5,967,500	-\$ 542,500	-0
3	1.1.1 Internal	\$ 0	\$ 0	\$ 0	0%	0	\$ 0	\$ 0	\$ 0	0
4	1.1.2 External	\$ 0	\$ 0	\$ 0	0%	0	\$ 0	\$ 0	\$ 0	0
5	1.1.3 Scope M	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1	\$ 1,085,000	\$ 1,085,000	\$ 0	1
6	1.1.4 Cost Ma	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1	\$ 1,085,000	\$ 1,085,000	\$ 0	1
7	1.1.5 Risk mar	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1	\$ 1,085,000	\$ 1,085,000	\$ 0	1
8	1.1.6 Procurei	\$ 1,085,000	\$ 1,085,000	\$ 542,500	50%	2	\$ 1,085,000	\$ 542,500	\$ 542,500	0
9	1.1.7 Other M	\$ 1,085,000	\$ 1,085,000	-\$ 1,085,000	-100%	0.5	\$ 1,085,000	\$ 2,170,000	-\$ 1,085,000	-0
10	1.2 Execution Pf	\$ 85,597,727	\$ 83,252,190	-\$ 4,060,537	-9%	0.92	\$ 96,250,000	\$ 104,718,014	-\$ 8,468,014	1.79
11	1.2.1 Project f	\$ 15,272,727	\$ 15,272,727	\$ 0	0%	1	\$ 16,800,000	\$ 16,800,000	\$ 0	1
12	1.2.2 Detail Ei	\$ 11,375,000	\$ 14,375,000	-\$ 500,000	-31%	0.76	\$ 14,375,000	\$ 18,798,077	-\$ 4,423,077	-6
13	1.2.2.1 Gatl	\$ 2,625,000	\$ 5,625,000	\$ 2,125,000	-33%	0.75	\$ 5,625,000	\$ 7,500,000	-\$ 1,875,000	1.41
14	1.2.2.2 Des	\$ 4,375,000	\$ 4,375,000	\$ 0	0%	1	\$ 4,375,000	\$ 4,375,000	\$ 0	1
15	1.2.2.3 Rep	\$ 4,375,000	\$ 4,375,000	-\$ 2,625,000	-60%	0.63	\$ 4,375,000	\$ 7,000,000	-\$ 2,625,000	-0
16	1.2.2.4 Cusi	\$ 0	\$ 0	\$ 0	0%	0	\$ 0	\$ 0	\$ 0	0
17	1.2.3 Procure	\$ 25,700,000	\$ 25,700,000	-\$ 350,000	-1%	0.99	\$ 25,700,000	\$ 26,050,000	-\$ 350,000	-0
18	1.2.3.1 Mal	\$ 0	\$ 0	\$ 0	0%	0	\$ 0	\$ 0	\$ 0	0
19	1.2.3.2 Arri	\$ 15,000,000	\$ 15,000,000	\$ 0	0%	1	\$ 15,000,000	\$ 15,000,000	\$ 0	1
20	1.2.3.3 Arri	\$ 10,000,000	\$ 10,000,000	\$ 0	0%	1	\$ 10,000,000	\$ 10,000,000	\$ 0	1
21	1.2.3.4 Fact	\$ 700,000	\$ 700,000	-\$ 350,000	-50%	0.67	\$ 700,000	\$ 1,050,000	-\$ 350,000	-0

22	1.2.4 Server C	\$ 6,300,000	\$ 6,300,000	-\$ 315,000	-5%	0.95	\$ 6,300,000	\$ 6,615,000	-\$ 315,000	-0
23	1.2.4.1 Inst.	\$ 525,000	\$ 525,000	\$ 210,000	40%	1.67	\$ 525,000	\$ 315,000	\$ 210,000	0
24	1.2.4.2 Inst.	\$ 1,050,000	\$ 1,050,000	-\$ 525,000	-50%	0.67	\$ 1,050,000	\$ 1,575,000	-\$ 525,000	-0
25	1.2.4.3 Con	\$ 1,575,000	\$ 1,575,000	-\$ 1,050,000	-67%	0.6	\$ 1,575,000	\$ 2,625,000	-\$ 1,050,000	-0
26	1.2.4.4 Con	\$ 2,625,000	\$ 2,625,000	\$ 1,050,000	40%	1.67	\$ 2,625,000	\$ 1,575,000	\$ 1,050,000	0
27	1.2.4.5 Fact	\$ 525,000	\$ 525,000	\$ 0	0%	1	\$ 525,000	\$ 525,000	\$ 0	1
28	1.2.5 Reports	\$ 26,950,000	\$ 21,604,463	-\$ 2,895,537	-13%	0.88	\$ 33,075,000	\$ 37,507,875	-\$ 4,432,875	1.34
29	1.2.5.1 Dat.	\$ 3,675,000	\$ 3,675,000	\$ 0	0%	1	\$ 3,675,000	\$ 3,675,000	\$ 0	1
30	1.2.5.2 Alar	\$ 7,350,000	\$ 7,350,000	\$ 0	0%	1	\$ 7,350,000	\$ 7,350,000	\$ 0	1
31	1.2.5.3 Org.	\$ 6,125,000	\$ 6,125,000	-\$ 1,225,000	-20%	0.83	\$ 6,125,000	\$ 7,350,000	-\$ 1,225,000	-0
32	1.2.5.4 Con	\$ 9,800,000	\$ 4,454,463	-\$ 1,670,537	-38%	0.73	\$ 9,800,000	\$ 13,475,250	-\$ 3,675,250	1.45
33	1.2.5.5 Indi	\$ 0	\$ 0	\$ 0	0%	0	\$ 3,675,000	\$ 3,675,000	\$ 0	1
34	1.2.5.6 Fact	\$ 0	\$ 0	\$ 0	0%	0	\$ 2,450,000	\$ 2,450,000	\$ 0	1
35	1.3 Precommissi	\$ 0	\$ 0	\$ 0	0%	0	\$ 25,200,000	\$ 25,200,000	\$ 0	1
36	1.3.1 Precomr	\$ 0	\$ 0	\$ 0	0%	0	\$ 7,875,000	\$ 7,875,000	\$ 0	1
37	1.3.2 Commis	\$ 0	\$ 0	\$ 0	0%	0	\$ 9,450,000	\$ 9,450,000	\$ 0	1
38	1.3.3 Support	\$ 0	\$ 0	\$ 0	0%	0	\$ 7,875,000	\$ 7,875,000	\$ 0	1
39	1.4 Training	\$ 0	\$ 0	\$ 0	0%	0	\$ 6,300,000	\$ 6,300,000	\$ 0	1
40	1.4.1 Operato	\$ 0	\$ 0	\$ 0	0%	0	\$ 3,150,000	\$ 3,150,000	\$ 0	1
41	1.4.2 Mainten	\$ 0	\$ 0	\$ 0	0%	0	\$ 3,150,000	\$ 3,150,000	\$ 0	1
42	1.5 Closing Phas	\$ 0	\$ 0	\$ 0	0%	0	\$ 5,600,000	\$ 5,600,000	\$ 0	1
43	1.5.1 Final Do	\$ 0	\$ 0	\$ 0	0%	0	\$ 5,600,000	\$ 5,600,000	\$ 0	1
44	1.5.2 Closure	\$ 0	\$ 0	\$ 0	0%	0	\$ 0	\$ 0	\$ 0	0
45	1.5.3 Perform	\$ 0	\$ 0	\$ 0	0%	0	\$ 0	\$ 0	\$ 0	0

Figure 24 Sample Earned Value Cost Indicators View

(Own elaboration)

4.4.24.3 Earned value schedule analysis.

When reviewing the EV in relation to the schedule in figure 25, it becomes noticeable that the project is deviating negatively, with a deficit of \$ 5,345,537; this figure corresponds to a 6% compared to the cost what was originally planned the project. In addition, the SPI is 0.94, which indicates that the project is delayed and that the activities must be carried out soon to achieve compliance with the delivery date.

ID	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	SV	SV%	SPI
0	SCHEDULE	\$ 91,022,727	\$ 88,677,190	-\$ 5,345,537	-6%	0.94
1	1 Project Title	\$ 91,022,727	\$ 88,677,190	-\$ 5,345,537	-6%	0.94
2	1.1 Planning Phase	\$ 5,425,000	\$ 5,425,000	\$ 0	0%	1
3	1.1.1 Internal Kick-off Meeting	\$ 0	\$ 0	\$ 0	0%	0
4	1.1.2 External Kick-off Meeting	\$ 0	\$ 0	\$ 0	0%	0
5	1.1.3 Scope Management Plan	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1
6	1.1.4 Cost Management Plan	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1
7	1.1.5 Risk management Plan	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1
8	1.1.6 Procurement Management Plan	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1
9	1.1.7 Other Management plan	\$ 1,085,000	\$ 1,085,000	\$ 0	0%	1
10	1.2 Execution Phase	\$ 85,597,727	\$ 83,252,190	-\$ 5,345,537	-6%	0.94
11	1.2.1 Project Management	\$ 15,272,727	\$ 15,272,727	\$ 0	0%	1
12	1.2.2 Detail Engineering	\$ 11,375,000	\$ 14,375,000	\$ 0	0%	1
13	1.2.2.1 Gathering Information	\$ 2,625,000	\$ 5,625,000	\$ 0	0%	1
14	1.2.2.2 Design Architecture Control system Document	\$ 4,375,000	\$ 4,375,000	\$ 0	0%	1
15	1.2.2.3 Reports and Indicators Design Document	\$ 4,375,000	\$ 4,375,000	\$ 0	0%	1

16	1.2.2.4 Customer Approval	\$ 0	\$ 0	\$ 0	0%	0
17	1.2.3 Procurement	\$ 25,700,000	\$ 25,700,000	\$ 0	0%	1
18	1.2.3.1 Make Purchases	\$ 0	\$ 0	\$ 0	0%	0
19	1.2.3.2 Arrival of Equipment	\$ 15,000,000	\$ 15,000,000	\$ 0	0%	1
20	1.2.3.3 Arrival of Licenses	\$ 10,000,000	\$ 10,000,000	\$ 0	0%	1
21	1.2.3.4 Factory Acceptance Test	\$ 700,000	\$ 700,000	\$ 0	0%	1
22	1.2.4 Server Configuration	\$ 6,300,000	\$ 6,300,000	\$ 0	0%	1
23	1.2.4.1 Install operating system	\$ 525,000	\$ 525,000	\$ 0	0%	1
24	1.2.4.2 Install Vantage Point Software	\$ 1,050,000	\$ 1,050,000	\$ 0	0%	1
25	1.2.4.3 Configure connections with alarm server	\$ 1,575,000	\$ 1,575,000	\$ 0	0%	1
26	1.2.4.4 Configure web portal and access	\$ 2,625,000	\$ 2,625,000	\$ 0	0%	1
27	1.2.4.5 Factory Acceptance Test	\$ 525,000	\$ 525,000	\$ 0	0%	1
28	1.2.5 Reports and Indicator Configuration	\$ 26,950,000	\$ 21,604,463	-\$ 5,345,537	-20%	0.8
29	1.2.5.1 Database Configuration	\$ 3,675,000	\$ 3,675,000	\$ 0	0%	1
30	1.2.5.2 Alarm Analysis	\$ 7,350,000	\$ 7,350,000	\$ 0	0%	1
31	1.2.5.3 Organization of Alarms	\$ 6,125,000	\$ 6,125,000	\$ 0	0%	1
32	1.2.5.4 Configuration of Reports	\$ 9,800,000	\$ 4,454,463	-\$ 5,345,537	-55%	0.45
33	1.2.5.5 Indicator Settings	\$ 0	\$ 0	\$ 0	0%	0
34	1.2.5.6 Factory Acceptance Test	\$ 0	\$ 0	\$ 0	0%	0
35	1.3 Precommissioning commissioning	\$ 0	\$ 0	\$ 0	0%	0
36	1.3.1 Precommissioning	\$ 0	\$ 0	\$ 0	0%	0
37	1.3.2 Commissioning	\$ 0	\$ 0	\$ 0	0%	0
38	1.3.3 Support	\$ 0	\$ 0	\$ 0	0%	0
39	1.4 Training	\$ 0	\$ 0	\$ 0	0%	0
40	1.4.1 Operator Training	\$ 0	\$ 0	\$ 0	0%	0
41	1.4.2 Maintenance Training	\$ 0	\$ 0	\$ 0	0%	0
42	1.5 Closing Phase	\$ 0	\$ 0	\$ 0	0%	0
43	1.5.1 Final Documentation	\$ 0	\$ 0	\$ 0	0%	0
44	1.5.2 Closure meeting	\$ 0	\$ 0	\$ 0	0%	0
45	1.5.3 Performance Evaluation	\$ 0	\$ 0	\$ 0	0%	0

Figure 25 Sample Earned Value Schedule Indicators View

(Own elaboration)

5 CONCLUSIONS

The development of this degree project allowed to draw the following conclusions:

- The needs of the company regarding the management of automation projects have been evaluated, and it can be concluded that companies that use a defined methodology in the development of their projects have fewer negative impacts during their execution and face novelties in a timely manner with greater efficiency.
- There is a great opportunity to satisfy with the needs of the company when these are compiled and analyzed through the recommendations found in the CSIA Best Practices and Benchmarks Manual (2018). These guidelines are intended for hundreds of companies worldwide that integrate and develop automation projects and solutions, and where the best practice experiences are collected from.
- The methodology developed in this degree project is thoroughly and sequentially explained to ensure all the appropriate formats are used at the right phase of the project execution.
- The information gathered through the interviews and proper research implies that the root problem consists of not having enough time to make decisions. The development of the sample methodology application shown in this FGP allowed to visualize an EV analysis at a specific date where an increase in the deviation is evidenced in a timely fashion and thus be handled immediately, (as

it should happen in a real project) by showing how the formats adjusted to the project scope can be filled out.

- It is evident that there are still companies that do not use an appropriate methodology in the execution of their projects, since they do not have defined formats and procedures to allow them to be aware of the status of the project at all times, and to adequately plan the scope, time, costs, risks, stakeholders, quality, resources, acquisitions and communication in such a way that no aspects that could influence the project results are left out.
- A simple methodology has been proposed for automation projects of the WAN SAS company, which includes the planning of all the knowledge areas as recommended by PMBOK (PMI, 2017). These parameters were adjusted to the development of automation projects in which the profiles assigned to all processes are well defined. The quantified efforts have also been quantified globally, by activity, or by work package, even when the supplies are few. These characteristics make it possible to adjust and simplify the methodology.
- According to the information gathered from the interviews, the evaluation of the projects exclusively at the end (as in a project post-mortem) is an unwanted condition due to the ever-present misinformation and the imperceptible lack of profit. This can be easily avoided by having an analysis tool such as MS Project, which is definitely the best option for continuous analysis. Therefore, it is highly recommended for WAN SAS to monitor its processes continuously in MS Project, and by specifically using this software's Earned Value tool.

6 RECOMMENDATIONS

The following are the recommendations given to WAN SAS for managing automation projects in an organized way.

- It is recommended to implement the methodology described in this FGP, to incorporate it into the company's integrated management system. Each one of the codes have already been defined in the formats for its control in the master list of documents to facilitate this process.
- The formats developed in the methodology are the generic framework for planning automation projects. More specifically, the information made available in the plans contain generic parameters proposed for automation projects. However, the project manager should modify said formats and plans as deemed necessary in order to ensure the correct development of the project in all the areas of knowledge as covered in PMBOK (PMI, 2017), and to ultimately ensure compliance with the project objectives, customer satisfaction and the expected profits of the organization.
- Evaluating the plans defined in the methodology annually will allow to improve them based on the company experiences. This will greatly strengthen the plans and overall processes, thus ensuring the correct execution of the projects.
- It is fundamental to allocate sufficient time for project planning, as it is exemplified in this FGP. It became evident that the cost overruns at the beginning of the project burdened the entire execution process, which could be avoided by proper planning and effective communication. This is a recurrent

issue in this type of projects due to the fact that more importance is given to the execution rather than to the planning process.

- It is recommended to carry out the planning stage properly as to allow the project manager to know what the main risks of the project are, to identify which aspects are affected the most, and to develop the best strategy to avoid risks or mitigate their effects. This FPG has defined a qualitative risk analysis process, however it is recommended to implement a quantitative risk analysis process in order to support the planning of the risk response.
- It is recommended to carry out a good stakeholder management plan in order to know who all the stakeholders involved in the project are, and the main expectations of the project and its requirements. Performing the Interest vs. Influence analysis will allow the project manager to lead the management effectively, focusing his efforts on the satisfaction of the stakeholders and the clients in general.
- It is highly recommended to use the Earned Value methodology to evaluate the progress of the projects. In fact, it is suggested to do so directly in MS Project by following the steps explained in the previous chapters. In this way, the project manager will be always aware of the time management indicators and the schedule to properly monitor the project. Most importantly, it is necessary to carry out this evaluation periodically (i.e., on a weekly basis) to take action in a timely fashion.

7 BIBLIOGRAPHY

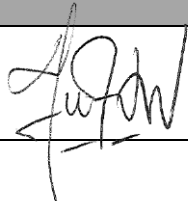
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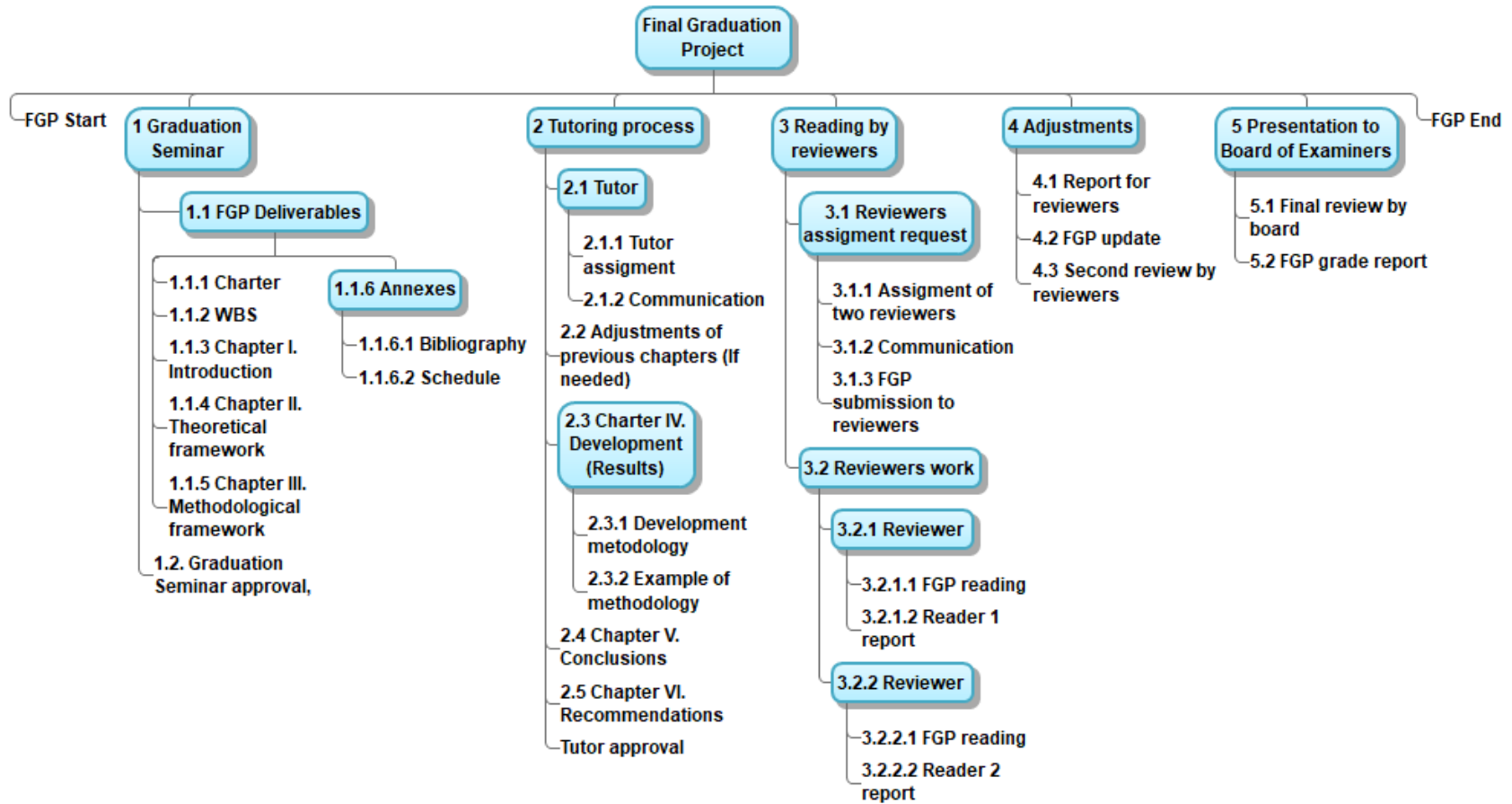
8 APPENDICES

8.1 Appendix 1: FGP Charter

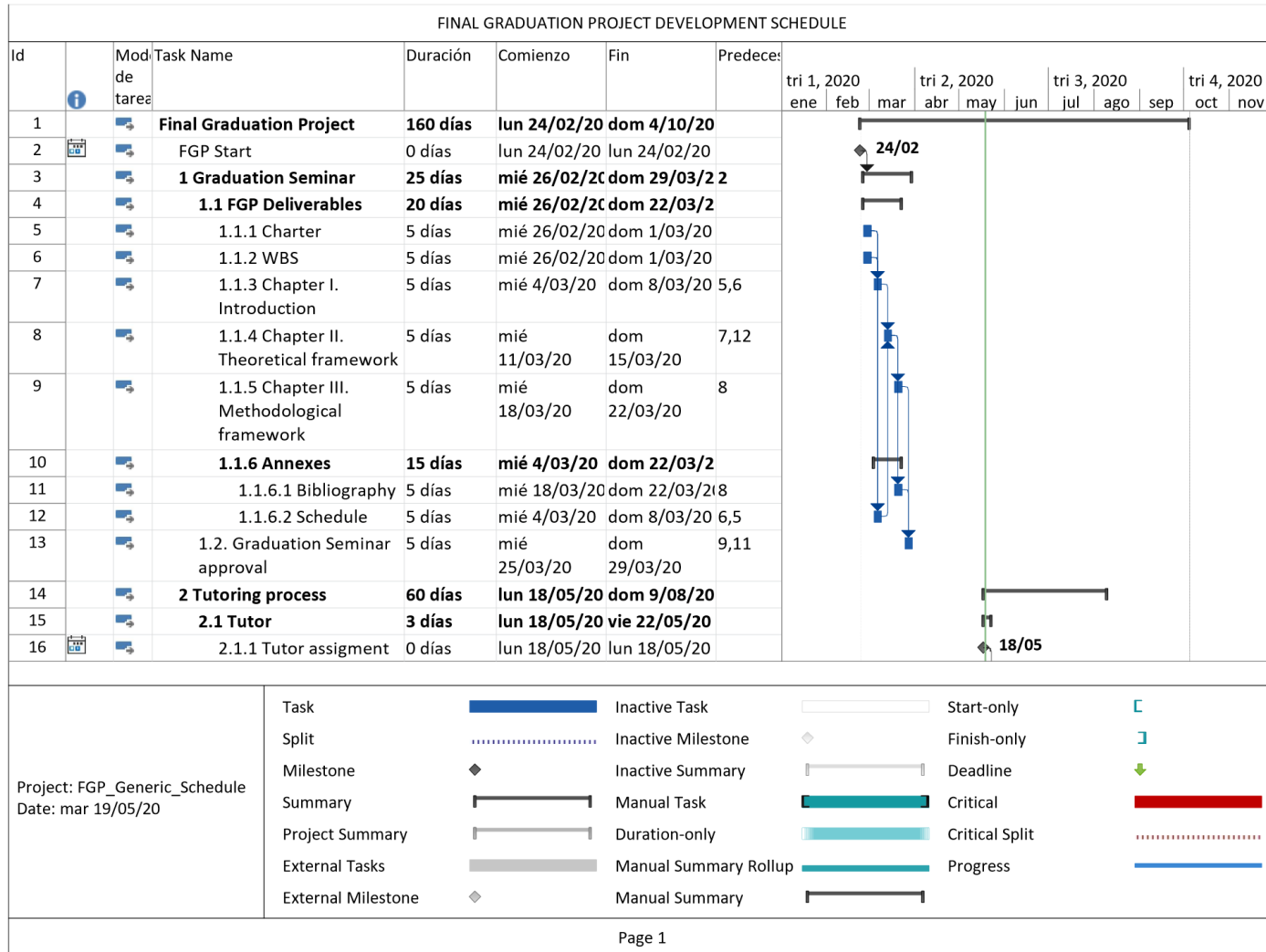
PROJECT CHARTER	
Date:	Project Name:
24-feb-20	Development of a project management methodology for automation projects according to PMBOK guide 6th ed. (PMI, 2017)
Knowledge Areas / PM Processes:	Application Area (Sector / Activity):
<p>Knowledge areas: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communication Management, Project Risk Management, Project Procurement Management and Project Stakeholders Management.</p> <p>Process groups: Initiating, Planning, Executing, Monitoring & Controlling and Closing.</p>	The approach of this project will be applicable in automation projects in the Oil & Gas, Water, Foods and beverages, Energy, and Industry sector.
Project Start Date:	Project Finish date:
24-feb-20	21-aug-20
Project Objectives (General and Specific):	
General Objective:	
To Define a project management methodology for the development of automation projects to improve the satisfaction of all stakeholders.	
Specific Objectives:	
<ol style="list-style-type: none"> 1. To evaluate the organization's needs regarding project management to establish the main components of the project management methodology. 2. To develop frameworks, templates and techniques to apply to the management of future projects. 3. To describe the application step by step in each of the phases of the methodology to ensure a deep understanding and correct implementation. 4. To apply the methodology to a typical process automation project to have a general application format applicable to future projects. 	
Project purpose or justification (merit and expected results):	
<p>In the companies where I have worked, the automation projects have a decentralized execution and assigned to the control engineer in charge. However, there were no clear guidelines on project management issues, which sometimes lead to deviations in scope, time, cost, and quality, among others.</p> <p>Although many experienced engineers have the necessary expertise to overcome these new issues, it is necessary to establish a clear, simple and focused methodology for this type of projects. This ensures client satisfaction and generates profit as expected by the company.</p>	
Description of Product or Service to be generated by the Project – Project final deliverables:	
The use of this project management methodology that will serve as a guide for initiating, planning, executing, monitoring, and controlling and closing processes pertaining the development of automation projects.	
Assumptions:	
<p>It is assumed that university staff will provide students with an appropriate support system.</p> <p>It is assumed that the time allocated for the development of this project is enough.</p> <p>It is assumed that the requirements to perform a management methodology that works for most automation projects will be adequately defined.</p>	
Constraints:	

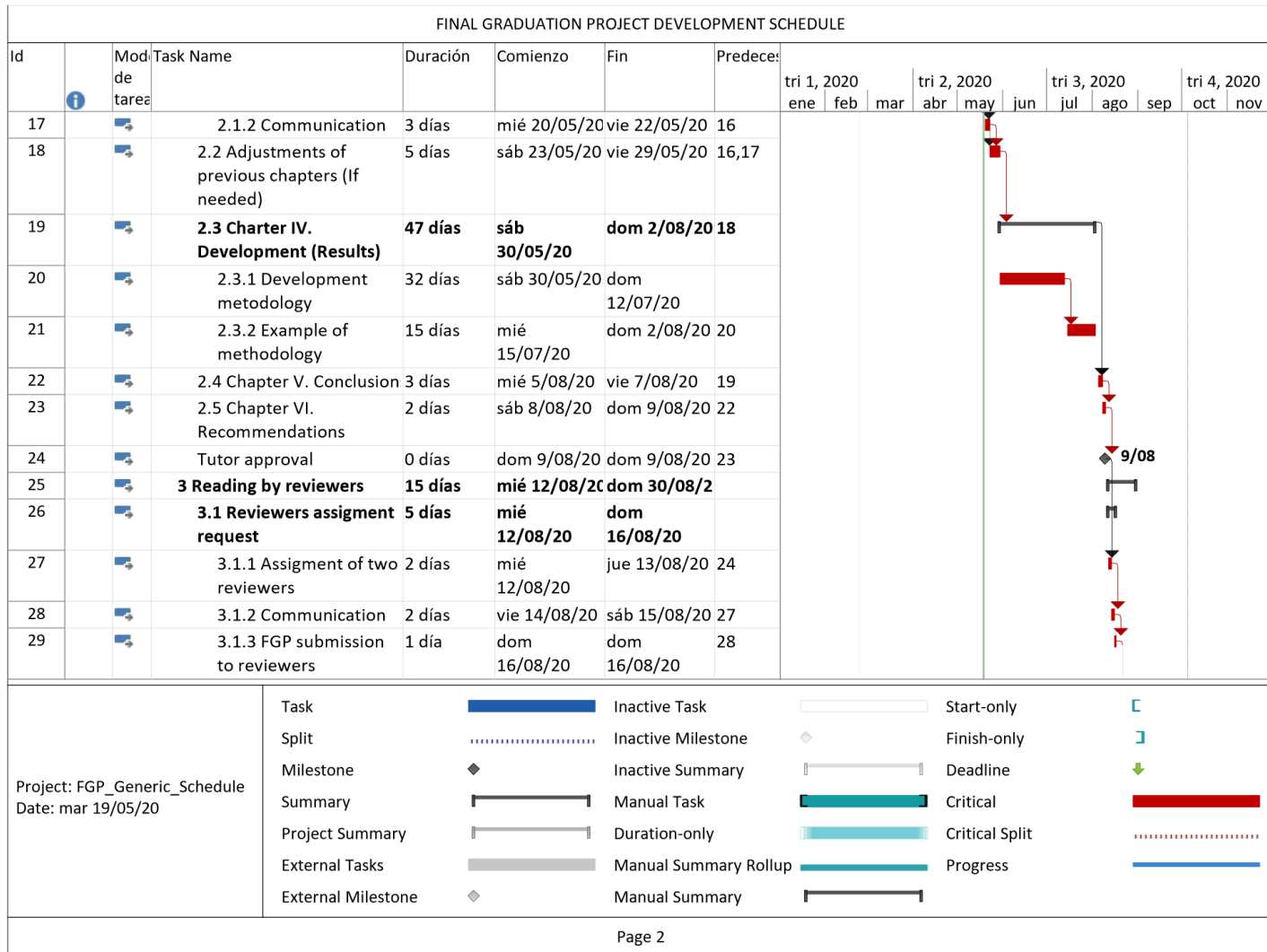
<p>Time: The twelve to complete the Final Graduation Project (FGP) is a short amount of time, amounting to twelve (12) weeks.</p> <p>Scope: It is difficult to focus only on the project management plan, so the development requires more effort.</p> <p>Communication: The period of revision of the degree project may be insufficient to guarantee a sound result.</p>		
Preliminary Risks:		
<p>If the project is presented late, I will not be able to graduate.</p> <p>If the project here developed does not meet the requirements, I will not be able to graduate.</p>		
Budget:		
Not defined yet.		
Milestones and dates:		
Milestone	Start date	End date
FPG Deliverables	February 24	March 20
Project Management Methodology	April 9	May 22
Example if methodology	May 25	June 12
Conclusions and Recommendations	June 15	June 26
Tutor Approval	June 26	June 26
Review Process	June 29	July 17
Adjustments	July 20	August 20
Presentation to board of Examiners	August 17	August 20
Relevant historical information:		
<p>The company for which I currently work executes process automation projects without any management methodology. However, it is a good source of information to find a management methodology and projects that fit this type of scope.</p>		
Stakeholders:		
Directly interested:		
<p>Global School of Project Management, University for International Cooperation (UCI)</p> <p>Organization of American States (OAS)</p> <p>Javier Augusto Wandurraga (Student)</p> <p>Tutors and teachers of the course</p> <p>Reviewers</p> <p>Board of Examiners</p>		
Indirect stakeholders:		
<p>Javier Wandurraga's family</p> <p>WAN SAS company</p>		
Approval:		
Project Manager: Javier Wandurraga	Signature:	
Authorized by: Jose Fernando Castillo	Signature:	

8.2 Appendix 2: FGP WBS



8.3 Appendix 3: FGP Schedule





FINAL GRADUATION PROJECT DEVELOPMENT SCHEDULE																	
Id	Mod de tarea	Task Name	Duración	Comienzo	Fin	Predece	tri 1, 2020			tri 2, 2020			tri 3, 2020			tri 4, 2020	
							ene	feb	mar	abr	may	jun	jul	ago	sep	oct	nov
30		3.2 Reviewers work	10 días	mié 19/08/20	dom 30/08/20												
31		3.2.1 Reviewer	10 días	mié 19/08/20	dom 30/08/20												
32		3.2.1.1 FGP reading	9 días	mié 19/08/20	sáb 29/08/20	29											
33		3.2.1.2 Reader 1 report	1 día	dom 30/08/20	dom 30/08/20	32											
34		3.2.2 Reviewer	10 días	mié 19/08/20	dom 30/08/20												
35		3.2.2.1 FGP reading	9 días	mié 19/08/20	sáb 29/08/20	32CC											
36		3.2.2.2 Reader 2 report	1 día	dom 30/08/20	dom 30/08/20	35											
37		4 Adjustments	20 días	mié 2/09/20	dom 27/09/20												
38		4.1 Report for reviewers	9 días	mié 2/09/20	sáb 12/09/20	36											
39		4.2 FGP update	1 día	dom 13/09/20	dom 13/09/20	38											
40		4.3 Second review by reviewers	10 días	mié 16/09/20	dom 27/09/20	38,39											
41		5 Presentation to Board of Examiners	5 días	mié 30/09/20	dom 4/10/20												
42		5.1 Final review by board	2 días	mié 30/09/20	jue 1/10/20	40											
43		5.2 FGP grade report	3 días	vie 2/10/20	dom 4/10/20	42											
44		FGP End	0 días	dom 4/10/20	dom 4/10/20	43										4/10	

Project: FGP_Generic_Schedule Date: mar 19/05/20	Task		Inactive Task		Start-only	
	Split		Inactive Milestone		Finish-only	
	Milestone		Inactive Summary		Deadline	
	Summary		Manual Task		Critical	
	Project Summary		Duration-only		Critical Split	
	External Tasks		Manual Summary Rollup		Progress	
	External Milestone		Manual Summary			

8.4 Appendix 4: Review of Dictum

Bogotá, Colombia

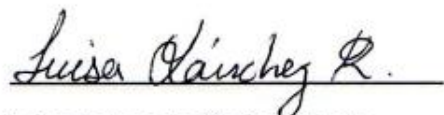
12 August 2020

To Whom It May Concern

I am a certified English teacher with six years of experience in teaching at elementary and high school levels. I also have experience in teaching language to adults and struggling learners up to advanced level. I have also overseen periodical training of fellow teachers and other staff at my current workplace, which demands extensive experience in academic composition teaching. Furthermore, I am currently pursuing a master's degree in Education and Communication. I am professionally proficient in English, achieving TOEIC top score level (CEFR C1 level).

I have reviewed Mr. Javier Wandurraga's Final Graduation Project making grammatical and typographical corrections. In addition, I made recommendations to improve the internal consistency of the project and its overall readability, including word choice, sentence reconstruction, punctuation, format standardization, and citation conventions.

Sincerely,



Luisa Fernanda Sánchez Rivera

C.C.: 1.016.065.731

REPÚBLICA DE COLOMBIA
MINISTERIO DE EDUCACIÓN NACIONAL Y EN SU NOMBRE



LA UNIVERSIDAD DISTRITAL FRANCISCO JOSÉ DE CALDAS

CONFIERE EL TÍTULO DE

Licenciada en Educación Básica con énfasis en Inglés

A

Luisa Fernanda Sánchez Ríbera

Con CC No. 1.016.065.731 de Bogotá D. C.

QUIEN CUMPLIÓ CON LAS CONDICIONES ACADÉMICAS REQUERIDAS.
EN TESTIMONIO DE ELLO OTORGA EL PRESENTE

DIPLOMA

EN LA CIUDAD DE BOGOTÁ D. C. A LOS 7 DÍAS DEL MES DE ABRIL DE 2017

RECTOR

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