

UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

METHODOLOGY FOR ENGINEERING PROJECTS MANAGEMENT AT
ALLERGAN COSTA RICA

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DEDICATION

Dedicated to my family, who have always believed in me and have supported me during the several journeys that I've decided to take.

To my mom, my angel in heaven! Thanks for being a motivation to continue fighting this battle.

To my father, the boss! Thanks for being my friend and my stronghold, thanks for help me grow and become a better version of myself.

This is for you!

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To God for giving me the strength and unconditional support to achieve this new challenge.

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INDEX OF CONTENTS

APPROVAL PAGE	ii
DEDICATION	iii
ACKNOWLEDGMENTS	iv
INDEX OF CONTENTS	v
INDEX OF FIGURES	vii
INDEX OF CHARTS	ix
ABBREVIATIONS AND ACRONYMS	x
EXECUTIVE SUMMARY (ABSTRACT)	xi
1 INTRODUCTION.....	1
1.1 Background.....	1
1.2 Statement of the problem.....	2
1.3 Purpose.....	2
1.4 General objective.....	3
1.5 Specific objectives.....	3
2 THEORETICAL FRAMEWORK.....	4
2.1 Company/Enterprise framework.....	4
2.1.1 Company/Enterprise background.....	4
2.2 Mission and vision statements.....	5
2.2.1 Mission.....	5
2.2.2 Vision.....	5
2.3 Organizational structure.....	5
2.4 Products offered.....	6
2.4.1 Silicone-gel Implants.....	7
2.4.2 Saline Implants.....	7
2.4.3 Tissue Expanders.....	7
2.5 Project Management concepts.....	7
2.5.1 Project.....	7
2.5.2 Project management.....	8
2.5.3 Project life cycle.....	8
2.5.4 Project management processes.....	10
2.5.4.1 Initiating Process Group.....	12
2.5.4.2 Planning Process Group.....	12
2.5.4.3 Executing Process Group.....	12
2.5.4.4 Monitoring and Controlling Process Group.....	13
2.5.4.5 Closing Process Group.....	13
2.5.4.6 Project Management Knowledge Areas.....	14
2.5.5 Project Integration Management.....	14
2.5.5.1 Project Scope Management.....	14
2.5.5.2 Project Time Management.....	14
2.5.5.3 Project Cost Management.....	15
2.5.5.4 Project Quality Management.....	15
2.5.5.5 Project Human Resources Management.....	15
2.5.5.6 Project Communications Management.....	15
2.5.5.7 Project Risk Management.....	16

2.5.5.8	Project Procurement Management.....	16
2.5.5.9	Project Stakeholder Management.....	16
2.6	Methodology Concept.....	16
3	METHODOLOGICAL FRAMEWORK.....	18
3.1	Information sources.....	18
3.1.1	Primary sources.....	18
3.1.2	Secondary sources.....	19
3.2	Research methods.....	20
3.2.1	Deductive method.....	21
3.2.2	Inductive method.....	21
3.2.3	Inductive-deductive method.....	21
3.2.4	Hypothetical-deductive method.....	21
3.2.5	Analytical method.....	21
3.2.6	Synthetic method.....	22
3.2.7	Analytic-synthetic method.....	22
3.2.8	Historical-comparative method.....	22
3.2.8.1	Quantitative or traditional method.....	22
3.2.8.2	Qualitative or non-traditional method.....	22
3.3	Tools.....	24
3.3.1	Expert Judgement.....	24
3.3.2	Meetings.....	24
3.3.3	Interview.....	24
3.3.4	Work Breakdown Structure.....	25
3.3.5	Gantt chart.....	25
3.3.6	Templates.....	25
3.3.7	Observations.....	25
3.3.8	Document Analysis.....	25
3.3.9	Group Creativity Techniques.....	25
3.4	Assumptions and constraints.....	26
3.5	Deliverables.....	28
4	RESULTS.....	29
4.1.1	Use of Project Management Methodology.....	30
4.1.2	Integration Management.....	31
4.1.2.1	Project charter.....	31
4.1.2.2	Management Plans.....	33
4.1.2.3	Change Control.....	34
4.1.2.4	Lesson learned.....	36
4.1.2.5	Project Closure.....	38
4.1.3	Scope Management.....	39
4.1.4	Requirement Definition.....	40
4.1.5	Work Breakdown Structure.....	42
4.1.6	Time Management.....	43
4.1.7	Cost Management.....	45
4.1.8	Quality Management.....	47
4.1.9	Human Resource Management.....	48
4.1.10	Communications Management.....	50
4.1.11	Risk Management.....	52

4.1.12	Procurement Management	54
4.1.13	Stakeholder Management.....	55
4.1.14	Current State Analysis Summary	58
4.2	Templates and procedures	61
4.2.1	Initiating	61
4.2.1.1	Project charter	61
4.2.1.2	Stakeholder register	66
4.2.2	Planning.....	69
4.2.2.1	Requirement Matrix.....	69
4.2.2.2	Work Breakdown Structure Template.....	72
4.2.2.3	Work Breakdown Structure Dictionary Template.....	73
4.2.2.4	Time Estimation Template.....	76
4.2.2.5	Cost Estimation Template	79
4.2.2.6	Human Resource Request Template	81
4.2.2.7	Responsibility Assignment Matrix Template.....	84
4.2.2.8	Communications matrix Template	86
4.2.2.9	Risk Register Template	88
4.2.3	Executing	93
4.2.3.1	Change Control Template	94
4.2.4	Monitoring and Controlling	97
4.2.4.1	Meeting Minute Template.....	97
4.2.4.2	Project Reporting Template.....	99
4.2.4.3	Milestones Status Template	101
4.2.5	Closing.....	104
4.2.5.1	Lesson Learned Control Template	104
4.2.5.2	Project Closure Template	106
4.3	Implementation Plan	109
4.3.1	Phase 2: Training Plan.....	110
4.3.1.1	Course contents	111
4.3.1.2	Course agenda.....	111
4.3.1.3	Evaluation Plan	113
4.3.2	Phase 3: Definition and control of indicators.....	113
4.3.3	Phase 4: Expand methodology	116
5	CONCLUSIONS.....	120
6	RECOMMENDATIONS.....	122
7	BIBLIOGRAPHY	124
8	APPENDICES	125

INDEX OF FIGURES

Figure 1 Organizational structure of Board of Directors (Own Elaboration).....	6
Figure 2 Organizational structure of Engineering Department (Own Elaboration)...	6
Figure 3 Project Life Cycle (Own Elaboration, taken from (PMI,2013)).....	9
Figure 4 Single-Phase Project Life Cycle (Own Elaboration, taken from (PMI,2013))	10
Figure 5 Process Groups Interaction (Own Elaboration, taken from (PMI,2013))..	11
Figure 6 Survey results. Question 1. Use of project management methodology (own elaboration).....	31
Figure 7 Survey results. Question 2. Project Charter Use (own elaboration).	32
Figure 8 Survey results. Question 3. Project Charter Template (own elaboration).33	
Figure 9 Survey results. Question 4. Project Charter Opportunities (own elaboration).	33
Figure 10 Survey results. Question 5. Use of Management Plans (own elaboration).	34
Figure 11 Survey results. Question 6. Change Control Board (own elaboration). .	35
Figure 12 Survey results. Question 7. Change Control Template (own elaboration).	36
Figure 13 Survey results. Question 8. Change Control Request Database (own elaboration).	36
Figure 14 Survey results. Question 9. Leason Learned Template (own elaboration).	37
Figure 15 Survey results. Question 10. Lesson Learned Database (own elaboration).	37
Figure 16 Survey results. Question 11. Project Closure Procedure (own elaboration).	38
Figure 17 Survey results. Question 12. Project Closure Template (own elaboration).	39
Figure 18 Survey results. Question 13. Requirement Identification (own elaboration).	40
Figure 19 Survey results. Question 14. Requirement Traceability Matrix (own elaboration).	41
Figure 20 Survey results. Question 15. Use of WBS (own elaboration).	42
Figure 21 Survey results. Question 16. Template or guide to create WBS (own elaboration).	43
Figure 22 Survey results. Question 17. Perform Time estimation (own elaboration).	44
Figure 23 Survey results. Question 18. Procedure for time estimation (own elaboration).	44
Figure 24 Survey results. Question 19. Use of tool for time management (own elaboration).	45
Figure 25 Survey results. Question 20. Perform cost estimation (own elaboration).	46
Figure 26 Survey results. Question 21. Procedure for cost estimation (own elaboration).	46

Figure 27 Survey results. Question 22. Tool or procedure for cost management (own elaboration).....	47
Figure 28 Survey results. Question 23. Policy for Quality Assurance (own elaboration).	48
Figure 29 Survey results. Question 24. Human Resource Planning (own elaboration).	49
Figure 30 Survey results. Question 25. Roles/Responsibilities Matrix (own elaboration).	50
Figure 31 Survey results. Question 26. Stakeholders' communication requirements (own elaboration).....	51
Figure 32 Survey results. Question 27. Communication matrix (own elaboration).52	
Figure 33 Survey results. Question 28. Risk Assessment (own elaboration).	53
Figure 34 Survey results. Question 29. Risk follow-up (own elaboration).	54
Figure 35 Survey results. Question 30. Procedure for project procurement (own elaboration).	55
Figure 36 Survey results. Question 31. Stakeholder identification (own elaboration).	56
Figure 37 Survey results. Question 32. Stakeholder classification (own elaboration).	57
Figure 38 Interest/Power Plot example at Quality Companion software (own elaboration).	58
Figure 39 Project Charter Template (own elaboration).....	63
Figure 40 Stakeholder Register Template (own elaboration).	67
Figure 41 Requirement Traceability Matrix Template (own elaboration).	70
Figure 42 Work Breakdown Structure Template (own elaboration).	72
Figure 43 WBS Dictionary Template (own elaboration).....	74
Figure 44 Time Estimate Equations (own elaboration).....	76
Figure 45 Time Estimate Template (own elaboration).....	77
Figure 46 Cost Estimate Template (own elaboration).	79
Figure 47 Human Resource Request Template (own elaboration).....	82
Figure 48 Responsibility Assignment Matrix Template (own elaboration).	85
Figure 49 Communications Matrix Template (own elaboration).	87
Figure 50 Probability/Impact Matrix (own elaboration).	90
Figure 51 Risk Register Template (own elaboration).	93
Figure 52 Change Control Request Template (own elaboration).	96
Figure 53 Meeting Minute Template (own elaboration).	98
Figure 54 Project Reporting Template (own elaboration).	101
Figure 55 Milestones Status Template (own elaboration).	104
Figure 56 Lessons Learned Template (own elaboration).	105
Figure 57 Project Closure Template (own elaboration).	107
Figure 58 Implementation Plan Phases (own elaboration).	109
Figure 59 Training Groups Dependency Relations (own elaboration).....	118
Figure 60 Gantt Chart of the Phase 4 (own elaboration).	119

INDEX OF CHARTS

Chart 1 Information sources for the FGP (Own Elaboration)..... 19
Chart 2 Research methods for the FGP (Own Elaboration) 23
Chart 3 Tools for the FGP (Own Elaboration)..... 26
Chart 4 Assumptions and constraints for the FGP (Own Elaboration)..... 27
Chart 5 Deliverables for the FGP (Own Elaboration)..... 28
Chart 6 Priority Groups (Own Elaboration)..... 68
Chart 7 Impact Scale for the Risk Register (Own Elaboration)..... 89
Chart 8 Probability Scale for the Risk Register (Own Elaboration)..... 89
Chart 9. Strategies for Negative Risks or Threats (Own Elaboration) 90
Chart 10. Strategies for Positive Risks or Opportunities (Own Elaboration)..... 91
Chart 11. Organizational groups for methodology expansion (Own Elaboration) 117

ABBREVIATIONS AND ACRONYMS

CAPA	Corrective Action, Preventive Action
CCB	Change Control Board
FDA	Food and Drug Administration
FGP	Final Graduation Project
KPI	Key Performance Indicator(s)
NPI	New Products Introduction
OPEX	Operational Excellence
PD	Process/Product Development
PM	Project Manager
PMBok	Project Management Body of Knowledge
PMI	Project Management Institute
RAM	Responsibility Assignment Matrix
R&D	Research and Development
URS	User Requirement Specification
WBS	Work Breakdown Structure

EXECUTIVE SUMMARY (ABSTRACT)

This final graduation project was developed at the engineering department of Allergan Costa Rica. This company focuses on developing, manufacturing and commercializing branded pharmaceuticals, devices and biologic product for patients around the world. Its Costa Rica division are intended to manufacture breast implants, of gel and saline families and variations, with the highest quality standards.

The engineering department must guarantee the operation continuity of the manufacturing environment through the regularly maintenance activities, also ensuring the implementation of the improvement opportunities, facilities expansion, and automation projects identified to maximize the profitability of the business.

Currently, the engineering department of Allergan does not have a methodology with clear and concise procedures and templates for project management, which causes recurrent problems during the execution of the projects that impacts the results in terms of scope, cost and time.

The general objective for the project was to develop a methodology for engineering projects management at Allergan Medical Costa Rica, in order to guarantee the successfully accomplishment of the projects in terms of scope, time and cost. The specific objectives were: to develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on; to elaborate procedures and templates to standardize the engineering projects management; and to propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.

To reach the objectives proposed, there was conducted a series of interviews and observation sessions to assess the current state of the project management at the engineering department, then there was used the tools, techniques, and good practices of the Guide to the Project Management Body of Knowledge (PMBok) as base to adapt and develop the project management methodology at the requirements found in the initial state analysis.

The current state analyzes demonstrate that there exist weaknesses in terms of project management in four of the different phases: initiating, planning, executing and closing, therefore the entire set of procedures and templates made and proposed by the methodology were based on those improvement opportunities detected as part of the initial results of the current final graduation project.

The procedures and templates developed by the methodology are explained in order to provide the basis for its completion and understanding their importance for the entire organization.

The document ends with the conclusions and recommendations, where it reaffirms the achievement of the stated objectives as providing the organization with tools and procedures that will help you manage each project, based on the best practices outlined in the PMI and bibliography related; to achieve this, it was suggested that the implementation be conducted by a person with knowledge in the administration of projects and with the skills needed to lead the organization in the start-up of the methodology; equally, its main users should be trained in according to the training plan in order to obtain the necessary knowledge bases regarding project management.

Finally, throughout the project, and once it was concluded, important aspects were identified for improving the organization, and therefore it is recommended that this proposed methodology, by its very nature, be subject to constant evaluation for continuous improvement, which train the staff so that each day they have more knowledge and contribute to the improvement of existing procedures, just as it is important to further develop the organizational culture focused on projects, meanwhile, it is recommended that the process of implementing this methodology, within the organization, it must be carried out gradually to evaluate the impact that these have on future projects and on the way in which the staff develops.

1 INTRODUCTION

1.1 Background

Allergan is a bold, global pharmaceutical company leader in a new industry model called Growth Pharma. Allergan is focused on developing, manufacturing and commercializing branded pharmaceuticals, devices and biologic product for patients around the world (Allergan, 2017).

The division of Allergan in Costa Rica, located at La Aurora de Heredia, focuses on the manufacturing of breast implants with the highest quality standards. The products are divided into two main families: gel and saline, with several variations depending on size and texture.

The company have been working the last few years in the area Operational Excellence, implementing programs to raise up the results of the business while creating a continuous improvement culture among the employees. This knowledge allowed to lay the foundations for the development of projects, nevertheless, a project management methodology that encompasses the needs of engineering department and projects has not been implemented.

The engineering department which is made up by two main managements, facilities and maintenance, and others sub-departments like precision workshop, calibration laboratory, design and automation teams. Since the beginning its staff have been involved in sustainability and improvement projects from a wide range of perspectives.

One of the tools implemented in the company, as part of the operational excellence program, is the accountability board which serve as a guidance to evaluate the accomplishment of the task for the entire set of projects in which engineering staff is involved. The metric measured in the department through this tool is the

compliance percentage, which have shown that the weekly average of fulfillment of the engineering department is below 70%.

This poor performance is triggered by the blurred requirement definition and the constant changes to the scope, that are not corresponding documented and the assessment of the changes in terms of schedule, cost, and risk aren't also documented.

The development of a methodology seeks to standardize the project management throughout engineering department, while improving the rate of compliance with the tasks and documenting the project and its changes per the basic concepts stated by the Project Management Institute (PMI).

1.2 Statement of the problem

The engineering department of Allergan does not have a methodology with clear and concise procedures and templates for project management, which causes recurrent problems during the execution of the projects that impacts the results in terms of scope, cost and time, therefore putting into risk the profitability of the business.

1.3 Purpose

The engineering department must guarantee the operation continuity of the manufacturing environment through the regularly maintenance activities, also ensuring the implementation of the improvement opportunities, facilities expansion, and automation projects identified to maximize the profitability of the business.

The intention of this endeavor is to increase the success likelihood at the execution of the engineering projects, improving the rate of compliance with the tasks and standardizing the project management under a unique and easy-use methodology.

This improvement in the process of project management will also generate a better use of the existing human resource in the department, through a correct disposition of the resources at the precise moment according the needs of the business and the projects.

1.4 General objective

To develop a methodology for engineering projects management at Allergan Medical Costa Rica, in order to guarantee the successful accomplishment of the projects in terms of scope, time and cost.

1.5 Specific objectives

1. To develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on.
2. To elaborate procedures and templates to standardize the engineering projects management.
3. To propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.

2 THEORETICAL FRAMEWORK

2.1 Company/Enterprise framework

The project arises as a need of the engineering department of the company Allergan, when it was saw that the compliance rate of the projects managed by this department were quite far from the expected.

2.1.1 Company/Enterprise background

Allergan is a global company leader in a medical industry; the company is focuses on developing, manufacturing and commercializing branded pharmaceuticals, devices and biologic products that allows people to life their lives to its great potential. (Allergan, 2016).

Allergan's innovative spirit is a characteristic inculcated by its founder the pharmacist Gavin S. Herbert, who despite owning a successful chain of pharmacies in Los Angeles, followed his instinct and together with chemist Stanley Bly created ALLERGAN® Nasal Drops, a Small laboratory in charge of developing nasal allergy drops. This product evolved to become the first treatment for conjunctivitis. (Allergan, 2017).

Currently the company has more than 18,000 employees around the world and with several modern research and development centers (R&D). With more than 60 years of experience, Allergan has a presence in more than 90 countries with quality products. (Allergan, 2016).

In Costa Rica, after a year of negotiations Allergan Corporation acquires INAMED Costa Rica, a company with more than 7 years of experience in the manufacture of breast profiles. That same year, the company starts operations in addition obtains the certification by the US Food and Drug Administration (FDA) regarding the production of the mammary profiles. (Allergan, 2016).

2.2 Mission and vision statements

2.2.1 Mission

Be an integrated organization, trustful, that responds, offers high quality products and creates value for our customers. (Allergan, 2017)

2.2.2 Vision

Be the reference for Growth Pharma. (Allergan, 2017)

2.3 Organizational structure

The organizational structure of Allergan Costa Rica is depicted in Figure 1, the staff is divided by specialty in the different departments such as human resources, finance, quality, operations, manufacturing, supply chain, and engineering.

This project is going to be developed in the engineering department; the organization structure of this department is depicted in Figure 2. Regarding project management, the engineering department act as a balance matrix structure, in which the resources reports as required to the project managers depending of the project.

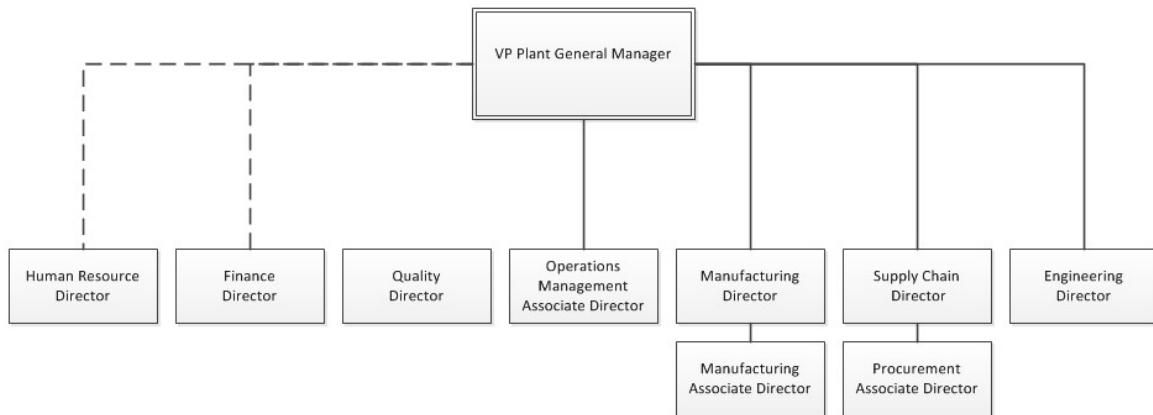


Figure 1 Organizational structure of Board of Directors (Own Elaboration)

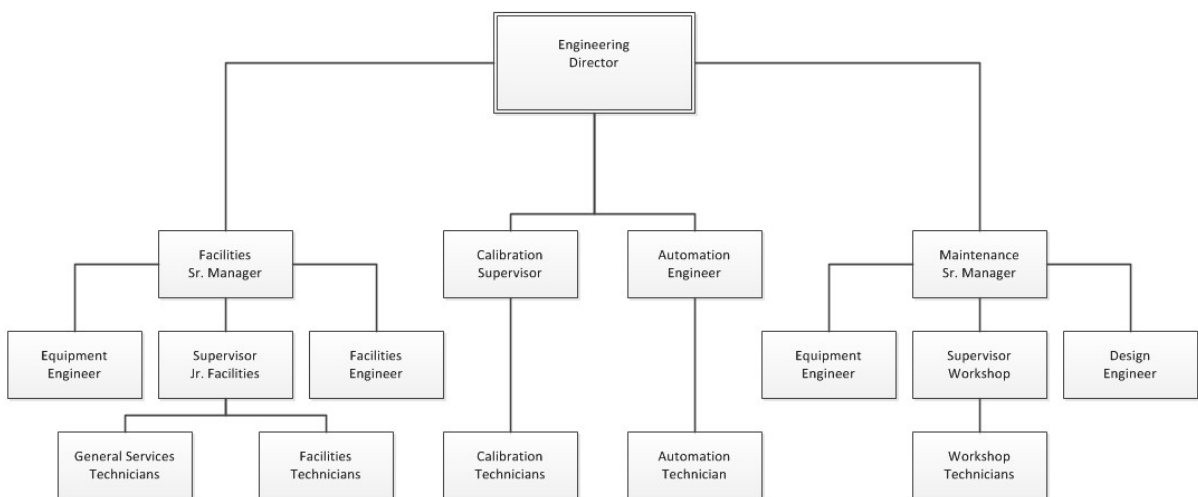


Figure 2 Organizational structure of Engineering Department (Own Elaboration)

2.4 Products offered

The facility of Allergan Medical Costa Rica oversees manufacturing the line of breast products, which is worth noting is produced only in this plant, and presents many part numbers due to variations in sizes and textures. This breast product line is divided into three major product types: silicone gel implants, saline implants and tissue expanders.

2.4.1 Silicone-gel Implants

This type of implants has an elastic layer of silicone rubber, filled with cohesive silicone gel. They have been widely accepted by the public for more than 25 years, and since 2006, the FDA has approved them free use in the United States.

2.4.2 Saline Implants

Saline breast implants have a silicone elastic layer, filled with sterile saltwater solution; these implants are inserted empty into the body and then filled with the solution. Since 2000, the FDA has approved them free use in the United States.

2.4.3 Tissue Expanders

The tissue expander is a silicone shell that is gradually filled for a certain time, usually 6 to 8 weeks, with saline solution in order to slowly stretch the skin and create space to place the implant. The surgery to place this implant is the same as a breast implant, and typically is used in women who have lost a breast because of cancer.

2.5 Project Management concepts

2.5.1 Project

According to the PMBoK®, a project can be defined as “a temporary endeavor undertaken to create a unique product, service, or result” (Project Management Institute, 2013, p.3).

A project is formed by a set of interrelated activities, that can be executed sequentially or in parallel, which consumes both resources (human and economic) and time in order to reach the goal(s) established for the project. The success is reached when the goal(s) are met, however any project can be terminated if there

is clarity that the objectives will not be reached or if the final product is no longer needed for the company/business.

Is worth noting that due the nature of the business environment at Allergan Costa Rica, most of the projects of engineering are focus in maximize the throughput or performance of the manufacturing equipment as well as automate the manual processes of the manufacturing floor. Those projects vary in terms of complexity, cost and time; however, the methodology proposed by this graduation project must be applicable for all the different levels or kinds of projects.

2.5.2 Project management

The PMBoK (2013) states that the project management is “the applications of knowledge, skills, tools, and techniques to project activities to meet the project requirements” and that the project management is truly accomplished through the applications/integration of several processes that are grouped into five main categories. (Project Management Institute, 2013, p.5)

According to Gido and Clements in its book *Administracion exitosa de proyectos*, the project management can be conceptualized as *planning the work, then working the plan* (Gido & Clements, 2012, p.14). It means that in order to obtain the benefits of the project management, there must be a well-defined plan for the activities or actions to be taken in each moment; and then the work must be performed according to the plan in order to accomplish the project objectives and satisfy the final customers of the project.

2.5.3 Project life cycle

Project life cycle can be understood as “the series of phases that a project passes through from its initiation to its closure”. (Project Management Institute, 2013, p.38). Additionally, the phases of the project life cycle can appear sequentially or even overlapped, and their names are determined by a series of factors such as

the nature of the project, the business and project needs, the areas of application, the methodology itself and others.

A quite interesting aspect of the project life cycle is that as stated in the PMBok (2013) the “life cycle provides the basis framework for managing the project, regardless of the specific work involved” (Project Management Institute, 2013, p.38). It is worth noting that as a project moves through its life cycle, the involvement of the different levels of stakeholders and the resources play preponderant roles in meeting the project objective.

Throughout the life cycle projects undergo some conditions like the decrease in the risk and uncertainty, the cost and staffing varies between low and high per the stage, and the cost of the changes raises as the project is reaching the due date.

Below figure depicts the generic structure for the project life cycle defined by the PMI:

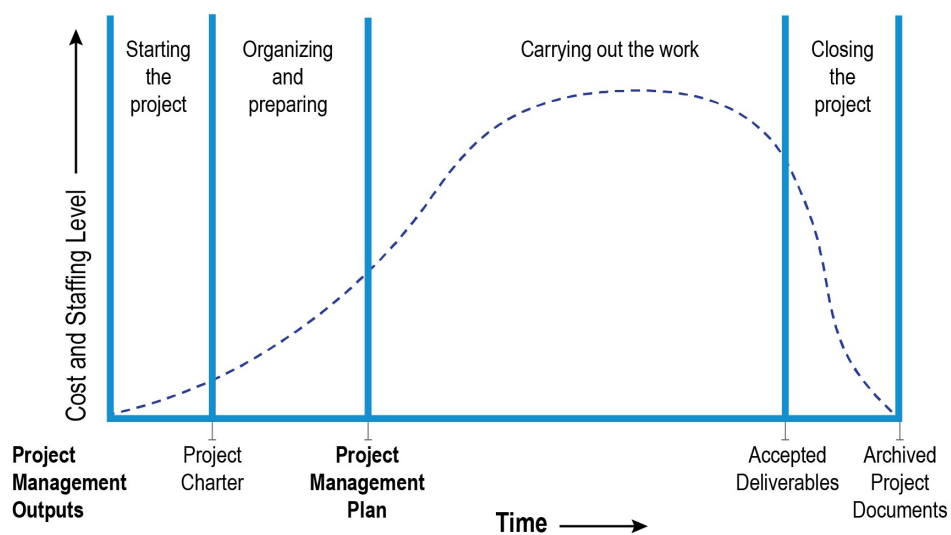


Figure 3 Project Life Cycle (Own Elaboration, taken from (PMI,2013))

Depending on the project methodology implemented within an organization, so will the project life cycle and its interaction with the different phases or processes. And there is no ideal and unique structure applicable to all projects, however, from a very practical perspective projects can behave under the processes shown in the image below, bearing in mind that these processes can be iterative within the same project depending on the management methodology.

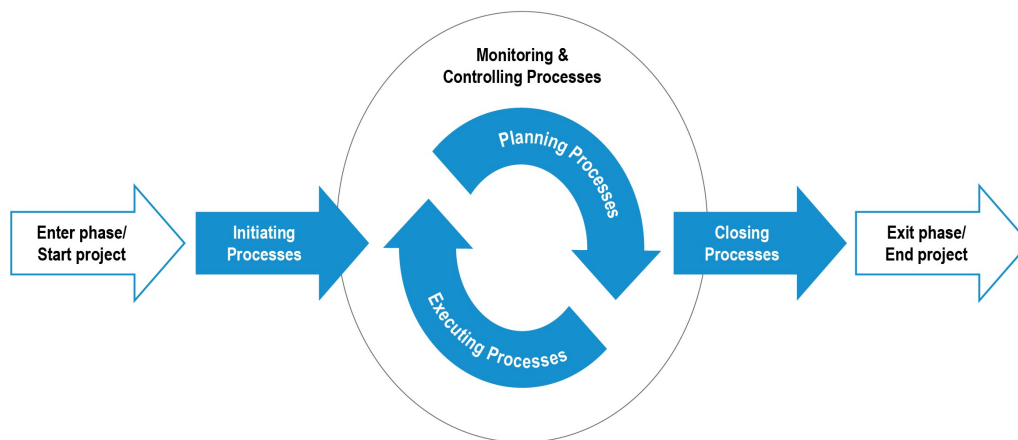


Figure 4 Single-Phase Project Life Cycle (Own Elaboration, taken from (PMI,2013))

2.5.4 Project management processes

A process is a set of interrelated actions and activities that must be performed to create a specific result (product or service). Per the PMBoK (2013), the project management processes “ensure the effective flow of the project throughout its life cycle. These processes encompass the tools and techniques involved in applying the skills and capabilities described in the knowledge areas”. (Project Management Institute, 2013, p.47).

When managing projects the PM (project manager) and the project team must take into consideration each process as well as its inputs/outputs to determine which are and which aren't applicable to the specific project. Due the nature of the

projects the management processes are interrelated, it means that the actions taken during one process can affect others processes.

The project management processes, according to PMI (2013), are grouped into five categories, which are also called as *Project Management Process Groups*: Initiating, Planning, Executing, Monitoring and Controlling, and Closing. (Project Management Institute, 2013, p.49)

In general terms, for the successfully achievement of the objectives established for a project it should cover at least one process of each groups. The figure 4 shows the normal flow interdependency of all the five Process Groups for a single-phase project, for projects with several phases the relation among the process groups becomes a fundamental aspect to take into consideration, especially in the planning, executing, and monitoring and control process groups as represented in Figure 5.

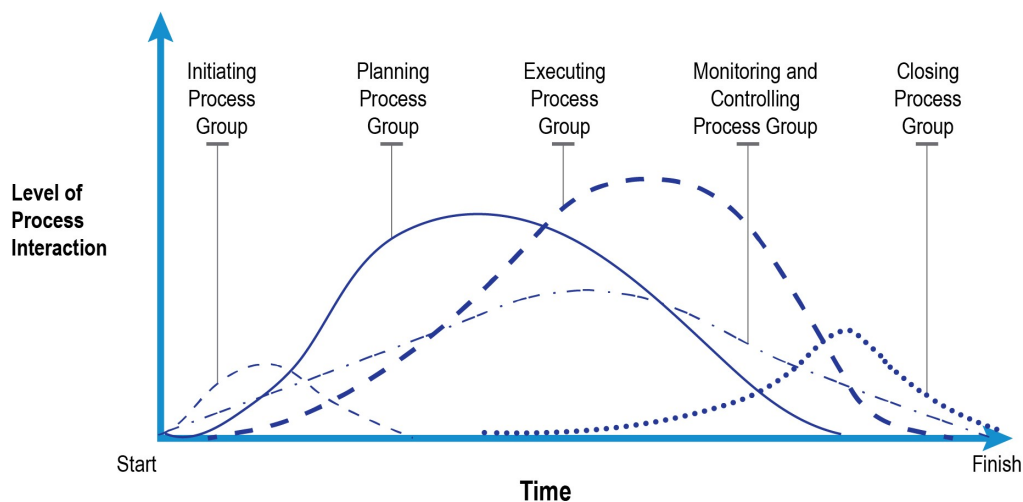


Figure 5 Process Groups Interaction (Own Elaboration, taken from (PMI,2013))

2.5.4.1 Initiating Process Group

The initiating process group englobes the processes required to define a new project (or phase from an existing project) by obtaining the corresponding authorization to start. From this group of processes are the initial scope definition and the initial financial assessment, both required to gain the authorization of a project.

According to PMBok (2013): “the key purpose of this process group is to align the stakeholder’s expectation with the project’s purpose, give them visibility about the scope and objectives, show how their participation in the project and its associated phases can ensure that their expectation are achieved” (Project Management Institute, 2013, p.54).

2.5.4.2 Planning Process Group

Planning process group incorporates the process required to establish the final scope of the endeavor, the final objectives of the project, and to develop the action plan to meet the objectives. Throughout the lifecycle, some of the information generated and documented as part of the planning process group will require a re-assessment triggered by new information obtained; this assessment can generate adjustments to the action plan in order to reach the project objectives through the best scenario possible. (Project Management Institute, 2013, p.55)

2.5.4.3 Executing Process Group

The executing process group consist of the processes executed in order to complete the work previously defined in the action plan (all the subsidiary management plans). During this process is quite important to coordinate the resources availability to perform the activities of the project in accordance of what was documented and defined in the project management plan. The baselines of

the project may require updates or changes according the results obtained during this process group. (Project Management Institute, 2013).

According to Gido and Clements: “The project team, led by the project manager, will execute the plan and perform the activities to produce all the deliverables and to accomplish the project objective. The pace of project activity will increase as more and various resources become involved in performing the project tasks”. (Gido & Clements, 2012, p.11)

2.5.4.4 Monitoring and Controlling Process Group

This process group consist, according to PMI (2013), of “those processes required to track, review and orchestrate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes. The key benefit is that the project performance is measured and analyzed at regular intervals.” (Project Management Institute, 2013, p.57).

This process also involves others processes as controlling the changes, giving recommendations in anticipation of possible problems, comparing the ongoing activities against the baselines. (Project Management Institute, 2013, p.57)

2.5.4.5 Closing Process Group

According to Gido and Clements: “The process of closing the project involves collecting and making final payments, evaluating and recognizing staff, conducting a post-project evaluation, documenting lessons learned, and archiving project documents.” (Gido & Clements, 2012, p.13).

The process group englobes the processes performed to conclude and formally complete the project (Project Management Institute, 2013, p.57).

2.5.4.6 Project Management Knowledge Areas

The PMI through the PMBoK has divided the processes into ten different knowledge areas: Integration, Scope, Time, Cost, Quality, Human Resources, Communications, Risk, Procurement, and Stakeholder.

2.5.5 Project Integration Management

“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. Integration includes characteristics of unification, consolidation, communication, and integrative actions that are crucial to controlled project execution through completion, successfully managing stakeholder’s expectations, and meeting requirements”. (Project Management Institute, 2013, p.63).

2.5.5.1 Project Scope Management

“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. Managing the project scope is primarily concerned with defining and controlling what is and is not included in the project”. (Project Management Institute, 2013, p.105).

2.5.5.2 Project Time Management

“Project Time Management includes the processes required to manage the timely completion of the project”. (Project Management Institute, 2013, p.141).

2.5.5.3 Project Cost Management

“Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget”. (Project Management Institute, 2013, p.193).

2.5.5.4 Project Quality Management

“Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken. It uses policies and procedures to implement, within the project’s context, the organization’s quality management system and, it supports continuous process improvement activities as undertaken on behalf of the performing organization”. (Project Management Institute, 2013, p.227)

2.5.5.5 Project Human Resources Management

“Project Human Resources Management includes the processes that organize, manage, and lead the project team.” (Project Management Institute, 2013, p.255)

2.5.5.6 Project Communications Management

“Project Communications Management includes the processes that are required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information”. (Project Management Institute, 2013, p.287).

2.5.5.7 Project Risk Management

“Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on project. The objectives are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project”. (Project Management Institute, 2013, p.309).

2.5.5.8 Project Procurement Management

“Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. The organization can be either the buyer or seller of the products, services, or results of a project”. (Project Management Institute, 2013, p.355)

2.5.5.9 Project Stakeholder Management

“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 expectation and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders”. (Project Management Institute, 2013, p.391).

2.6 Methodology Concept

A methodology is a system of practices, techniques, procedures and rules used by those who work in certain discipline. From a scientific standpoint, a methodology is a researching plan that allows the achievement of a goal and is widely associated with the standardization.

According to Harold Kerzner the characteristics of a good methodology based upon integrated processes includes (Kerzner, 2009, p.76):

- A recommended level of detail.
- Use of templates.
- Standardized planning, scheduling, and cost control techniques.
- Standardized reporting format for both in-house and customer use.
- Flexibility for application to all projects.
- Flexibility for rapid improvements.
- Easy for the customer to understand and follow.
- Readily accepted and used throughout the entire company.
- Use of standardized life-cycle phases and end of phase reviews.

3 METHODOLOGICAL FRAMEWORK

This FGP seeks to develop a methodology for engineering projects management at Allergan Medical Costa Rica, in order to guarantee the successfully accomplishment of the projects in terms of scope, time and cost.

For the development of this FGP the good practices, tools and techniques of the PMBoK was took as baseline and adapted to the organization need in terms of project management.

3.1 Information sources

According to Huamán (2011) the information sources are diverse types of documents that contains information that serves to satisfy an existent demand of information or knowledge. The information can be found and compiled from different means; printed or digital.

Information sources are instruments for the knowledge, research and access to information. In order to keep abreast of new development in a given field of knowledge, different sources of information that offer concrete answers to certain previously raised questions are used. The usefulness of information sources is determined by their response to the need for information from users. (Muñoz, 2011).

3.1.1 Primary sources

A primary source is a source that contains original firsthand information about a topic. The primary sources allow researchers to get as close as possible to original ideas, events, and empirical research as possible. Such sources may include creative works, first hand or contemporary accounts of events, and the publication of the results of empirical observations or research. (Virginia Tech, n.d.)

For purposes of this FGP is considered as primary sources to the interviews with the specialists (engineers and technicians), the revision of meetings' minutes and own experience during the execution of the engineering projects.

3.1.2 Secondary sources

A secondary source is a source that contains commentary on or discussion about a primary source, offering an interpretation of information gathered from primary sources. The secondary sources analyze, review, or summarize information in primary resources or other secondary resources. Even sources presenting facts or descriptions about events are secondary unless they are based on direct participation or observation. Moreover, secondary sources often rely on other secondary sources and standard disciplinary methods to reach results, and they provide the principle sources of analysis about primary sources. (Virginia Tech, n.d.)

For purposes of this FGP is considered as secondary sources the progress reports from previous engineering projects, company's procedures and protocols, final graduation projects with similarities, the guide to the project management body of knowledge PMBok, and other books and internet articles related with project management knowledge.

Chart 1 Information sources for the FGP (Own Elaboration)

Objectives	Information sources	
	Primary	Secondary
To develop an analysis of current state of the engineering department regarding the project management, in order	Interviews with the specialists (engineers and technicians). Revision of meetings' minutes.	Revision of FGP with similarities. The Guide to the project management body of knowledge PMBok.

to identify the areas of improvement at which the methodology must focus on.	Own experience during the execution of the engineering projects.	Company's procedures and protocols.
To elaborate procedures and templates to standardize the engineering projects management.	Expert Judgement. Own experience during the execution of the engineering projects.	The Guide to the project management body of knowledge PMBok. Other books with project management knowledge.
To propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.	Expert Judgement. Own experience during the execution of the engineering projects.	The Guide to the project management body of knowledge PMBok. Other books with project management knowledge.

3.2 Research methods

According to Eyssautier (2006) there is a relation between method, science and research. The method is a set of procedures that serves as an instrument to achieve the purposes of the investigation.

From this perspective, the scientific method is the planned procedure that is followed in the investigation to discover the forms of existence of the objective processes, to unravel their internal and external connections, to generalize and deepen the acquired knowledge, in order to demonstrate them with rational rigor and to check in the experiment and with the techniques of your application. (Eyssautier, 2006, p.97-98)

3.2.1 Deductive method

This method of reasoning consists in taking general conclusions to obtain particular explanations. The method starts with the analysis of postulates, theorems, laws, principles, etc., of universal application and proven validity, to apply them to particular solutions or facts. (Bernal, 2010, p.59)

3.2.2 Inductive method

This method uses the reasoning to obtain conclusions that start from particular facts accepted as valid, to arrive at conclusions whose application is of a general character. The method starts with an individual study of facts and formulates universal conclusions that are posited as laws, principles or foundations of a theory. (Bernal, 2010, p.59-60)

3.2.3 Inductive-deductive method

This method of inference is based on logic and studies particular facts, although it is deductive in a sense (part of the general to the particular) and inductive in the opposite (goes from the particular to the general). (Bernal, 2010, p.60)

3.2.4 Hypothetical-deductive method

It consists of a procedure based on assertions as hypotheses and seeks to refute or falsify such hypotheses, deducing from them conclusions that must be confronted with the facts. (Bernal, 2010, p.60)

3.2.5 Analytical method

This cognitive process consists in breaking down an object of study, separating each of the parts of the whole to study them individually. (Bernal, 2010, p.60)

3.2.6 Synthetic method

Integrates the dispersed components of a study object to study them in their entirety. (Bernal, 2010, p.60)

3.2.7 Analytic-synthetic method

It studies the facts, starting from the decomposition of the object of study in each one of its parts to study them in an individual form (analysis), and then integrates those parts to study them in a holistic and integral way (synthesis). (Bernal, 2010, p.60)

3.2.8 Historical-comparative method

A procedure for the investigation and elucidation of cultural phenomena that consists in establishing the similarity of these phenomena, inferring a conclusion about their genetic relationship, that is, of their common origin. (Bernal, 2010, p.60)

3.2.8.1 Quantitative or traditional method

It is based on the measurement of the characteristics of social phenomena, which implies deriving from a conceptual framework pertinent to the problem analyzed, a series of postulates that express relationships between the studied variables in a deductive way. This method tends to generalize and normalize results. (Bernal, 2010, p.60)

3.2.8.2 Qualitative or non-traditional method

Is oriented to deepen specific cases and not to generalize. Their concern is not primarily to measure, but to qualify and describe the social phenomenon based on determinants features, as perceived by the very elements that are within the situation studied. (Bernal, 2010, p.60)

Chart 2 Research methods for the FGP (Own Elaboration)

Objectives	Research methods		
	Analytic-synthetic method	Inductive-deductive method	Observation
To develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on.	Analysis of current state of the engineering department, and detection of weakness areas regarding project management.	N/A	Interviews with the specialist. Following of the specialist during tasks execution.
To elaborate procedures and templates to standardize the engineering projects management.	After the diagnosis was developed the methodology, which contains the tools that are weaknesses in the organization.	A list of critical procedures according to PMBoK knowledge areas and process were established.	A current state analysis was performed; the improvement opportunities were documented and serve as base for the methodology.
To propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.	Implementation strategy of the methodology was established according to the action plan defined by the organization	Implementation strategy based on PMBoK best practices.	

3.3 Tools

The tools are all those means that facilitate the collection of the information and the obtaining of the results that serve to carry out some work, in this case to develop a methodological guide for the engineering projects management at Allergan Costa Rica.

For purposes of this FGP the following tools or techniques are going to be used as required per the different objectives and deliverables:

3.3.1 Expert Judgement

Judgement provided based upon expertise in an application area, knowledge area, discipline, industry, etc., as appropriate for the activity being performed. Such expertise may be provided by any group or person with specialized education, knowledge, skill, experience, or training. (Project Management Institute, 2013, p.539)

3.3.2 Meetings

Meetings are used to discuss and address pertinent topics of the project. Attendees at the meetings may include the project manager, the project team, and appropriate stakeholders involved or affected by the topics addressed. Each attendee should have a defined role to ensure appropriate participation. (Project Management Institute, 2013, p.84).

3.3.3 Interview

A formal or informal approach to elicit information from stakeholders by talking to them directly. (Project Management Institute, 2013, p.544)

3.3.4 Work Breakdown Structure

A hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables. (Project Management Institute, 2013, p.567)

3.3.5 Gantt chart

A bar chart of schedule information where activities are listed on the vertical axis, dates are shown on the horizontal axis, and activity durations are shown as horizontal bars placed according to start and finish dates. (Project Management Institute, 2013, p.542)

3.3.6 Templates

A partially complete document in a predefined format that provides a defined structure for collecting, organizing, and presenting information and data. (Project Management Institute, 2013, p.564).

3.3.7 Observations

A technique that provides a direct way of viewing individuals in their environment performing their jobs or tasks and carrying out processes. (Project Management Institute, 2013, p.548)

3.3.8 Document Analysis

An elicitation technique that analyzes existing documentation and identifies information relevant to the requirements. (Project Management Institute, 2013, p.538).

3.3.9 Group Creativity Techniques

Techniques that are used to generate ideas within a group of stakeholders. (Project Management Institute, 2013, p.542).

Chart 3 Tools for the FGP (Own Elaboration)

Objective	Tools
To develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on.	Interview. Observation. Expert Judgement. Document Analysis.
To elaborate procedures and templates to standardize the engineering projects management.	Document Analysis. Expert Judgement. Work Breakdown Structure.
To propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.	Gantt Chart. Expert Judgement.

3.4 Assumptions and constraints

According to PMI (2013) a constraint can be defined as: “a limiting factor (internal or external) that affects the execution of a project or process. When a project is performed under an agreement, contractual provisions will generally be constraints. The information regarding constraints may be listed in the project scope statement of in a separate log”. (Project Management Institute, 2013, p.124).

Besides, assumptions are defined according to PMI (2013) as a “factor in the planning process that is considered to be true, real, or certain, without proof or demonstration. Also, describes the potential impact of those factors if they prove to be false. Project teams frequently identify, document, and validate assumptions as part of their planning process. Information on assumptions may be listed in the

project scope statement or in a separate log”. (Project Management Institute, 2013, p.124).

Chart 4 Assumptions and constraints for the FGP (Own Elaboration)

Objectives	Assumptions	Constraints
<p>To develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on.</p>	<p>Availability of documentations regarding engineering project management.</p> <p>The information provided by the engineering personnel during the interviews is real.</p> <p>Availability of engineering staff to attend the interviews.</p>	<p>Lack of information on past projects to feed the diagnostic.</p>
<p>To elaborate procedures and templates to standardize the engineering projects management.</p>	<p>Availability of project management related bibliography.</p> <p>Availability of engineering staff to support the procedures elaboration.</p>	<p>The timeframe of the project is 4 months, including the preliminary draft of the project.</p>
<p>To propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.</p>	<p>Commitment of the engineering staff to adopt the project management culture.</p>	<p>This FGP does not contemplate the implementation of the methodology.</p>

3.5 Deliverables

According to PMI (2013) deliverable can be defined as: “Any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project” (Project Management Institute, 2013, p.537).

Chart 5 Deliverables for the FGP (Own Elaboration)

Objectives	Deliverables
To develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on.	Report of the current state analysis regarding the project management at engineering department at Allergan.
To elaborate procedures and templates to standardize the engineering projects management.	Procedures for initiating, planning, executing, monitoring and controlling, and closing for engineering projects.
To propose an implementation strategy to offer a guide with the steps required for the application of the project management methodology.	Action plan for the implementation of the project management methodology at the engineering department of Allergan.

4 RESULTS

This chapter depicts the deliverables that were developed for each of the specific objectives. The section started with an analysis of the current state of project management at the engineering department of Allergan, in order to detect the weaknesses and improvement opportunities regarding in which the methodology must focus on; later the procedures and templates were developed to standardize the engineering project management and finally the implementation strategy was established to offer a guidance for the application of the methodology.

4.1 Current State Analysis

In the present analysis, a diagnosis of the current state, in terms of project management processes of the company, is made to identify the weaknesses and improvement opportunities. This is done to define the areas in which the methodology proposed in this paper should be centralized. For this purposes was used the methods of direct observation, study of existing documentation and interviews with median management personnel and surveys with engineers from different areas of the engineering department. The interview and survey format are shown in Appendix 4 and Appendix 5.

As shown in figure 2, the engineering department is formed by the director or top management, four (4) engineers/managers or median management, six (6) engineers distributed in maintenance and facilities, and the technicians. The survey was applied to five (5) engineers, my position was not taken into consideration within the results in order to avoid a bias, with the positions of Supervisor Jr. Facilities, Facilities Engineer, Equipment Engineer, Supervisor Workshop, and Design Engineer, due these are the engineers in charge of dealing with the management of the engineering projects. Moreover, the interviews were conducted to the median management, in order to understand their opinion of the needs of the department regarding the project management from the perspective of each operative area.

4.1.1 Use of Project Management Methodology

Regarding the use of a project management methodology, 80% of the engineers who attend the survey manifested that they do not use a formal and standardized project management methodology.

According to the comments of the engineers, the usage of tools and resources to manage the projects is not seen as a standard requirement at the department and it is based upon the personal skills and the preparation/knowledge in both engineering and project management.

From the interviews with the median management of the department, it was noticed that they agreed on the issue that the lack of a standardized methodology carry problems such as: people performing more/less tasks than expected, blurred responsibilities and roles at the project, delays in the executions of the tasks, and difficulties to delegate work to the team members.

For both perspectives, engineers and median management, the implementation of a formal and standardized project management methodology is great improvement opportunity at the engineer department that will serve as a guidance to align the team to the same north, and to ensure the successful development and management of engineering projects.

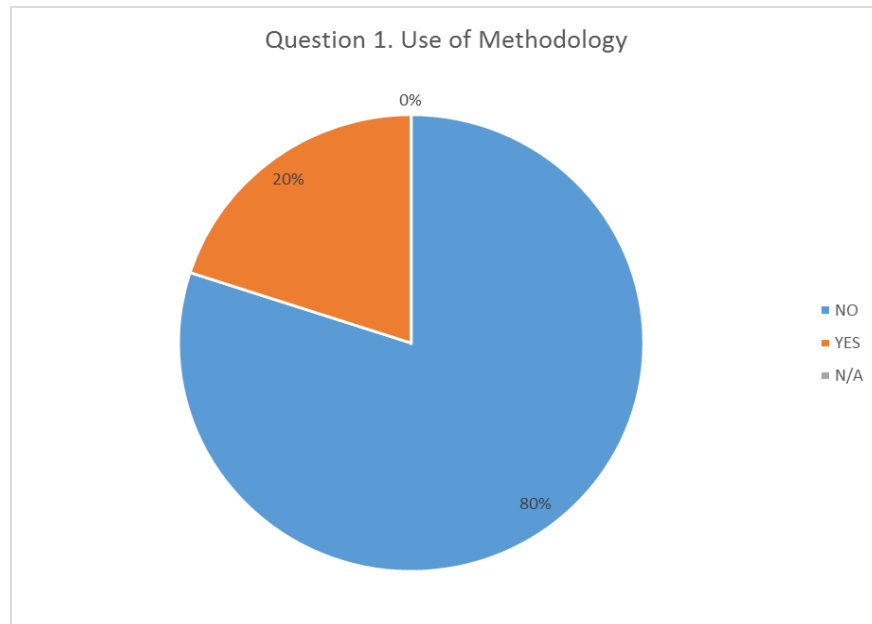


Figure 6 Survey results. Question 1. Use of project management methodology (own elaboration).

4.1.2 Integration Management

4.1.2.1 Project charter

Regarding the creation or use of project charters as figure 7 shows, the 20% of the respondents said that they have carried out a project charter for each of the projects in which they have been in charge, while the remaining 80% stated that they have never created a project charter during its experience at the Engineering Department.

From the median management standpoint, it is well known that there is an opportunity for improvement when implementing a standard procedure to establish the generalities of each of the projects, however there is some expectation about the information that should be included in the project charters, as well as the level(s) of review and approval, since they want to avoid that the start of projects becomes a highly bureaucratic process.

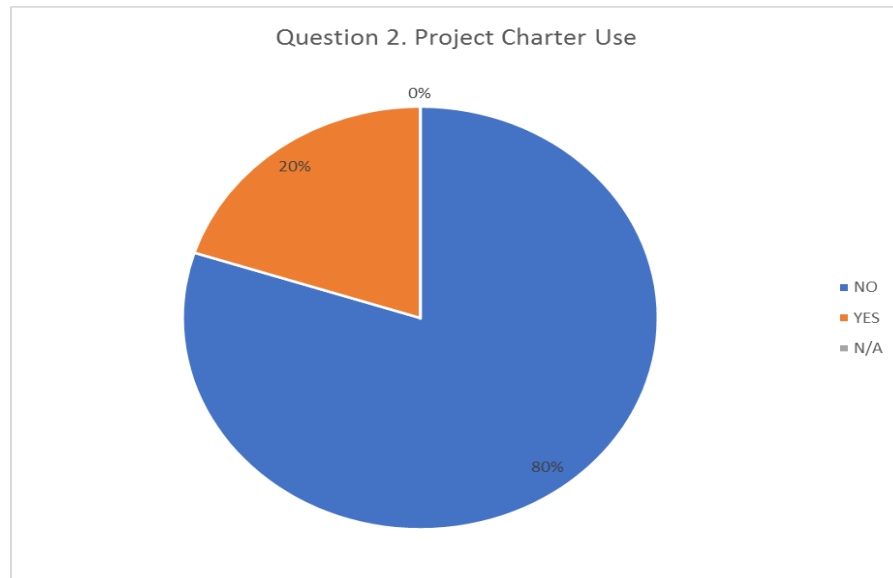


Figure 7 Survey results. Question 2. Project Charter Use (own elaboration).

Surveyed manifested that there is not a template to document the objectives, rationale or justification, deliverables, constraints and assumptions, preliminary risk, budget, stakeholders and preliminary schedule as part of a well-structured project charter. Therefore, there question of improvement opportunities related to the project charter template was not applicable as shown in the results.

During additional researching, it was found that the key engineering projects must request funding to the finance department through a local procedure called CER (Capital Expenditure Requisition), in which the engineer in charge of the project must document the objectives, justification, budget and schedule of the project in a document that must be uploaded to a software for its approval.

Even though there is this CER procedure, it is not applicable for the entire set of project of the engineering department besides it is not a standard template to document the project charter; therefore, in order to solve this issue, the current methodology propose a formal and standard project charter template to document in a consistent manner the project charter for all the engineering projects.

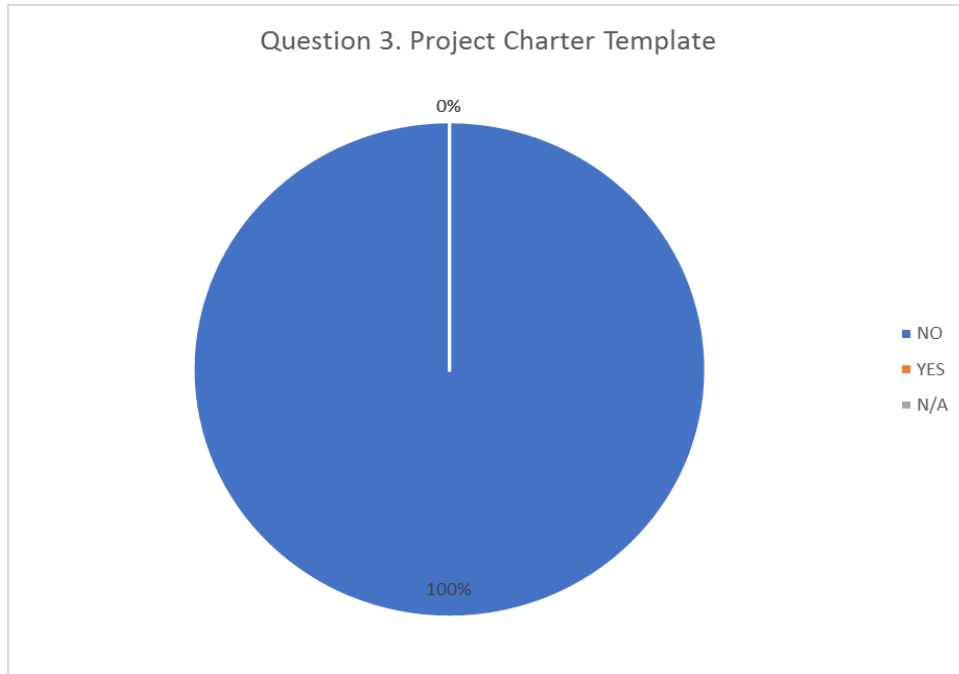


Figure 8 Survey results. Question 3. Project Charter Template (own elaboration).

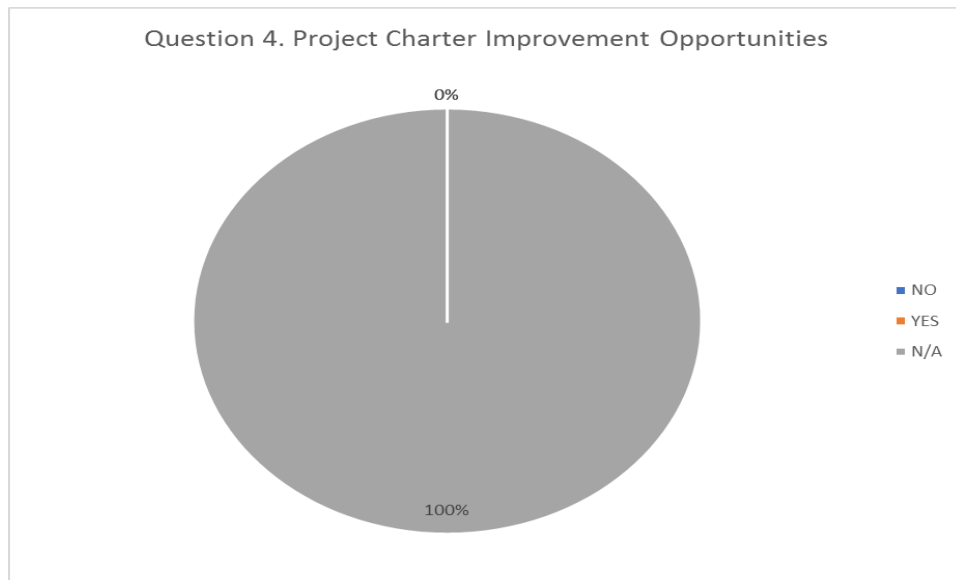


Figure 9 Survey results. Question 4. Project Charter Opportunities (own elaboration).

4.1.2.2 Management Plans

Regarding management plans, all the engineers surveyed stated that for no one of the projects they have been involved in, neither as administrators nor as members of the team, they have seen the development of management plans for the

different knowledge areas of project management. The management of the projects is based on the previous experiences from the project manager and team members.

Current methodology will provide the basis for the creation of a series of contents that are considered segments of the general management plan of a project since the management plan defines how a project is executed, monitored, controlled, closed, and depends on the complexity of the project; nevertheless, a template for the entire management plan is not considered part of the project scope.

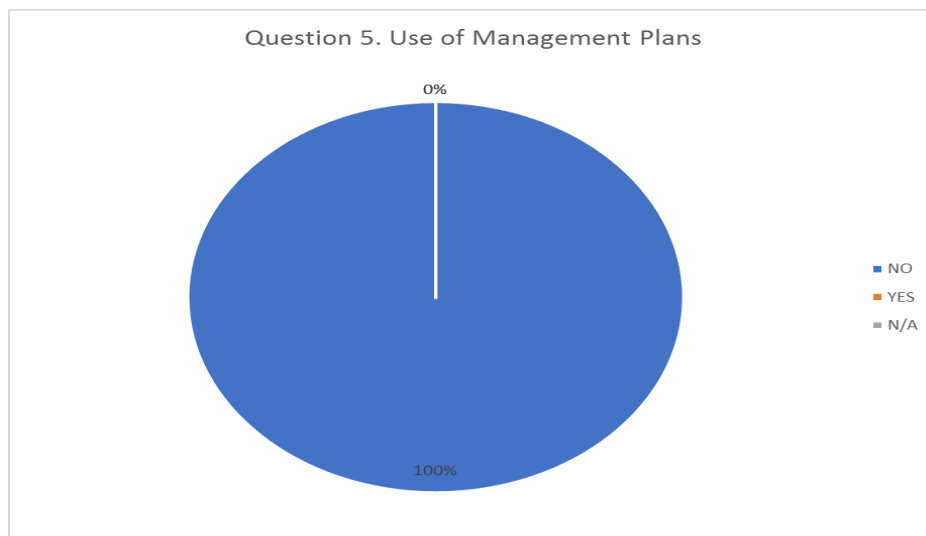


Figure 10 Survey results. Question 5. Use of Management Plans (own elaboration).

4.1.2.3 Change Control

In terms of change control, as figure 11 shows all the respondents affirmed that exist a change control board in charge of approve the change requests for the projects of the company. This CCB includes the top management of Costa Rica facility, which is formed by the VP Plant General Managers and its staff (directors and associate director from all the departments).

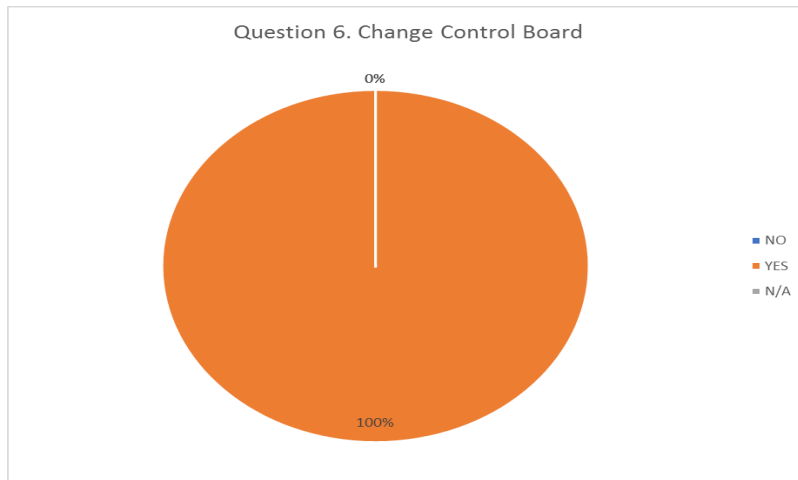


Figure 11 Survey results. Question 6. Change Control Board (own elaboration).

Nevertheless, according to the median management interviews this CCB is focused just in the most important projects also called *Key Operational Projects KOP*, which are the set of projects with the higher exposure and impact to the manufacturing environment of the company. Therefore, for the rest of projects of engineering which are not categorized as KOP, the change control board is formed by the engineering director and the main stakeholders.

Even though there is this an established structure or board for the review and approval or rejection of the change requests, there is no a template to document the generalities of the proposed change as well as its impact in terms of schedule, cost, quality or other; neither a database with the approved/rejected changes. This lack of template and database was evidenced as result of the questions #7 and #8 of the survey in which the engineers answered, as shown in figures 12 and 13, that there is not a template nor database, therefore in order to solve this issue the current methodology propose a formal and standard change control template to be used when requesting a change for a project, and its procedure to maintain the change requests and its response during the project life cycle.

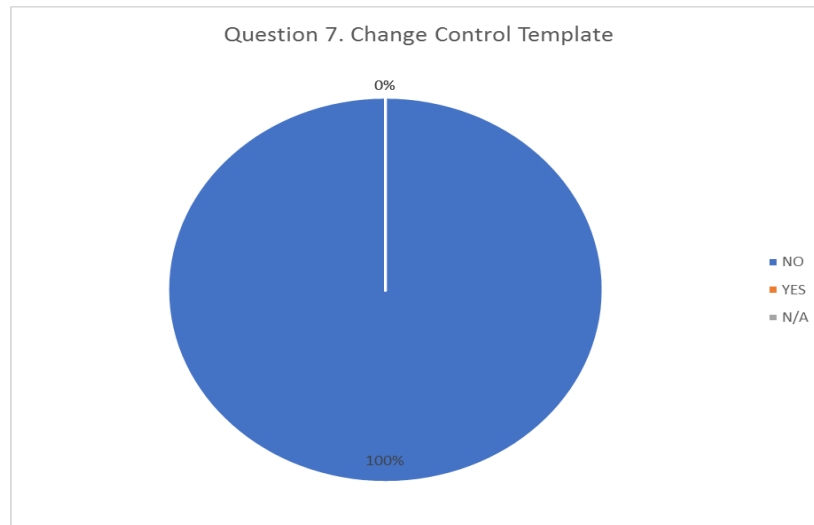


Figure 12 Survey results. Question 7. Change Control Template (own elaboration).

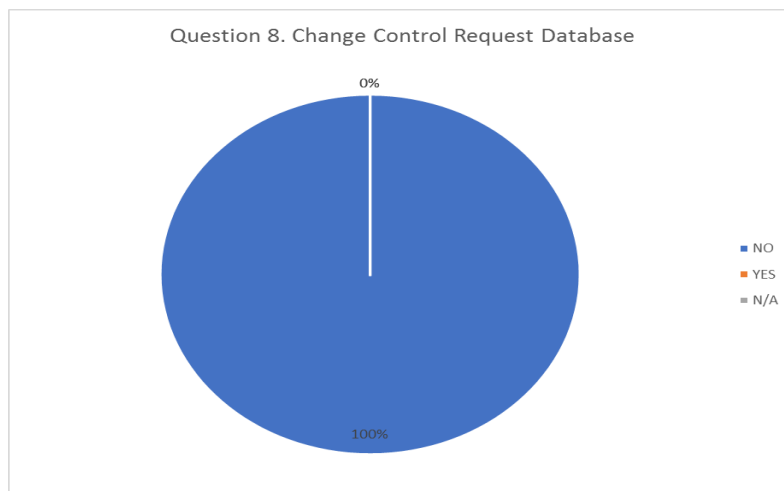


Figure 13 Survey results. Question 8. Change Control Request Database (own elaboration).

4.1.2.4 Lesson learned

Regarding lesson learned, there is not a procedure, template neither database for document the lessons learned from the previous projects managed at the engineering department. The engineers who attended the survey manifested that there is not a template for document the lesson learned when concluded a project, and that most of the knowledge is kept by verbal communication among the department nevertheless, over time the lesson are forgotten, and there is not traceability to the countermeasures taken to deal with specific issues.

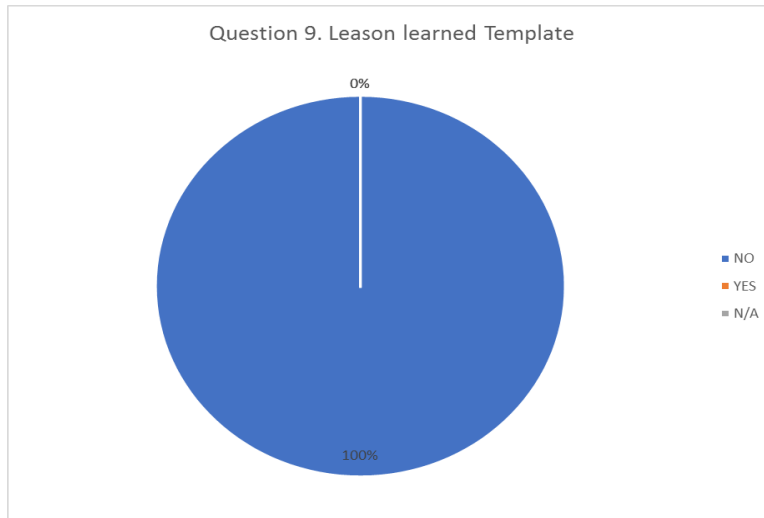


Figure 14 Survey results. Question 9. Leason Learned Template (own elaboration).

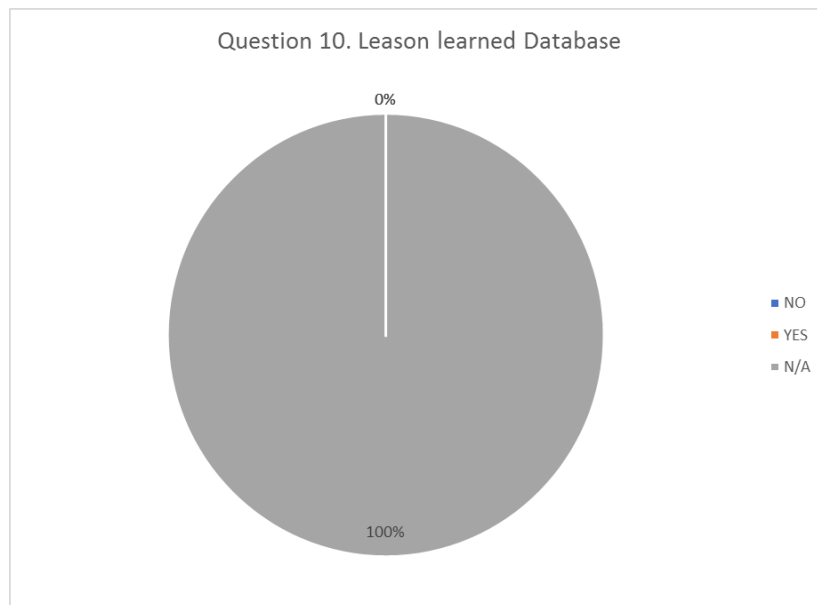


Figure 15 Survey results. Question 10. Lesson Learned Database (own elaboration).

In order to mitigate this issue, the current methodology proposed a template to document the lessons learned during the project lifecycle, additionally the closure procedure will include a section to archive this document in a SharePoint in which the personnel of engineering department could easily find the lessons from previous projects to improve the management of new projects.

4.1.2.5 Project Closure

In terms of project closure, as figures 16 depicts the respondents confirmed that there is not a defined procedure with the instructions or indications of how is expected to proceed in order to formally close a project.

According to the opinion of the median management gathered through the interview, the usually method used for projects closure is the approval of the validations or the submission with the regulatory entities, however due the wide nature of projects not all the projects pass throughout this validation and submission process, therefore most of projects concludes just when the PM consider that the project objective have been meet.

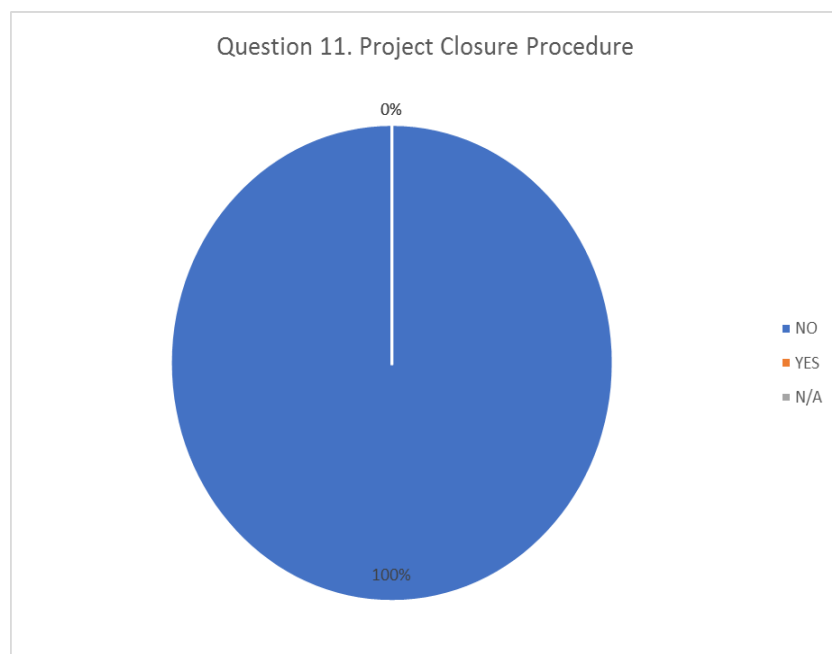


Figure 16 Survey results. Question 11. Project Closure Procedure (own elaboration).

While it is true that the purpose of any project is to meet the goals or objectives set out in the beginning of the project, it is important that the project closure process is completed in an appropriate manner, verifying together with stakeholders and sponsors compliance of all the objectives, besides documenting the lessons learned and communication with all the interested and involved areas that the

project has been completed in order to readjust the organization and the personnel according to the new projects and needs of the department and the company.

Regarding the project closure template, it was identified according to the answer of the respondents that similar to the closure procedure there is not a template to document the closure in a standardized manner.

The current methodology proposes a project closure template with a brief procedure with the instructions of how the template must be completed, in order to eliminate the gap between the PMI best practices and the current practices at the engineering department in terms of project closure.

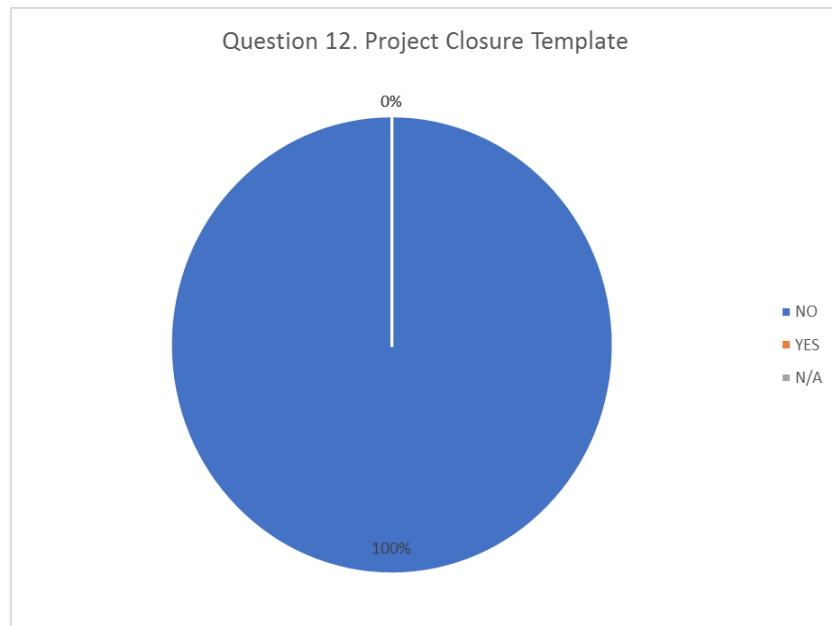


Figure 17 Survey results. Question 12. Project Closure Template (own elaboration).

4.1.3 Scope Management

The scope management was assessed in terms of requirement identification and definition with the stakeholders, the scope definition and the use of work breakdown structure for the project. The initial or high level scope definition must be documented at the project charter; therefore, the proposal of project charter

template will be provided with a segment to document the scope definition in terms of what is included and what is not from a high-level perspective.

4.1.4 Requirement Definition

According to the results of the survey as shown in figure 18 related to question 13, the engineers affirmed that they perform the requirement identification for all the projects in which they are in charge. Additionally, it was identified that the requirement identification and definition process is well structured among the engineering department.

There is a procedure who establishes the involvement of the different areas of the company in order to communicate its expectations or requirements for the project, after that the project team formalizes the requirements in a document called user requirement specification (URS). According to this procedure the requirements must be grouped per technical area and assigned with a unique identifier, additionally the URS must contain generalities and expected use of the deliverable of the project. Finally, the URS go through the approval panel which basically is formed by the head (manager or director) of the areas who previously request a requirement.

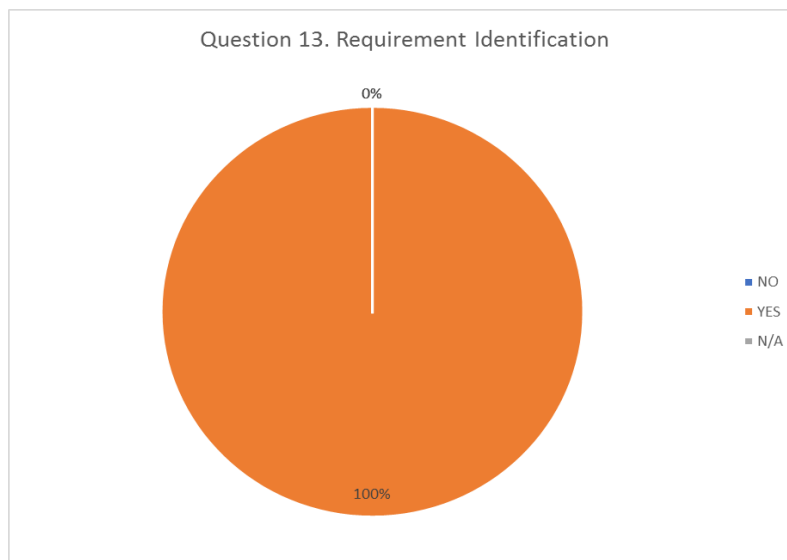


Figure 18 Survey results. Question 13. Requirement Identification (own elaboration).

The approved version of the URS is then uploaded into an electronic repository with a revision number in order to protect the integrity of the document and its traceability during the project lifecycle, due the URS could be updated as required and approved by the CCB.

In terms of requirement traceability matrix, 40% of the engineers claim to have created traceability matrixes but 60% affirm to have never used or created this matrix. According to the requirement procedure established within the company, the creation of traceability matrix is only applicable to the projects that pass throughout a validation process (for example changes to manufacturing equipment, changes in the facility, changes in manufacturing process parameters). In the case of the projects that does not apply the validation process, it is not required to generate the requirement traceability matrix.

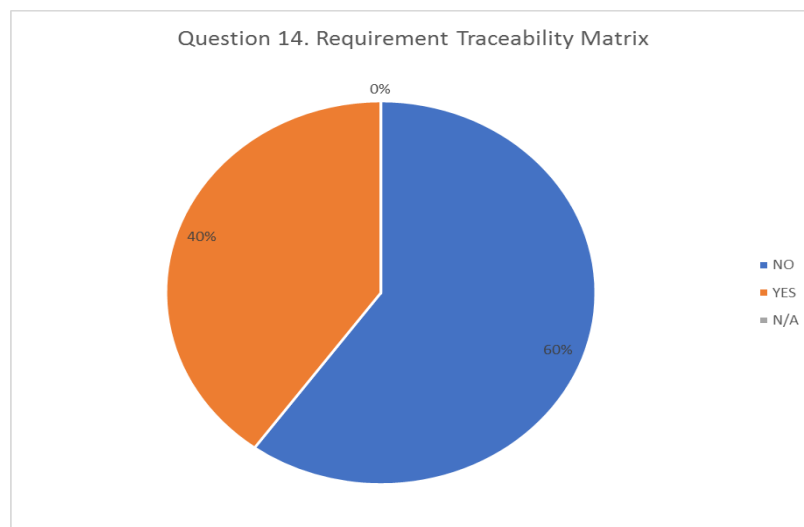


Figure 19 Survey results. Question 14. Requirement Traceability Matrix (own elaboration).

Due the maturity of the company in terms of requirement identification and definition, the current methodology will not propose further changes to this procedure solely the establishment of the practice of generation of the requirement traceability matrix per all the projects for engineering. Additionally, due the lack of a formal template to generate the matrix within the organization, the current

methodology proposes a template and the set of instructions to complete it in a standard and consistent manner.

4.1.5 Work Breakdown Structure

As figure 20 shows, 80% of the engineers that attended the survey manifested that they do not use the work breakdown structure when managing or dealing with projects, even most of the participants did not know the concept of WBS. In the other hand, 20% of the respondents' clam to have used the WBS but not for all the projects, just for the small projects (no more than 2 months).

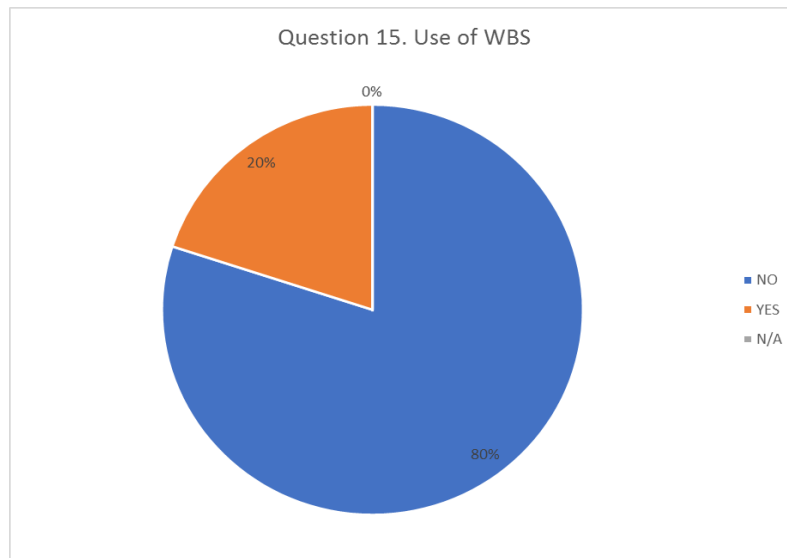


Figure 20 Survey results. Question 15. Use of WBS (own elaboration).

Likewise, all respondents claim to have no tool, procedure or template to generate the WBS as shown in Figure 21 corresponding to question 16. In order to correct this situation, the current methodology proposed a basic and adjustable WBS template as well as its instructions and rules to be considered when completing the document.

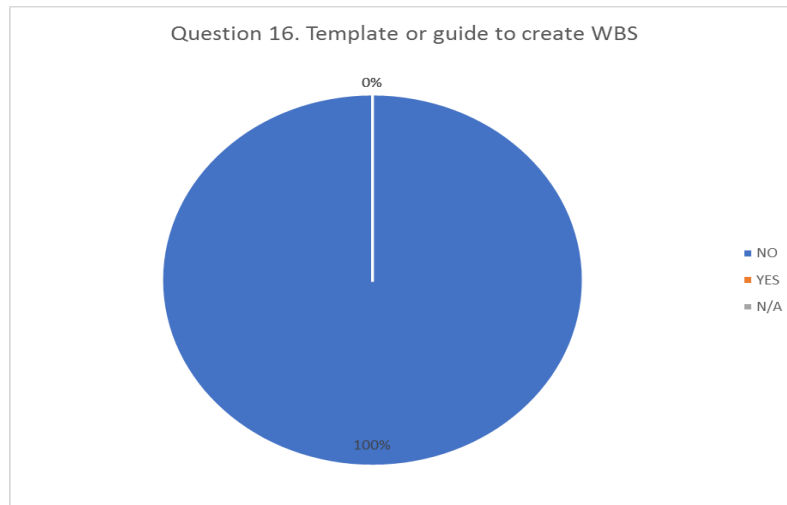


Figure 21 Survey results. Question 16. Template or guide to create WBS (own elaboration).

4.1.6 Time Management

In terms of time estimation, the 60% manifest to have performed the time estimation for the tasks of the projects while the remaining 40% said that they have never performed the time estimation. According to further conversation with the engineering team, the time estimation for the projects is calculated with expert judgement, nevertheless one of the biggest problems of the department is the no accomplishment on time of the tasks.

The 100% of the respondents stated as shown in figure 22, that there is no procedure or template that allows the detailed time estimation for engineering projects. For the interviewees with the management the implementation of a formal template proposal for the time estimation would allow the development of successful projects that meet the scope, time and costs established by the company, improving positive image of the department in terms of compliance and project management.

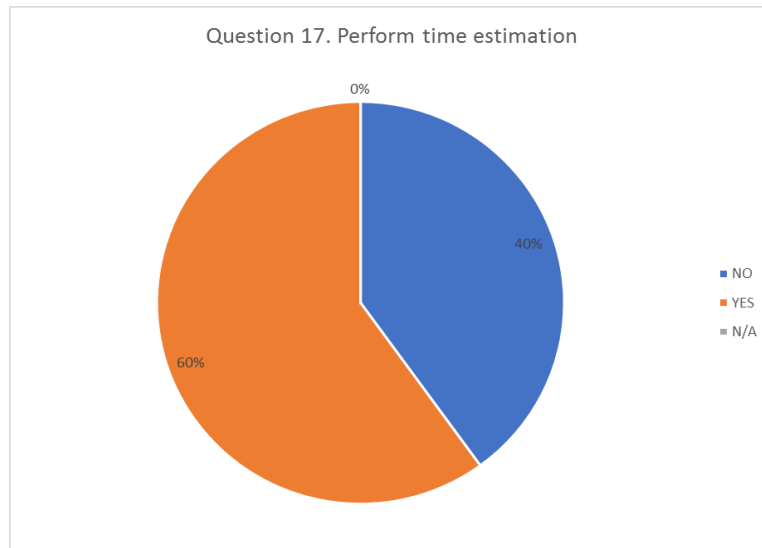


Figure 22 Survey results. Question 17. Perform Time estimation (own elaboration).

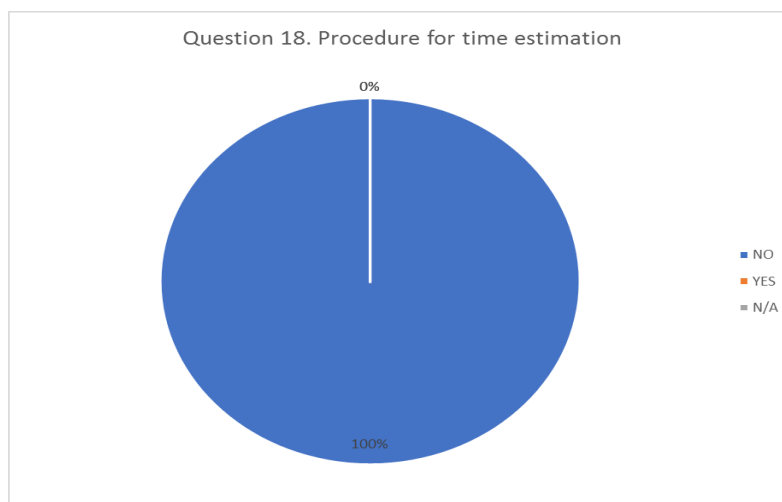


Figure 23 Survey results. Question 18. Procedure for time estimation (own elaboration).

Regarding the use of any tool for time management, the 80% of the respondents stated as shown in figure 24 that they do use a tool, which is basically the software Microsoft Project 2010 for the creation and review of the project Gantt, and the arrangement of the resources; however, a 20% stated that they do not use any tool for that purposes mainly because of the lack of knowledge using the software.

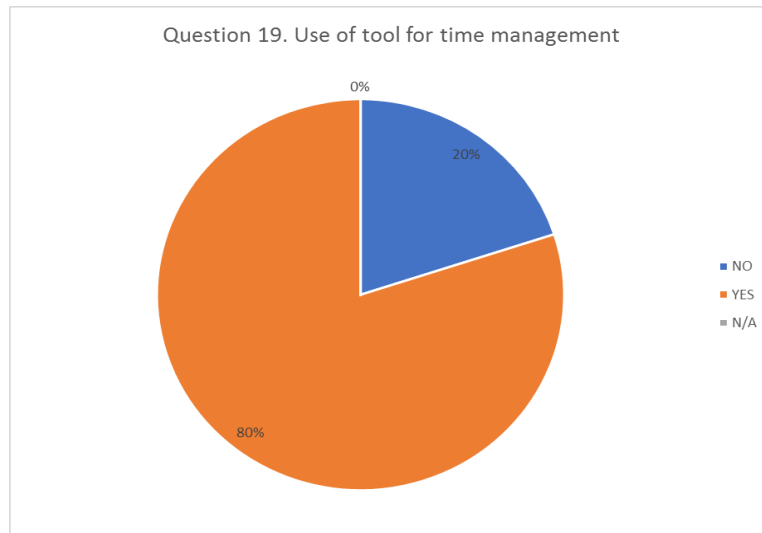


Figure 24 Survey results. Question 19. Use of tool for time management (own elaboration).

From the interviews with the management, they all agreed on the fact that the no standardized time management leads to multiple issues such as work overload for some team members, confusing or blurred start and end dates for the tasks, wrong follow up of the project, which can definitively affect the schedule and the committed with the sponsors.

The current methodology proposes a template for the time estimation, as well as a brief procedure regarding how to complete the template and how to perform the time estimation correctly based on the previous information and the work breakdown structure. Additionally, as a part of the implementation plan, there will be a task corresponding to the staff training regarding the correct use of the Microsoft Project 2010 software in order to ensure the successful of time management for the engineering projects.

4.1.7 Cost Management

In terms of cost estimation, the 100% manifest to have performed the estimation for the overall project as shown in figure 25, nevertheless they confirmed that there is not a procedure to be followed, as depicted in figure 26, in order to perform the

cost estimation and consequently there is not a template to be completed as part of the cost management. According to further conversation with the engineering team, the cost estimation for the projects is calculated with expert judgement, and based on the quote requested for the vendors of the different services.

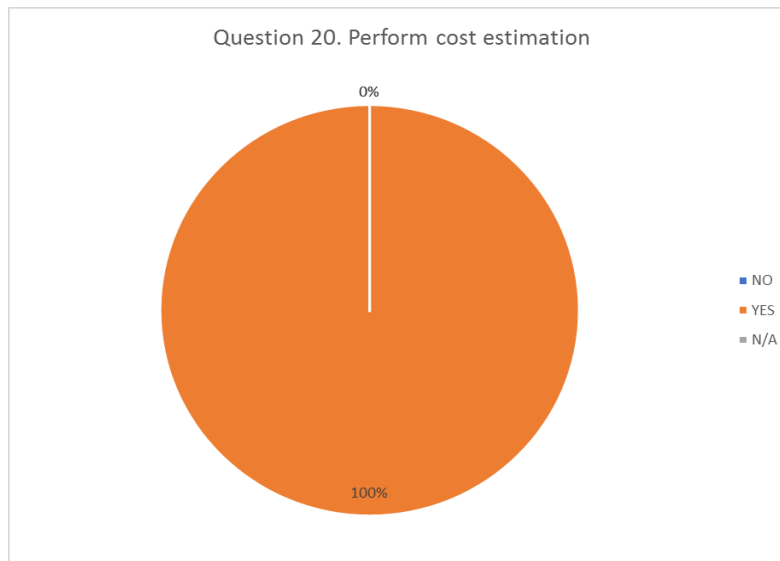


Figure 25 Survey results. Question 20. Perform cost estimation (own elaboration).

From the interviews with the management, they all agreed on the fact that the current method to estimate the project usually does not represent the real cost of the project, therefore the budget tends to fall short before the end of the project.

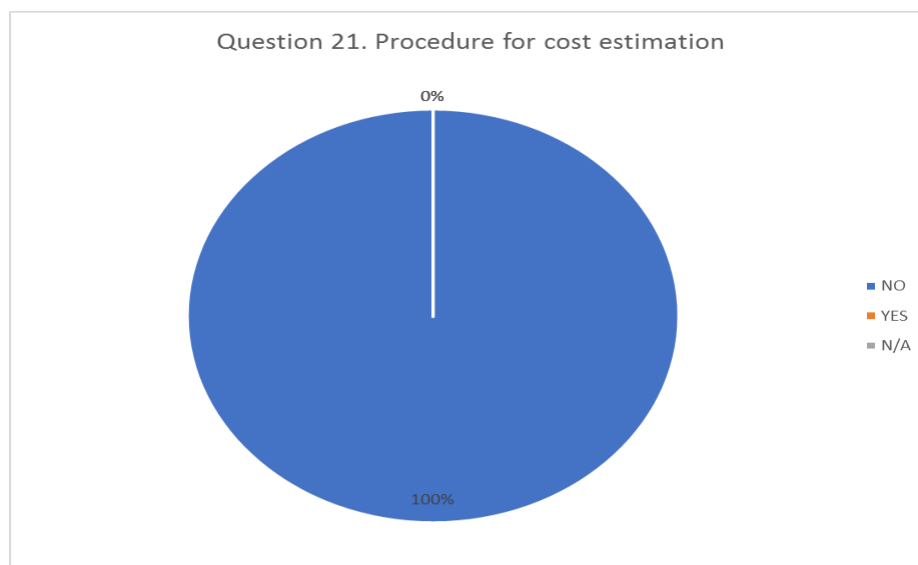


Figure 26 Survey results. Question 21. Procedure for cost estimation (own elaboration).

Regarding the use of any tool for cost management, all the respondents stated as that they do not use a tool and that there is not a formal procedure for cost estimation, however there is software as MS Project and excel that can be used to control the cash flow of the project and reduce as much as possible the cash overflow.

The current methodology proposes a template for the cost estimation, as well as a brief procedure regarding how to complete the template and how to perform the cost estimation taking into consideration the individual cost of the tasks defined in the work breakdown structure, the contingency reserve, and the management reserve.

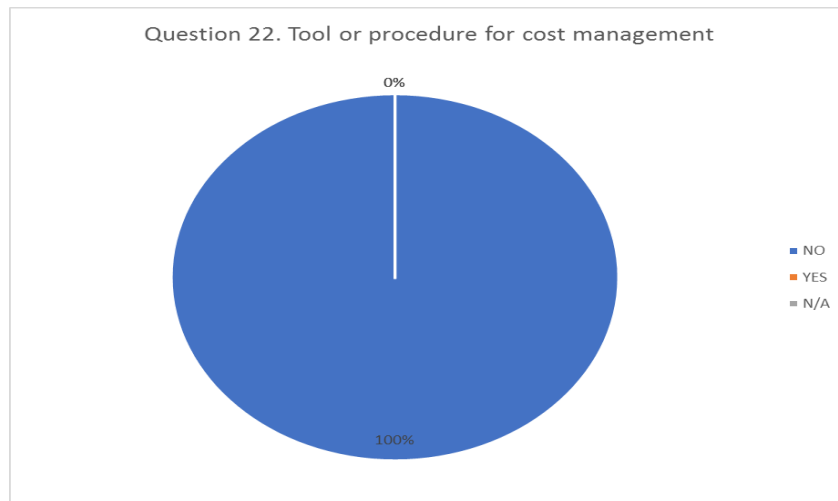


Figure 27 Survey results. Question 22. Tool or procedure for cost management (own elaboration).

4.1.8 Quality Management

Regarding the existence and use of a policy to be followed in order to assess and ensure the quality of the deliverables of the projects a 100% of the engineers who attends the survey manifested that it exist and that they use it when managing the engineering projects.

According to the comments of the engineers, the policy covers from generalities of how to perform the identification of the quality requirements and regulatory

standards applicable, the methods to perform the quality assurance, to the process to assess the performance and recommend the changes from the quality perspective.

Additionally, according to the interviews with the median management of the department, they agreed on the fact that the quality management is taken extremely seriously within the company due to its nature of medical device manufacturing plant, therefore there are templates to assess the deliverables of the projects within the quality requirements.

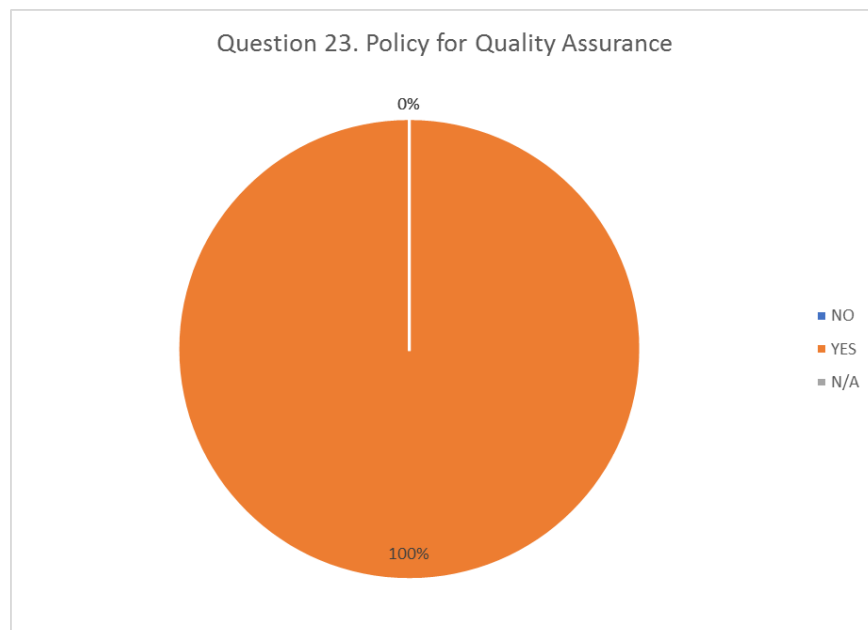


Figure 28 Survey results. Question 23. Policy for Quality Assurance (own elaboration).

4.1.9 Human Resource Management

In terms of human resource management, only the 40% manifest to have performed the project team planning and its corresponding acquisition, the remaining 60% assure that they usually do not perform the human resource planning due there is not a template neither a procedure that states how to perform the planning, therefore the team acquisition is made on demand as required in the last moment and based on the project manager experience and ability to negotiate resources.

One of the main concerns of the median management of the engineering department is the lack of planning in terms of human resources, this condition causes that many project tasks be executed through the payment of overtime which implies an increase in the project costs, work overload for some resources and/or delays in the schedule.

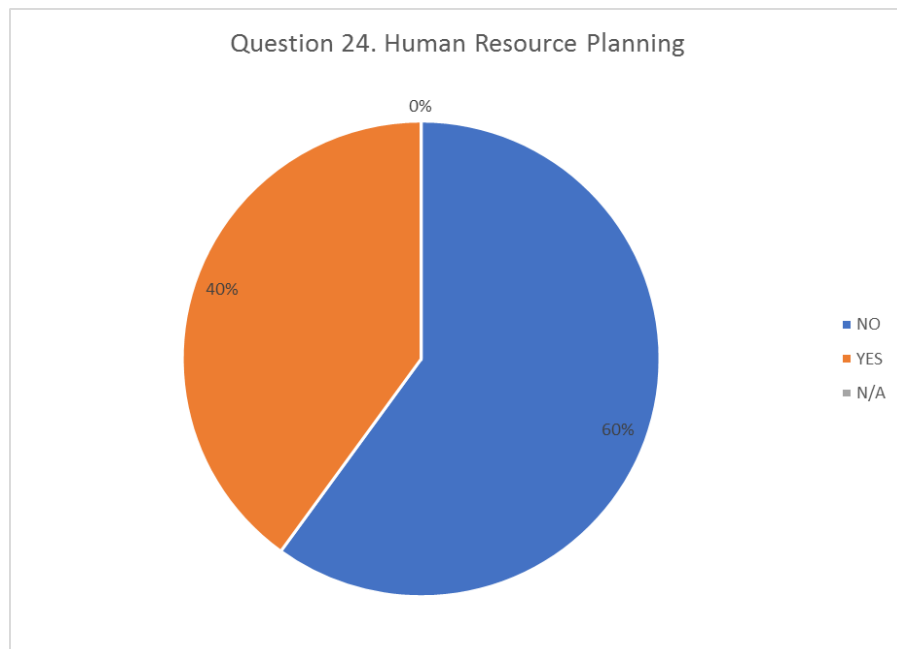


Figure 29 Survey results. Question 24. Human Resource Planning (own elaboration).

Regarding the creation of a roles and responsibilities matrix for each project, the totality of respondents agreed with the idea that the creation of this matrix will delimit the responsibilities for each team member, ensuring that everyone understands their importance for the projects and becomes accountable for the tasks assigned.

The current methodology proposes a template to request the human resource required in order to successfully complete the activities of the project, a RAM (responsibility assignment matrix) template that should be used for both high-level and lower-level to create the connection between the components/activities of the

WBS and the team members of the project; and a brief procedure explaining how to fill out those templates.

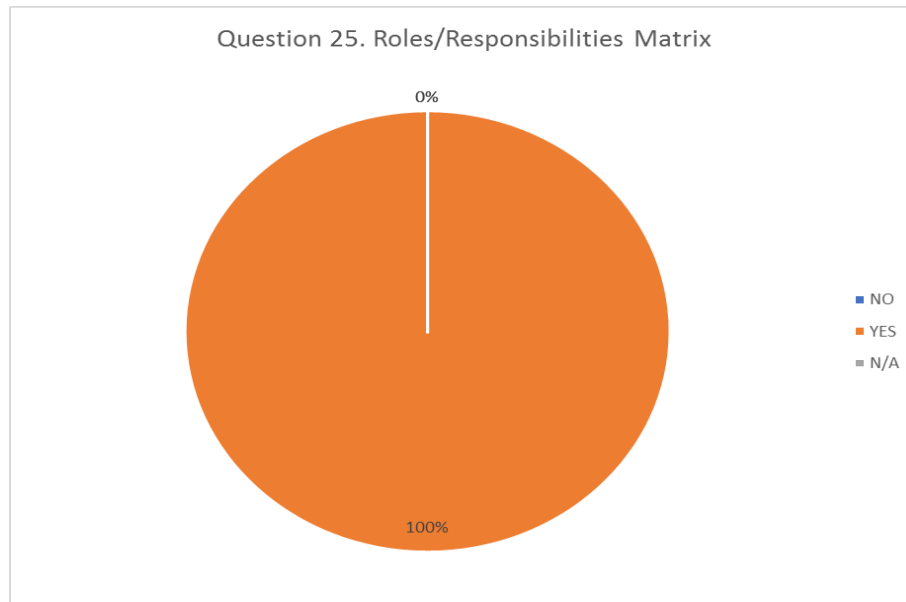


Figure 30 Survey results. Question 25. Roles/Responsibilities Matrix (own elaboration).

4.1.10 Communications Management

In terms of communications management, the 80% manifest to have performed the identification of the stakeholders' communication needs while the remaining 20% said that they have never performed this identification even when the stakeholders are already identified. According to further conversation with the engineering team, the stakeholders' communication needs are identified just in non-formal and verbal basis, since there is not a procedure nor template that establishes this as requirement.

According to the opinion of the median management gathered through the interviews process, one of the complaints of most of directors or high management personnel is the lack of communications of the project status. This is caused because the project managers suppose that team members maintain an open and

continuous communication with their departmental management, nevertheless in most of the cases the project status is not shared.

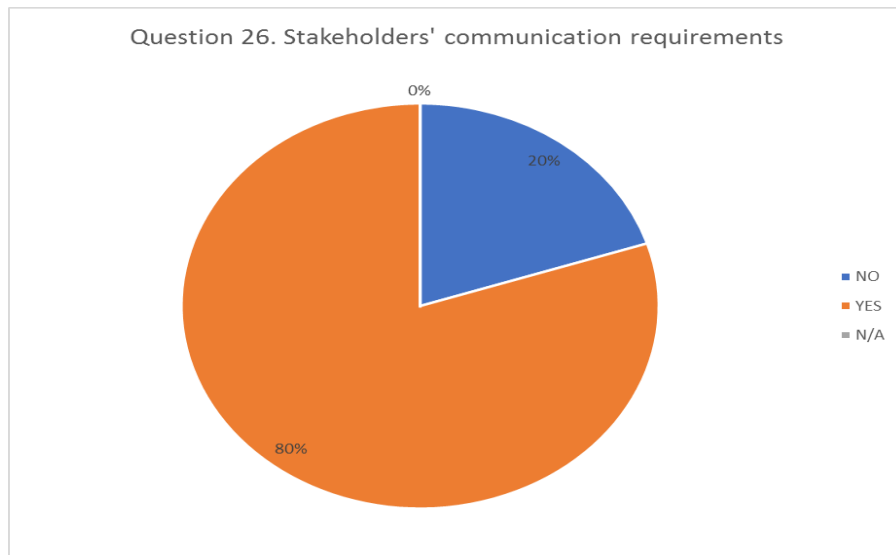


Figure 31 Survey results. Question 26. Stakeholders' communication requirements (own elaboration).

The 100% of the respondents stated as shown in figure 32, that the generation of the communication matrix with the means and frequency of communication for each stakeholder (as required) would help to keep adequately informed the different management levels in terms of project's events such as delays, goals or milestones achieved, and general status; which will impact positively the image of the department in terms of compliance and project management.

The current methodology proposes a template that serve to identify the stakeholders' communications needs in terms of means and frequency, which should be used for the project manager in order to meet the expectations of the stakeholders in terms of communication of the project; and a brief procedure explaining how to complete the template.

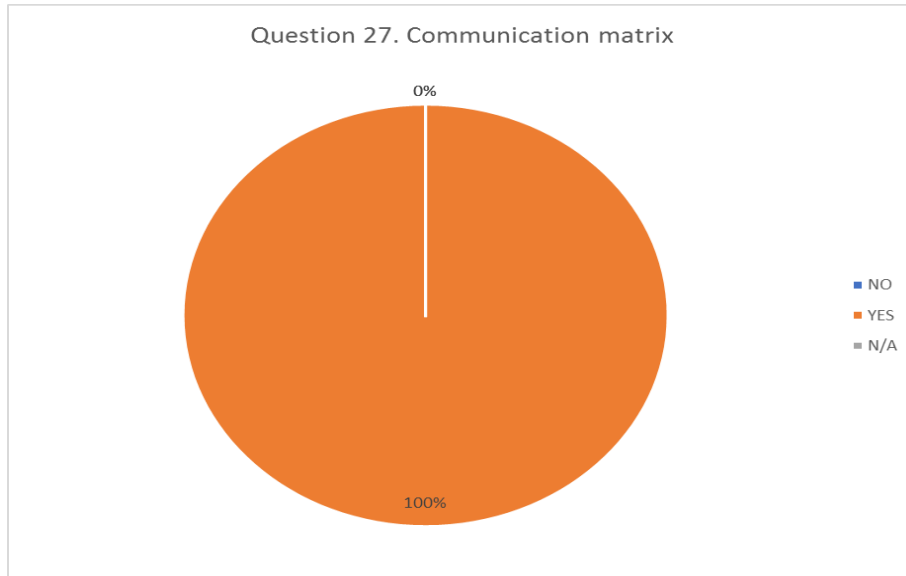


Figure 32 Survey results. Question 27. Communication matrix (own elaboration).

4.1.11 Risk Management

In terms of risk management, as figure 33 shows, 80% of the engineers that attended the survey manifested that they have never performed the initial risk assessment, for the projects that they managed, from the perspective of risk for the project; while the remaining 20% said that they have performed the assessment for its projects. According to the analysis of the procedures and policies of the company and department in terms of risks, it was found that there are procedures that establishes how to perform two different risk assessment called: *System Risk Assessment* and *Functional Risk Assessment*, which both should be completed when a project is intended to modify the manufacturing process or equipment.

These procedures are both focused on the risk of the proposed change in three different aspects: the product design, equipment operability and patient safety; therefore, there are not applicable to the risk assessment from the project standpoint. Nevertheless, even though these procedures are not applicable, they provide the basis for the criteria that should be used in the new procedure and templates for the risk management from project perspective.

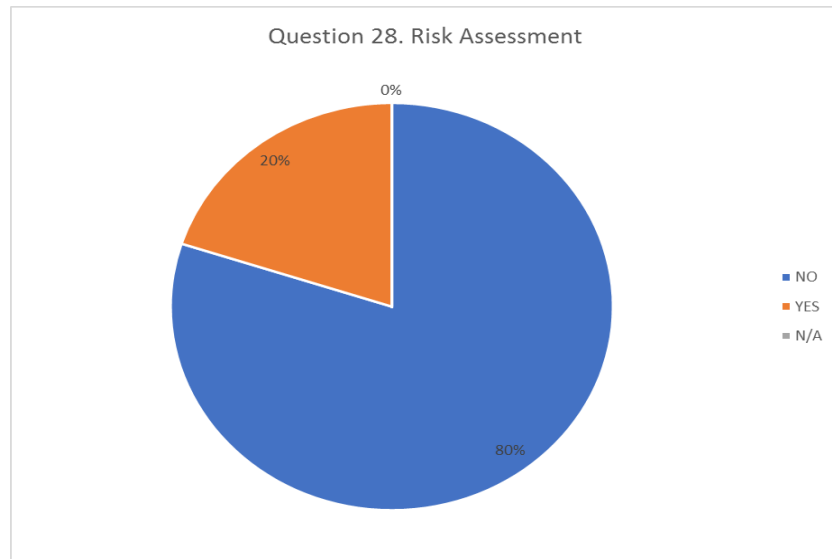


Figure 33 Survey results. Question 28. Risk Assessment (own elaboration).

Regarding the risk follow-up, the 100% of the respondents manifest that they have never performed a formal follow-up of the risk identified (including the product, equipment and patient safety standpoint), because they assumed that the countermeasures that were taken to mitigate, transfer, avoid, or accept the risk were enough and still effective.

According to the engineering director, in the recent history of the department, a couple of projects, in which a huge amount of money and human resources had been invested, have been canceled in advanced stages, due to an incorrect identification and follow-up of the risks of the project; therefore, it is important to execute periodic reviews of the risks to determine the validity of the measures taken, the existence of new risks, and the mitigation plans for the key/critical risks in the different phases of the project based on limitations and assumptions.

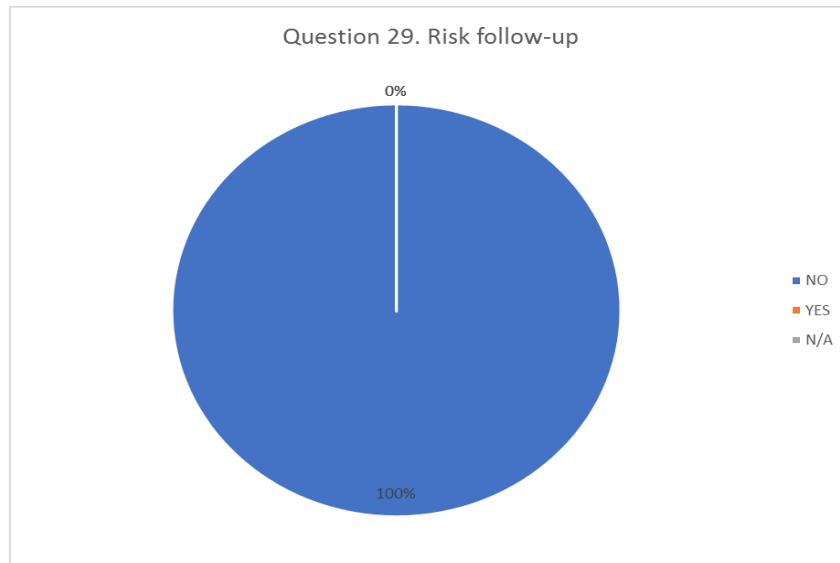


Figure 34 Survey results. Question 29. Risk follow-up (own elaboration).

The current methodology proposes a risk register template that will serve to identify the risk, the cause and the effect of the risk; to classify the risk according to the different parameters, to propose a strategy and countermeasure(s) to manage the risks; a procedure explaining how to fill-out the risk register template, how to classify the risks and how frequent re-assess the project from the risk perspective based on their complexity and scope.

4.1.12 Procurement Management

Regarding the existence and use of a procedure to be followed in order to manage and perform the procurement of goods and services for the projects, a 100% of the engineers who attend the survey manifested that it exists and that they use it when managing the engineering projects.

According to the comments of the engineers, the procedure covers the basis of identifying potential sellers/vendors according to the project's needs; the quoting process with the different sellers/vendors, the selection of the final offer based on quality, cost and schedule; and the process of managing procurement relationships with the suppliers (monitoring performance and compliance according to

contracts). The procurement process is performed by the purchasing team, for this reason the project manager must involve a resource from this department as part of the team in order to ensure that the procurement strategy is performed as required per the project and within the limits of the procedure.

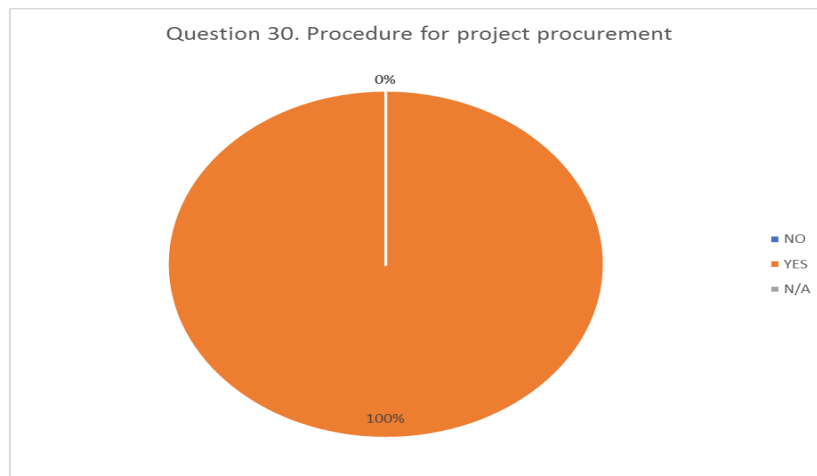


Figure 35 Survey results. Question 30. Procedure for project procurement (own elaboration).

4.1.13 Stakeholder Management

Regarding the process of identification of the stakeholders for the projects, all respondents stated that they perform it during their early stages, even though there is not a procedure or template that formally states the requirement to perform and document the stakeholder identification. Additionally, the stakeholder identification is performed based on previous experience from the project manager and its perspective from the level of complexity of the project.

Nevertheless, according to the interviews performed to the median management of the engineering department, one of the main complains of the directors from others departments of the company is that in the projects managed by the engineering team there is not involvement of personnel from all the different areas from each department, therefore their requirements are not always considered nor meet.

In order to solve this issue, the current methodology propose a brief procedure to assess the participation of personnel from all the areas of the company. This procedure includes a template to document the review of the manager from each area and the assignment of the human resources as required for each project.



Figure 36 Survey results. Question 31. Stakeholder identification (own elaboration).

In terms of the classification for the stakeholders, the 80% of the engineers that attend the survey ensured that there is not procedure or method established to classify the stakeholders in terms of power and interest in the accomplishment of each project, therefore they do not perform any kind of sorting for its projects; however, there was a 20% of the consulted answer that they perform a classification process using a software that the company has and the personal experience.

After a deeper research, it was found that the company has a shared license for a software called *Quality Companion* in which the project manager can list the names or roles of the stakeholders previously identified, and then assign a value for the power and interest of each stakeholder from 0 to 10.

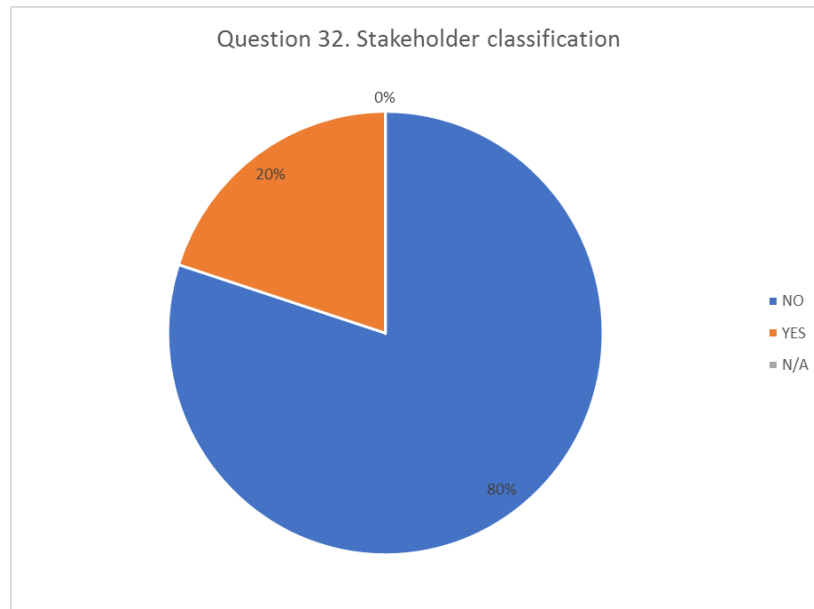


Figure 37 Survey results. Question 32. Stakeholder classification (own elaboration).

This software delimits the important or key zone to focus as the top right corner of the chart (see figure 11), which is based on theory the zone which must be closely manage due its critic level of interest and power; however, it is important to have the understanding that the others zones (keep satisfied, keep informed, and monitor) must be taken into consideration when creating the follow up plan for each stakeholders/category.

Due the existence of this tool (software) at the company, the current methodology proposes a brief procedure and description to be used when completing the stakeholder classification through the *quality companion* software.

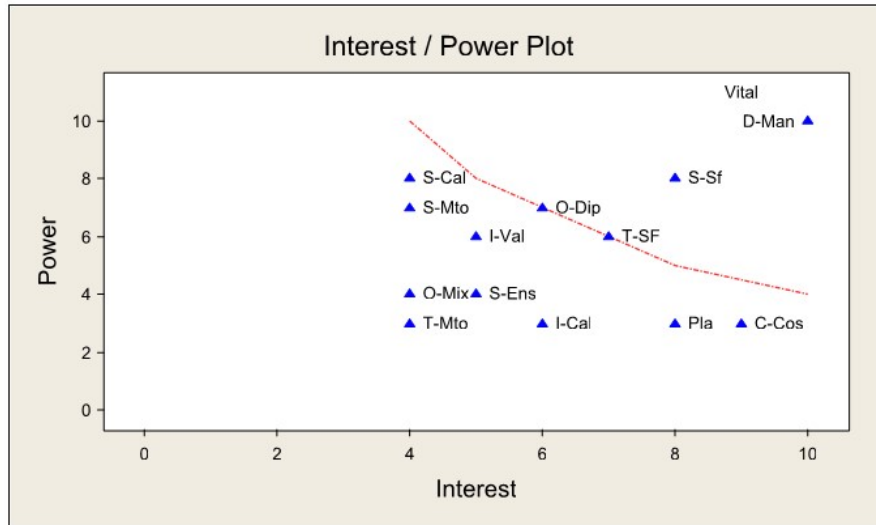


Figure 38 Interest/Power Plot example at Quality Companion software (own elaboration).

4.1.14 Current State Analysis Summary

The result obtained by the application of the survey to the engineers and the interviews with the median management of the engineering department, in conjunction with the review of the policies and procedures existing among the department allows the identification of the elements, tools or procedures belonging to the knowledge areas in which this methodology should be focused to strengthen the weaknesses found in project management issues:

1. **Project Charter:** This document has the objective to formally authorize the existence of a project as well as the creation of a formal record of the project with a well-structured template to document the business needs, assumptions, constraints and other boundaries.
2. **Change Control Template:** This document has the objective to formally receive and document the change request in order to be reviewed and approved or rejected by the change control board, and stored by the project manager or designee. This template document the change as well as their impact on cost, time or scope as required.

- 3. Lessons learned template:** This document is intended to standardize the record of the lessons learned in the engineering projects, in order to avoid that the same mistakes are committed during the execution of projects, and supporting the successful management of new projects within the organization.
- 4. Project closure template:** This document is intended to standardize and formalize the closure of the project with the stakeholders or clients of the engineering department. The procedure states the way in which the templates must be stored in order to keep the information.
- 5. Requirement Matrix and procedure:** This document has the objective to link the project requirements from their origin to the deliverables that satisfy them, by providing a means to track the requirements throughout the project life cycle and providing a structure for managing the changes to the project scope.
- 6. WBS template and procedure:** This template is intended to provide the basis for the identification of the project work packages, in order to create a structured vision of what has to be completed in pursuance of the successfully completion of the project. The procedure indicates the general rules of the WBS, as well as the linking between the work packages and their cost and time.
- 7. Time estimation template and procedure:** This document has the objective to formally establish a standard procedure for the time estimation of the smaller work packages identified at the WBS of each project, the estimation procedure assumes that the information included as duration points is based on previous data gathered by similar tasks or by expert judgement.

- 8. Cost estimation template and procedure:** This document is intended to formally establish a standard procedure for the cost estimation of the smaller work packages identified at the WBS of each project in order to estimate the project cost. The procedure will reflect the bottom-up method as well as the reserve analysis for the determining of project budget.
- 9. Human resource request template:** This document has the objective to formalize the request for human resources for the development of projects, additionally this template will serve for the evaluation and approval of the human resources by each area/department manager.
- 10. Responsibility assignment matrix:** This document is intended to create connections between the activities (work packages) and the project team members in charge of the tasks. This template could be used for both low and high level activities, as required per the projects.
- 11. Stakeholder's register template:** This document is intended to identify the people, departments or organizations impacted by the project and documenting their interest, involvement and impact on the project success.
- 12. Communication matrix template:** This document has the objective of capture the communication needs of the stakeholders, in other words it serves to establish the flow of information that must be communicated with the stakeholders as well as the frequency, the means and the person in charge of perform the communication.
- 13. Risk register template:** This document will serve to identify the risk, the cause and the effect of the risk; to classify the risk according to the different parameters, and to propose a strategy and countermeasure(s) to manage the risks.

4.2 Templates and procedures

In the present section, according to the results obtained from the current state analysis, a series of templates and procedures are made in order to strengthen the areas of weakness found. For this purpose, the templates and procedures were divided into four (4) of the five (5) phases: initiating, planning, executing, and closing; in order to focus the documents that must be generated, according to this methodology, in each phase of the development and lifecycle of the engineering projects. The monitoring & controlling was not considered into the scope of the methodology since the current state analysis does not show the need to create further templates for this phase.

4.2.1 Initiating

Project initiating involves the formal authorizing of the project and provides the key information to the PM in order to begin with the project. The initiating phase includes the creation of the project charter as well as the identifying and analysis of the stakeholders, for this purposes the methodology propose the following documents:

4.2.1.1 Project charter

The project charter is the document created by the initiator or sponsor that formally authorizes the existence of a project, additionally it provides to the project manager with the power to apply resources from the organization to complete the project activities. The act of create the project charter involves a high-level planning in order to assess the feasibility of the project according to the constraints established.

In order to complete the project charter, it is recommended to consult any group or individual with specialized knowledge or training from many sources such as consultants, subject matter experts or other units within the organization.

According to the Project Management Institute the project charter should have at least the following components:

- Purpose or justification,
- Objectives and related success criteria,
- High-level requirements,
- Assumptions and constraints,
- High-level description and boundaries,
- High-level risks,
- High-level schedule,
- Summary budget,
- Former stakeholder list.
- Project manager assigned,
- Name and authority of the sponsor,
- Approval panel.



Eng Project Charter Template

Rev. 01

Project Name			
Project Sponsor (Position)			
Project Manager assigned			
Start Date		Finish Date	
Project Type	<input type="checkbox"/> Maintenance <input type="checkbox"/> Design <input type="checkbox"/> Automation <input type="checkbox"/> EHS <input type="checkbox"/> Facilities <input type="checkbox"/> Other: _____ <input type="checkbox"/> Calibration		
Current State			
Future State			
Purpose or Justification			
Project Objectives (Acceptance Criteria)	1. 2. 3. 4.		
Preliminary Description of Main Deliverables	1. 2. 3. 4.		
Plant Objectives Supported	1. 2. 3. 4.		
Assumptions			
Constraints			
Preliminary Description of Risks			
Preliminary Stakeholder Identification	1. 2. 3. 4.	5. 6. 7. 8.	9. 10. 11. 12.
Budget			
Prepared By:			
Approved By:			
Approved By:			

Figure 39 Project Charter Template (own elaboration).

The project charter proposed by this methodology is shown in Figure 39, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Clear and concise description of the project name, the name should be representative for the endeavor.
- **Project Sponsor(position):** Write down the name of the project sponsor as well as their position(authority) within the organization.
- **Project Manager Assigned:** Name of the proposed project manager chosen by the sponsor and the engineering director, as well as their position within the organization.
- **Start Date:** Include the expected start date for the project, it **must** be a date posterior to the project charter is approval.
- **Finish Date:** Fill out with the expected finish date for the project, this date will provide a high-level schedule for the project.
- **Project Type:** Choose between the different options depending on the objectives or changes proposed by the project, if the type is not among the options choose *Other* and write it down the type that is the most adequate for the project based on expertise.
- **Current State:** Brief description of the current state.
- **Future State:** Brief description of the future state (when the project is executed).
- **Purpose or Justification:** Include in this section the associate risk if the project will not be carried out and the expected benefits of the project.

- **Project Objectives:** Include the statement of the general and the specific objectives of the project.
- **Preliminary Description of Main Deliverables:** Fill out with high level description of the deliverables expected as part of the project.
- **Plan Objectives Supported:** Include in this section the plant objectives with which the project is aligned, if the project is not aligned with any of the plant objectives complete the section with a *Not Applicable N/A* symbol.
- **Assumptions:** Fill out with the factors that are considered as true, real or certain; even when there is not a proof or demonstration. Include the potential impact of those factors if they prove to be false.
- **Constraints:** Complete with the **limiting** factors that affects the execution of the project, some examples are: predefined budget, predefined vendor, imposed dates, contractual agreements.
- **Preliminary Description of Risks:** Include in this section the preliminary list of risks identified as well as their impact in the project in terms of scope, time and cost. This section is not intended to propose the strategy to control the risks.
- **Preliminary Stakeholder Identification:** Fill out with the stakeholders identified for the project, this list will be later updated when the project charter be approved as part of the project planning phase.
- **Budget:** Include the estimated budget to perform the project.
- **Prepared by:** Date and sign the document in order to complete the documentation of the project charter.

- **Approved by:** The document **must** be approved by the engineering director and the project sponsor. They must date and sign the project charter.

4.2.1.2 Stakeholder register

The stakeholder register is the document created by the project manager aimed by the sponsor that identify the people, departments or organizations that could impact or be impacted directly or indirectly by the project, furthermore this document helps to gather relevant information of the stakeholders regarding their interest or expectations, influence and power within the organization for then be categorized according to these factors.

One of the most important benefits of the stakeholder register document is that it allows the project manager to identify the adequate method to deal with each stakeholder or groups of stakeholders; it is quite important for the success of the project to early identify the stakeholders.

In order to complete the stakeholder register template, it is recommended to review the project charter for the preliminary stakeholder list and additionally take in consideration factors such as the enterprise environmental factors and the organizational structure. There are multiple classification models that can be used for the stakeholder analysis, nevertheless as explained in section 4.1, the organization has a software called *Quality Companion* in which the *Power/Interest grid* can be generated, therefore the template will serve to gather the values of level of authority “Power” and level of concern “Interest” to create the grid.

The Stakeholder Register Template proposed by this methodology is shown in Figure 40, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.

- **Stakeholder:** Include the name of the stakeholder, it is important consider both internal and external people, the people that can be affected now and in the future by the implementation of the project, and the persons who can have interest such as: financial, legal, politic, EHS or others.



Eng Stakeholders Register Template

Rev. 01

Project Name						
Stakeholder (Name)	Role in the Organization	Role in the Project	Expectations	Level of Concern	Level of Authority	Priority Group
Prepared By:						(Signature, Date)

Figure 40 Stakeholder Register Template (own elaboration).

- **Role in the organization:** Name of the position of the stakeholder in the organization, note that for those who are external to the company this space must be filled according to the function that the stakeholder has with the organization, for example: vendor, client or others.

- **Role in the Project:** Complete with the expected role of the stakeholder in the project, for example: sponsor, team member or others.
- **Expectations:** Write down the main expectations that the stakeholder has regarding the project.
- **Level of Concern:** Include a value from zero (0) to ten (10) taking into consideration that zero means *no interest at all* and ten means *fully committed with the project*. The value must be given according to the level of interest shown by the stakeholder in the project or its deliverables.
- **Level of Authority:** Include a value from zero (0) to ten (10) taking into consideration that zero means *no power at all* and ten means *total power*. The value must be given according to the level of power that the stakeholder has in the organization and the execution of the project or its activities.
- **Priority Group:** Write out the priority group number as well as the following strategy for each stakeholder based in the criteria depicted in Chart 6.

Chart 6 Priority Groups (Own Elaboration)

Level of Concern	Level of Authority	Priority Group	Following Strategy
0-5	0-5	4	Monitor
6-10	0-5	3	Keep Informed
0-5	6-10	2	Keep Satisfied
6-10	6-10	1	Manage Closely

- **Prepared by:** Date and sign the document in order to complete the documentation of the stakeholder register template.

The data gathered by the completion of the Stakeholder Register Template in terms of stakeholder name, interest and power must be copied into the software *Quality Companion* in order to complete the stakeholder analysis. As shown in

figure 38, the stakeholders that must be **managed closely** are the ones located in the grid at the right upper quadrant.

4.2.2 Planning

Project initiating involves the processes performed to establish the total effort to be executed as part of the scope, to define and refine the project objectives, and to develop the path that must be filled in order to accomplish those objectives. The planning is a reiterative process, when more project information or characteristics are gathered and understood then more planning will be needed.

In order to close the gap identified at the current state analysis for the engineering department, this methodology propose the following documents for the planning phase:

4.2.2.1 Requirement Matrix

The requirement traceability matrix is the document created by the project manager that serve to determining, documenting, and managing stakeholder needs and requirements to meet the project objectives, by the time of linking the requirements from their originator or requestor to the final deliverables that satisfy them.

The generation of this traceability matrix helps to ensure that each requirement adds value to the business by linking it to the project objectives or deliverables, additionally the matrix provides a means to track requirements through the project life cycle, aiming to ensure that the requirements initially approved are delivered at the end of the project. Moreover, the matrix provides a simple structure for managing changes to the scope.

Within the organization, this matrix is intended to gather the requirements and their originator in order to be subsequently detailed in the user requirements

- **Unique ID:** Include a numeric consecutive ID for the requirement, this ID **must** be unique and should not be modified in order to keep a clear tracking of the requirements.
- **Requirement Description:** Fill out with a brief and concise description of the requirement, be clear and direct.
- **Requirement Priority:** Fill out with a value from zero (0) to ten (10) taking into consideration that zero means *no priority at all* and ten means *high priority*. The value must be given per the level of priority identified for each requirement.
- **Rationale for inclusion:** Complete this section with the rationale used to request and include the requirements among the scope of the project.
- **Requestor:** Include the name of the requirement's requestor.
- **Project Objectives:** Complete with the specific project objectives with which the requirement is aligned.
- **WBS Deliverables:** Include the identifiers of the WBS activities that serves to meet the requirement.
- **Current Status:** Complete with the current status of the requirement, for example: active, cancelled, deferred, added, approved, assigned, completed.
- **Prepared by:** Date and sign the document in order to complete the documentation of the requirement traceability matrix template.

4.2.2.2 Work Breakdown Structure Template

The work breakdown structure template is an adjustable document created by the project team that serve to subdivide the project deliverables into smaller and more manageable elements or activities, providing a structured vision of what has to be completed in pursuance of the successfully completion of the project.

The WBS organizes and defines the full scope of the project, the planned work is contained in the lowest levels of the WBS and are used to group the activates where work is scheduled, monitored and controlled.

In order to complete the WBS it is recommended to review the project scope statement, the requirement documentation, and additionally take in consideration factors such as the enterprise environmental factors and the organizational structure. The expert judgement is the key tool used in order to decompose the objectives and/or deliverables into the work packages.



Eng Work Breakdown Structure

Rev. 01

Project Name		
Major Deliverables	Subdeliverables	Work Packages
Task level 1 Description	Task level 2 Description	Task level 3 Description
		Task level 3 Description
	Task level 2 Description	Task level 3 Description
Task level 1 Description	Task level 2 Description	Task level 3 Description
		Task level 3 Description
	Task level 2 Description	Task level 3 Description
		Task level 3 Description
Prepared By:	<i>(Signature, Date)</i>	

Figure 42 Work Breakdown Structure Template (own elaboration).

The WBS Template proposed by this methodology is shown in Figure 42, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Major deliverables:** Include a unique numeric consecutive ID for the task followed by the description, for example: 1. Completion of the Results chapter of the thesis.
- **Sub deliverables:** Include a unique numeric consecutive ID for the second level task followed by the description, for example: 1.1 Completion of the Current State Analysis.
- **Work Packages:** Include a unique numeric consecutive ID for the third level task followed by the description, for example: 1.1.1 Creation of the survey.

The template proposed by this methodology seeks to be a guide for the documentation of the WBS, however, this template can be modified/adjusted as required due the tasks can be subdivided into multiple levels each with multiple activities.

4.2.2.3 Work Breakdown Structure Dictionary Template

The WBS dictionary template is document completed by the project team that serve to provide detailed information regarding each component in the WBS. This template serve as the linking between the work packages and their characteristics such as cost, time and responsible organization or person.



Eng WBS Dictionary Template

Rev. 01

Project Name			
Date			
Work Package ID			
Due Date		Responsible	
Description of work			
Assumptions			
Constraints			
Resources Required	1. 2. 3. 4.		
Scheduled Milestones	1. 2. 3. 4.		
Associated activities	1. 2. 3. 4.		
Cost estimates			
Prepared By:	<i>(Signature,</i>		
Assigned To:	<i>Signature,</i>		

Figure 43 WBS Dictionary Template (own elaboration).

The WBS Dictionary Template proposed by this methodology is shown in Figure 43, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Date:** Fill out with the date when the template is being completed.
- **Work Package ID:** Include the numeric identifier assigned for the task in the WBS.

- **Due Date:** Include the estimated due date for the work package.
- **Responsible:** Include the person or organization in charge of perform the work package.
- **Description of work:** Complete with a brief and concise description of the work to be performed within the scope of the work package.
- **Assumptions:** Fill out with the factors that are considered as true, real or certain; for the work package. Include the potential impact of those factors if they prove to be false.
- **Constraints:** Complete with the **limiting** factors that affects the execution of the work package.
- **Resource required:** List the resources required in order to successfully achieve the completion of the work under the work package.
- **Scheduled milestones:** List the scheduled milestones expected for tracking the work package.
- **Associate activities:** List the activities or work packages that are associated with the work package.
- **Cost estimates:** Fill out with the estimation of the total cost for the completion of the work under the work package.
- **Prepared by:** Date and sign the document in order to complete the documentation of the WBS dictionary template.
- **Assigned to:** The person or organization responsible for the successfully accomplishment of the work package must date and sign the document.

4.2.2.4 Time Estimation Template

The time estimation template is a document that serve to estimate the durations of the smaller work packages or activities identified at the WBS, providing an overall time baseline for the entire project. The most important benefit of the estimation is that provides the amount of time that each activity will take in order to be successfully completed, which serves as an input for the development process of the project schedule.

There are several tools or techniques that could be used to estimate the durations of the activities for the projects, such as the expert judgement, the analogous estimating, the parametric estimating, and the three-point estimating. The time estimation template is based on the three-point estimating method, in which for a specific activity there are three possible values: the optimistic, the pessimistic and the most likely. According to the traditional PERT technique, the distribution recommended is the **Beta Distribution** in which the final value is calculated as shown in the figure 44:

1)	$T_e = \frac{T_p + 4 * T_m + T_o}{6}$
2)	$\sigma^2 = \left(\frac{T_p - T_o}{6}\right)^2$
3)	$\sigma = \sqrt{\sigma^2}$
Where:	
	$T_e =$ Time estimate
	$T_m =$ Time most likely
	$T_o =$ Time optimistic
	$T_p =$ Time pessimistic
	$\sigma^2 =$ Variance
	$\sigma =$ Standard deviation

Figure 44 Time Estimate Equations (own elaboration).



Eng Time Estimation Template

Rev. 01

Project Name			
Date			
Work Package ID			
Due Date		Responsible	
Description of work			
Item	Optimistic Duration	Pessimistic Duration	Most Likely Duration
Scheduled Milestone 1			
Scheduled Milestone 2			
Scheduled Milestone 3			
Scheduled Milestone 4			
Total			
Time Estimated		Standard deviation	
Prepared By:	<i>(Signature,</i>		

Figure 45 Time Estimate Template (own elaboration).

The Time Estimation Template proposed by this methodology is shown in Figure 45, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Date:** Fill out with the date when the template is being completed.
- **Work Package ID:** Include the numeric identifier assigned for the task in the WBS.
- **Due Date:** Include the estimated due date for the work package.

- **Responsible:** Include the person or organization in charge of perform the work package.
- **Description of work:** Complete with a brief and concise description of the work to be performed within the scope of the work package.
- **Optimistic Duration:** Complete with the activity duration based on analysis of the best scenario for the activity.
- **Pessimistic Duration:** Complete with the activity duration based on analysis of the worst scenario for the activity.
- **Most Likely Duration:** Complete with the activity duration based on analysis of the realistic expectations of availability resources and their productivity.
- **Total:** Complete with the result of the sum of the values in the column.
- **Time Estimated:** Fill out with the result given by the application of the equation 1 shown in figure 39, using the values in the **Total** row as the optimistic, pessimistic and most likely duration.
- **Standard deviation:** Fill out with the result given by the application of the equation 3 shown in figure 44, using the values in the **Total** row as the optimistic, pessimistic and most likely duration.
- **Prepared by:** Date and sign the document in order to complete the documentation of the time estimation template.

For the estimation of the project's duration, the next step to be taken after the duration of all the smaller work packages or activities identified at the WBS are calculated, is the implementation of the bottom-up estimating. This method

In order to complete the cost estimation, it is recommended to review the project scope statement, the work breakdown structure documentation, the work breakdown structure dictionary, and additionally take in consideration factors such as the enterprise environmental factors and the organizational structure. The tools and techniques applied in the time estimation can be used also for the cost estimation of each activity, nevertheless the current methodology propose a combination of the different techniques in order to expand the possibilities of cost data generation.

The Cost Estimation Template proposed by this methodology is shown in Figure 46, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **WBS ID:** Include the numeric identifier assigned for the task in the WBS.
- **Time estimated:** Include the value of the time estimated to complete the activity according to the time estimation template.
- **Qty:** Include the quantity of human resources required to complete the task.
- **Price:** Fill out with the average price for the human resources required to complete the task.
- **Cost:** Fill out with the result of multiply the values in the columns: time estimated, qty and price.
- **Hardware:** Write out the price obtained in quote for the hardware required to complete the activity.
- **Software:** Write out the price obtained in quote for the software required to complete the activity.

- **Others:** Include the value of any other expense that must be considered to complete the task.
- **Sub Total Cost:** Fill out with the result of sum the values from the columns: Human resource cost, hardware, software and others.
- **Activity Contingency Reserve:** Include the calculated value to address the *known-unknowns* that can affect a project, this value is calculated as a fixed 7% of the value from column *Sub Total Cost*.
- **Total Cost:** Fill out with the result of sum the values from the columns: Sub Total Cost and activity Contingency Reserve.
- **Total Activities Cost:** Fill out with the result of sum the values from the entire Total Cost column.
- **Management Reserve:** Include the calculated value to address the possible changes generated by the change control process, this value is calculated as a fixed 5% of the value in the *Total Activities Cost*.
- **Project Cost:** Fill out with the result of sum the values from *Total Activities Cost* and *Management Reserve*.
- **Prepared by:** Date and sign the document in order to complete the documentation of the cost estimation template.

4.2.2.6 Human Resource Request Template

The human resource request template is the document created by the project manager to request the personnel required in order to achieve the successful accomplishment of the project activities. This process of acquiring the project team could be considered as a confirmation of the human resource availability, and its key benefit consist of delimiting and guiding the team selection in order to create an effective project team.

The Human Resource Request Template proposed by this methodology is shown in Figure 47, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Project Manager:** Write out the name of the project manager assigned.
- **WBS ID:** Include the numeric identifier assigned for the task in the WBS.
- **Resource Type:** Include the type or resource required for the completion of the activity, for example: calibration technician, validation engineer, manufacturing supervisor, and others.
- **Department:** Fill out with the name of the department at which the resource required belongs to, for example: calibration, validation, manufacturing, and others.
- **Resource Name:** Write out the name of the resource required for the completion of the activity.
- **Start Date:** Include the start date at which the resource is required for the project activity.
- **End Name:** Write out the end date at which the resource required will be released for the project.
- **Manager Approval:** The manager of the resource **must** approve the request for the human resource.
- **Prepared by:** Date and sign the document in order to complete the documentation of the human resource request template.

4.2.2.7 Responsibility Assignment Matrix Template

The responsibility assignment matrix template is a document created by the project team that shows the project resources assigned to each work package. This process belongs to the Plan Human Resource Management that is the process of identifying and documenting the project roles, responsibilities, required skills and reporting relationships.

The RAM template organizes all the activities associated with a specific human resource as well as all the people associated with a specific work package. One benefit of the creation of the RAM, is that it ensures that there is only one accountable person for a task, therefore it serves to avoid confusion of who is ultimately in charge or has the authority for the activity.

The key input required to complete the Responsibility Assignment Matrix is the human resource request template, which must be completed and approved prior to initiate the completion of the RAM. The Responsibility Assignment Matrix Template proposed by this methodology is shown in Figure 48, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Project Manager:** Write out the name of the project manager assigned.
- **WBS ID:** Include the numeric identifier assigned for the task in the WBS.
- **Team Member:** Assign each column of the team member section to one of the members of the project team, then complete the relation between the team member and the task according to the RACI values. If it is required to

- **Prepared by:** Date and sign the document in order to complete the documentation of the RAM template.

4.2.2.8 Communications matrix Template

The Communications Matrix Template serve as the pivotal document of the Communication Management Plan, guiding the process of developing an appropriate approach for the project communications based on stakeholder's needs for information. The key benefit obtained for the project when completing the communications matrix is that it identifies the most effective and efficient manner to communicate with the stakeholders, avoiding both the excess and/or lack of information flow.

The Communications Matrix Template ensures to address interrogates such as:

- What needs to be communicated (message).
- To whom the message must be communicated (audience).
- When and how often the message must be communicated (frequency).
- Who must communicate the message (responsible).
- What method or means must be used for communicate the message.

The Stakeholder Register Template is the document that triggers the completion of the communications matrix, it must be completed and approved prior to spend resources in the completion of the Communication Matrix. The Communications Matrix Template proposed by this methodology is shown in Figure 49, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Stakeholder or Audience:** Write out the name of the stakeholder or audience that is being under assessment.

- **Information or Message:** Complete with the information or message that is required per the stakeholder or audience that is being under assessment.
- **Frequency:** Write out the frequency required per the stakeholder or audience that is being under assessment. For example: daily, weekly, monthly, quarterly.
- **Method of Communication:** Complete with the method or means of communication required per the stakeholder or audience that is being under assessment. For example: e-mail, report(s), 1:1 meetings.



Eng Communications Matrix Template

Rev. 01

Project Name					
Stakeholder or Audience	Information or Message	Frequency	Method of Communication	Stakeholder Approval	Responsible
Prepared By:		<i>(Signature, Date)</i>			

Figure 49 Communications Matrix Template (own elaboration).

- **Stakeholder approval:** The stakeholder under assessment **must** approve the completion of the communication matrix.

- **Responsible:** Write out the person responsible for communicate the information or message with the stakeholder or audience.
- **Prepared by:** Date and sign the document in order to complete the documentation of the communication matrix template.

4.2.2.9 Risk Register Template

The risk register template serve as the main document of the risk management plan, since it is where most of the information regarding the risks is kept. The risk register contains information from the risk identification process to the risk strategy and the risk index.

The key benefit of completing the risk register, is that provides to the project team with the desirable knowledge and ability to anticipate negatively events that could affect the project execution. Identify risks is an iterative process, due new risk may evolve or become known as the project progresses through its lifecycle, therefore the use of the risk register will be repeated as soon as new risk become identified.

The Risk Register Template proposed by this methodology is shown in Figure 51, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Risk ID:** Write out a consecutive unique number that will be used for identify the risk.
- **Date risk Identified:** Write out the date when the risk was identified.
- **Risk Description:** Complete with a brief and concise description of the risk identified.

- **Risk Cause(s):** Complete with the cause(s) that lead to a materialization of the risk.
- **Risk Effect(s):** Fill out with the possible effects caused by the materialization of the risk.
- **Impact:** Write out the numeric value of the impact based in the criteria depicted in Chart 7. The value must be given according the higher value obtained in the impact assessment, for example: a risk impacts the project in terms of cost by less than 1%, with minimal scope implications, and delays in schedule between 4 to 8 weeks, in this case in terms of cost the scale impact is 0.5, in terms of scope the scale impact is 0.5 and in terms of schedule the scale impact is 2, therefore the risk scale impact is the higher value, which is 2.

Chart 7 Impact Scale for the Risk Register (Own Elaboration)

Impact on Project				
Schedule	Cost	Scope	Impact Scale	Scale Definition
< 2 wks	< 1%	Minimal	0.5	Very Low
2 wks to 4wks	1% to 2%	Minor areas	1	Low
4wks to 8 wks	3% to 5%	Major areas	2	Moderate
8 wks to 16 wks	6% to 10%	Unacceptable to sponsor	5	High
>16 wks	>10%	Project abandoned	10	Very High

Probability: Write out the numeric value of the probability based in the criteria depicted in Chart 8.

Chart 8 Probability Scale for the Risk Register (Own Elaboration)

Probability on Project		
Probability Scale	Rate of Occurrence	Descriptor

Probability on Project		
Probability Scale	Rate of Occurrence	Descriptor
10%	Less than one in a 1.5-year period.	Very Low
30%	Once in a 1.5-year period.	Low
50%	Once in a 1-year period.	Moderate
70%	Once in a 9-Month period.	High
90%	More than once in a six-Month period.	Very High

- **P x I Index:** Fill out with the result of multiply the values obtained for risk impact and risk probability, according to the applicable entry values the result must be between 0.05 and 9.00.
- **Classification:** Use the result of the P x I index to found the classification of the risk according to the classification criteria is shown in Figure 50 Probability/Impact matrix. The interpretation of the risk classification must be based on the color of the box that contains the same value as the result of the Pxl index.

		Impact									
		Negative Risks					Positive Risks				
		0.5	1	2	5	10	10	5	2	1	0.5
Probability	10%	0.05	0.10	0.20	0.50	1.00	1.00	0.50	0.20	0.10	0.05
	30%	0.15	0.30	0.60	1.50	3.00	3.00	1.50	0.60	0.30	0.15
	50%	0.25	0.50	1.00	2.50	5.00	5.00	2.50	1.00	0.50	0.25
	70%	0.35	0.70	1.40	3.50	7.00	7.00	3.50	1.40	0.70	0.35
	90%	0.45	0.90	1.80	4.50	9.00	9.00	4.50	1.80	0.90	0.45

Low
Medium
High

Figure 50 Probability/Impact Matrix (own elaboration).

- **Risk Strategy:** Write out the strategy that will be used to deal with the risk according to the risk strategies criteria shown in Chart 9 and Chart 10.

Chart 9. Strategies for Negative Risks or Threats (Own Elaboration)

Risk Strategy	Description of Strategy
Avoid	Risk strategy whereby the project team acts to

Risk Strategy	Description of Strategy
	eliminate the threat or protect the project from its impact. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information or acquiring expertise.
Transfer	Risk strategy whereby the project team shifts the impact of the threat to a third party, it is important to understand that transfer simply gives another party the responsibility for manage the risks but it does not eliminate the risk.
Mitigate	Risk strategy whereby the project team acts to reduce the probability of occurrence or the impact of the risk. The sooner than the actions are taken to reduce impact and/or probability of the risk, the more effective the actions will be.
Accept	Risk strategy whereby the project team decides to acknowledge the risk and not take any action unless the risk occurs. This strategy is adopted where it is not possible or cost-effective to address a specific risk in any other way.

Chart 10. Strategies for Positive Risks or Opportunities (Own Elaboration)

Risk Strategy	Description of Strategy
Exploit	Risk strategy whereby the project team acts to ensure that the opportunity is realized. This strategy seeks to eliminate the uncertainty associated with an opportunity by ensuring the opportunity happens.
Enhance	Risk strategy whereby the project team works to increase the probability and/or the positive impacts of an opportunity; by identifying and maximizing key drivers.
Share	Risk strategy whereby the project team acts to share the positive risk by allocating some or all the ownership of the opportunity to a third party who is best able to capture the opportunity for the benefit of the project.
Accept	Risk strategy whereby the project team decides to take advantage of the opportunity if it arises, but not actively pursuing it.

- **Countermeasure(s):** Complete this section with the countermeasure(s) that will be taken in order to meet the strategy defined in the previous row, the responsible to ensure that each action is completed and a target date for the completion of each action.
- **New Impact:** Write out the numeric value of the impact based in the criteria depicted in chart 7, after the countermeasure(s) taken as part of the risk response strategy.
- **New Probability:** Write out the numeric value of the probability based in the criteria depicted in Chart 8, after the countermeasure(s) taken as part of the risk response strategy.
- **New Pxl Index:** Fill out with the result of multiply the values obtained for risk new impact and risk new probability, the result must be equal or lower that the result obtained in the previous Pxl Index.
- **New Classification:** Use the result of the new Pxl index to found the classification of the risk according to the classification criteria is shown in Figure 50 Probability/ Impact matrix.
- **Prepared by:** Date and sign the document in order to complete the documentation of the risk register template.
- **Authorized by:** The document must be approved/authorized by the Engineering Director or the Project Sponsor. They must date and sign the Risk Register Template.



Project Name			
Risk ID		Date Risk Identified	
Risk Description			
Risk Cause (s)			
Risk Effect (s)			
Impact		Probability	
Pxl Index		Classification	
Risk Strategy			
Countermeasure(s)	Action	Responsible	Target Date
New Impact		New Probability	
New Pxl Index		New Classification	
Prepared By:	<i>(Signature, Date)</i>		
Authorized By:	<i>(Signature, Date)</i>		

Figure 51 Risk Register Template (own elaboration).

4.2.3 Executing

Project executing involves the processes performed to complete the work defined in the planning phase to satisfy the project specifications. The execution involves the coordination of resources, the managing of stakeholders' expectations, as well as integrating and performing the project activities in accordance to the Project Plan.

During the execution of the project, certain uncertainties or unknowns that existed may arise, resulting in a need for planning documentation updates. Those changes must be detailed analyzed prior to the be approved, due they can lead to modifications in the project management plan, the project documentation and even possible changes in baselines such as: cost, time and/or quality.

4.2.3.1 Change Control Template

The change control request template serve as the pivotal document of the execution phase, since it allows for documented changes within the project to be considered in an integrated fashion while reducing project risk.

The change control process consist in 3 stages: the first phase is the ***change request submittal*** in which the change owner or designee fill out the change control request with the information requested per the template and submits the document for review, the second phase is the ***change request review*** in which the change owner or designee explains the impact of the change at the CCB meeting additionally answers the question that the members of the board has regarding the change, the third phase is the ***change request disposition*** in which the panel of the CCB defines what to do with the request: approve, reject, defer.

The Change Control Request Template proposed by this methodology is shown in Figure 52, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Change Requestor:** Fill out with the name of the requestor of the change.
- **Change ID:** Write out a consecutive unique number that will be used for identify the change, request the number to the CCB administrator.

- **Description:** Complete this section with a brief and concise explanation of what is the change.
- **Rationale/Justification:** Write out the problem or business case that is intended to be solved and the benefit for the project of include the change, it can be included what is the scenario of the project in case the change is not approved.
- **Alternatives:** Include the alternatives previously reviewed to solve the problem presented in the rationale section.
- **Impact of change:** Select all the variables that could be affected/impacted by the change.
- **Description of impact:** Include a brief explanation of what could be impacted from the perspective of each variable selected in the section *Impact of change*.
- **Risks:** Fill out with a list of the risks associated to the change.
- **Estimated Cost:** Write out the estimated cost associated to the execution of the change.
- **Estimated Time:** Write out the estimated time associated to the execution of the change.
- **Priority Level:** Fill out with the priority level that has the change. For example: immediate, urgent, medium, low.
- **Risk Level:** Include the higher risk level obtained for the risks listed in the section *Risks*, when completing the risk register template.



Eng Change Control Request Template

Rev. 01

Project Name			
Change Requestor		Change ID	
Description			
Rationale/Justification			
Alternatives	1. 2. 3.		
Impact of change	<input type="checkbox"/> Schedule <input type="checkbox"/> Resources <input type="checkbox"/> Cost <input type="checkbox"/> Requirements/Deliverables <input type="checkbox"/> Scope <input type="checkbox"/> Other		
Description of impact			
Risks	1. 2. 3.		
Estimated Cost		Estimated Time	
Priority Level		Risk Level	
Change Disposition	<input type="checkbox"/> Approve <input type="checkbox"/> Reject <input type="checkbox"/> Defer		
Change Control Approval			
Approved by:	<i>(Signature, Date)</i>		
Approved by:	<i>(Signature, Date)</i>		
Approved by:	<i>(Signature, Date)</i>		

Figure 52 Change Control Request Template (own elaboration).

- **Change Disposition:** Select the disposition to be taken with the change request, this section must be completed by the change control board after the analysis of the change request.
- **Approved by:** The document must be approved by the change control board. They must date and sign the change control request template.

4.2.4 Monitoring and Controlling

Project monitoring and controlling involves the processes required to track, review, and orchestrate the progress and performance of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes. The most important benefit of this processes is that project performance is measured and analyzed in regular basis.


4.2.4.1 Meeting Minute Template

The meeting minute template serves to document the main aspects and generalities of the meetings as part of the monitoring and controlling phase, since it allows to document the agreements, actions items and any changes or issue with which the project is dealing during a certain moment of the execution phase. The meeting minute must be filled out and sent to the personnel invited to the meeting.

The Meeting Minute Template proposed by this methodology is shown in Figure 53, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Date:** Fill out with the date at which the meeting occurred.
- **Time:** Fill out with the hour at which the meeting occurred.
- **Agenda:** Write out the topics that were covered during the meeting, the responsible of present each topic and the time provided for each topic. Examples of general topics that could be covered during meetings are: milestones completion, changes on project budget, changes on project scope, changes on deliverables, challenges and help needed, among others.

- **During the meeting:** Complete this section with a brief explanation of any other topic that were covered during the meeting that were not contemplated within the initial agenda of the meeting.
- **Decisions:** Write out the decisions or agreements taken during the meeting.
- **Follow up:** Include the deliverables that must be completed before the next session, the responsible to ensure that the deliverable or task is completed, and the due date at which the deliverable must be completed.
- **Attendance:** Fill out with the name of the participants in the meeting.



ENG Meeting Minute
Rev.01

Date	Time

Agenda

Topic	Responsible	Time

During the meeting

Decisions

1
2
3

Follow Up

Deliverable	Responsible	Due Date

Attendance

Figure 53 Meeting Minute Template (own elaboration).

4.2.4.2 Project Reporting Template

The project reporting template serves to report the performance of the project and to provide information at an appropriate level for the main stakeholders as part of the monitoring and controlling phase, since it allows to document performance information, the progress measurements and the next steps for the project. The project reporting template must be documented with the corresponding information of the project, and presented to the main stakeholders during a meeting session. The reporting frequency must be monthly for the most important projects in the engineering department.

The Project Reporting Template proposed by this methodology is shown in Figure 54, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Manager:** Fill out with the name of the project manager assigned in the project charter, followed by the name of the project that is being reporting.
- **Update date:** Fill out with the date at which the reporting meeting will be take
- **Progress %:** Write out the percentage of progress according to the tasks completed according to the planned schedule/Gantt.
- **Target Date:** Complete with the target date at which the project is expected to be completed.
- **Customer complains KPI to date:** Write out the number of complains that the customers or stakeholders has regarding the project, its activities and deliverables.

- **Milestones On-Time KPI to date:** Write out the percentage of completion of milestones on time according to the planned schedule/Gantt.
- **Implementation Highlights:** Include the relevant milestones that were completed on time since the last reporting meeting, and the milestones that are delayed or that have changes in terms of cost or performance.
- **Issues & mitigations:** Fill out this section with the problems that the project is having, as well as the countermeasures or mitigations taken in order to handle those issues.
- **People & Recognition:** Include the name of the resources that are currently dedicated to work in the project as well as their role in the project success, include a recognition mention for outstanding work of the resources if applicable, and mention any change in the amount of human resource required to ensure the project success.
- **Next Steps/Help Needed:** Write down in this section the most important tasks or milestones that must be completed as well as any special help needed to accomplish a particular activity.
- **Prepared by:** Date and sign the document in order to complete the documentation of the project reporting template.



Project Manager			
Update Date			
Progress %	Target Date	Customer Complains KPI To Date	Milestone On-Time KPI To Date
Implementation Highlights		Issues & Mitigations	
People & Recognition		Next Steps / Help Needed	
Prepared By:	<i>(Signature, Date)</i>		

Figure 54 Project Reporting Template (own elaboration).

4.2.4.3 Milestones Status Template

The milestone status template serves to gather information regarding the performance of the project and provide information to monitor and calculate the KPI Milestone On-Time as part of the monitoring and controlling phase. The project milestones status template must be documented in a regular weekly basis, in order to kept the KPI as updated as possible without generating overwork for the project managers.

The Milestones Status Template proposed by this methodology is shown in Figure 55, the description of the elements that are part of this template and the information with which they must be completed are detailed below:

- **Project Name:** Fill out with the project name assigned in the project charter.

- **Project Manager:** Fill out with the name of the project manager assigned in the project charter.
- **Implementation/Launch Date:** Complete with the target date at which the project is expected to be implemented/launched.
- **Updated:** Complete with the date at which the project milestone status is being updated.
- **Next Update:** Complete with the next date at which the project milestone status must be updated.
- **Milestone:** Fill out with the description of the milestone, this description must be taken from the work packages of the work breakdown structure.
- **Owner:** Write down the name of the person in charge of ensure that the milestone is completed.
- **Original Target Date:** Write down the original target date established for the work package in the initial project schedule/Gantt.
- **Current Target Date:** Include in this section the target date established for the work package at the most recent project schedule/Gantt.
- **Actual Completion Date:** Complete this section with the date at which the milestone was completed.
- **Status:** Select the corresponding status of the work package/milestone among the following options:
 - 1) Not started: delayed.
 - 2) In process: delated.
 - 3) In process: on track.
 - 4) Completed: on time.

5) Completed: late.

- **Overall status against plan:** Include in this section the overall status of the project against the plan (delayed, on track).
- **Completed milestones:** Complete this section with the total number of milestones completed after the last update.
- **Completed milestones - On Time:** Complete this section with the total number of milestones completed on-time after the last update.
- **Completed milestones - Late:** Complete this section with the total number of milestones completed late after the last update.
- **On track milestones:** Fill out with the percentage of open milestones (activities that are currently opened) that are on track.
- **Monthly Status:**
 - **Total month milestones:** Complete this section with the total number of milestones completed during the month.
 - **Completed milestones - On Time:** Complete this section with the total number of milestones completed on-time during the month.
 - **Completed milestones - Late:** Complete this section with the total number of milestones completed late during the month.
- **Prepared by:** Date and sign the document in order to complete the documentation of the milestones status template.



Project Name					
Project Manager:					
Implementation / Launch Date:		Updated:		Next Update:	

Milestone	Owner	Original Target Date	Current Target Date	Actual Completion Date	Status

Overall status against plan:		Monthly status:	
Completed milestones		Total month milestones	
Completed milestones: On Time		Completed milestones: On Time	
Completed milestones: Late		Completed milestones: Late	
On track milestones <small>(As % of opened milestones)</small>			

Prepared by:	<i>(Signature, Date)</i>
--------------	--------------------------

Figure 55 Milestones Status Template (own elaboration).

4.2.5 Closing


Project executing involves the processes performed to conclude all activities to formally complete the project. This process verifies that the defined processes are completed within all the process groups to close the project, additionally establishes the premature closure of the project. Prematurely closed projects may include for example: aborted projects, cancelled projects, and projects having a critical situation.

4.2.5.1 Lesson Learned Control Template

The lesson learned control template serve to capture all the essential information learned from the experience during the different phases of the project life cycle, in order to generate a knowledge base to be consulted when initiating other projects or endeavors among the engineering department.

The key benefit of the document, is that helps to expand among the team members and personnel of the engineering staff the practical knowledge acquired and/or generated by the successes and errors or improvements opportunities that arises during the project.

The Lesson Learned Template proposed by this methodology is shown in Figure 56, the description of the elements that are part of this template and the information with which they must be completed are detailed below:



Eng Lessons Learned Template
Rev. 01

Project Name	
Lesson Learned - successes	Description, Impacts, and Solutions
Lesson Learned - improvement opportunities	Description, Impacts, and Solutions
Prepared By:	<i>(Signature, Date)</i>

Figure 56 Lessons Learned Template (own elaboration).

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Lesson Learned - Successes:** Write down a situation, that the project team faced during the project life cycle, that can be considered a success because of the way in which it was managed.
- **Lesson Learned – Improvement Opportunities:** Write down a situation, that the project team faced during the project life cycle, that can be considered an improvement opportunity because of the way in which it was managed.
- **Description, impacts, and solutions:** Complete this section with a brief description of the manner in which the situation in question was handled, the impact generated by the situation, and the possible solutions or alternatives that could be taken to reverse or improve the situation.
- **Prepared by:** Date and sign the document in order to complete the documentation of the lesson learner template.

4.2.5.2 Project Closure Template

The project closure template serve in conjunction with the lesson learned template as the pivotal document of the project closing phase, and captures the information regarding how the project objectives have been met, what is their success criteria and what is their result by the end of the project life cycle. The key benefit of this process is that takes the former objectives of the project, stated at the project charter, and performs a compliance analysis to finally document if the result was achieved or if it exists a variance.

The Project Closure Template proposed by this methodology is shown in Figure 57, the description of the elements that are part of this template and the information with which they must be completed are detailed below:



Eng Project Closure Template
Rev. 01

Project Name			
Project Objectives		Success Criteria	Results
Scope Result	Time Result	Cost Result	Quality Result
Post Implementation Activities			
Responsible:			
Prepared By: <i>(Project Team Member)</i>		<i>(Signature, Date)</i>	
Accepted By: <i>(Project Stakeholder)</i>		<i>(Signature, Date)</i>	
Accepted By: <i>(Project Stakeholder)</i>		<i>(Signature, Date)</i>	
Accepted By: <i>(Project Stakeholder)</i>		<i>(Signature, Date)</i>	

Figure 57 Project Closure Template (own elaboration).

- **Project Name:** Fill out with the project name assigned in the project charter.
- **Project Objective:** Write down the description of the objective stated in the project charter, as well as how it was accomplished throughout the project life cycle.

- **Success Criteria:** Write down the description of the success criteria stated in the project charter for the corresponding objective.
- **Results:** Document the result of the project according to the objective, using the success criteria to determine whether or not the objective have been met.
- **Scope Result:** Fill out with the result of evaluate the project in terms of scope compliance.
- **Time Result:** Fill out with the result of evaluate the project in terms of time compliance.
- **Cost Result:** Fill out with the result of evaluate the project in terms of cost compliance.
- **Quality Result:** Fill out with the result of evaluate the project in terms of quality compliance. The quality result of the project, as well as the entire quality management, must be calculated and performed per the procedure *QM-001 Costa Rica Quality Manual*, in its effective version.
- **Post Implementation Activities:** Fill out with any activity out of the scope of the project that should be completed or followed up after the implementation and closure of the project. For example: wait for regulatory approvals, evaluate improvements to the equipment designed by the project.
- **Responsible:** Complete with the name of the person who will be the accountable for the achievement of the post implementation activities.
- **Prepared by:** Date and sign the document in order to complete the documentation of the project closure template.

- **Accepted by:** The document must be accepted/approved/authorized by the main project stakeholders, for example: engineering director, project sponsor. They must date and sign the project closure template.

4.3 Implementation Plan

The Implementation Plan of the methodology is composed by four phases, as depicted in Figure 58, starting with the current state analysis and ending with the expansion of the methodology within other departments of the organization. The elements that belongs to the **Phase 1** were developed as part of the current document/project, therefore no further explanations will be made in this section.

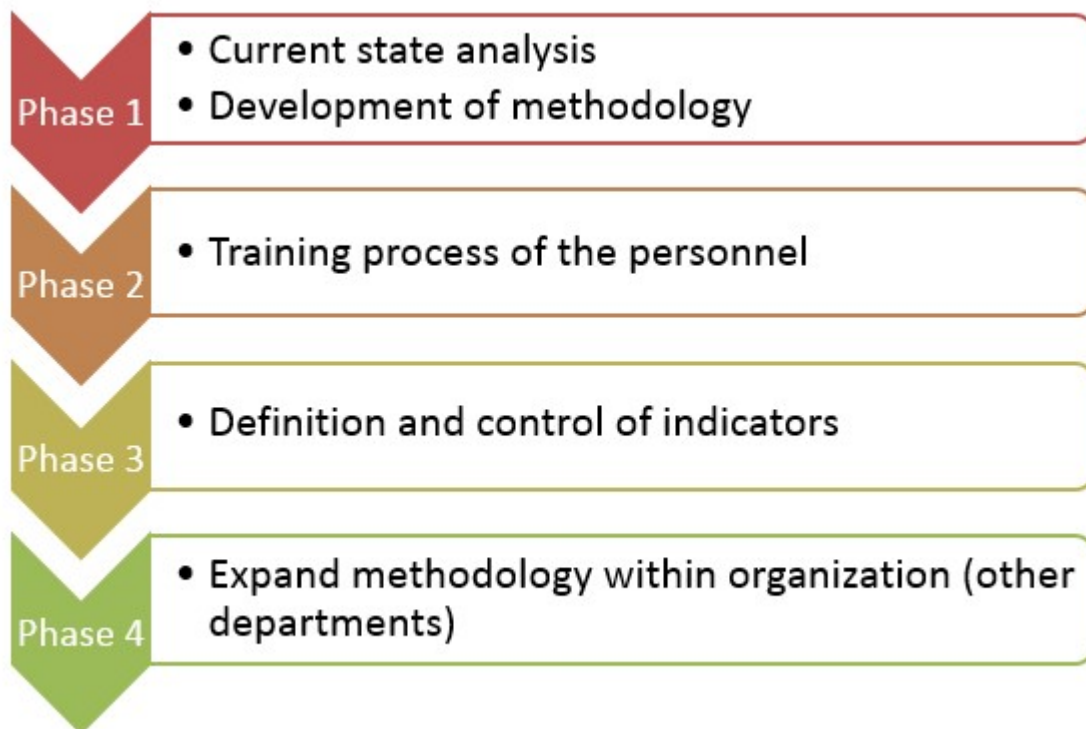


Figure 58 Implementation Plan Phases (own elaboration).

4.3.1 Phase 2: Training Plan

The second phase of the implementation for the proposed engineering project management methodology will start with the development of a Training Plan for the personnel of the department involved in the projects from both perspectives: project managers and project team members, in other words the personnel involved in the training process is the personnel shown in Figure 2, excepting the technicians.

The training for the understanding of the project management methodology has the objective to develop the skills and methods necessary for the initiating, planning, executing and closing of the projects managed by the engineering department of the organization. The second phase of the implementation plan will include exclusively the training of the engineering personnel, nevertheless the intention of the methodology is to expand its coverage for the others departments.

The proposed training consists of a theoretical-practical course to be imparted by the developer of the present methodological proposal in four (4) classes (one per week) each one with an individual duration of four (4) hours. The training sessions will be imparted during working hours; therefore, the engineering director must approve the capacitation in order to schedule the classes.

This capacitation program is intended primary to define the conceptual and methodological bases for the initiation, planning, execution, and closure of the engineering projects based on the methodology developed, while achieving secondary objectives such as: the understanding of generalities of process and knowledge areas of project management, and the application of the methodology in study cases.

4.3.1.1 Course contents

During the capacitation program the following topics are going to be covered:

- Project Management concepts.
- Project Management processes and knowledge areas.
- Use of project management methodology and templates.
- Use of electronic resources available in the organization.

4.3.1.2 Course agenda

As above mentioned, the course will be divided into four (4) classes, the agenda for each class is below detailed:

- **Training session 1:**
 - General description of the capacitation.
 - Develop of basic concepts of project management
 - What is a project?
 - What is project management?
 - The importance of the project management.
 - The role of the project manager, responsibilities and competencies.
 - Project team: roles and composition.
 - Project lifecycle.
 - Project phases.

- **Training session 2:**
 - Develop of project management process
 - Generalities of initiating process groups.
 - Generalities of planning process groups.
 - Generalities of executing process groups.
 - Generalities of monitoring and controlling process groups.
 - Generalities of closing process groups.

- Interactions among process groups.
 - Develop of project management knowledge areas.
 - Generalities of integration management.
 - Generalities of scope management.
 - Generalities of time management.
 - Generalities of cost management.
 - Generalities of quality management.
 - Generalities of human resource management.
 - Generalities of communications management.
 - Generalities of risk management.
 - Generalities of procurement management.
 - Generalities of stakeholder management.
- **Training session 3:**
 - Use of project management methodology and templates according study cases
 - Project charter.
 - Stakeholder register.
 - Requirement matrix.
 - Work breakdown structure.
 - WBS dictionary.
 - Time estimation.
 - Cost estimation.
 - Human resource request.
 - Responsibility assignment matrix.
- **Training session 4:**
 - Use of project management methodology and templates according study cases
 - Communication matrix.
 - Risk register.

- Change control.
 - Lessons learned.
 - Project closure.
- Use of electronic resources for project management
 - Microsoft Project 2010.
 - Quality Companion.
 - Engineering SharePoint.

4.3.1.3 Evaluation Plan

This capacitation program proposes an evaluation of the knowledge based on the assignment of a study case for everyone in which the understanding of the methodology will be tested, everyone has to use the templates as required per the assigned case. The results must be presented and defended to a board formed by the methodology creator and the engineering director in order to complete the capacitation in project management.

4.3.2 Phase 3: Definition and control of indicators

The Phase 3 of the Implementation Plan for the current methodology proposal consist in the definition and control of indicators related with the project management process within the engineering framework. While each project has different tasks to complete and roles to play, they all must support the KPIs in their own way, understanding the role of the key performance indicators in project management can help to build team synergy and provide a framework for the data collection needed to keep track of organizational project success.

Among the benefits of use a well-structured set of key performance indicators, it could be mentioned that the use of KPI serves as a tool for tracking the performance effectiveness of the project team; additionally, it helps to forecast and

monitor in a reliable, repeatable and accurate way the effects of a change during the project lifecycle.

As previously mentioned in the section 1.1, the accountability board is one of the tools currently implemented in the company as part of the operational excellence program. The metric measured in the department through this tool is the compliance percentage, which have shown that the weekly average of fulfillment of the engineering department is below 70%; based on the above consideration and to determine the effectiveness of the project management methodology, the following indicator is proposed:

- **Milestones On-Time:** The percentage of milestone completed under the estimated duration. The success criteria expected for this indicator is to be higher than 90% for the weekly average.

Note: The weekly average is equal to the ratio of the milestones achieved on-time over the total number of milestones of the week.

Due to the existing quality culture within the company typical of a medical device manufacturing company, a factor that must be considered is a good indicator in terms of quality compliance and customer service. Currently the engineering department has an average of three customers complains per month, this is caused by the lack of compliance of the requirements and expectations of the stakeholders; based on the above consideration and to determine the effectiveness of the project management methodology, the following indicator is proposed:

- **Customer Complains:** This KPI serves as the measure of the total amount of complains that the customers or stakeholders has regarding the project, its activities and deliverables. The success criteria must be zero complains, however a reduction in the complains to a rate of one per month will be enough to consider that the methodology is reaching their objective.

Finally, one of the main concerns of the management of the engineering department and the board of directors is the increase in the duration of the tasks of modification and validation of the manufacturing equipment as well as the increase in the projects duration, this is a concern because when the production equipment is disabled from manufacturing, the productive index and product delivery are far from the goals established by the organization; based on the above consideration and to determine the effectiveness of the project management methodology, the following indicators is proposed:

- **Modification & Validation Duration:** The total duration used for the projects for the modification and validation of manufacturing equipment. The current average duration for those changes are 3 months, therefore the success criteria for this indicator is to reduce the average duration to a value of 2 months.
- **Project Duration:** The total duration used for the projects to successfully achieve the objectives stated for the project. The current average duration for the engineering projects is one year, therefore the success criteria for this indicator is to reduce the average duration to a value of 10 months.

The using of the methodology and the monitoring of the indicators will serve for the detection of improvement opportunities to the methodology and the creation of a project management culture among the department. Once the indicators show a stable tendency, the developer of the methodology in conjunction with the engineering director trigger the decision to move forward to the next phase. The expected result is that the Phase 4 starts in a time no more than 18 months after the initial training program is performed.

4.3.3 Phase 4: Expand methodology

The Phase 4 of the implementation for the proposed engineering project management methodology will include the expansion of the coverage of the methodology to the entire organization. This phase will require a massive deployment of the information, procedures, and templates that make up the methodology; as well as repeating the training process towards the entire administrative population of the company, in order to provide the conceptual and methodological bases for the initiation, planning, execution, and closure of the engineering projects based on the methodology developed, while achieving secondary objectives such as: the understanding of generalities of process and knowledge areas of project management, and the application of the methodology in study cases.

Due the organization is composed of several departments, which in turn are divided into different functional areas, the expansion of the project management methodology proposal will be a gradual process carried out by the departmental directors, a resource of the engineering department selected by the director of engineering and the developer of the methodology.

As shown in chart 11, the organization was segregated into 9 different groups, each one has a priority level which was assigned according to the level of involvement that those resources have in the current projects of engineering. The responsible of the training process for each group was assigned according to the priority index, for those which has high priority the responsible is the developer of the methodology, for the medium priority the responsible is the engineering resource, while for those groups with low priority level the person in charge will be the director of the area.

Chart 11. Organizational groups for methodology expansion (Own Elaboration)

ID	Department	Subdepartment	Quantity	Priority	Responsible
1	Board of Directors	N/A	10	High	R. Valverde
2	Human Resources	N/A	8	Low	Human Resources Director
3	Finance	Payment(s)	6	Low	Finance Director
4	Finance	Accountant(s)	4	Medium	Engineering Personnel
5	Quality	Quality in Process	6	High	R. Valverde
	Quality	Validation	10	High	
	Quality	Internal Audits	3	High	
6	Quality	Suppliers	6	Medium	Engineering Personnel
	Quality	Regulatory Affairs	2	Medium	
	Quality	Microbiology	7	Medium	
	Quality	CAPA	5	Medium	
7	Operations	OPEX	5	High	R. Valverde
	Operations	NPI	3	High	
	Operations	PD	4	High	
8	Manufacturing	Supervisors	12	Medium	Engineering Personnel
9	Manufacturing	Improvements	8	High	R. Valverde
10	Supply Chain	Procurement	6	Medium	Engineering Personnel
11	Supply Chain	Warehouse	3	Low	Supply Chain Director
	Supply Chain	Planning	5	Low	

Due to the existing limitation of the resources assigned to execute the training in the project management methodology during the expansion process, a Gantt in which the planning of the expansion process is contemplated considering the limitation before mentioned is proposed. As shown in figure 59, the first training to be carried out corresponds to the team of directors, since they will be in charge of imparting various trainings to the personnel of their own areas.

	Task Name	Duration	Predecessors	Resource	
Gantt Chart	1	Training Group 1	1 mon		R. Valverde
	2	Training Group 2	1 mon	1	HR Director
	3	Training Group 3	1 mon	1	Finance Director
	4	Training Group 4	1 mon		Engineering Personnel
	5	Training Group 5	1 mon	1	R. Valverde
	6	Tranning Group 6	1 mon	4	Engineering Personnel
	7	Training Group 7	1 mon	5	R. Valverde
	8	Training Group 8	1 mon	6	Engineering Personnel
	9	Tranning Group 9	1 mon	7	R. Valverde
	10	Training Group 10	1 mon	8	Engineering Personnel
	11	Training Group 11	1 mon	1	Supply Chain Director

Figure 59 Training Groups Dependency Relations (own elaboration).

The expansion process, as shown in figure 57, must be completed in a time equal to or less than 4 months after the start of phase 4 of the implementation plan. After this training process, it is considered the responsibility of the staff to use the project management processes according to the stipulations of the methodology, and the responsibility of the engineering director to keep the project system under control and in search of improvement opportunities. An important aspect of Figure 60 is that it shows the general structure of relationships between the tasks of this phase 4, however, the dates shown are for illustrative purposes only to depict the 4 months of duration of all these tasks.

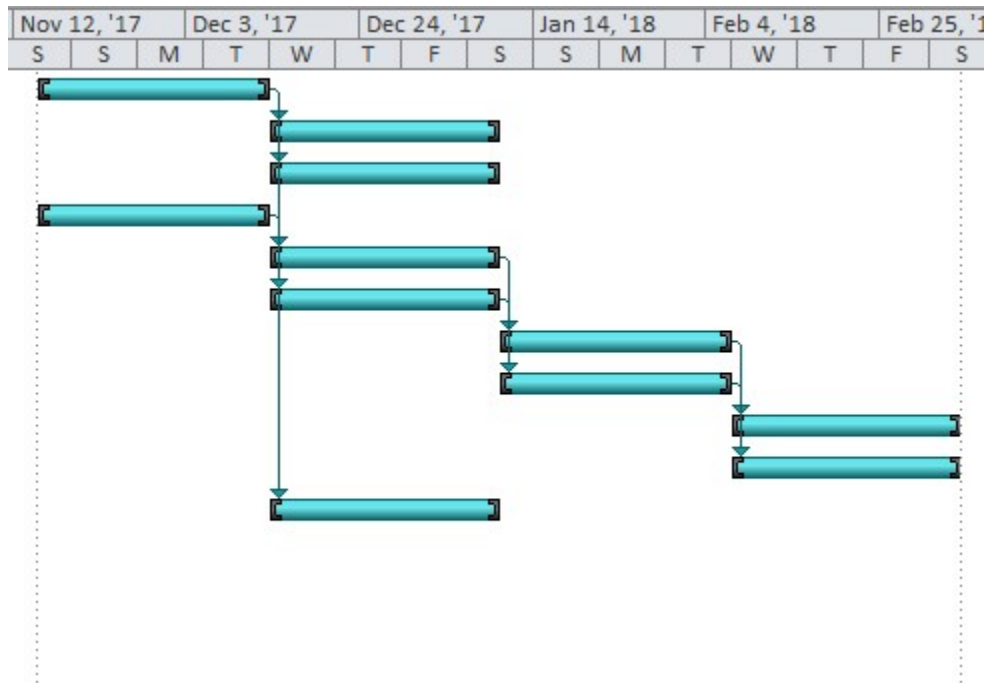


Figure 60 Gantt Chart of the Phase 4 (own elaboration).

5 CONCLUSIONS

1. A current state analysis of the engineering department regarding project management was conducted through surveys and interviews with the engineering staff, and reviews of existing procedures and documentation. The current state analysis showed that there exist improvement opportunities in several areas, therefore the methodology was elaborated according to the needs of the engineering department.
2. The resources that the organization has for project management, are good in general, the drawback is that it applies the same method to any project without analysis for each specific case. The methodology proposed helps to assess and manage each project as a unique and individual unit, this will serve to successfully accomplish the projects established by the company.
3. A methodology proposal that includes procedures and templates for the standardization of the project management within the engineering department was elaborated according to the needs. This methodology offers a significant improvement over the current initiatives that the engineering department has in terms of project management, since it is aligned with the best practices and theoretical knowledge stated in the PMI standard.
4. Most of project managers use to put a lot of effort performing the planning, execution and monitoring of the projects nevertheless is quite often to ignore the process of document adequately the project. Therefore, this methodology focuses in the creation of easy-use templates, that were made to facilitate the project manager work while ensuring the adequately documentation process of the projects.
5. An implementation strategy for ensure the application of the project management methodology was proposed. This implementation plan is composed by four phases starting with the development of the methodology, passing through the training process and indicators definition and control,

and concluding with the expansion or inclusion of the methodology within the entire organization of the company.

6. It is of vital importance to have properly trained personnel within the organization, as well as a body of advisors or external suppliers with high experience in both technical and project management issues; for this reason, it is that the training plan will be aimed at strengthening the skills of the team, with what seeks to ensure the efficient management of projects within the organization.
7. A simple and easy-to-use project management methodology proposal was developed, this tool will serve to guarantee that the projects managed by the engineering staff be successfully accomplish in terms of scope, time and costs as established by the company.
8. The key of create the WBS is that the deliverables and the work to be done as part of the projects are subdivided in a way that it clearly shows the activities that must be developed to finalize it, while contributing with the definition of the activities and their duration which serves to have a well-defined scope. Additionally, the creation of the WBS dictionary serves to document in a detailed manner each of the components of the WBS, making the work easy to be understood.
9. It was evidenced that an adequate roles and responsibilities assignment will ensure that the activities defined as part of the WBS are linked with the available human resources, therefore the definition of the project schedule and their respective Gantt chart could be made based on the relations among the activities and the relation among human resource and activity.

6 RECOMMENDATIONS

1. The director of engineering and the director of operational excellence are encouraged to include the present project management methodology within the scope of continuous improvement and operational excellence programs, using the lessons learned generated by the use of the methodology as an input for future improvements in the same, since although it is true that the proposed methodology was made according to the needs found during the analysis of the current state, the environmental factors of the company and the needs in terms of project management varies constantly.
2. Departmental directors are encouraged to ensure active participation in the use and knowledge of this methodology for personnel in all areas of the company that are related to project management, in addition to the creation of a continuous training program that serves to strengthen the management of projects at different levels of the company in order to create a robust organizational culture in terms of project management.
3. Board of directors are encouraged to analyze the possible creation of a Project Management Office that serves to guide the project managers in the use of the methodology as well as initiate with the alignment of the projects with the strategic objectives of the company at the level of program management.
4. It is recommended to the board of directors to create a series of criteria under which all the projects can be classified in order of importance, this in order to allocate the limited human resources in the main projects of the plant, which in turn benefits in the fulfillment of the company's organizational objectives.
5. It is recommended to the director of engineering to carry out a study of the existing software options for the development of the WBS, in addition it is recommended to acquire the license of use of the corresponding product so

that the professionals of the department can carry out in an easier way the development of an adequate structuring of the tasks to be executed during the projects.

6. It is recommended to the engineering staff to generate a standard worksheet for each work position, this in order to establish a repetitive and foreseeable basis for continuous improvement and to involve each of the members of the department in the initial and current to later achieve the highest levels in terms of performance when managing projects.
7. It is recommended to the organization, to include the templates and procedures generated as part of this methodology in the official document repository, this with the purpose of providing a better traceability and control of the versions for ensure that the personnel are using a current template and/or procedure.
8. Project managers are recommended to execute periodic reviews of the risks identified through the tools proposed by the present methodology, in order to evaluate the validity of the assigned values during the risk analysis, as well as the strategy and the measures taken for those risks. Maintaining the risks at a low level, help firmly in the achievement of the objectives set for the projects.

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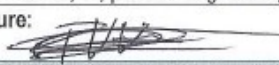
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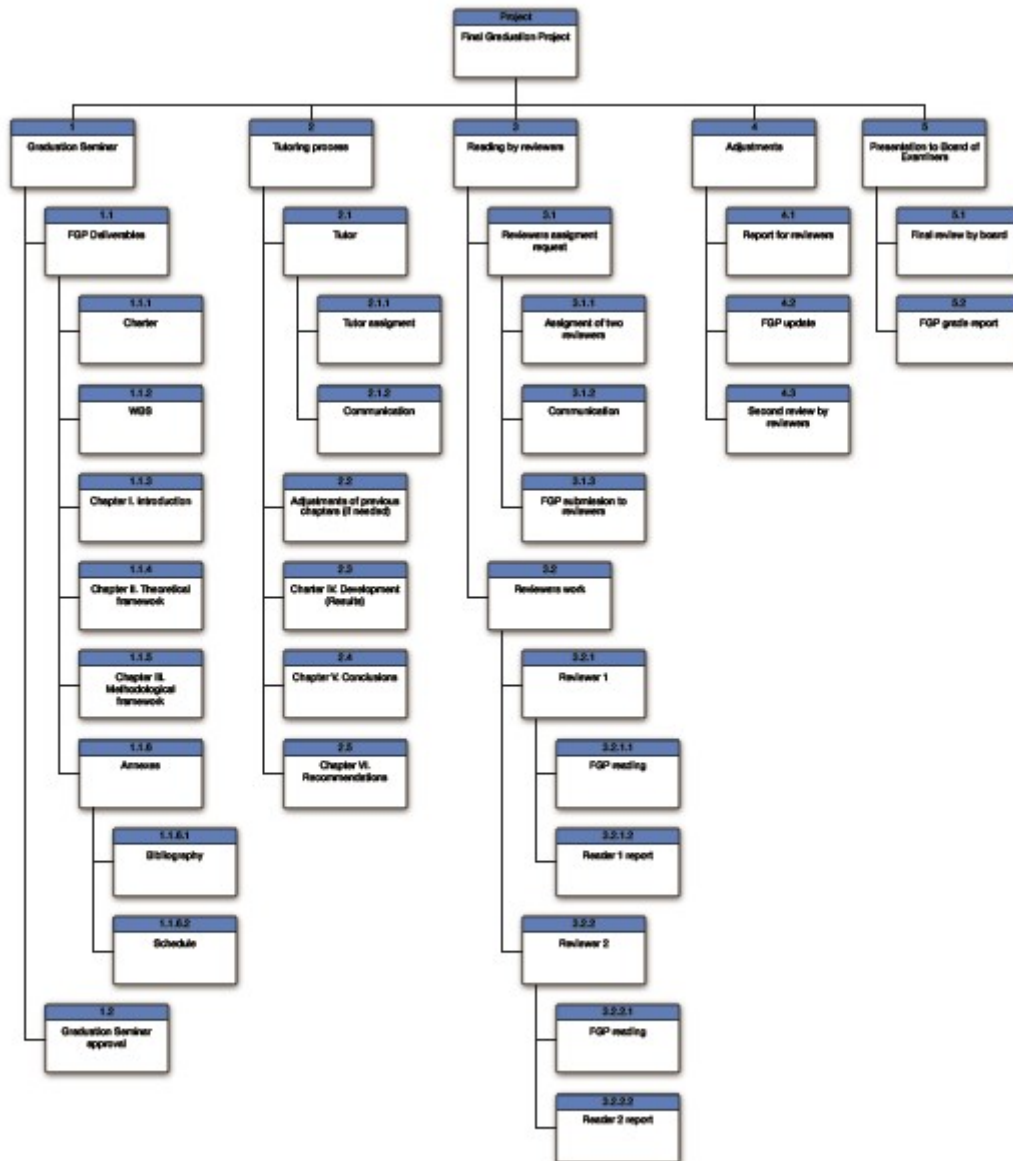
8 APPENDICES

Appendix 1: FGP Charter

PROJECT CHARTER	
Date	Project Name:
26- Jun -17	Methodology for Engineering Projects Management at Allergan Costa Rica.
Knowledge Areas / Processes	Aplicacion Area (Sector / Activity)
Knowledge areas: Integration, Scope, Time, Cost, Quality, Human Resource, Communication, Risk, Procurement and Stakeholder. Process groups: Initiating, Planning.	Medical Devices Manufacturing Industry/ Engineering
Start date	Finish date
26- Jun -17	22- Dec -17
Project Objectives (general and specific)	
<p>General objective: To develop a methodology for engineering projects management at Allergan Medical Costa Rica, in order to guarantee the successful accomplishment of the projects in terms of scope, time and cost.</p> <p>Specific objectives: 1 To develop an analysis of current state of the engineering department regarding the project management, in order to identify the areas of improvement at which the methodology must focus on. 2 To elaborate procedures and templates to standardize the engineering projects management. 3 To propose a implementation strategy to offer a guide with the steps required for the application of the project management methodology.</p>	
Project purpose or justification (merit and expected results)	
The engineering department of Allergan Costa Rica has been part of a huge number of projects, as project managers and team members, without applying a standardized procedures / methodology of project management. It is expected that with this methodology the management of engineering projects will be standardized, which allows the effective accomplishment of the projects in terms of scope, time and cost, and the adequate documentation process of the results and lessons learned of the projects.	
Description of Product or Service to be generated by the Project – Project final deliverables	
<p>A report will be provided on the current state of project management at engineering department.</p> <p>A series of detailed procedures and templates will be provided specifying the necessary instructions for the use of the standardized methodology for the engineering projects management.</p> <p>An action plan will be provided with the recommended steps to the implementation of the methodology at the engineering department.</p>	
Assumptions	
<p>There is a high level of disponibility and openness of the engineering personnel who is or was involved in projects as managers or team members.</p> <p>The information provided by the engineering personnel is real.</p> <p>The documentation and information required to develop the methodology is available.</p> <p>A high level of interest exist among the engineering department, and they will be supporting the implementation of the methodology proposed per this FGP.</p>	
Constraints	
<p>There is no personnel or staff dedicated to gather and analyze the data required to the design of the methodology.</p> <p>The research will demand time from all the engineering team.</p> <p>The timeframe of the project is 4 months.</p> <p>There is not budget assigned for the implementation of the methodology, all the cost should be covered as regular expenses of the department.</p> <p>The project scope does not includes the implementation nor the monitoring&control of the methodology.</p> <p>The methodology must be aligned with the quality management practices of the company.</p>	

Preliminary risks		
<ul style="list-style-type: none"> • If the information required is not available on time it can affect the results of the research, impacting the quality of the analysis and the schedule of the project. • Lack of availability of the engineering staff can affect the assessment of the current state, delaying the project. • Changes in the requirements or structure of projects at engineering department can affect the scope of the project impacting the schedule of the FGP. 		
Budget		
No budget have been assigned for this FGP.		
Milestones and dates		
Milestone	Start date	End date
Development of FGP Charter and WBS	26 Jun 17	02 Jul 17
Development of Introduction Chapter and Schedule.	03 Jul 17	09 Jul 17
Development of Theoretical framework Chapter.	10 Jul 17	16 Jul 17
Development of Methodological framework Chapter.	17 Jul 17	23 Jul 17
Development of Executive Summary, and Bibliography Chapters	24 Jul 17	30 Jul 17
Development of the FGP	31 Jul 17	31 Oct 17
Reading and corrections	01 Nov 17	22 Dic 17
Relevant historical information		
<p>Allergan Medical is a transnational company dedicated to the manufacture and commercialization of medical products, from drugs to botox. The division of Allergan in Costa Rica, located in La Aurora de Heredia, focuses on the development of breast implants with the highest quality standards. The department of engineering is conformed by two managements (facilities and maintenance) and other sub-departments like precision workshop, calibration workshop, design and automation team. The company's knowledge of Lean and Six Sigma has allowed to lay the foundations for the development of projects for continuous improvement, however, a project management methodology that encompasses the needs of all departments has not been implemented.</p> <p>The department of engineering through the accountability board has begun to measure the fulfillment of the tasks of all the projects in which they are involved and the results have shown that there are problems with the management of the projects, especially in the accomplishment of tasks , the definition of requirements and scope, and the communication of progress within the stakeholders.</p> <p>This FGP will help the engineering staff to integrate the basic concepts of administration to the projects in which they are involved, in order to initiate the culture of the company in issues of formal project management</p>		
Stakeholders		
<p>Direct stakeholders:</p> <ul style="list-style-type: none"> • Engineering Staff. • Project Manager. • UCI staff: Graduation Seminar Profesor and Assistants,tutor and reader of the FGP. <p>Indirect stakeholders:</p> <ul style="list-style-type: none"> • Clients of Engineering (manufacturing, quality, supplychain, finance, IT, process engineering). 		
Project Manager: <i>Ronald Valverde</i>	Signature: 	
Authorized by:	Signature:	

Appendix 2: FGP WBS



Appendix 3: FGP Schedule

ID	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1	1		Final Graduation Project	130 days	Mon 6/26/17	Fri 12/22/17	
2	1.1		FGP Start	0 days	Mon 6/26/17	Mon 6/26/17	
3	1.2		Graduation Seminar	25 days	Mon 6/26/17	Fri 7/28/17	2
4	1.2.1		FGP Deliverables	20 days	Mon 6/26/17	Fri 7/21/17	
5	1.2.1.1		Charter	5 days	Mon 6/26/17	Fri 6/30/17	
6	1.2.1.2		WBS	5 days	Mon 6/26/17	Fri 6/30/17	
7	1.2.1.3		Chapter I. Introduction	5 days	Mon 7/3/17	Fri 7/7/17	5,6
8	1.2.1.4		Chapter II. Theoretical framework	5 days	Mon 7/10/17	Fri 7/14/17	7,12
9	1.2.1.5		Chapter III. Methodological framework	5 days	Mon 7/17/17	Fri 7/21/17	8
10	1.2.1.6		Annexes	15 days	Mon 7/3/17	Fri 7/21/17	
11	1.2.1.6.1		Bibliography	5 days	Mon 7/17/17	Fri 7/21/17	8
12	1.2.1.6.2		Schedule	5 days	Mon 7/3/17	Fri 7/7/17	6,5
13	1.2.2		Graduation Seminar approval	5 days	Mon 7/24/17	Fri 7/28/17	9,11
14	1.3		Tutoring process	65 days	Mon 7/31/17	Fri 10/27/17	
15	1.3.1		Tutor	3 days	Mon 7/31/17	Wed 8/2/17	
16	1.3.1.1		Tutor assignment	1 day	Mon 7/31/17	Mon 7/31/17	13
17	1.3.1.2		Communication	2 days	Tue 8/1/17	Wed 8/2/17	16
18	1.3.2		FGP deliverables	60 days	Thu 8/3/17	Wed 10/25/17	16,17
19	1.3.2.1		Adjustments of previous chapters	3 days	Thu 8/3/17	Mon 8/7/17	
20	1.3.2.2		Charter IV. Development (Results)	50 days	Thu 8/3/17	Wed 10/11/17	
21	1.3.2.3		Chapter V. Conclusions	5 days	Thu 10/12/17	Wed 10/18/17	20
22	1.3.2.4		Chapter VI. Recommendations	5 days	Thu 10/19/17	Wed 10/25/17	21
23	1.3.3		Tutor approval	2 days	Thu 10/26/17	Fri 10/27/17	22
24	1.4		Reading by reviewers	15 days	Mon 10/30/17	Fri 11/17/17	
25	1.4.1		Reviewers assignment request	5 days	Mon 10/30/17	Fri 11/3/17	
26	1.4.1.1		Assignment of two reviewers	2 days	Mon 10/30/17	Tue 10/31/17	23
27	1.4.1.2		Communication	2 days	Wed 11/1/17	Thu 11/2/17	26
28	1.4.1.3		FGP submission to reviewers	1 day	Fri 11/3/17	Fri 11/3/17	27
29	1.4.2		Reviewers work	10 days	Mon 11/6/17	Fri 11/17/17	
30	1.4.2.1		Reviewer	10 days	Mon 11/6/17	Fri 11/17/17	
31	1.4.2.1.1		FGP reading	9 days	Mon 11/6/17	Thu 11/16/17	28
32	1.4.2.1.2		Reader 1 report	1 day	Fri 11/17/17	Fri 11/17/17	31
33	1.4.2.2		Reviewer	10 days	Mon 11/6/17	Fri 11/17/17	
34	1.4.2.2.1		FGP reading	9 days	Mon 11/6/17	Thu 11/16/17	28
35	1.4.2.2.2		Reader 2 report	1 day	Fri 11/17/17	Fri 11/17/17	34
36	1.5		Adjustments	20 days	Mon 11/20/17	Fri 12/15/17	
37	1.5.1		Report for reviewers	9 days	Mon 11/20/17	Thu 11/30/17	35
38	1.5.2		FGP update	1 day	Fri 12/1/17	Fri 12/1/17	37
39	1.5.3		Second review by reviewers	10 days	Mon 12/4/17	Fri 12/15/17	37,38
40	1.6		Presentation to Board of Examiners	5 days	Mon 12/18/17	Fri 12/22/17	
41	1.6.1		Final review by board	2 days	Mon 12/18/17	Tue 12/19/17	39
42	1.6.2		FGP grade report	3 days	Wed 12/20/17	Fri 12/22/17	41
43	1.7		FGP End	0 days	Fri 12/22/17	Fri 12/22/17	42

Appendix 4: Survey

General Information

Name
 Job Title
 Academic Background
 Years at Company
 Years Managing Projects

Project Management Questions

1. Do you use a methodology for the management of engineering projects at the company?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
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2. Do you create a Project Charter for each project?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

3. Is there a Project charter template that must be used for each project?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

4. Do you think the template could be improved?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

5. Do you create the management plans for each project?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

6. Is there a change control board in charge of approve/reject the changes for the project scope and/or budget?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

7. Is there a template to register the change control requests?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

8. Is there a database with the change control requests and its resolutions?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

9. Is there a template to document the lesson learned for the engineering projects?

NO	<input type="checkbox"/>	YES	<input type="checkbox"/>	N/A	<input type="checkbox"/>
----	--------------------------	-----	--------------------------	-----	--------------------------

10. Is there a database with the lesson learned for previous engineering projects? NO YES N/A
11. Is there a procedure for the management of project closure? NO YES N/A
12. Is there a template for the project closure? NO YES N/A
13. Do you perform the requirement identification and the scope definition? NO YES N/A
14. Do you create a requirement traceability matrix? NO YES N/A
15. Do you use the work breakdown structure? NO YES N/A
16. Is there a template or guide to create the work breakdown structure? NO YES N/A
17. Do you perform the time estimation for the projects? NO YES N/A
18. Is there a procedure to be used for the time estimation? NO YES N/A
19. Do you use any tool for the project time management? NO YES N/A
20. Do you perform the cost estimation for the project? NO YES N/A
21. Is there a procedure to be used for the cost estimation for the projects? NO YES N/A
22. Is there a tool or procedure for the cost

management of the projects?

23. Is there a policy or procedure for projects quality assurance? NO YES N/A
24. Do you perform a human resource planning process for the execution of the project tasks? NO YES N/A
25. Do you consider adequate to create roles/responsibilities matrix for the engineering projects in order to delimit the responsibilities for each team member? NO YES N/A
26. Do you perform stakeholders' communications needs identification? NO YES N/A
27. Do you consider adequate to generate a communication matrix which includes the means and frequency of communications for each stakeholder? NO YES N/A
28. Do you perform a risk assessment for each project (from the project standpoint, not equipment nor product)? NO YES N/A
29. Is there a follow-up for the risks identified for each project? NO YES N/A
30. Is there a procedure for the management of procurements? NO YES N/A
31. Do you perform a stakeholder identification for each engineering project? NO YES N/A

32. Is there a tool or method used for classify the stakeholders in terms of power and interest? NO YES N/A
33. Give us your personal opinion regarding the project management at the engineering department, are there improvement opportunities? What are the main gaps to be cover?

Appendix 5: Philologist Dictum

Cristina Campos Marcia

TO WHOM IT MAY CONCERN

I, Cristina Campos Marcia, Bachelor in teaching English from the Universidad Latina; identity card 1-1121-0166; enrolled in COLYPRO (*Colegio de Licenciados y Profesores*), with the card No. 1-1121-0166, I note that I have reviewed the final graduation project and have corrected in it the errors found in spelling, writing, grammar and syntax. Which is entitled:

**METHODOLOGY FOR ENGINEERING PROJECTS MANAGEMENT AT
ALLERGAN COSTA RICA****RONALD ALBERTO VALVERDE VENEGAS****FINAL GRADUATION PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE
MASTER IN PROJECT MANAGEMENT (MPM) DEGREE
UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)**

The present certification is extended at the request of the interested party, in the city of San Isidro de El General on the twenty-second day of the month of November of two thousand and seventeen.



Celular 83115373
Correo electrónico: vadamarcia@gmail.com

Appendix 6: Philologist Credentials

UNIVERSIDAD LATINA DE COSTA RICA

En virtud de la potestad otorgada por las leyes de la
República de Costa Rica y por haber cumplido con los
requisitos reglamentarios de la carrera respectiva

confiere a

Cristina María Campos Marcia

Cédula No. 1-1121-166

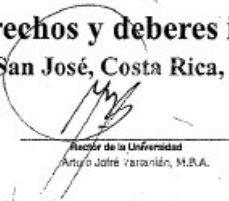
EL GRADO ACADÉMICO DE

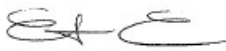
BACHILLERATO EN LA ENSEÑANZA DEL INGLÉS

Con todos los derechos y deberes inherentes al mismo

Dado en la ciudad de San José, Costa Rica, el día 15 de mayo del 2008


Vicerrector Académico
Ing. María Solano Quesada


Rector de la Universidad
Antonio Joffre Izararán, M.B.A.


Por CONESUP
MSc. Evelyn Chen Quesada
Directora Ejecutiva

Inscrito en CONESUP
Inscrito en la Universidad

TOMO 64 FOLIO 216 ASIENTO 38344
TOMO V FOLIO 458 ASIENTO 39456