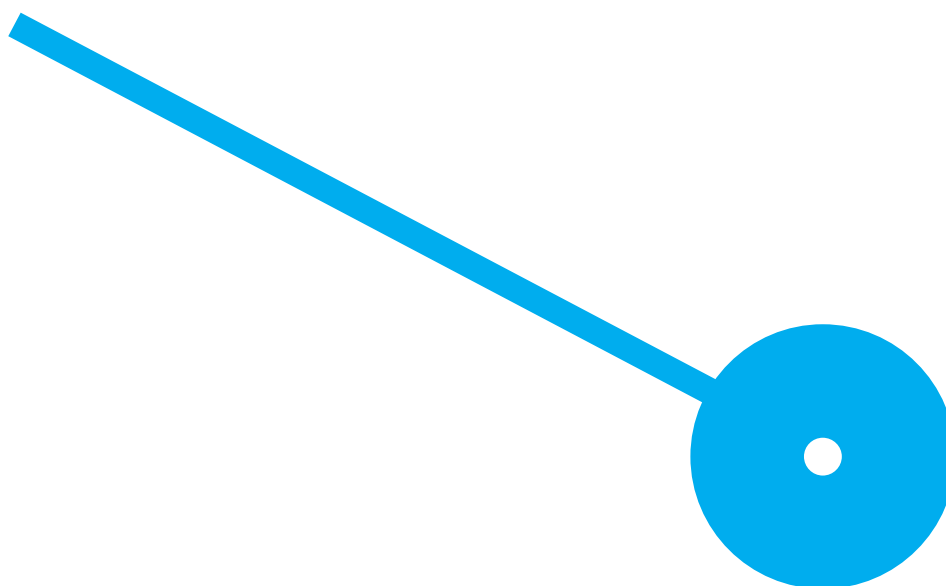


Implementation of a PMO in a new automation business unit in the company Siemens

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ABSTRACT

The present work presents the research and implementation of a Project Management Office (PMO) in an automation laboratory in the industry sector within Monterrey, Mexico. The objective was to fully understand the concepts that surround the project management environment, the PMOs, as well as the challenges that must be overcome in order to successfully implement this PMO framework. The implementation of the PMO had the main purpose to solve the pain points that the laboratory was confronting in its daily business, such as difficulties to present information, prioritize projects, establish standardized processes, handover complications, poor portfolio management among others. We used the action research methodology for this implementation; providing the automation laboratory the best practices to handle extensive information derived from the complex projects they manage. With this new structure and tools, they are now applying standardized procedures, having efficient reports to management, better allocation of resources between the different projects on their portfolio and applying the right project management tools to deliver projects in the most effective and efficient way.

Key words: PMO, Project Management, Project, Portfolio, Tools

RESUMO

O presente trabalho apresenta a pesquisa e implementação de um Project Management Office (PMO) num laboratório de automação no setor da indústria em Monterrey, México. O objetivo era entender completamente os conceitos que rodeiam o ambiente de gestão de projetos, o portfólio de projectos existente, assim como os principais desafios a endereçar para implementar esta PMO framework. A implementação do PMO teve como principal objetivo solucionar as principais dores que o laboratório enfrentava no seu dia-a-dia, como por exemplo: dificuldades na apresentação de informações, priorizar projetos, estabelecer processos padronizados, dificuldades na entrega, gestão ineficaz do portfólio de projetos, entre outros. Utilizamos a metodologia de pesquisa-ação para a implementação, disponibilizando ao laboratório de automação um conjunto de boas práticas para lidar com os seus projetos complexos. Com essa nova estrutura e ferramentas, foram fomentados procedimentos padronizados para obter: relatórios mais eficientes e completos para a administração, uma melhor alocação de recursos entre os diferentes projetos no seu portfólio de projetos e aplicando as técnicas mais adequadas para alcançar o sucesso nos projetos da maneira mais eficaz e eficiente.

Palavras-chave: PMO, Gestão de Projetos, Projeto, Portfólio, Ferramentas

RESUMO ALARGADO

Hoje em dia as indústrias têm um novo aliado chamado tecnologia, e com ela surgem novas oportunidades para as estratégias e processos das indústrias. O processo de industrialização passou por diferentes fases conhecidas como revoluções industriais. A revolução atual, conhecida como Indústria 4.0, procura gerar valor nos seus processos de fabricação, serviços e estratégias de negócios (Lu, 2017).

A posição global da Siemens Monterrey (a empresa na qual o projeto foi realizado) no contexto da Indústria 4.0 levou à criação da sua própria unidade de automação com o objetivo de projetar e executar projetos de automação que podem ser desenvolvidos para empresas internas (SIEMENS em todo o mundo) e externas.

Esta nova unidade foca-se na automação de processos. Clientes de vários tipos de indústrias têm solicitado serviços desta nova unidade com todo tipo de necessidades de automação e integração. Infelizmente, e de acordo com a experiência recente com os projetos iniciais, o laboratório enfrenta dificuldades com o planeamento, desenvolvimento, execução e encerramento de projetos. Tornou-se uma tarefa laboriosa que requer mais tempo, mais esforços e conseqüentemente mais recursos que o esperado.

Após análise das lições aprendidas nos primeiros projetos desenvolvidos por essa nova entidade na empresa, foram detectadas as principais áreas de melhoria/oportunidades. A lista principal continha: falta de metodologia padronizada para desenvolver os projetos; gestão insatisfatória de recursos; falta de processo para avaliar o desempenho do projeto; atraso nas datas de implementação; planeamento deficiente; estimativa imprecisa de tempos de tarefa; dificuldade na indicação do ponto de execução do projetos; cálculo de orçamento impreciso; exigência ambígua dos clientes; falta de método de gestão de mudança; falta de método para priorizar projetos e problemas na atribuição e identificação de responsáveis.

Na maioria destas questões a estrutura do Project Management Institute (PMI) e as boas práticas do Guia do Conhecimento em Gerenciamento de

Projetos (PMBOK®) tornam-se as principais ferramentas na organização desta nova unidade de negócios. O papel fundamental da estrutura do PMI nesse processo de automatização será orientar a implementação de um Project Management Office (PMO).

Com a revisão da literatura, abordamos os conceitos relacionados com a gestão de projetos, os processos organizacionais e a importância de os aprimorar ao longo do tempo. Além disso, validamos a relevância dos PMO nas organizações; Os PMO providenciam as ferramentas certas para a gestão de projetos, portfólios, programas e recursos. Analisamos os diferentes tipos de PMO existentes atualmente, concluindo que a melhor solução depende das características da organização. Como qualquer outra estratégia, existem vantagens e desafios ao implementar e manter um PMO. Após a análise das duas partes, reconhecemos que a introdução de um PMO pode ter um impacto positivo na nova unidade de automação da Siemens.

A metodologia de investigação-ação que utilizamos para este trabalho, potenciou a colaboração com a empresa. Trabalhamos juntos para diagnosticar o problema e desenvolver uma solução. Além disso, a metodologia permitiu testar as propostas num ambiente de trabalho real. A base para essa metodologia foi a recolha de dados reunidos pela equipa, para fazer melhorias nos processos. A equipa da organização percebeu o projeto de implementação de um PMO como uma forma de contribuir para minimizar as dificuldades já identificadas e, em alguns casos, reduzir a carga de trabalho.

O PMO implementado apoia o desenvolvimento de projetos eficientes e gere todo o portfólio de forma suave, prática, transparente, organizada e padronizada. Também contribui para a gestão ideal de recursos ideal, funcionando ainda como suporte metodológico e administrativo para elementos no portfólio.

O desenvolvimento deste projeto de investigação e implementação permitiu uma melhor compreensão sobre os elementos da gestão de projetos, e de como a teoria é aplicada nas empresas. Além de uma boa estrutura de projeto, é essencial ter sempre uma boa comunicação com todas as pessoas envolvidas.

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LIST OF ABBREVIATIONS

AR	Action Research
CCPM	Critical Chain Project Management
CPM	Critical Path Method
ERP	Enterprise Resource Planning
IoT	Internet of Things
PfM	Portfolio Management
PMI	Project Management Institute
PMO	Project Management Office
POO	Project-Oriented Organization
PRiSM	Projects Integrating Sustainable Methods
RAD	Rapid Application Development
R&D	Research and Development

1. Introduction

Nowadays industries have a new ally called technology, and along come new opportunities for the industries strategies and processes. The process of industrialization went through different phases known as industrial revolutions. The first revolution (end of 18th century) achieved to mechanize production and equipment thanks to the use of water and steam power. The second revolution (beginning of 20th century) stood out for having electrical power as the primary source to generate mass production. The third revolution (beginning of 70s of 20th century) was characterized by the use of electronic and information technology to automate production (Lu, 2017). Finally, nowadays we are living the fourth revolution, which integrates computation, networking and physical processes “cyber physical systems” (Bloem, Van Doorn, Duivestein, Excoffier, Maas, Van Ommeren, 2014).

The actual revolution provides the technological developments that have been transforming our society. It promotes the interaction and collaboration of humans and machines (Dombrowski and Wagner, 2014). The concept of industry 4.0 was initially proposed for developing the German economy in 2011 (Lu, 2017), it includes numerous technologies as the Internet of Things (IoT), artificial intelligence, robotics, 3D printing, enterprise resource planning (ERP), among others (Hatzakis, 2016).

It is centralized in the development of more intelligent manufacturing processes, including devices, machines, production modules and products capable of independently exchange information, trigger action and control each other; enabling an intelligent manufacturing environment (Pereira and Romero, 2017). In other words, is the usage of intelligent machines that exploits the digitalization in the production processes and supply chains (Fernández-Miranda, Marcos, Peralta, Aguayo, 2017).

The Industry 4.0 not only promotes the automation of production lines but is also looking for the industries to be able to create intelligent manufacturing facilities characterized by a high level of adaptability, efficiency in the use of

resources, and good ergonomics. Looking always to generate value on their manufacturing processes, services and business strategies (Lu, 2017).

Aligned to this concept, Siemens (the company in which the project was held) is convinced that every company will have to develop its own comprehensive digital enterprise platform on the way to the Digital Enterprise. It includes machines, automation systems and in particular the software tools that are starting to play an ever-greater role in all these areas. They have set itself the goal of supporting its customers in building such platforms from engineering through the automation (Huber, 2016).

The global position of the company to the Industry 4.0 lead SIEMENS Monterrey to create their own automation laboratory that was introduced on 2017 with the purpose to design and execute automation projects that can be developed for internal (SIEMENS around the world) and external companies. This laboratory develops equipment and automation solutions using their own capabilities such as electronic design, software electrical design.

This facility focuses on the automation of processes. For these improvements to happen, the laboratory needs specific mechanical tools, software implementation and a physical infrastructure capable of satisfying these new demands. Therefore, the level of technological complexity increases.

Clients from multiple types of industries came for help to this new unit with every kind of automation and integration needs. But what works in one specific industry may not work in another. Projects should be treated according to the needs and type of support that each industry or company is requiring (Milosevic and Patanakul, 2005). At the same time the automation laboratory has to standardize processes to deal with this dynamic environment.

Unfortunately, and according to recent experience with initial projects, the laboratory is facing difficulties with the planning, management, execution and closure of projects. It has become a laborious task that end up with additional time consumed and much more effort than the expected.

After reviewing the lessons learned on the first projects developed by this new entity in the company, main opportunities areas were detected. The main list contained: lack of standardized methodology to manage the projects; unsatisfactory resources management; lack of process to evaluate project performance; delay in implementation dates; poor planning; inaccurate estimation of task times; difficulty to provide a status of projects; inaccurate budget calculation; ambiguous requirement from clients; lack of change management method; lack of method to prioritize projects and, difficulty to take over activities that somebody else performed.

This is where the Project Management Institute (PMI) framework and the good practices of the Project Management Body of Knowledge (*PMBOK*®) Guide become the main tools in the organization of this new business unit. The key role of the PMI framework in this automatization process will be to guide the implementation of a Project Management Office (PMO).

A PMO “is an organizational structure that standardizes the project-related governance processes and facilitates the sharing of resources, methodologies, tools, and techniques. The responsibilities of a PMO can range from providing project management support functions to the direct management of one or more projects” (PMI, 2017a, p.48)

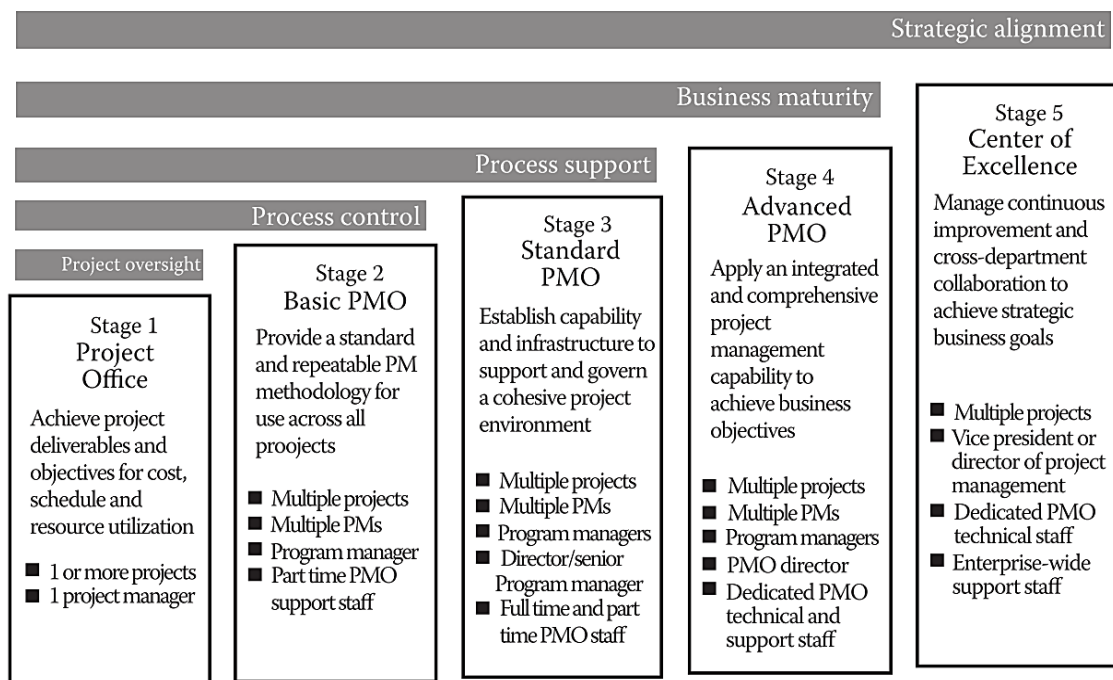


Figure 1. Overview of PMO capabilities across the PMO competency continuum (Hill, 2013)

Hill (2013) proposed 5 stages for PMO implementation (Figure 1). These stages are also denominated as maturity levels of a PMO by Brown (2012). The stages show the progress that a PMO gain within time and experience. The author also claims that not all the organizations need a PMO in stage 5. Most of the organizations accomplish their project management objectives having a Stage 3 PMO. It depends on the business strategies and objectives. However, in order to implement any stage of the PMO, first, the company must guarantee that the lower stages have been achieved.

A complete PMO considers several roles to be fulfilled in the companies, and for those roles, a large quantity of activities are needed to be completed. The implementation of an advanced PMO structure would take from 1 to 2 years (Hill, 2013). In this case and taking in consideration the Figure 1, the competencies of a Stage 1, they are already being performed at the laboratory; they are achieving deliverables by managing the cost, times and resources for the different projects. That is why after an analysis, and after reviewing the complications that the laboratory faced, it has been decided to focus on the Stage 2 Basic PMO, enforcing those main roles that will help to solve the pain points that the laboratory currently has through the adoption of the right tools. Tools that will coordinate,

organize, focus efforts correctly and create a clear path to follow during all the complex projects that the automation laboratory is carrying out.

The following characteristics defined by Hill (2013) were decisive to lead us to implement a Stage 2 Basic PMO at the Siemens' laboratory:

- Deals with multiple project oversight and control.
- Will likely have minimal staff, in some cases just one individual assigned to build the PMO's capability. And sometimes a few additional part-time support resources.
- Should be able to achieve basic PMO capability within one year or less. (This time could vary based on the business commitment and project management culture).

The Basic PMO performs a variety of centralized project management activities (Hill, 2013), that are part of our objectives, listed as follows:

- Introduction of common tools, repeatable processes, and preferred practices ideally represented by implementation of a comprehensive project management methodology.
- Supply and analysis of projects status and projects progress. Evaluation of project performance and ensuring the achievement of project objectives.
- Establishment of standards and provide training.
-

The main objective of this project is the implementation of a Stage 2 Basic PMO to be able to fulfill five specific roles:

1. Standardization of the project management processes
2. Templates implementation for project planning, monitoring and controlling
3. Establishment of strategic reports for management and clients
4. An objective method to prioritize the projects
5. Development of guidelines for PMO tools

These five roles involve project documents adapted to the needs of the company, such as: Project charter template, planning template, scheduling

template, closing template and an easy-visual way to give status of the projects and/or portfolio to client/management. The Basic PMO has the essential project information management, reporting, collaboration procedures, tools to manage information, methods to gather data and record lessons learned to be used in the future. The stage 2 Basic PMO adapts perfectly to Siemens needs, it will solve the problems faced in the handling of projects and could be done in the time that we have available for the implementation.

We also established secondary long-term objectives for the project that have to do with the management of information. The PMO will not only allow improving the way of managing projects and to reach a high level of specialization on the main activities developed during the management of projects. But also, as a direct consequence, the collection of data that the PMO help to gather, could be used to:

1. Create different statistics to find their opportunities areas and create corrective actions.
2. Reduce the cost and the time consumed on the projects.
3. Develop a tool to have more precise and quicker bids offered to the clients for future projects.
4. Manage allocation of resources among the different ongoing projects.

In order to perform the proposed research this dissertation is organized as follows.

- Chapter 2 contains the literature review, information that was gathered during the project and that has been used as a foundation for many of the decisions taken.
- Chapter 3 introduces the company Siemens and the case of study in the laboratory, as well as the research methodology that was followed and the explanation of its application into this project.
- Chapter 4 presents the results of the implementation
- Chapter 5 contains the discussion.
- Chapter 6 has the conclusion of this work.

2. Literature review

2.1 Projects, management and their elements

This chapter aims to present the definitions and the main concepts related to the project management. This will help us to fully understand the laboratory needs and to use the information to provide Siemens the best solution to solve their pains points. Being the PMO usually the entity in charge of establishing processes, policies and procedures (PMI, 2017a), we will analyze past researches related to this field area to comprehend and find the most suitable model and stage to implement in the laboratory. The PMO that we choose needs to help establish the methodology that will become the key to provide a structure and guidelines to achieve successful projects.

According to the (Project Management Institute, 2017, pp.4), a **project** is temporary, has a beginning and an end, producing something specific. It is *“A unique process, consisting of a set of coordinated and controlled activities with start and finish dates, undertaken to achieve an objectives conforming to specific requirements, including constraints of time, cost and resources”*. Lester (2014) states that a project is undertaken to generate revenue making improvements and changes that need resources of people and/or equipment. These projects must meet criteria as specified time, budget and quality.

Project Management helps to guide the project activities to meet specifications regarding time, cost and performance. The PMBOK® Guide have 5 process groups for the project management (Initiating, Planning, Executing, Monitoring and Closing) and 10 Knowledge areas (integration, time, cost, quality, communication, risk, human resources, procurement and stakeholders). All the tools and activities are organized around these concepts (PMI, 2017a). Project management can be seen as the application of standardized and structured projects that are being performed in a chronological way (Carvalho, Patah, and Bido, 2015).

Some factors that determine the success of the project management are the project managers' competencies and emotional intelligence, the organizational structure and culture and the project management standards and techniques.

Theoretically, the combination of all these factors should guarantee successful projects. Depending on the needs of the organization, the orientation of the project and the quantity of projects being managed, the importance of these factors would vary (Radujković and Sjekavica, 2017).

Usually, the manufacturing companies produce more than one type of product, and depending on the size of the company, the amount of production could vary. To complete the production of one specific product it is necessary to perform various different processes. On those companies that are continuously looking forward to improve and update their processes, it is typical to find more than one ongoing project to achieve these goals.

For this collection of ongoing projects, there is specific word, a **program**, which refers to a group of projects that are managed together because that generates a benefit. It consists of a set of related projects and required organizational changes to reach a strategic goal and achieve the defined business benefits; it is also the action of carrying out the coordinated organization, direction and implementation of projects and transformation activities to achieve outcomes and get benefits of strategic importance to the business (Maravas and Pantouvakis, 2013).

In a project, time and cost are defined in the business case and are manageable leaving the business benefit excluded from the project. In a program, time and cost are roughly defined within the strategy, since both are broken down into individual projects; anyhow the business benefits are largely included. The goal of a project is to produce deliverables, the goal of program is to achieve strategic change (Maravas and Pantouvakis, 2013).

There is another important concept regarding the management of projects, which is the **portfolio**. It could be a group of projects or programs, the different project or programs are divided into categories, but at the end all of them are aligned to a business goal (Greene and Stellman, 2013).

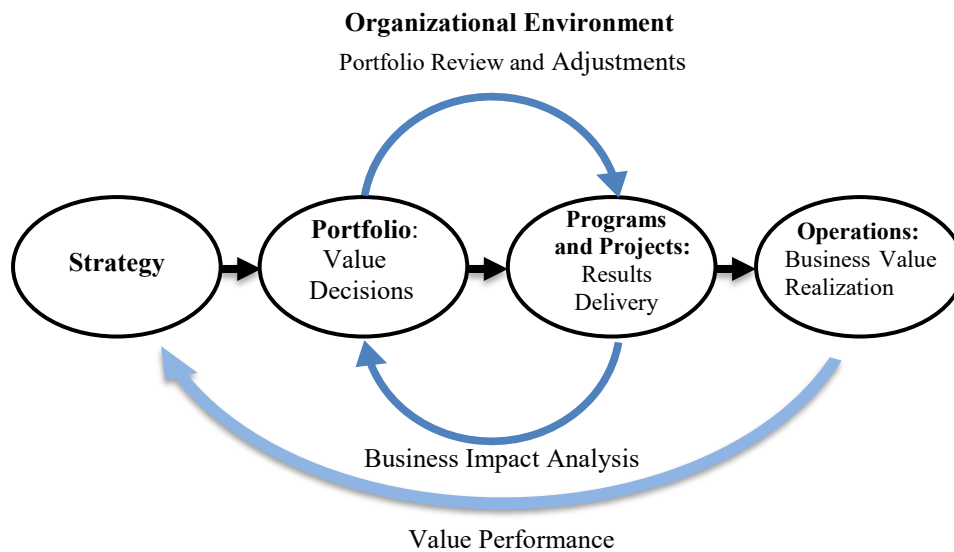


Figure 2. Organizational Project Management (PMI, 2017a)

Figure 2 clearly shows the relation between the 3 concepts, being the Portfolio the one that can add value to the organization, managing the programs and/or the projects together in order to generate a greater impact for the company.

A **portfolio** refers to projects, programs, sub portfolios, and operations managed as a group to achieve strategic objectives (PMI, 2017a). Portfolio management (PfM) became a fundamental factor in research and development projects (Bilgin, Eken, Ozyurt, Dikmen, Birgonul, Ozorhon, 2017). PfM helps to prioritize and select the right projects to meet strategic objectives and improve project success rates (Hadjinicolaou and Dumrak, 2017).

In the practice, the PfM mainly have the purpose of 4 key aspects: (1) the **control** of the projects and programs. We can easily see all the deliverables, the comparison between the planned and actual costs and the benefits for management. (2) The **visibility**, in a practical and visible way we have access to the whole panorama, like the resource utilization and the status of the projects, programs and the portfolio itself. (3) The **efficiency**, the PfM has the purpose to manage as a group all the project and programs in order to obtain the best performance not only for each one of them, but also for the company's goals using the skills of the project manager and the team for planning and scheduling. And (4) the **governance**, this means to focus in the way to report and the standardization of policies and regulations.

The portfolio management and the PMO have a direct co-relation (Bredillet, Tywoniak, and Tootoonchy, 2016). Prior research has shown that an increasing number of organizations established PMOs assuming this was an effective means of addressing the challenges of portfolio management. What follows is that in order to better leading strategic change and strategy implementation, practitioners require a detailed understanding of the interactions between PMOs and PfM. Portfolio management refers to the centralized management of one or more portfolios to achieve strategic objectives. Portfolio management focuses on ensuring that projects and programs are reviewed to prioritize resource allocation, and that the management of the portfolio is consistent with and aligned to organizational strategies (PMI, 2017a).

Portfolio managers divide up the projects, programs, and operations the company is doing so that they align with the business goals. In this way, they can be sure that projects get the most out of managing their timelines, budgets, and resource commitments so that the company's goals are met (Greene and Stellman, 2013).

Working with a portfolio structure means that you are working with processes, tools and techniques already proven and used to manage previous programs and portfolios with success. Portfolio looks to also meet the company's strategic goals, and not only the goals for each project. Portfolio managers need to prioritize work in environments with limited resources, budgets, risk tolerance, and many other constraints that set up the environment for their portfolio's success (Greene and Stellman, 2013).

For the management of projects, several methodologies have been created and developed to support the organizations with the execution of projects. These methodologies have the purpose to carry out the projects with more control, smoother and higher efficiency. Some examples are: Waterfall, Agile, Hybrid, Scrum, Critical Path method (CPM), Critical Chain Project Management (CCPM), PRiSM, PRINCE2, Kanban, Six sigma, RAD, ISO 10006, etc. The use of a specific methodology depends on the nature of the project as well as the organization

environment. Some of these methodologies were created and developed based on the principles of the *PMBOK*® Guide (See APPENDIX A for definitions of methodologies).

2.2 Organizational processes and project management

As stated in the previous chapter, when companies are working with a portfolio structure means that they are working with processes (Greene and Stellman, 2013). The management of projects has different processes to be followed during all the stages of a project, since the initiation until the closing. To this extend, we also need to review what the organizational processes are.

The Organization

An organization is the combination of various parts that work together to achieve goals. In the pursue of accomplishing desired objectives, the efficient organizations are constantly modifying and re-defining their strategies (Miles, Snow, Meyer, Coleman, 1978). Any organization needs to have well implemented organizational processes, which in combination should result in a work environment where every part of the team understands its responsibilities and perform tasks according to established rules.

Processes

Processes provide a solution to guide and define the roles and expectations of the different parts that constitute an organization (people, hierarchies, departments, communication levels). Can be seen as the collection of activities, tasks and tools that together transform inputs into outputs (Garvin, 1998).

The organization's management systems incorporate various management processes and sub-process that consist in different specialized tasks. These are created according to the initial stage and desired goal. Once the organization begins its development, the processes are adapted to respond to the emerging challenges (Gerasimov and Gerasimov, 2017). Processes are supposed to be defined taking into consideration some aspects, such as the plans and objectives

of the organization, the activities needed to accomplish the objectives, roles definition, assignation of the activities and dependencies. Processes are commonly represented in a process map which help to fully understand the requirements and constraints of each part of the system.

In the case of project management environment, the PMO is the one responsible to align the objectives of the company with the objectives of the projects in the portfolio. For this integration, the PMO implements practices to both project management processes and business processes (Hill, 2013).

In the following chapters we will look deeply into the advantages and value that a PMO generates for the organizations.

Processes monitoring and improvement

Processes must be monitored, which involves reviewing their performance and deliveries to determine if the processes are being followed and if they are being done correctly. For this purpose, the audits are one of the most reliable ways to determine how process implementation is progressing. These may be done informally; nevertheless, a formal approach is preferred. The goal of these audits is to improve quality through results. The audits will help determine the effectiveness of the implemented processes, relative to achieving the results required to meet primary goals for quality improvement (Oyewole, 2004).

Companies' needs to keep updating and improving their processes according to the problems or dilemmas that they confront during the performance of the activities designed for each process. They should collect, organize and analyze the information about previous performances or looking for examples of similar functions in other companies. Hence they can redesign existing business processes, invent new processes, organize and share knowledge about organizational practices (Malone, Crowston, Lee, Pentland, Dellarocas, Wyner, Quimby, Osborn, Bernstein, Herman, Klein, O'Donnell, 1999). Organizations are constantly under significant tension, they need to adapt and evolve throughout the time to keep satisfying and meeting their client's expectations. This means they

have to improve their products and services if they want to keep having a competitive advantage among their competitors.

To this purpose the organizations may adopt project management practices (knowledge, skills, tools and techniques) applied in the different organizational processes. The usage of these practices helps to meet the strategic requirements and objectives designed for the development of competitive advantages. The complexity, as well as the number of projects executed at the same time by a company or industry has increased; it is essential to have a better method of coordinating them. For that coordination PMI presents the PMO framework. The PMO was born as an alternative to improve the execution of projects and help to avoid wasting resources (Monteiro, Santos, & Varajão, 2016). PMO implements governance processes using standards and policies and aligning projects with strategic objectives, portfolio tracking, coaching and mentoring (PM Solutions, 2016).

2.3 PMO

2.3.1 The importance of a PMO in organizations

Generally, the PMO is seen as the entity inside the companies that define and implements the project management principles, standards, processes, methodologies, skills, knowledge, tools and techniques (Reddy & Priyadarshini, 2016) that best suited to the type of projects developed in the company or department.

The PMO is a system or a structure that helps to standardize the administration of projects. It is the authority that advises how to handle the resources, methodologies, tools and techniques. The duty of a PMO is to give project management support about the different processes involved in a single project or a group of them. The PMO integrates data and information from corporate strategic projects and evaluates how higher-level strategic objectives are being fulfilled. It is the natural connection between the organization's portfolios, programs, projects, and the corporate measurement systems (PMI, 2017a).

The PMI identifies some benefits that the PMO directly has for the support of managers:

- *“Managing shared resources across all projects administered by the PMO;*
- *Identifying and developing project management methodology, best practices, and standards;*
- *Coaching, mentoring, training, and oversight;*
- *Monitoring compliance with project management standards, policies, procedures, and templates by means of project audits;*
- *Developing and managing project policies, procedures, templates, and other shared documentation (organizational process assets); and*
- *Coordinating communication across projects”*. (Project Management Institute, 2017a, pp. 49)

A PMO usually combines project management skills to improve the performance, productivity and the quality of complex projects. Widforss and Rosqvist (2015) research sustains that the answer of many companies and organizations when handling complex projects is the implementation of a PMO. In 2018, the PMI's *Pulse of the Profession*® conducted a survey to 4,455 project management practitioners directors from a range of industries, including government, information technology, telecom, energy, manufacturing, healthcare, and construction; located in North America, Asia Pacific, Europe, Middle East and Africa, Latin America and Caribbean regions. That survey reveals that 68% of them currently have a PMO in their organization, which also means a rise in the implementation of PMOs; compared with a 61% in 2006.

PMOs typically perform a number of functions: project definition and planning, cost/benefit analysis of projects, risk management, monitoring and control, supply of experience and knowledge, support in undertaking PM processes and procedures, knowledge capture and dissemination, provision of specialist skills, maintenance of projects tools, standards and processes (Pellegrinelli and Garagna, 2009). It also collects and stores project knowledge through different project documents. Documents that record relevant information of the project performance such as status reports, variance analysis and changes to the baseline plan, risk lists and other risk management documents, information on

prior successful and unsuccessful projects and a database of lessons learned (Dai and Wells, 2004).

A PMO is a dynamic organizational entity, which has a significant participation into achieving the strategic goals and objectives of the companies. The appropriate management of the portfolio by a PMO is especially important for project organizations where revenue directly depends on the performance of the projects (Szalay, Kovács, and Sebestyén, 2017). PMO helps to gather the critical information from previous projects and help to transform it into tools and strategies that help the incoming projects to have a prosperous development. The PMO is known as the responsible to manage projects, programs and/or portfolios at the same time. It has the capability to look at the general panorama and decide how to move all the variables in favor of the projects, and as a consequence, of the company's strategies.

PMO value

Besides the functions performed by the PMOs, there is the value that they deliver to the organizations. Value that according to PM Solutions (2016), is shown in the following areas: Improvement in projects delivered under budget 33%, Improvement in customer satisfaction 27%, Improvement in productivity 25%, improvement in alignment of projects with firm's objectives 43%, decreased in failed projects 25% and cost savings per project 175K USD. These factors are commonly used to measure the value gained due to the implementation of a PMO. It has been proven that when a company embraces the usage of project, program, and portfolio management practices, projects are more successful (PMI, 2017b).

The PMO value lays in the transparency of information. A PMO is able to visualize the portfolio progress and confirm if the processes are being effective, through the establishment of metrics that measure the different key aspects of the projects. The PMO can be a helpful ally in the implementation of the company strategy, which is one of the reasons to have a PMO in the organization (PMI, 2013b). Generally a PMO which is perceived by high management as an entity that adds value to the company, is the one who optimizes business performance

and ensures projects to have the required resources to meet criteria of time, scope and budget (ESI International, 2015).

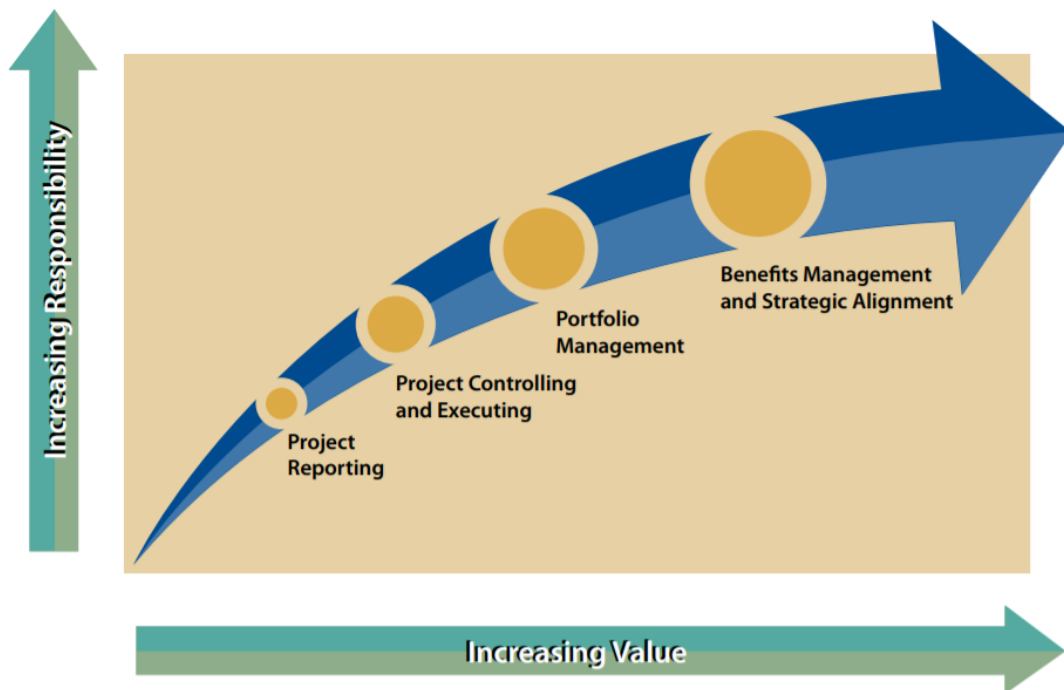


Figure 3. PMO value Continuum (Ward, 2012)

The ESI International (Ward, 2012) created the Figure 3 to explain the extent until which the activities of the PMO are developed, reaching a strategic level aligned to the objectives of the company. The value of the PMO increases at the perception of the high management, becoming an asset worth to keep in function.

2.3.2 Adoption of PMO in the industry

The PMO has become a strategic solution to satisfy the new market demands and to manage the numerous projects developed at the same time by organizations. This is relevant because not only the number of projects increased, but also they became strategically more important (Hobbs, Aubry, and Thuillier, 2008). A study from Computer Economics (2015) revealed that there is a tendency for companies to standardize their processes' management through the application of the PMO. This tendency has been increasing over the last years.

Maturity Profile: Project Management Office

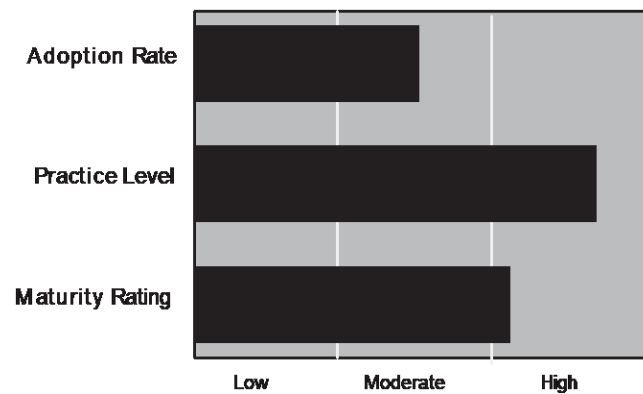


Figure 4. Maturity profile: Project Management Office (Computer Economics, 2015)

Figure 4, presents the results from an analysis regarding the situation of PMO implementation in the organizations. Adoption rates relate to the amount of companies that recently started using PMOs. Practice level refers to the amount of companies that are currently effectively using a PMO structure. The practice level in companies is high which means that once the procedures are adopted the tendency is to keep using them in a consistent way. Companies that have adopted a PMO now embrace the use of it and start specializing in PMO activities, thus, a higher level of maturity will be reached.

On the other hand, the adoption of the PMO in new organizations seems to be in a medium rate, this means that the industry is not commonly implementing (adopting) a PMO structure.

Maturity levels are a comparison between practice levels and adoptions rates, if companies continue to practice PMOs and additional organizations start adopting this structure, PMOs will increase its usage, thus, its maturity will escalate (Computer Economics, 2015).

A study made by PM Solutions (2016) with a total of 226 organizations around the world from different types of industries, as can be seen in Figure 5, reveals that the PMO has become the central organization structure for standardizing the practices of companies in the delivery of projects. 85% of the firms on this study have a PMO implemented.

Respondents by Industry



Respondents by Geography

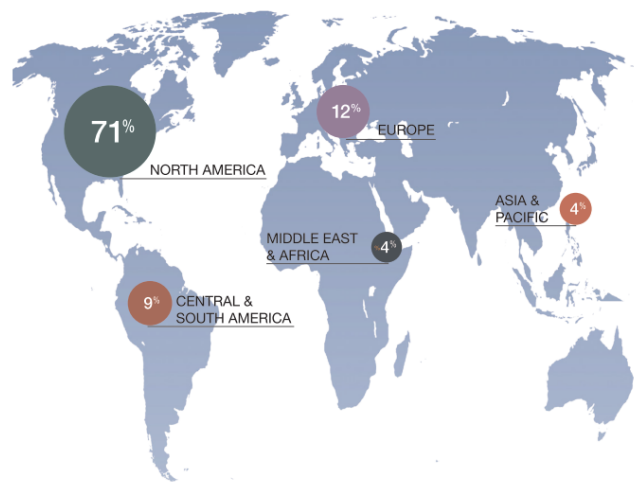


Figure 5. The State of the PMO 2016: Enabling Strategy Execution Excellence Introduction (PM Solutions, 2016)

The results of this study are shown in Figure 6 where the 75% of the small organizations (Revenue < US\$100M) on this study have implemented a PMO, the 83% of the Mid-size companies (Revenue US\$100M-\$1B) and the 95% of the large companies (Revenue > US\$1B). It is also important to emphasize that in comparison with the last study made by PM Solution in 2014 there's a significant growth in the percentage of manufacturing firms that have PMOs (93% in 2016 vs. 78% in 2014).

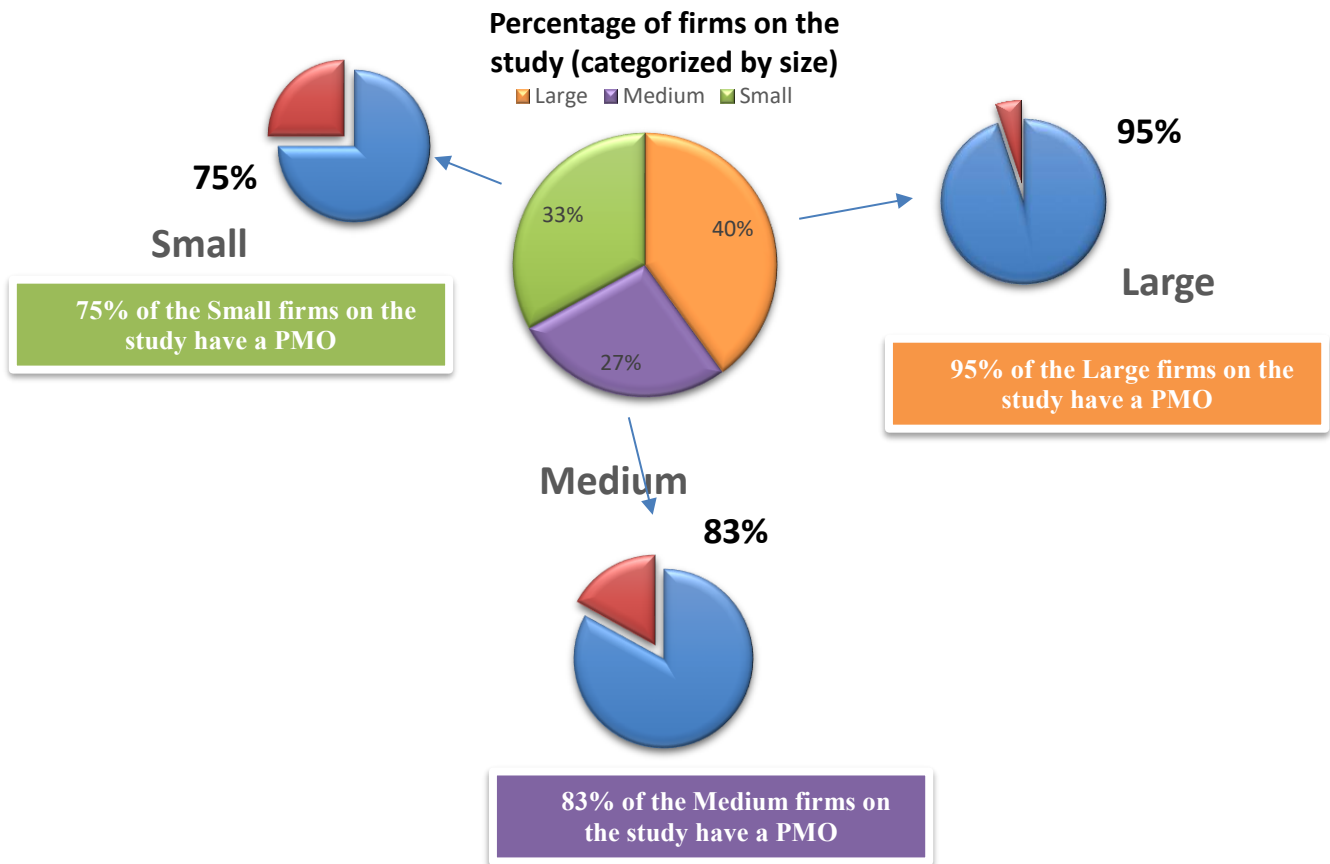


Figure 6. The State of the PMO 2016: Firms with PMO categorized by size (PM Solutions, 2016)

Another survey made by the Project Management Institute (2017b) to 3,234 project management practitioners, 50% from North America, 23% from EMEA, 20% from Asia Pacific and 7% from Latin America. The remark on this survey is that 71% of the practitioners have a PMO to help standardize project management practices in their companies.

These studies confirmed that the tendency is to establish PMOs in the companies, commonly in large organizations, in order to contribute in the management of projects. The PMO has become an ally to overcome the challenges that the management of several and complex projects could have.

2.3.3 PMO Functions

Along the time, studies demonstrate that the main purpose or functions of the PMO falls into almost the same main categories. The organizations that have

adopted the PMO structure found several impacts in their daily business. In the following tables and figures some of those impacts are presented.

PMO Function	Areas where PMO have more impact
Report project status to upper management	83%
Develop and implement a standard methodology	76%
Monitor and control of project performance	65%
Develop competency of personnel, including training	65%
Implement and operate a project information system	60%
Provide advice to upper management	60%
Coordinate between projects	59%
Develop and maintain a project scoreboard	58%
Promote project management within organization	55%
Monitor and control performance of PMO	50%

Table 1. PMO functions inside the organizations in decreasing order of importance (Esults, Hase, Brian, Aubry, 2007)

Table 1 is the summary of the first 10 functions of a PMO in companies. According to Esults, et al. (2007) research, the main functions of a PMO in the organizations are related to the way of organizing, coordinating, controlling, and monitoring projects.

Figure 7 states that among the contributions that a PMO could have in a company, the ones that have more impact on them are the same main objectives that we want to achieve for this project, including report project status to upper management, development and implementation of a standard methodology and monitoring and controlling of project performance.

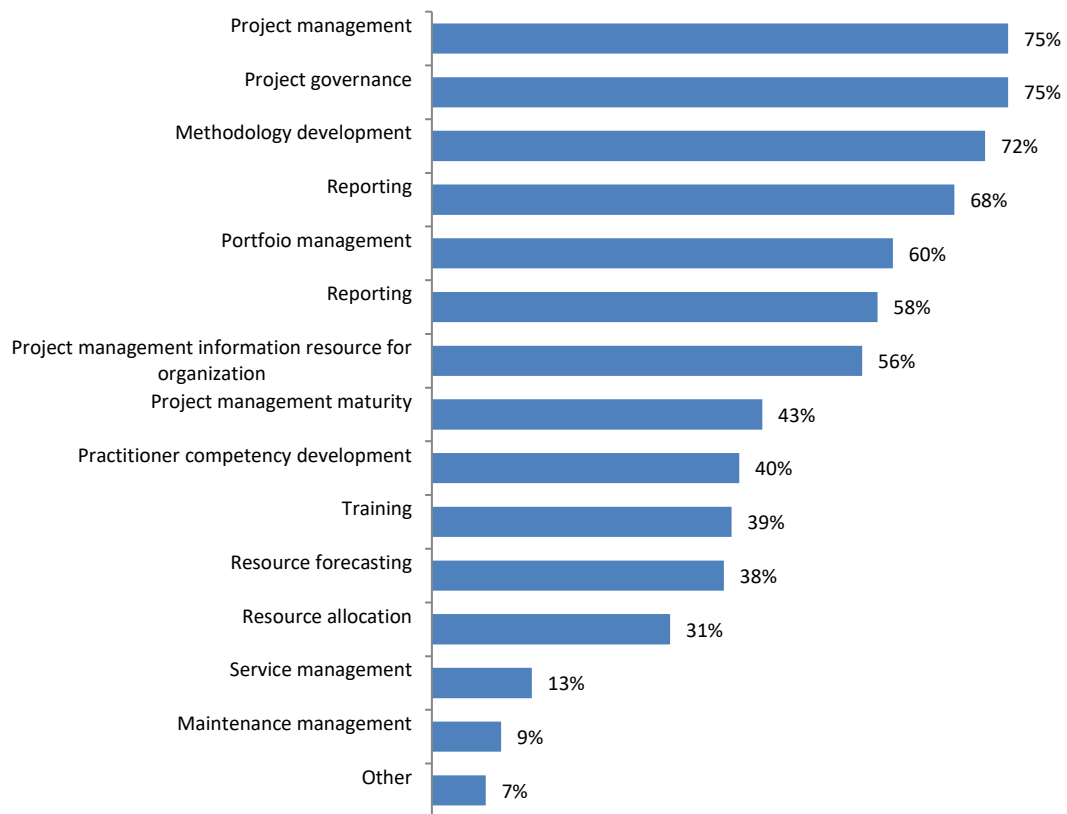


Figure 7. Global Project Management Office Online Survey (Fersht, 2011)

The role that a PMO plays in the industry is to help with the selection of projects in terms of their connection with the strategic objectives; methodical, organizational and administrative support for the implementation of programs of a strategic nature. PMO also contributes to the creation of the methodological standards, substantial and administrative support for programs of a strategic nature, management of communication with stakeholders, managing risk under the portfolio, management of the central repository of information and support for the reporting process (Mariusz, 2014).

Other contributions that a PMO has had in the companies are better use of resources, methodologies applied and governance of the processes, improved coordination and integration, improved project planning and risk management, visual management, portfolio management progress, accessible historic data that provides support for further projects (Van Der Linde and Steyn, 2016).

Also, the study of PM Solutions, (2016) identified the following PMO functions: PM methodology, standards implementation/management, Project policies, procedures, templates implementation/ management, PM coaching and mentoring, Governance process implementation/ management, Alignment of projects with strategic objectives, Portfolio tracking (performance monitoring), Multi-project coordination, Roles and responsibilities documentation, Project performance monitoring/controlling, Change control and issue tracking, Dashboard/scorecard implementation/ management, Interface with functional units, Project/program management software implementation/ management and Governance steering committee facilitation. Reddy, (2016) claims that there are 4 main roles of the PMO in organizations which are: Monitor and control project performance, development of project management methods, strategic management and organizational learning.

Finally we reviewed the results of the survey made to 3,234 project management practitioners in the PMI's Pulse of the Profession (PMI, 2017).

Figure 8 shows that the most important roles within the organizations are establishing and monitoring project success metrics, project management standardization, contribution to the development of core project management competencies, program management, among others.

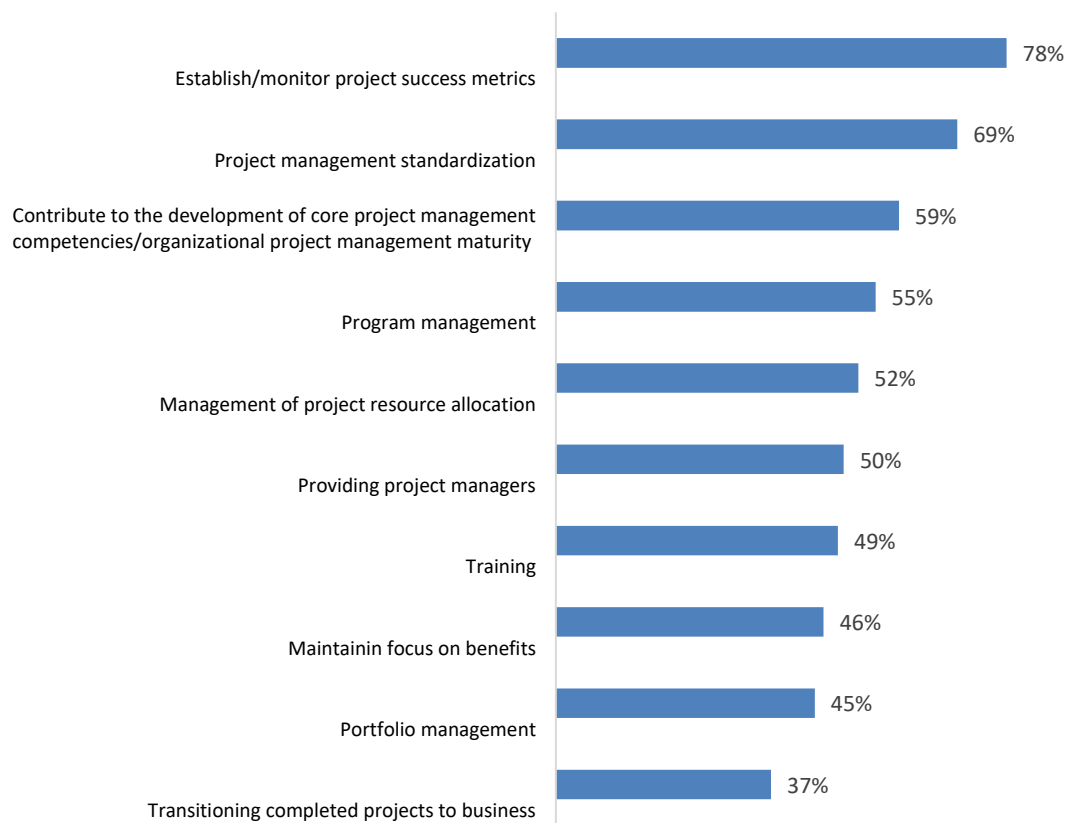


Figure 8. Roles that PMO fulfill within your organization. (Project Management Institute, 2017)

On the Table 1 we did a summary of the different point of views of the analyzed authors. Identifying the 9 listed functions as the main ones perceived by the companies that have a PMO.

PMO Functions	Esults, Hase, et al., 2007	Fersht 2011	Mariusz 2014	Van Der Linde and Steyn 2016	PM Solutions 2016	Reddy 2016	PMI 2017b
Methodology development	x	x	x	x	x	x	x
Project management standardization	x	x	x	x	x	x	x
Reporting and monitoring	x	x	x		x	x	x
Portfolio Management	x	x	x	x	x		x
Project Governance	x	x	x	x	x	x	x
Project management information	x	x	x	x	x	x	
Resource allocation	x	x		x	x		x
Develop competency of personnel, including training	x	x			x		x
Project Management maturity	x	x					x

Table 2. Main functions of a PMO

Source: Own Elaboration

We can summarize that the functions of the table above are the ones that had been the principle roles on the companies supported by a PMO through the years. Standardization and appliance of a methodology, reporting and monitoring, portfolio management, project governance, project management information, resource allocation, develop competency on personnel and project management maturity. All these roles are the ones that could help the laboratory to improve the management of their projects. Our main 5 objectives for this project are covered with these principal functions of the PMOs.

2.3.4 PMO: Advantages

PMO should be considered as an investment; therefore, we can expect that the revenues will come along as time goes by. As Pansini and Terzieva (2013) suggest, an organization will reach a series of benefits deriving from the implementation of a PMO, such as:

- Proactive project risks/issues management;
- Better evaluations in terms of time and budget,
- Increasing of effectiveness and efficiency in Project Management,
- Increasing in output quality,
- Increased percentage of success of project activities,
- Better coordination and control of tasks and resources,
- Availability and circulation of information,
- Creation of data-clearing house of information and project best-practices. This could be useful also in case of re-organizations, making handovers easier,
- Implementation of Project Management competencies and know-how within the organization,
 - Increasing of transparency due to information sharing,
 - Increased predisposition to change and innovation,
 - Identification of synergies between activities and projects,
 - Gaps fulfillment, especially during feasibility analysis, due to increased attention and awareness,
- Better definition of project priority and possibility of negotiations in order to manage urgencies.

Szalay, Kovács, and Sebestyén (2017) agree that an effective PMO has as a result greater efficiency in managing a portfolio of projects, allowing the selection of the right project mix; furthermore, doing more quality work with fewer resources and less risk. The result of these benefits is an improved strategy execution and a better project success rate. One of the big problems is the selection, approval,

following and measuring of the right indicators to follow as well as analyzing the results, for then showing and communicating the added value of PMO activities.

Reddy (2016), identified some benefits or advantages that were grouped into four main categories. Risk reduction, keep projects on budget, keep projects on time and ensure improved project quality.

Rad and Levin (2002) claim that the advantages to implementing a PMO range from the availability of tools, techniques and principles, to the implementation of quantitative performance measures for project cost, schedule and scope. The PMO also helps to be sensitive to the client and team needs.

PMO Advantages	Rad and Levin (2002)	Pansini and Terzieva (2013)	Reddy (2016)	Szalay, Kovács, and Sebestyén (2017)
Increasing of effectiveness and efficiency in Project Management	x	x	x	x
Better coordination and control of tasks and resources	x	x	x	x
Better definition of project priority and possibility of negotiations	x	x	x	x
Proactive project risks/issues management		x	x	x
Better evaluations in terms of time and budget	x	x	x	
Increased percentage of success of project activities	x	x	x	
Availability and circulation of information	x	x	x	
Creation of data-clearing house of information and project best-practices	x	x	x	
Increasing in output quality		x	x	
Provide mentoring and skill development		x	x	
Increasing of transparency due to information sharing		x	x	
Identification of synergies between activities and projects		x	x	
Increased predisposition to change and innovation	x	x		
Increase attention and awareness	x	x		

Table 3. Advantages of having a PMO
Source: Own Elaboration

In table 3 we have analyzed the different perspectives of the advantages that a PMO could have for the organizations, watching clearly the repeatability among the authors.

After the analysis of the different advantages already proven in the organizations that currently have a PMO, we believe that Siemens could have a great benefit with its implementation. More specifically to achieve more control on its projects, better coordination, better communication with team and management, and the security that the most essential activities to the laboratory are being completed by the project management.

2.3.5 PMO Types and Models

2.3.5.1 Types

Depending on the author, the terminology used for the categorization of a PMO may vary. Along the different studies and publications, we have found words as “Type”, “Model” or “Framework” to differentiate between the various kinds of PMOs. Nevertheless, we did not find any relevant difference on the meaning of these words. All of them are used to categorize the PMO depending on its structure, authority, way of managing the projects, the value that the PMO creates, autonomy, among others. Authors as Hubbard and Bolles (2015) and Monteiro (2016) tried to differentiate between type, model and framework. But, for the purpose of this dissertation and after reviewing the different papers that exist about the subject we will present the information as most of the authors recognize [Hill (2013), Monteiro, Santos, Varajão, (2016), Hubbard and Bolles (2015), (Unger, Gemünden, and Aubry, 2012), the PMI itself].

Types are seen as the general categorization of the PMOs. These types depend on the level of authority that the PMO has inside the organization. The PMBOK® Guide recognizes three types: supportive, controlling and directive. The difference between them varies with the level of control that each one has on the projects. The supportive type has a consultative role; this type of PMO has a low control on the projects, more seen as the organism that helps to clear doubts or to suggest best practices. The controlling type is mainly in charge to provide support;

it normally has the mission to communicate the information about the projects through the organization as well as monitoring them; it has moderate control. The directive type takes control of the projects by directly managing the projects, which consequently allows to have high control on the projects (PMI, 2017a). Reddy (2016) also refers to these same 3 types as “Lite”, “Coach” and “Manager” accordingly.

2.3.5.2 Models

Researches as Hill (2013), Monteiro et al (2016), Hubbard and Bolles (2015), (Unger, Gemünden, and Aubry, 2012), the PMI itself; have defined different models of PMO. The Project Management Institute (2013) conducted a survey with 9 Subject Matter Experts (SMEs) from United States and Canada where the following models or frameworks were defined as the most prevalent in practice. We have found that these are also the most commonly described by other authors.

Business unit PMO

As its name points out, this model of PMO manage the projects and programs of a business unit or department (PMI, 2013a). This model allows to oversee all the projects of the division and to manage resources among the different projects to accomplish their objectives (Hubbard and Bolles, 2015). Hobbs (2007) conducted a study among 30 PMOs in different organizations and industries from Canada, United States, Europe, and other, where 62% of the respondents have PMO located in business, functional or regional units. PMI's Report: The Impact of PMOs on Strategy Implementation (2013) listed the following 3 main functions executed by this type of model: (1) Project/Program delivery management, (2) Standards, Methodologies, processes establishment and (3) Portfolio Management prioritization.

Project Office

This entity provides support to a specific project or program, it only exist while the project is running (PMI, 2013a). The main function of this model is to provide and maintain the project documents, as well as providing support to non-complex projects. The project office in some cases could also manage the

projects, reporting to the project manager (Hubbard and Bolles, 2015). The approach of this model is to get closer to the customer by setting up an organization dedicated to the project or program (Kerzner, 2003).

Project Support Office

This model provides administrative support to one or more projects or programs (PMI, 2013a). It provides processes to support the management of project work (Salameh, 2014). The support office has the function to control the projects; it provides their progress and status. It normally reports to project managers or a business unit manager (Hubbard and Bolles, 2015).

Enterprise PMO

It is seen as the highest level PMO, it basically aligns the project and programs activities with the business strategy (PMI, 2013a). The Enterprise PMO prioritization of projects depends directly on the business objectives. It is the organism in charge of the integration of project processes, operational processes and business processes, with the purpose to fulfill the company goals (Hubbard and Bolles, 2015). This model of PMO normally communicates the performance of their projects quarterly, and reports to high management. It is commonly used in government, manufacturing and energy organizations (Salameh, 2014).

PMoCE (Project Management Center of Excellence)

The PMoCe establish methodologies, standards, tools, practices, training, etc. All the necessary to support the execution of projects and the delivery of better projects (PMI, 2013a). It also manages the communications, maintaining and updating tools as reports, intranet, website, and dashboards (Hubbard and Bolles, 2015). The Center of excellence is the guide for the project management environment continuous improvement, provides direction and influence for the organization's project management operations (Hill, 2013). It usually reports to management. The Center of Excellence is also described by Hill as the highest of the stages of a PMO.

After reviewing the different models, the Business unit PMO model or framework perfectly copes into our project. This PMO will have under its control

only the governance of the laboratory portfolio, which is a business unit inside Siemens. This business unit or departmental PMO will be also responsible for the consolidated reporting for the projects, programs and/or portfolios within its domain.

2.3.6 Challenges to implement a PMO

It is normal to expect that the implementation of a PMO will face some difficulties, it implies changes and new rules, dealing with people who is used to work in a certain way and organization policies already established. We must be careful and understand these challenges in order to try to minimize their impact during the implementation. We will look through different author’s opinions on the main challenges that an organization faces.

The authors Singh, Keil, and Kasi (2009) developed a study where 13 important challenges were detected, shown in

Table 4. They used the Delphi method to gather their information.

Challenges to Implement a PMO	
1.	Rigid corporate culture and failure to manage organizational resistance to change
2.	Lack of experience project managers and PMO leadership
3.	Lack of appropriate change management strategy
4.	Failure to design a PMO around a company’s specific needs
5.	Lack of stakeholder commitment to common methodology and tools for the PMO
6.	Poor definition and communication of PMO goals and purpose
7.	Lack of full support of the senior management and various stakeholders to the PMO.
8.	Role, authority, and responsibility of the PMO is poorly defined or understood
9.	Lack of defined scope and size of PMO implementation
10.	Failure to align PMO implementation strategy to organizational strategy
11.	Difficulty in evaluating the effectiveness of PMO in the organization
12.	Lack of training and communication on PMO implementation to all stakeholders
13.	Difficulty in staffing PMO with most experienced personnel

Table 4. Challenge to PMO implementation (Singh, Keil, and Kasi, 2009)

Source: Own Elaboration

The report of PM Solutions (2016) reveals 5 main challenges for the implementation of a PMO. PMO processes seen as overhead, organizational resistance to change, demonstration of the added value of the PMO, assurance of the consistent application of defined processes and project managers with inadequate project management skills.

Reddy (2016) identified the following 4 challenges: Not defining PMO value proposition, lack of perceived impact of PMO on project delivery abilities, no buy-in from senior functional managers, PMO creating unnecessary overhead.

Spalek (2013) conducted a study where the following challenges were detected: Inability to show added value, top management reluctance, staff resistance, lack of scope definition, unacceptable running costs. These challenges are also identified as the reasons why a PMO could be shutting down.

Salamah and Alnaji (2014) detected the following challenges during the establishment of a PMO. Lack of a defined project management methodology, not tracking project's resources hours and utilization, project managers not managing all aspects of their projects, PMO is not empowered to make needed decisions, resource contention, lack of a defined project management methodology framework, project managers managing several projects simultaneously, lack of executive and top management support, ad-hoc projects prioritization and tasks assignments, PMO is only being a process controller and regulator, finally a rigid project management methodology.

After reviewing the different inputs of the five authors mentioned above, we have identified that the 37 challenges in total described by all of them could be grouped into 3 main categories, shown in table 5.

Challenges categories Authors	Lack of experience project managers and PMO leadership	Failure to demonstrate PMO value	Resistance to change/ Lack of change management strategy
Singh, Keil, and Kasi (2009)	5	4	4
Spalek (2013)	1	2	2
Salamah and Alnaji (2014)	7	1	2
PM Solutions (2016)	2	2	1
Reddy (2016)	0	4	0
Total per category	15	13	9

Table 5. Challenges per category

Source: Own Elaboration

In the category of lack of experience of project managers and PMO leadership we found problems related to the insufficient skills that the project managers have that consequently causes weak PMO procedures, or not well defined. The category of failure to demonstrate PMO value, groups the challenges about the lack of support from top management caused by the difficulty to demonstrate the effectiveness of the PMO procedures. For this reason, the PMO ends up being seen as overhead instead of an advantage for the organization. This challenge category is linked to the resistance of change; initially people would not believe that they need to do things differently, but once they start to see the results, they will be willing to cooperate and embrace the new methods. And finally, the lack of change management strategy category involves the poor communication during all the implementation phase that ends up having resistance to the changes, which can also cause that the PMO is not empowered to take decisions.

To assure the PMO implementation success and overcome the challenges that have been phased in the past, the company needs to have some conditions which are mostly related to the organizational structure. Flexible framework, project-based view, resources, organizational culture, willingness to innovate, ability to work in dynamic environments, low opposition to change, predisposition to working in team and proactive attitude (Pansini and Terzieva, 2013).

Resistance to change / Lack of change management strategy

Change management was defined by Moran and Brightman (2000) as *“the process of continually renewing an organization’s direction, structure, and capabilities to serve the ever-changing needs of external and internal customers”*. In order to overcome the resistance to change is recommended to adopt a flexible change management strategy, considering that it has to be adapted to the organization needs. The change strategy must be aligned with the organizational strategy (Todnem By, 2005).

Specifically when implementing a PMO it is recommended to standardize the processes before the implementation (Singh, Keil, and Kasi, 2009). Pansini and Terzieva (2013) suggest that PMO should be introduced carefully since employees can misunderstand the purpose of the implementation, workers might feel threatened or frustrated due to re-organization. Besides, the more procedures introduced to maintain control, the more stress and loss of motivation people can experience as a result. Before making any change is critical to prepare people, explain tasks and further steps, and try not to insist with control and judgment. Some actions they propose are the definition of specific tasks that PMO will cover and its competencies, definition of re-organizational schedule and timetable, monitoring of PMO integration processes, prompt intervention in case of conflicts or critical situation, careful listening at complains from employees/PMO, continuous dialogue and comparisons between involved parts (Pansini and Terzieva, 2013).

Kendall and Rollins (2003) stated that when the entity or organization where you want to make changes has already a perfect functional system to work, imposing a different system or procedure means that the implementation will face a huge resistance to change.

In our case this fact is highly important and will make a difference. The team in the laboratory knows that the processes need an improvement in order to reduce the extra work that causes the lack of a process and standardization. They are open to the changes if that means their daily job will get easier and they would be able to focus their efforts to the execution part of the automation projects.

Lack of experience of project managers and PMO leadership

It has been demonstrated that the fact that the project managers are poor trained to control highly complex projects has a direct effect in the PMO implementation failure (Kutsch, Ward, Hall, Algar, 2015).

Skill category (in order of importance)	Ranked skills
1. Communication	Verbal communication
	Listening
	Written communication
2. Team management	Leadership
	Ability to motivate team members
3. Project Management	Scope management
	Project planning
	Time management
	Resource management
	Risk management
	Cost Management
4. People skills	Good people skills
	Negotiation
	Relationship building
	Conflict management
5. Personal characteristics	Attention to detail
6. Organizational	Organization skills
	Multi-tasking
7. Problem solving	Analytical skills

Table 6. Relative importance of skill categories based on mean rank (Keil, Lee, and Deng, 2013)

Table 6 shows the results of a study driven by Keil, Lee, and Deng (2013), which demonstrates the main skills that a good project manager must have. But mostly, what we can learn here are the abilities which happen to be extremely useful during the implementation of a PMO, such as a high level of verbal and written communication, leadership, ability to motivate team members, conflict management, good people skills and negotiation, in addition to the project management skills.

It is recommended to have a person who is trusted and accepted by the stakeholders involved. Someone who understands the culture and the power

relationships within the client organization; and who can successfully direct the PMO implementation. The project manager needs to structure the PMO team in a way that people who are most experienced in project management have operational roles and responsibilities. In situations requiring a lot of interaction with various stakeholders, one of the most experienced staff member, not necessarily well versed in PMO implementations, but who has been around in the organization for many years should take the role of program management to guide the program in consultation with the stakeholder (Singh, Keil, and Kasi, 2009).



Figure 9. The PMI Talent Triangle (PMI, 2017a)

According to Figure 9, there are 3 main skills sets to be considered as leaders: technical project management; leadership and strategic; and business management.

The technical project management involves all the knowledge and skills related to the technical aspects of managing projects, programs and portfolios. The leadership involves the skills needed to guide, motivate and direct a team. Moving the right cords in each person to achieve the organizational goals. A leader knows that having the right team in place is the differentiator between success and failure. As well as to establish project management as a formally recognized role, create a defined path, and provide everyone in the organization with appropriate levels of learning for their role in projects (Forrester Consulting by PMI, 2013). The strategic and business management which is the knowledge of the industry as a universe as well as the knowledge of the company where the project/program/portfolio is being implemented; this aspect is important because it will lead the efforts and help to implement strategic plans (PMI, 2017a).

Failure to demonstrate PMO value

It is not good when the PMO is not able to demonstrate that the projects are being delivered and completed meeting the objectives of time, cost and quality. But it is even worse when you do have satisfactory results not being communicated. In both scenarios the top management has the perception that the desired results are not being achieved, consequently the PMO framework is not seen as an entity worth to keep (Salamah and Alnaji, 2014).

Viglioni, Cunha and Moura (2016) argue that the PMO can be the battlefield between power and control, including people, processes, and political factors. Given this situation, the definition of a performance evaluation mechanism allows the verification of how the PMO can serve the interests of project managers and stakeholders and at the same time, serves as a strategic framework within the company.

There are three basic principles recommended related to the Six sigma approach to prove the value of a PMO. The first principle is to have a clear definition of which are the objectives and how is the company going to measure if they are being achieved. Top management must be communicated about how the PMO works, the processes, the dependencies, the goals, assuring they have a deep understanding. And, assure stability of the processes, having as a result that 95% of more of the projects meet their goals, or even exceeds them (Kendall and Rollins, 2003).

After reviewing the literature, we can conclude that a PMO perfectly cope with our mission at Siemens. A PMO is the organizational structure that will allow having organized processes to manage the projects in the laboratory, processes that will be adapted to their needs. We will implement the right tools that allow the organization to align their objectives with the business goals, always looking forward to improving the processes according to the evolution of the laboratory and the new challenges that will emerge within time.

In the next chapter we will give an overview about Siemens and the laboratory. As well as the case study presented in this work.

3. Organization and Research Methodology

3.1 Siemens Monterrey

Siemens was founded in 1847 by Werner von Siemens with his design for the pointer telegraph. For more than 170 years, the name Siemens has been synonymous with internationality and worldwide presence.

Siemens is a global powerhouse positioned along the electrification value chain from power generation, transmission and distribution to smart grid solutions and the efficient application of electrical energy; it also has influence in the areas of medical imaging and laboratory diagnostics. Today, Siemens has around 377,000 employees in more than 200 countries. They operate in production and manufacturing plants around the globe. They also have office buildings, warehouses, research and development facilities or sales offices in almost every country in the world.

Electrification, automation and digitalization are the long-term growth fields of Siemens. In order to take full advantage of the market potential in these fields, their businesses are bundled into eight divisions: building technologies, digital factory, energy management, financial services, mobility, power and gas, power generation services, process industries and drives. In addition, the company has Siemens Healthcare and Siemens Wind Power, which are being managed as separately businesses (Siemens AG, n.d.).

Siemens first project in Mexico was in 1894. Since then, Siemens has been active in continually improving the country's infrastructure, ensuring reliable power, optimizing Mexican industry and ensuring high quality healthcare (Mexico, n.d.).

Siemens Fabrica Monterrey inaugurated in 2012 its first Research and Development (RandD) center for the low voltage line. They launched the initial phase of expansion of the Electrical Testing Laboratory, which allowed testing of durability and overload to high capacity electrical switches (Siemens Mexico, 2012).

Siemens is convinced that every company will have to develop its own comprehensive digital enterprise platform on the way to the Digital Enterprise. It

includes machines, automation systems and in particular, the software tools that are starting to play an ever-greater role in all these areas. They have set themselves the goal of supporting their customers in building platforms from engineering through to automation (Huber, 2016).

In the last 15 years the company has invested a large part of its total investment in building up and extending its software portfolio. This portfolio serves to support the entire industrial value creation chain, from product definition to after sales service. The suite of software, the extension and integration of which continues to be pursued with strength, is called the “Digital Enterprise Software Suite”. Today it already offers the basic software framework needed by companies wanting to maintain their position in the Internet industry (Huber, 2016).

Aubry, Hobbs, Thuillier, (2007) study supports the theory that an industry as Siemens can be considered as a complex environment where management decisions need to address several portfolios as well as operational activities.

The company’s global position regarding Industry 4.0, leads Siemens Monterrey to create its own automation laboratory that was introduced the last year with the purpose to design and execute automation projects that can be developed for internal (Siemens around the world) and external companies. This laboratory develops equipment and automation solutions using its own capabilities such as electronic design, software and electrical design. For the operation of the laboratory, a group of people was designated to execute the projects allocated; these people are specialists in different areas, the combination of all their work and effort leads to obtain automation solutions.

The automation laboratory, as part of the Research and Development (R&D) department in Siemens Fabrica Monterrey, provide complex products and services. Which also means, that the more complex the products are, the heavier is the PM structure needed (Hobday, 2000).

This facility implemented diverse methods to automate processes, consequently, the level of technological complexity increased. For these improvements to take action the laboratory needs specific mechanical tools,

software implementation and a physical infrastructure capable of satisfying these new demands.

Clients from multiple types of industries came looking for help to this new unit with every kind of automation and integration needs. We can expect that what works in one industry may not work in another. Projects should be treated according to the needs and type of support that each industry or company is requiring. At the same time the automation laboratory should have standardized processes to define, execute and present all the projects status.

The current maturity of the automation laboratory about project management is very low, the purpose of this project is to implement major changes that will generate more value at the short term and that will help to increase its maturity. The combination of the identified problems, along with the knowledge on the PMI framework was the perfect scenario for the present project. One of the project's goals is the use of the PMI framework in this new Siemens unit, using the best practices and knowledge that the institution provides in order to achieve better results and meet the defined criteria for each one of the projects.

We reviewed the different characteristics of our client, such as, the complexity of the laboratory projects, the company's background, and the available resources, the possible constraints of the projects, the type of management, the team and the current tools used in the processes. After reviewing the lessons learned in the first projects developed by this new entity in the company, main opportunities areas were detected, such as lack of standardized methodology to develop the projects, unsatisfactory resources management, lack of process to evaluate project performance, delay in implementation dates, poor planning, inaccurate estimation of task times, difficulty to provide a status of projects, inaccurate budget calculation, ambiguous requirement from clients, lack of change management method, lack of method to prioritize projects, difficult to take over activities that somebody else performed.

Based on the reviewed literature we can expect that most of the pain points detected during the initial stage of this automation laboratory can be addressed by a successful stage 2 Basic PMO implementation. We are confident that a PMO

cope perfectly with the client projects (automation ones), dealing with several technical variables and implying a greater level of documentation and cost. In these cases, a proficient level of information management becomes critical for the project success.

We will do it through the implementation of a Business Unit PMO. This PMO will provide a structure and standards related to project governance and will help to establish methodologies, tools and techniques for the portfolio and single project management (PMI, 2013a). The PMO needs to have a reliable management of this business unit Portfolio; have a good understanding of the ongoing projects and a clear view of the individual and global status.

Taking into consideration how *PMBOK®* Guide defines a directive PMO, it is expected that it will supply templates, best practices, training, access to information and lessons learned from other projects. It will also take control of the projects by directly managing them (PMI, 2017a).

The components of a PMO could be divided in 2 main groups: the ones related to people, and the ones related to things. People-related activities consist of leadership, conflict-management, contract development, negotiations, and communication. Things-related activities involve skills and tools required in planning and managing scope, estimating costs and schedule, identifying, analyzing and managing risks. Among the tools, we can find monitoring procedures, auditing checklists, performance metrics, documentation templates, change management, and reporting standard (Rad and Levin, 2002).

A PMO focuses on combining effective project practices, encouraging the use of recommended tools and templates, as well as providing guidance and support during all the stages of the life of a project (Rad and Levin, 2002). That is why we will pursue the stage 2 PMO implementation which consists in the development of the tools that will return the greater benefits to the company in the short term. Specifically, the development of project documents.

Documents that will allow the client to easily categorize the incoming projects (internal and external) according to the innovation level, complexity and

criticality. Templates for planning, status report, change request and closure. Template for Portfolio overview according to specific indicators that will show the performance in a consistent, unified and comparable way. And instruction sheets, allowing every member of the team to understand and use every template and information.

The use of these documents will help to gain experience and learn about the strengths and weakness of the management of the projects along the time. Beyond having established documents for the successful planning, management and execution of the diverse tasks involved in a project, templates have an essential role in the standardization and the compilation of information. This information can be used to analyze the positive and negative aspects of the projects; this will allow having a deeper understanding of what needs to be improved in future jobs.

The specific objectives or results that we would like to accomplish inside the laboratory are:

1. Achieve high level of project performance tracking.
2. visible and efficient method to show status of projects to management and clients
3. standardize “change request” methodology
4. standardize system to prioritize projects
5. Make transparent and available information for all the team.

The proposal is to establish methods that will help the automation laboratory to have a smooth way to manage its projects, so the staff members can focus their efforts in the complex part of the execution. All the extensive information shared during the development of each project must be more a tool that contributes to the success of the project and not an obstacle to its accomplishment.

3.2 Research Methodology

This project follows the Action Research (AR) methodology. It is a methodology that focuses on the solving of organizational problems which enhances the relevance of academic research by linking research and practice (Wong and Davison, 2017). This kind of methodology is about the usage of the gathered information during the research, the applying of the acquired knowledge inside the company when trying to solve a problem, rather than just reading and investigating about work or actions that somebody else applied or performed in the past (Spinks and Canhoto, 2015).

Davison, Martinsons, Ou, (2012) defined the practice of this methodology as the aim to address real world problems and improve organizational performance by combining scholarly observations with practical interventions. Davison found one challenge which is common in AR, it relates to the tension between the researcher and the organizational client. McKay and Marshall (2001) associate this tension to the dual role that researchers have. They must serve two masters: a theoretical research which is based on past studies knowledge, normally ending with a paper publication, thesis or public report as an outcome; and also, the commitment to ensure a positive outcome for the organizational client. It is crucial that the client agrees with all diagnoses, planned changes and evaluations, since he is the principal beneficiary of the project (Wong and Davison, 2017).

Understanding and following the suggestions done by the authors, during all the stages of this project, the client has been and will continue being actively involved, initiating from the diagnosis. It is important for the project's success to keep an open communication with the client; to understand every part of the process; and to obtain approval. Directives must develop a suitable action plan to their necessities that leads to favorable results.

Following the Action research methodology, all the research performed during this project will be focused in learning the best practices of previous works and obtaining tools and strategies that lead to a successful PMO implementation.

The process of action research aims to evaluate the organization needs, document the steps to take, analyze data, and make informed decisions based on the previous research that can lead to desired results (Aires, Roos, Gonçalves, Schneider, Olschowsky, 2010).



Figure 10. Action research methodology cycle (Spinks and Canhoto, 2015)

Figure 10 describes the AR methodology steps, which are seen as a cycle. **Planning**, initiating with the identification of the research problem as well as the organization and action plan. It also includes the initial research about the literature, studies and documentation already developed in the area (Spinks and Canhoto, 2015). During this step it is also common to have the client commitment, the establishment of roles and responsibilities, the goals of the project and the ethical issues, including confidentiality agreements (Davison, Martinsons, and Kock, 2004).

Second step is **Act**, where you implement the plan from the previous phase. This part is also connected with the **Observing** that is basically the control and monitoring of the project and the collection of new data. This latest information should be analyzed, reported and shared with the team, this is how we arrive to following step **Reflecting**. Finally, after the evaluation, if new amendments are necessary the cycle could be repeated (Spinks and Canhoto, 2015).

Reddy and Priyadarshini (2016) suggested that to implement a PMO four steps are needed:

1. PMO Initiation: where the team is selected, physical location and definition of roles.
2. PMO planning: during this phase the PMO selects the methods, standards, processes and tools to be adopted.
3. PMO Execution: This is the operational phase, the managing of projects using the tools developed in the previous phase.
4. PMO Improvement: After a reasonable time of the PMO working, the methods established should be reviewed and improved. This should be done by measuring how well the projects are meeting expectations of time and budget. During this phase, new services can be implemented, the stage could be upgraded. The purpose is to level up the project management maturity.

These steps could be combined with the four phases of the action research, as follows:

Planning (PMO initiation and planning)

The planning part includes the literature research; this information is the basis of the project. The different author's theories and knowledge provide inputs that support the implementation of the PMO in Siemens and lead to get the desirable results. Also, in this stage we have the initial approach with the client and the statement and signing of a non-disclosure agreement.

Justification and Initiation (situation analysis)

- Maturity level of Project Management in the laboratory
- Organization Structure Type
- Identification and classification of the people involved (stakeholders)
- PMO model to be implemented

Requirements List and Design of the PMO:

- Define the PMO responsibilities areas
- Methods and processes that will be implemented
- Tools and resources needed

Act (PMO execution)

Implementation of processes and tools

- Communicate the plan about the PMO functions inside the laboratory to all stakeholders

Observing and Reflecting (PMO improvement)

- Keeping the PMO functional and operational
- Coaching

We will carry out meetings and documents evaluations, constantly sharing information that end up having a win-win strategy for the researcher and the client.

After the first implementation of tools and methods, we will have a test phase to collect first results and make necessary adjustments for a better performance.

- Monitoring performance evaluation (indicators)

The results of the PMO application should be reviewed; first a re-evaluation in a short period to do the necessary adjustments but it is also important within the years to confirm if the PMO is reaching the desired potential. The approach of the PMO should be also examined as the needs of the company change, PMO needs to keep evolving in order to remain viable and adding value to the organization (Van Der Linde and Steyn, 2016).

The main 3 indicators for the company to determine if a PMO is being successful are: the reduced project cycle times, more project completed during the fiscal year with the same resources, and more tangible contribution to the company's internal KPI (Kendall and Rollins, 2003). Success can be determined according to the company's achieved goals due to the project's completion; the shorter the cycle time of the projects is and the quantity of projects that are being completed within the same resources and time.

4. Results

4.1 Initiation

The *PMBOK*® Guide was the main instrument used during all the implementation phase, the tools and techniques performed were based on the framework of the PMI.

Following the following stages is how we analyzed the situation and information in Siemens and that helped to end up with the most suitable documents for the company to adopt in future projects.

- **Initial approach with the client**

The client identified the problems in its automation laboratory and seeking for a solution is how this research started.

After an initial meeting that took place in SIEMENS Fábrica Monterrey, the negotiation and initial agreements were made between the researcher and the client. Followed by the signing of a non-disclosure agreement.

The client was very clear about the main pain point: they did not have time to establish the methodology or process to follow the project management before they started the operation of the laboratory. Therefore, the initial projects had no structure and a lack of organization and standardization; this made it difficult to define and keep a standardized approach.

One of the imperative inputs of the client is that this project guarantees the development of tools that will benefit the team. Tools that will support all the projects but will not be too extensive or complex.

As part of this initiation part, the team, the location and the roles were already defined.

The schedule agreed with the client is represented in the following Figure 11:

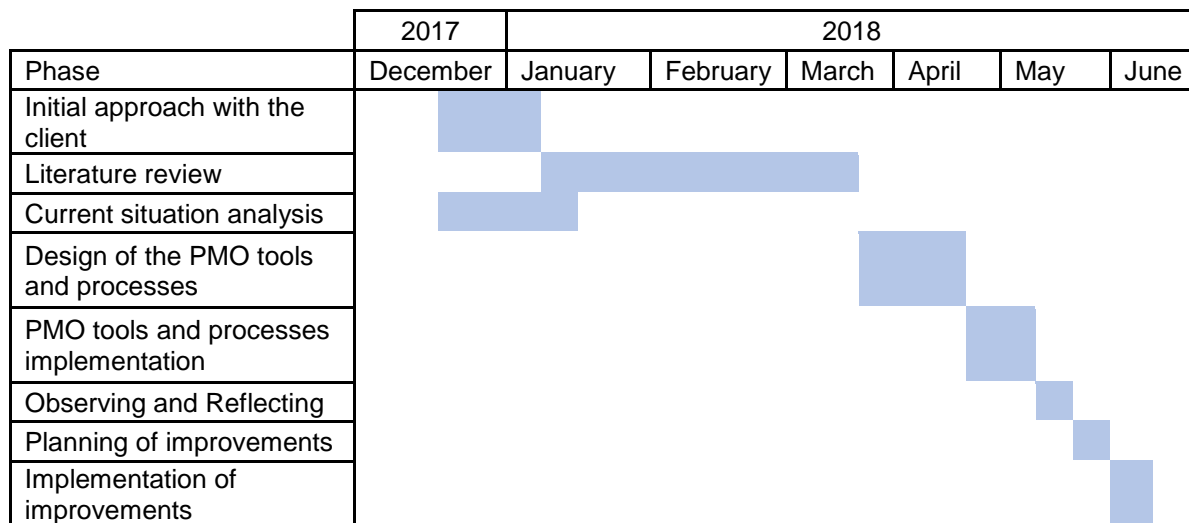


Figure 11. Timeline
Source: Own Elaboration

4.2 Planning

Justification and Initiation (situation analysis)

- **Maturity level of Project Management in the laboratory**

Even though the Siemens' general project management maturity is high (Sopko and Husemeier, 2009), the laboratory, as a new entity, does not count with the conditions and criteria needed to have a satisfactory level of Project Management.

As the structure and nature of the laboratory was something completely new and innovative inside Siemens Fabrica Monterrey, it was necessary to implement tools and a project management methodology well-adjusted to the nature of the projects and processes driven by the laboratory. The experience with the initial projects revealed that they are being developed as different entities and with no standardization in their project management processes. The documentation used during all the stages of the different projects is not related and can vary depending of the person that is leading and planning the project.

This lack of standardization makes the measurement of the performance of the projects a challenging task. This also creates unnecessary obstacles to the compilation of information that can help to analyze the best practices and improve the opportunities areas.

As we have identified in Table 7 , the laboratory does not count with established reports to show management and/or clients about the status and performance of the projects. They do not count with templates that gather all the transcendent information about the activities in progress or planned. There is no path to follow during the planning, development, changes or closure of the projects. And, they are not currently measuring the different projects in order to get the real impact in the company.

PMO Function to accomplish	Tools to implement	Pain to be solved
Reports to management and clients	<input type="checkbox"/> Individual project status <input type="checkbox"/> Portfolio status	✓ difficulty to provide a status
Project documents implementation	<input type="checkbox"/> Project charter <input type="checkbox"/> Project scheduling/ timeline <input type="checkbox"/> Project tracking <input type="checkbox"/> Closure <input type="checkbox"/> Change request	✓ poor planning ✓ delay in due dates ✓ lack of change management method ✓ lack of performance monitoring
Standardization and Training	<input type="checkbox"/> Methodology to develop the projects <input checked="" type="checkbox"/> Instructions sheets	✓ lack of standardization ✓ complicate to handover activities
Prioritizing	<input type="checkbox"/> Project evaluation method	✓ lack of method to prioritize projects

Table 7. PMO Functions to accomplish matrix

Source: Own Elaboration

Among the articles available in the Project Management Institute library, there is one from 1985. In spite of the fact that it was written several years ago, the foundations of this article about project management model continues to be true. It describes 18 components that encompass all the elements of project management systems. Although the importance level could vary depending on the project, all the components need to be present for an acceptable execution of projects (Salapatras, 1985). Nowadays these aspects have been developed and detailed, but these 18 components continue to be the foundations of a valuable project management model.

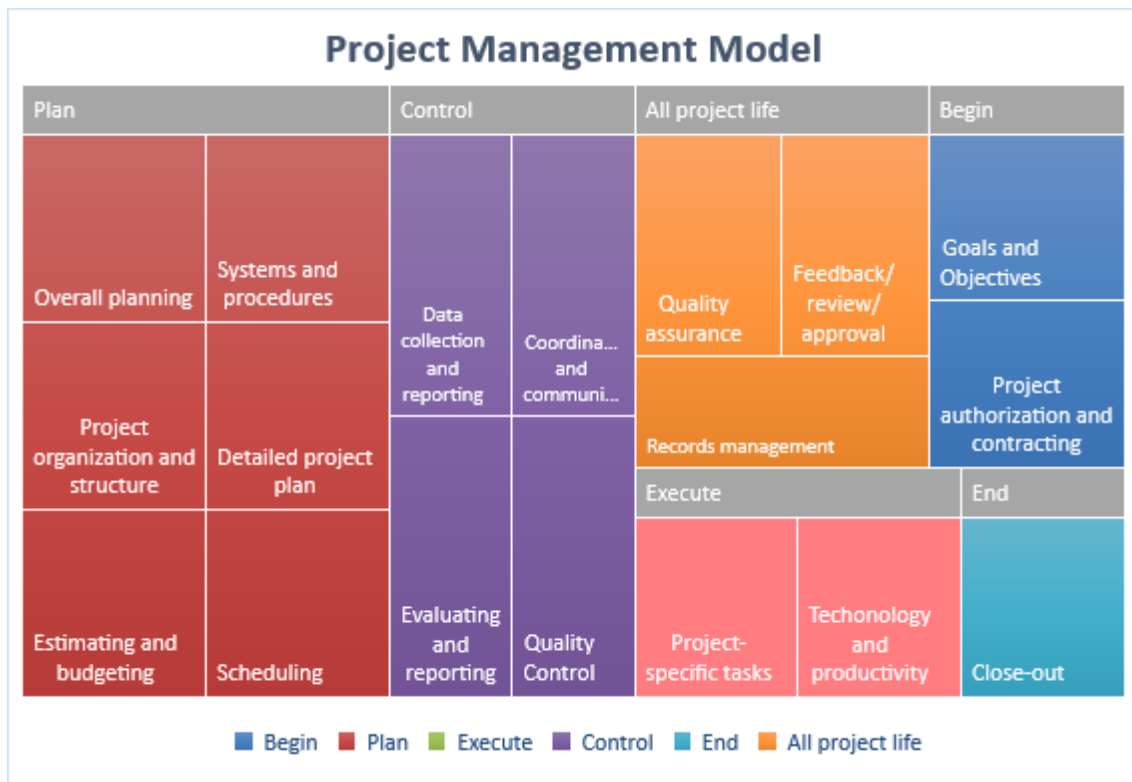


Table 8. Project Management Model (Salapatras, 1985)

Based on these components and together with the team of the laboratory the project management level was evaluated. According to the experience of previous projects and using the tools of brainstorming¹ and focus group², the data was analyzed, and the results of this study are shown in figure 12.

¹ Brainstorming: individuals are brought together to develop a solution to a problem (Lunenburg, 2011)

² Focus group: a technique involving the use of in-depth group interviews in which participants are selected because they are a sampling of a specific population, this group being 'focused' on a given topic (Rabiee, 2004)

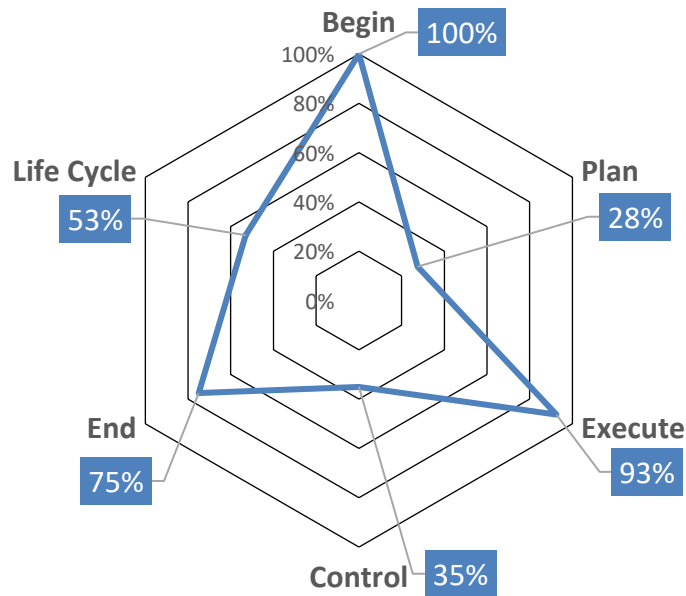


Figure 12. Project management level in the laboratory
 Source: Own Elaboration

If having the 18 components at their highest level is a 100%, the current overall performance of project management in the laboratory is at 64%. At the “Begin”, where the objectives are established, and the authorization and contracting are settled, is the moment where the company has more control. The “Plan” has the lowest performance, mainly due to the deficiency on the organization, structure, system, procedures and scheduling. The “Execute” has a satisfactory level; they have an extensive knowledge and experience on automation matter and are aware of all the actions that must be completed to get the desired results.

The “Control” has also room for improvement; there is not an organized method to collect information, to issue status reports, or to communicate changes. The “End” achieved 75% because they have delivered all the projects with some setbacks but always delivering what was previously contracted. The problem here is that they do not have an official way to close the project (documentation) and a way to collect the lessons learned during the development of the project. The author also determined three components that must exist during the entire project “Life Cycle”. In this aspect the result is at 53%, for the reason that they have a well-established method to assure the quality of the product that they are

developing, but on the other hand, the records management part is not strong enough.

- **Organization Structure Type**

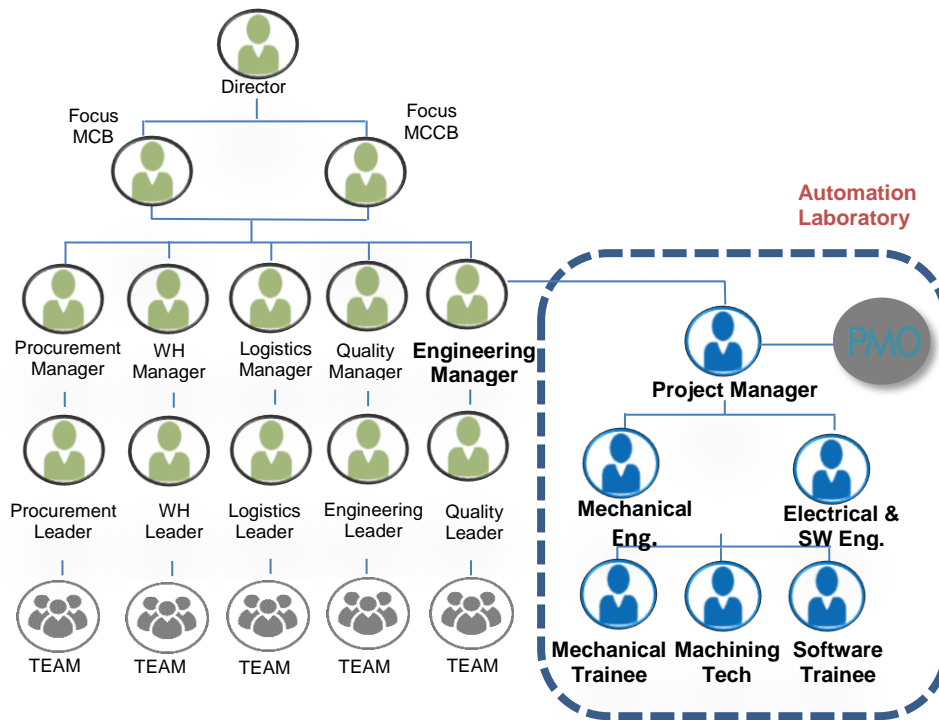


Figure 13. Organization structure type

Source: Own Elaboration

The automation laboratory, as an entity out of any department, has the advantage to be self-sufficient with regard to the use of resources and machinery. They have a project manager in charge of all the projects related to automation.

We have classified the automation laboratory as the project-oriented type of organization (POO). The team is arranged by project, the authority of the project manager is high, the project manager's role is a full-time designated job and the resource availability is almost total (PMI, 2017a).

The POO as an organizational strategy creates teams by project; which can manage a project portfolio of different project types and perceive it to be project-oriented. The POO identifies projects and programs as temporary organizations for the performance of complex processes, such as contracts for external clients or product development for internal clients (Gareis and Huemann, 2016).

- **Identification and classification of the people involved (stakeholders)**

For the identification and classification of the people involved in our project, as well as the evaluation of the level of power, interest and influence, the following tools were used.

Personal Interview with Sponsor, as the technique for the identification of the stakeholders. During a meeting, the client, who is a person strongly involved in the company and with the automation laboratory, used his high level of understanding of the politics, structure and culture of the company to define the people who is impacted with the implementation of this project. Also, he has deep knowledge of the industry and each team member's contributions/expertise.

The **Stakeholder register** is where we identified the relationship between the stakeholders and the power/interest level for each one.

Then, the grid in figure 14 shows the classification of the stakeholders into four big groups, the ones that we need to keep satisfied, the ones to be closely managed, the ones that need monitoring and the ones that need to be informed. As we can see, the greater number of people is in the section of "keep informed", most of them are part of the team of the laboratory; and they are into this category because they are an essential part on the implementation. Although they do not have

Project title		PMO Implementation					
ID	Name	Title	Role	Main responsibility	Interest (1-5)	Power (1-5)	Classification
A	Isaac Garcia	Engineering manager	Sponsor	Provide capital for the PMO	5	5	Manage closely
B	Armando Yoyel	Automation Leader	Project Manager	Management/operational	5	3	Manage closely
C	Homero Javalera	Company Director	Operations director	Approval/Revision	2	5	Keep Satisfied
D	Miguel Morales	Financial director	Controlling	Approval/Revision	2	4	Keep Satisfied
E	Carlos Zepeda	Mechanical Engineering	Team member	Mechanical activities	4	2	Keep informed
F	Omar Flores	Electrical & SW Engineering	Team member	Electrical & SW activities	4	2	Keep informed
G	Carlos Chavarria	Mechanical Trainee	Team member	Mechanical activities	4	1	Keep informed
H	Saul Balderas	Machining Technician	Team member	Machining activities	4	1	Keep informed
I	Guillermo Zapata	Software	Trainee	Software activities	4	1	Keep Informed

Table 9. Stakeholder register
Source: Own Elaboration

power in decisions, it is vital that they are aware of the changes to assure they feel as contributors.

The people in the category of “keep satisfied” have the most power; they are part of the higher management and need to be handled with special attention to achieve their buy-in. The category of “manage closely” has the sponsor and the project manager in charge of the laboratory right now. They are the ones that will transmit the results to the team.

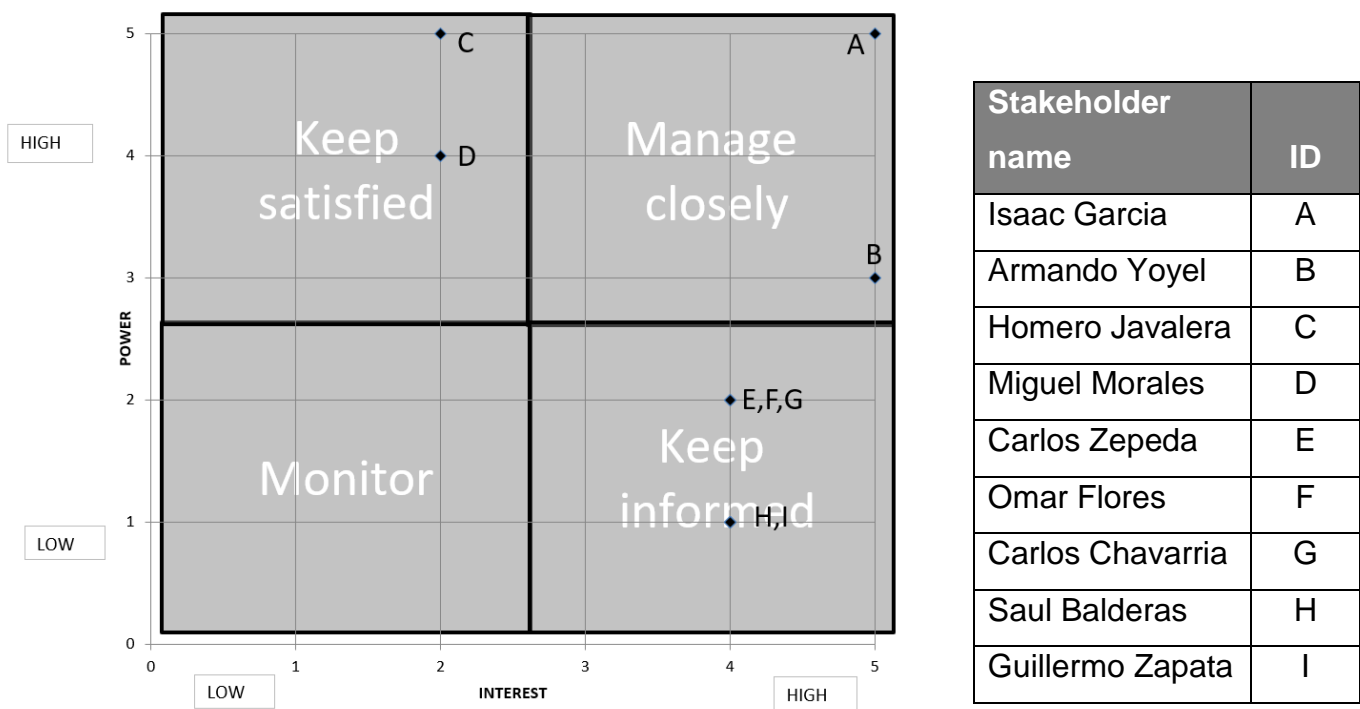


Figure 14. Stakeholders' classification grid
Source: Own Elaboration

- **PMO model to be implemented**

Throughout the reviewed literature we analyzed the different approaches about types and models of a PMO. Being the type, the one that defines the range of responsibility of the PMO during the development of the projects. And the model, the role and level of authority of the PMO inside the organization.

From a model perspective we are implementing the **Organizational Business Unit PMO** which provides structure and standards related to project governance and will help to establish methodologies, tools and techniques for the portfolio and single project management, the PMO will report to the division manager (PMI, 2013a). The methodologies and tools will be highly specialized for the nature of the projects that the laboratory runs.

The type that we will implement is the **directive** project management office. The PMO will supply templates, best practices, training, access to information and lessons learned from other projects, but will not be limited just to that, PMO will take control of the execution of projects developed in the laboratory (PMI, 2017a). As we previously discussed, the laboratory owns a group of people in charge to develop the allocated projects, this means that the resources are working only for the portfolio on this business unit.

- **Design of the PMO**

Definition of the PMO responsibilities areas:

The stage 2 Basic PMO that we are working on is focused on the planning, scheduling, tracking, evaluation, change management, and closure of the projects. Which are mainly the ones related to the performance and organization of the projects. It will have the roll to ensure the use of a standardized and consistent methodology for the projects.

The PMO will be responsible for providing support and templates during all the execution of the projects. Since the initiation and evaluation of the priority between projects to the planning, monitoring, change management, and closure of them.

The compilation of information is one of the fundamental functions; this information is the key to be able to provide data and statistics to improve the methodology for future projects.

- **Methods and process implemented:**

Organizations should focus on establishing consistent, repeatable processes for project scheduling, resource assignment, time tracking, project tracking, and general project oversight and support (Brown, 2012). That's the reason why, as part of the PMO capability, we have established the methodology to follow once the project has been awarded to the laboratory. A methodology, which is the process to guide project performance from concept to completion, could be accomplished by introducing a series of steps to follow. This process should address the five-process groups, initiating, planning, executing, controlling and closing. The methodology must guarantee that the activities of project management that are most essential to the organization are being completed (Hill, 2013). By doing this, we are assuring to have standardized and repeatable processes for every existent project in the laboratory. We have developed project documents that will support in each of the project management process group.

The introduction of project management practices should be gradual, beginning with those that have the greatest impact on project business success (Hill, 2013). To upgrade the current Stage 1 to the Stage 2 Basic PMO, we will implement the following methodology, practices and tools.

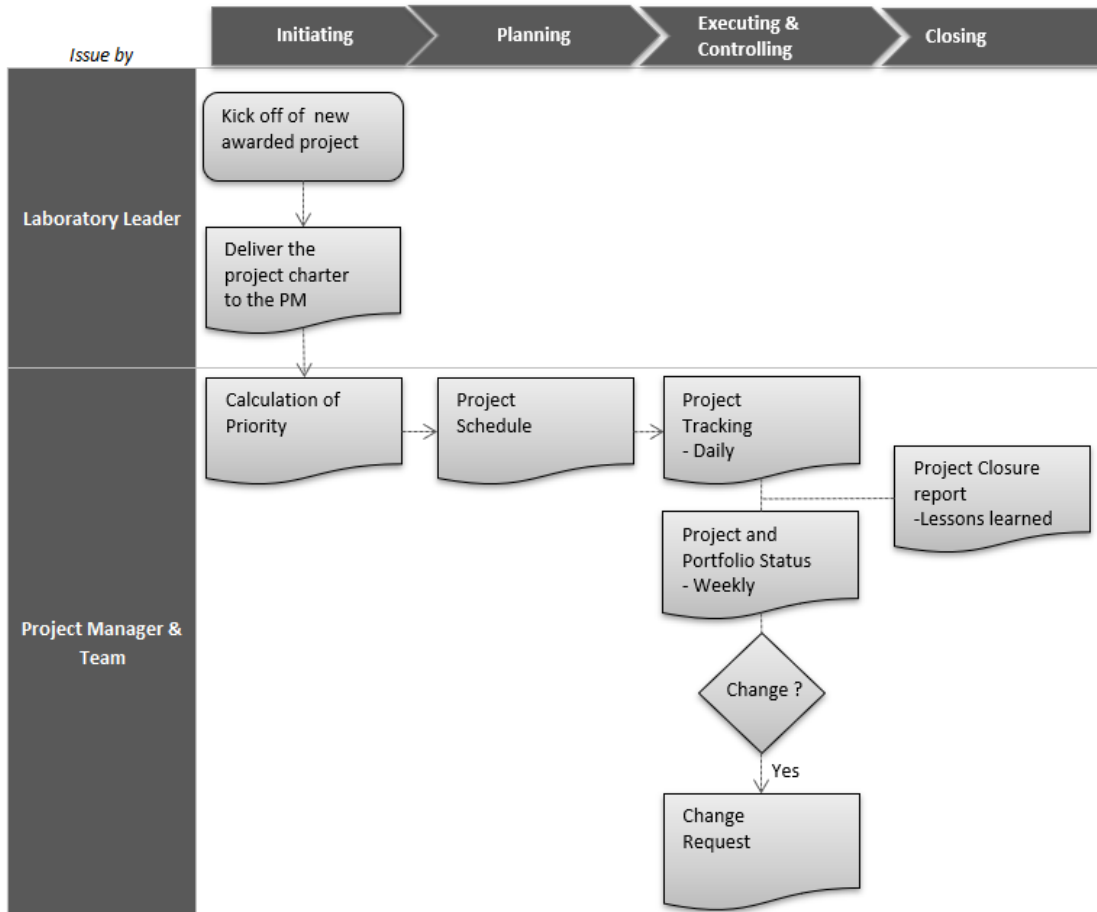


Figure 15. Methodology to follow for projects

Source: Own Elaboration

PROJECT DOCUMENTS LIST









1	 PROJECT CHARTER	Initiating	A project charter must be filled up and approved. It includes all the relevant information about the project and the agreements made between the parties.
2	 PROJECT SCHEDULING	Planning	The estimation about times will happen here and the milestones will be defined in order to provide the keys to have an appropriate follow up during the evolution of the project.
3	 PRIORITY CALCULATOR	Planning	It's necessary to find out the priority according to the criteria in the "Priority Calculator". This tool provides the guidance about the level of commitment and gathers information about expenses, resources, time and in the best cases, the savings that the company can obtain with the implementation.
4	 PROJECT TRACKING	Executing/ Monitoring and Controlling	This template allows managing the project activities in a daily basis; it is focused on the team and the detail about the execution part of the project.
5	 PROJECT CHANGE REQUEST	Monitoring and Controlling	Need to be used to when changes are requested by the client, it gathers the relevant information that allows evaluating the change and inform about the impacts.
6	 PROJECT STATUS REPORT	Monitoring and Controlling	Once a week basis. Is a visual and complete way to show to clients and management about the status of a project including current situation and opened issues.
7	 PORTFOLIO STATUS REPORT	Monitoring and Controlling	Once a week basis (if there is more than 1 project running). Visual report to understand the status of the portfolio, it gathers the more relevant information for management.
8	 CLOSURE REPORT	Closing	Once the project is completed, this template must be filled up and approved.

Figure 16. Project Documents List

Source: Own Elaboration

The methodology and the documents are the main tools that are being implemented to support the management and development of the projects performed by the laboratory.

TOOLS DESIGN

The tools developed are defined in the following matrix where we can see the co-relation between the tools and the pain point to be solved in the laboratory in Siemens.

These are the ones which generate the bigger benefit to the company. As per our client demand, they have been created trying to maintain the most relevant information that will generate value and, avoid the excess of workload. These tools were designed for everybody around the project to be able to understand, use and update. The tools developed were shown in Table 7.

Project Charter

The project charter is the official document where the authorization of the project's execution is settled, as well as the approval for the use of resources to perform the essential tasks for the project to be completed. It creates a formal record and shows the organizational commitment to the project (PMI, 2017a).

A lot of different examples of formats were found during the research, but we were focused on developing a project charter that includes just the essential information. The idea is to avoid having an extensive document that could need abundant time just for filling it. Also, it needed to be a document easy to see and understand.

Previous to the kickoff of a project, Siemens has meetings with its clients where they agree about costs, timing and details about the project development. The project charter is more an internal communication document. During the creation of this template we considered the following key components.

KEY Components:

- Project Sponsor and Project Manager
- Project scope: What needs to be achieved and the work that must be done to deliver a project (the goals of the project).

- **Acceptance criteria:** The criteria of accepting the completed product, services or result. Name of the person responsible for accepting (signing off on) the project completion.

- **Project deliverables:** Deliverables include the outputs that comprise the product(s) or service(s) of the project, as well as any project management reports and documentation.

- **Milestones (name and date).**
- **Project budget**
- **Project Exclusions:** Exclusions anticipate and avoid scope creep by identifying any related product or service features that are not required as outcomes of the project. Explicitly stating what is out of scope helps to manage the stakeholder expectations.

- **Dependencies:** Activities or other projects that this project relies on or feeds into.

- **Assumptions:** Assumptions are factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstration

- **Known risks:** Uncertain events or conditions that, if they occur, will have a positive or negative effect on the projects' objectives

- It should have the name, signature and stamp of the high management person who is authorizing the project.



[Project Title]

Project Sponsor			
Project Manager			
Author		Issued date	
Version		Published date	
Authorized by:			

Project Scope	<i>What needs to be achieved and the work that must be done to deliver a project (the goals of the project)</i>	
Acceptance criteria	<i>The criteria of accepting the completed product, services or result</i>	
	<i>Name of the person responsible for accepting (signing off on) the project completion</i>	
Project deliverables	Deliverables the outputs that comprise the product or service of the project, as well as any project management reports and documentation	
Milestones	Start	Date
	Milestone name	Date
	Milestone name	Date
	Milestone name	Date
	Milestone name	Date
	Milestone name	Date
	End	Date
Project budget	\$\$	
Project exclusions	Exclusions anticipate and avoid scope creep by identifying any related product or service features that are not required as outcomes of the project. Explicitly stating what is out of scope helps to manage stakeholder expectations	
Dependencies	Activities or other projects that this project relies on or feeds into	
Assumptions	Assumptions are factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstration	
Known risks	Uncertain events or conditions that, if they occur, will have a positive or negative effect on the projects' objectives	

Figure 17. Project Charter

Source: Own Elaboration

Project Scheduling

The project scheduling provides the details about how and when the deliverables will be completed in order to achieve the results defined in the scope of the project; it also has the information about the resources needed to complete the different tasks. It is a communication tool that provides a method to manage the expectations of the stakeholders, and is the base of the performance report (PMI, 2017a).

This document will show the performance of the planned activities dates versus the actual dates of completion. It provides an estimation of when the potential end date is, taking into consideration the delay that the project might already have. It includes the main information that is used to be shown on the status report.

To manage this document, it is necessary to define the main milestones, the deliverables and the activities that need to be completed in each milestone. After that, the estimation of resources and time can be established (Newton, Mewton, Kloppenborg, Petrick, 2015).

KEY COMPONENTS:

- Milestones
- Responsible
- Planned duration days
- Actual duration days
- Starting date
- Finishing date
- Baseline start date
- Baseline end date
- Delay (days)
- % Progress
- Gantt chart
- Forecast of finish date

[Name of the Project]

Initiation date 2-Apr-18 Monday
Last update 16-May-18 Wednesday

Instructions for filling

* Just update cells in blank, task title and responsible column
* Baseline start date column is only updated at the beginning of the project, then it shouldn't be changed

Forecast 22-Jun-18
Days until BED 27

Task	Responsible	Planned duration (days)	Actual duration (days)	Start date	Finish date	Baseline start date	Baseline end date	Delay (task duration)	% Progress
22		59	33	02-Apr-18	16-May-18	02-Apr-18	21-Jun-18	1	55%
7	[Name]	14	16	02-Apr-18	23-Apr-18	02-Apr-18	19-Apr-18	0	100% 32%
1	China CADs on Site	2	2	02-Apr-18	4-Apr-18	2-Apr-18	04-Apr-18	0	Done
2	Mechanical Design	2	3	4-Apr-18	9-Apr-18	4-Apr-18	06-Apr-18	1	Done
3	Electrical Design	2	1	9-Apr-18	10-Apr-18	6-Apr-18	10-Apr-18	(1)	Done
4	Design Review	2	2	11-Apr-18	13-Apr-18	10-Apr-18	12-Apr-18	0	Done
5	Bill of Materials	2	3	13-Apr-18	18-Apr-18	12-Apr-18	16-Apr-18	1	Done
6	Software Development	2	2	17-Apr-18	19-Apr-18	16-Apr-18	18-Apr-18	0	Done
7	Purchasing	2	2	19-Apr-18	23-Apr-18	17-Apr-18	19-Apr-18	0	Done
2	High Mix Accessory Testboard	8	10	24-Apr-18	07-May-18	20-Apr-18	01-May-18	0	100%
1	Accessories	3	2	24-Apr-18	26-Apr-18	20-Apr-18	25-Apr-18	(1)	Done
2	Test Specification	3	4	26-Apr-18	2-May-18	26-Apr-18	01-May-18	1	Done
3	Materials	2	3	2-May-18	7-May-18	1-May-18	03-May-18	1	Done
4	Mechanical Design (3D & 2D)	11	7	08-May-18	16-May-18	08-May-18	17-May-18	0	75% 18%
1	Sprint 1	2	2	8-May-18	10-May-18	3-May-18	07-May-18	0	Done
2	Sprint 2	2	1	11-May-18	14-May-18	7-May-18	09-May-18	(1)	Done

Figure 18. Project Scheduling
Source: Own Elaboration

Project Status Report

One of the functions of the PMO is to provide regular reports that illustrate what has happened and how those events compare to what was promised (Kendall and Rollins, 2003). The project status report represents the work performance information compiled in project documents which has the purpose to generate decisions, detect issues, trigger actions, and recognize potential risks (PMI, 2017a).

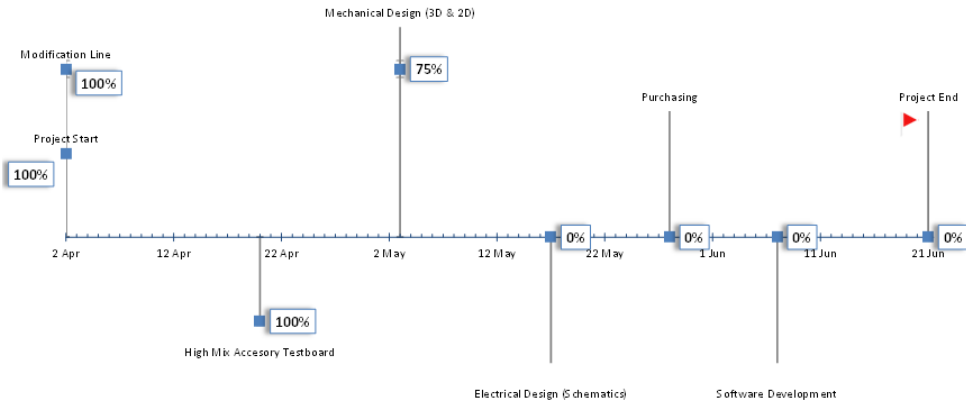
This document has been integrated to the Project Scheduling, which is the main source of information to maintain this report, but it also includes information for the Project tracking. The purpose in using the same document is that the client does not need to introduce the information twice; the document will take the necessary information from the schedule and it will do some calculations to display in the Project Report.

KEY COMPONENTS:

- Project Progress %
- Graphic about milestones progress
- Milestone's Planned start date
- Milestone's Planned finish date
- Milestone's Actual start date
- Milestone's Actual finished date
- Status
- Delay
- Team progress (Planned activities vs Actual activities)
- Main objectives to accomplish
- Activities planned to be performed the following week
- Open Issues
- Open change request
- Open risk

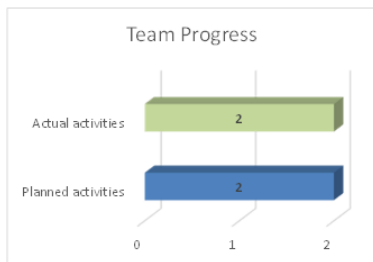
LL-USA wTestboard

55%
Progress



Milestone	Planned start date	Actual start date	Planned finish date	Actual finish date	Status	Delay
Modification Line	2-Apr-18	2-Apr-18	19-Apr-18	23-Apr-18	●	2
High Mix Accessory Testboard	20-Apr-18	24-Apr-18	1-May-18	7-May-18	●	4
Mechanical Design (3D & 2D)	3-May-18	8-May-18	17-May-18		●	
Electrical Design (Schematics)	17-May-18		6-Jun-18		●	
Purchasing	28-May-18		6-Jun-18		●	
Software Development	7-Jun-18		21-Jun-18		●	

6
Delay



2
Activities for next week

Main objectives to accomplish

Open Issues

Draw attention to any new issues that have come up since the last report. Additionally, provide a status update on any previously identified issues and their management strategies.

Open risk

Acknowledge any new risks that have occurred since the last report, and present the management plan(s) to deal with them. Additionally, provide an update on the risk management plan being used to handle existing risks.

Open change request

Highlight any open change requests and next steps that need stakeholders attention, for example, extending the schedule or budget due to an increase in the project's requirements.

Figure 19. Project Status Report

Source: Own Elaboration

Priority Calculator

As we have discussed before, the laboratory has different types of projects, either external or internal (Siemens around the world). The internal projects are sub-divided into the ones that generate savings and the ones that do not generate savings in Siemens Fabrica Monterrey.

For the development of this document, it was required to gather historic information from past projects. Detailed Information as time, resources, profits and expenses. With this information it was possible to define the criteria to establish the priority between projects, within the strategic plans. Therefore, the PMO can ensure that resources are working on the right projects at the right time (Kendall and Rollins, 2003). This is one of the benefits of a PMO, it helps to determine a better definition of project priority that support the decisions when managing urgencies (Pansini and Terzieva, 2013).

KEY COMPONENTS:

- Project Name
- Time
- Resources
- Type
- Expenses
- Profit (if the project is external)
- Savings (if the project is internal it could have or do not have savings)
 - Number of lines to replicate (is it possible to replicate the project in another production line?)
 - Total potential of project savings
- Percentage of value according to the defined criteria
- Priority between projects

*Insert data
*Contains formula, don't insert data
*Blocked cell, no data needed

Project Name	Total value	Priority	Type	Savings Savings value	Savings Amount (per year)	Time Value	Resources	Resources value	Profit value	Profit	Expense value	Expense	Lines to replicate	Total Potential Project Savings
Project A	90%	2	External	0%		>9 Months	>1449 hrs	20%	>\$'800	>\$'800	>\$'30	>\$'30	10%	\$
Project B	100%	1	Internal	40%	\$ 2 000	>9 Months	>1449 hrs	20%	0%		>\$'30	>\$'30	10%	2 \$ 4 000
Project C	90%	2	Internal	0%		>9 Months	>1449 hrs	20%	>\$'800	>\$'800	>\$'30	>\$'30	10%	\$
Project D	54%	4	External	0%		3 Months	483 hrs	8%	<\$'50~\$'200	0	\$'15~\$'30	\$'15~\$'30	6%	\$

Figure 20. Priority Calculator
Source: Own Elaboration

Project tracking

The project tracking is also another role of the PMO (Reddy and Priyadarshini, 2016) for this purpose we developed a template as the method to support the team to follow up the activities planned for the entire project. This document includes: the detailed list of activities needed to complete each milestone, the deliverables, the resources assigned, the area of the resources and the information about the duration. It also includes a comparison with the actual duration and a summary that allows seeing the difference between the work performed and the work that was supposed to be completed until a specific week.

Tracking the project and its activities on a regular basis will serve as an indicator of how effectively the team is meeting its goals and the project's objectives. One of the biggest advantages of the PMO is the visibility of project plans, progress, and tracking of activities (Van Der Linde and Steyn, 2016). This document will be crucial during all the execution, monitoring and controlling process of the projects.

KEY COMPONENTS:

- Task description
- Milestone for which the task is assigned to
- Responsible
- Area
- Deliverable of the task
- Planned duration date
- Actual duration date
- Starting date
- Finishing date
- Baseline start date
- Baseline end date
- Status of the task
- Delay (days)
- Summary for each week

[Name of the Project]															
Initiation date		2-Apr-18		Monday											
Last update		16-May-18		Wednesday											
Instructions for filling *Don't move cells in gray															
												Days until BED		26	
№	Milestone	Task	Responsib	Area	Deliverables	Planned duration (days)	Actual duration (days)	Start da	Finish da	Baseline start dat	Baseline end da	Status	Delay (task duratic)		
1	Modification Line	Activity 1	Worker 1	Software		4	3	2-Apr-18	4-Apr-18	2-Apr-18	06-Apr-18	Done	(1)		
2	High Mix Accesory Testboard	Activity 2	Worker 2	Purchasing		2	4	4-Apr-18	9-Apr-18	4-Apr-18	06-Apr-18	Done	2		
3	Mechanical Design (3D & 2D)	Activity 3	Worker 3	Logistics		2	2	9-Apr-18	10-Apr-18	6-Apr-18	10-Apr-18	Done	0		
4	Electrical Design (Schematics)	Activity 4	Worker 4	Mechanical		3	3	11-Apr-18	13-Apr-18	10-Apr-18	13-Apr-18	Done	0		
5	Purchasing	Activity 5	Worker 1	R&D		4	4	13-Apr-18	18-Apr-18	12-Apr-18	18-Apr-18	Done	0		
6	Software Development	Activity 6	Worker 2	Software		1	3	17-Apr-18	19-Apr-18	16-Apr-18	17-Apr-18	Done	2		

Figure 21. Project Tracking
Source: Own Elaboration

Project Change request

Any adjustment on the original plan that involves significant additional time, resources or budget require a change request (PMI, 2017a). A Project Change Request is required in the following circumstances: additional funding of more than 5% of the approved project budget is needed, additional time greater than 5% of the original finishing date is required to complete the project, additional project resources that were not included in the project charter are required, changes in project scope and/or deliverables are required in order to achieve the objectives of the project, the project sponsor determines that the strategic visibility for a project needs to change, or other project decisions are necessary. This document includes the description of the change, as well as the benefits, impact and consequences of not doing the change. It must have the authorization of high management, it is the method to inform and get approval that a meaningful change on the efforts is needed. After a change has been documented and authorized, the baseline has to be updated incorporating the change in the project scheduling document (Greene and Stellman, 2013).

KEY COMPONENTS:

- Project description
- Projects sponsor and project manager
- Author and date
- Description of the change
- Impacts
- Benefits
- Consequences of not doing it
- Decision to apply the change
- Conditions (if applicable)
- Budget approved to proceed with the change
- Authorization

[Project Title]			
Project Description	<i>[Copy from project charter]</i>		
Project Sponsor		Project Manager	
Author		Date	
Description	<i>[Reasons]</i>		
	<i>[Description of change]</i>		
Impacts	<i>[List the impacts to the project scope, deliverables, budget, scheduling and/or resourcing]</i>		
Benefits	<i>[List the benefits of implementing this change]</i>		
Consequences	<i>[List the consequences of not making the change]</i>		
Decision	[Select]	Conditions	
Decision date		Budget approved	\$\$
Authorized by	<i>Name and date</i>	<i>Stamp</i>	

Figure 22. Project Charter
Source: Own Elaboration

Portfolio Status Report

The PMO maintains portfolio status reports to inform higher management about the progress in the different ongoing projects (Kendall and Rollins, 2003). It is desirable for the PMO to keep a regular practice of communicating to the senior management team over an integrated report that combines all information into one report. This report has the purpose to provide early warnings of obstacles detected on the ongoing projects. One of the most efficient format is the “dashboard” which provides a quick visual status of the portfolio (Brown, 2012). It is visual and efficient in showing the “digested” information.

KEY COMPONENTS:

- Quantity of ongoing projects
- Progress
- Delay
- At risk projects
- Quantity of resources
- Budget projected vs actual one
- Starting and finishing date of each project
- Forecast for completion
- The global Gantt for the portfolio
- And any open issue that needs to be reported

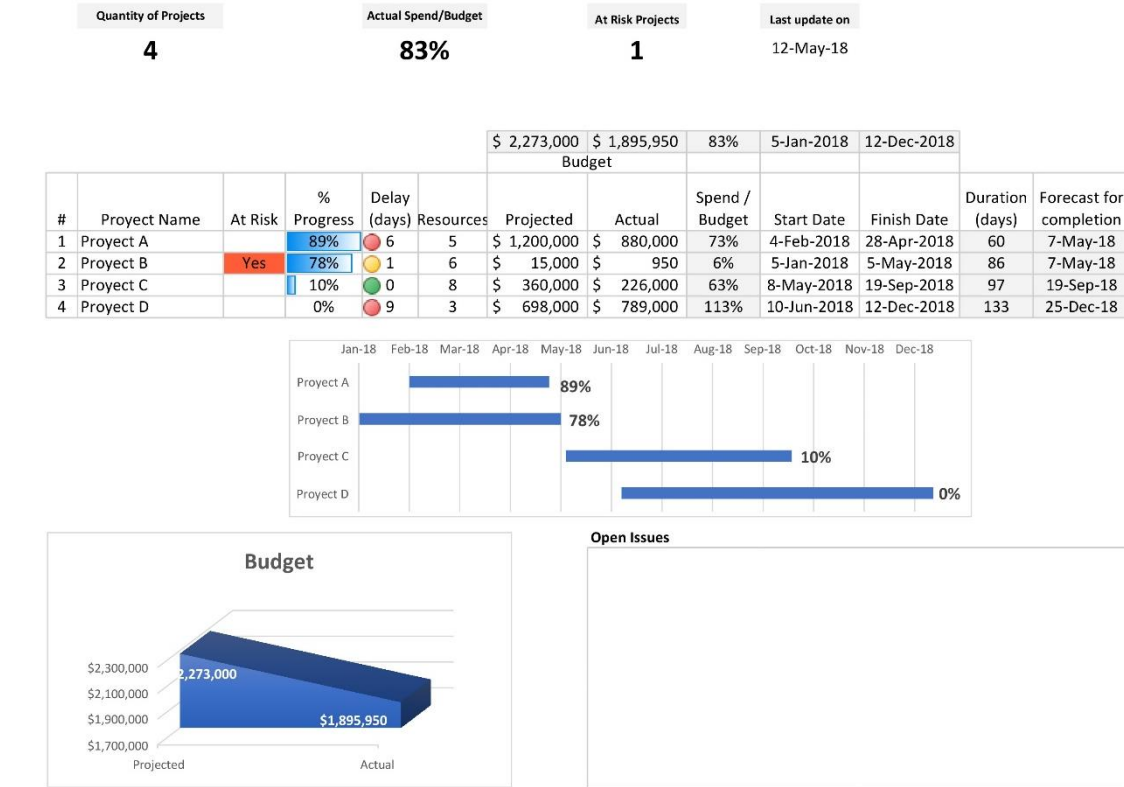


Figure 23. Portfolio Status Report
Source: Own Elaboration

Closure report

When a project is closed, the project manager checks that the objectives defined in the plan have been accomplished (PMI, 2017a). The deliverables must be formally accepted and validated to assure administrative closure (Brown, 2012).

The closure report retains the historical data for the benefit of subsequent projects (Brown, 2012). This document has the following objectives: assess the success of the project, identify best practices for future projects, resolve all open issues, and formally close the project.

KEY COMPENENTS:

- Information about the project (name, description, project manager)

- Summary about the milestones starting and finishing date, with a comparison with the planned dates.
- Acceptance criteria, that is the same established in the project charter
- Project deliverables with the acceptance
- Lessons learned, Information that reflects the positives and negative experiences of the project, this information will help to improve future projects.
- Client acceptance
- Authorization of high management



[Project Title]			
Project Description	<i>Copy from last version of Project Charter</i>		
Project Sponsor		Project Manager	
Author			
Date		Version	

	Start date	End date	
	Planned	Actual	Variance
Time (days)			
Cost (USD)			
Resources (hours)			

Acceptance criteria	<i>Copy form last version of project charter</i>	
	<i>Copy form last version of project charter</i>	
Project deliverables	<i>Copy form last version of project charter</i>	
	<i>Copy form last version of project charter</i>	
	<i>Copy form last version of project charter</i>	
	<i>Copy form last version of project charter</i>	
Lessons learned	<i>Information that reflects the positives and negative experiences of the project</i>	
	<i>(This information will help to improve future project)</i>	
Client acceptance		<i>Comments</i>
Authorized by	<i>Name and date</i>	<i>Stamp</i>

Figure 24. Closure Report
Source: Own Elaboration

4.3 Execution

Act: PMO implementation

- Implementation of processes and tools

The project documents were delivered to the project manager designated by the company. He gave the first impressions and small adjustments that were immediately applied to some of the documents. Once we got his approval, we organized a meeting to present all the material to the entire team. These documents were delivered before the initiation of a new internal project which was the perfect opportunity to apply the tools and methodologies suggested.

- Communication plan about the PMO functions inside the organization

At a meeting held at the beginning of May with all the team, the methodology was explained, and the tools were presented. During this meeting,

the function of the documents was explained as well as the purpose of the information contained in each of them. The team was very receptive and participative; they easily understood how to manipulate the documents and provided some initial thoughts. The team felt their ideas and concerns were considered and the tools proposed were the best solution to their pain points.

4.4 Improvement

Observing and Reflecting

- Keeping the PMO functional and operational

The company's new project started at the beginning of April 2018, the use of the proposed methodology and project documents started as well.

The team started to use the templates and methods. We receive feedback about changes and adjustments that they needed. We planned and made the requested adjustments, and then the team tested again the updated tools.

- Coaching

All the documents have their own "guidelines" where they can easily learn about the tool usage. These are simple and visual guides that have brief explanations of the components of each document, as well as detailed instructions for the more complex documents.

During all the implementation phase the customer had direct coaching and support for any doubt or possible difficulties they could face. This has the purpose to provide the client the knowledge and skills to help them improve the execution and control of the project's management.

- Monitoring performance evaluation (indicators)

The main goal of having indicators is to assure that the implemented methods continue successfully to work through time. These indicators will help trigger the documents or processes that need to be updated.

The PM Solutions, (2016), considers eight measures of organizational performance where the PMO adds value. They are: strategy execution, shareholder satisfaction, financial success, schedule/budget performance, customer satisfaction, resource allocation, strategic alignment and project prioritization.

The most relevant points that are being covered by this implementation of stage 2 Basic PMO, and that can be used to evaluate the improvements on the laboratory are:

- Achieving business objectives through delivered projects – as they now possess a standardized and methodological manner to develop the projects. The efforts will be directed mainly towards execution; moreover, improving the process will increase the product's deliverables quality.
- Customer and stakeholder's satisfaction – the more projects delivered good and on time, the happier the stakeholders and clients are.
- Schedule and budget performance – The tools keep a detailed tracking of the performance of each project, they also help to obtain statistical data that can be transformed into triggers for contingency plans to avoid delays or over budgeting.

Besides the above indicators we have delivered to the client a "PMO function evaluation", that was suggested to be used at least once a year. Along the evolution of the laboratory the development of different or additional needs is expected, this evaluation basically determines if the PMO functions that were put into action are achieving the desired results. If they do not, the client will detect which area needs to be adjusted in order to keep the PMO working favorably. The tool used for this purpose was a simple evaluation sheet that measures the documents efficiency level according to the target they should be accomplishing.

SIEMENS

PMO function evaluation

Instructions: Choose from the list the level that best represents the document function for each criteria. Being 5 the higher lever and 1, the lowest.

You can use the comments section to provide further feedback

PMO function evaluation	100%
Reports to management and clients	100%
Individual project status	100%
Is it easy to prepare a status report?	5
Is it fast to prepare a report?	5
Does it have all the relevant information?	5
Portfolio status	100%
Is it easy to prepare a status report?	5
Is it fast to prepare a report?	5
Does it have all the relevant information?	5
Templates implementation	100%
Project charter	100%
Does it have all the relevant information?	5
Is it easy to understand what the project needs?	5
Is it easy to understand what the project is about?	5
Project scheduling	100%
Does it help to understand the constraints about time?	5
Does it have all the relevant information?	5
Does it help to understand the constraints about resources?	5
Does it help to do a better planning?	5
Project tracking	100%
Does it have all the relevant information?	5
Does it help to keep a proper tracking of the activities?	5
Does it help to understand the team performance efectiveness?	5
Project Closure Report	100%

Does it have all the relevant information?	5
Does it help to identify the best practices for future projects?	5
Does it help to assess the success of the project?	5
Change request	100%
Does it have all the relevant information?	5
Does it help to understand what needs to be accomplished?	5
Does it helps to understand the impacts of the change (time, cost, resources needed)?	5
Standardization & Training	100%
Methodology to develop the projects	100%
Is the project's methodology clear for the team?	5
Is it easy to follow?	5
Is it effective?	5
Instructions sheets	100%



PMO function evaluation

Date:

	Result	Target	Under target	Over target
Reports to management and clients	100%	96%		100%
Templates implementation	100%	96%		100%
Standardization & Training	100%	96%		100%
Prioritizing	100%	96%		100%
PMO final function evaluation	100%	96%		100%

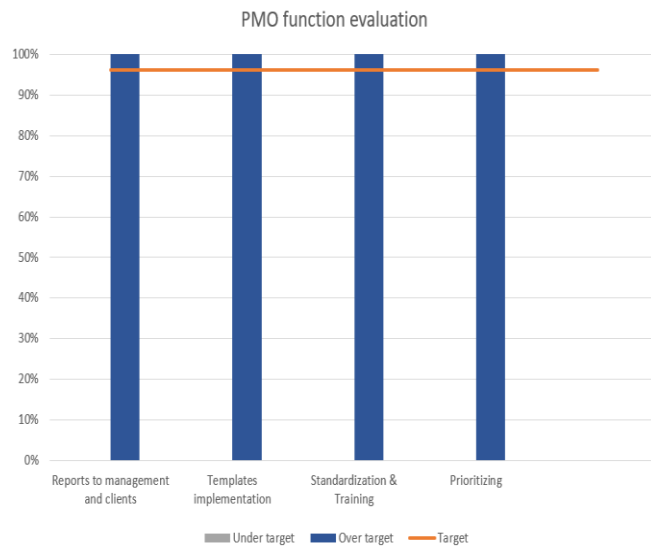


Figure 25. PMO Evaluation
Source: Own Elaboration

5. Discussion

The development and implementation of a new PMO structure, was made in a company located in Monterrey, Mexico. The processes and strategy that was being carried out in its daily work was studied and analyzed. The aspects that were declared essential in the workplace were emphasized.

In this stage of initial recognition, the following aspects were described as essential components for the PMO framework that was being developed:

- Current scenarios
- Goals and objectives perceived by the team
- Functions of the laboratory
- Characteristics of the personnel that should adopt the new PMO framework
- Characteristics of the functions to be developed
- Processes identification and description

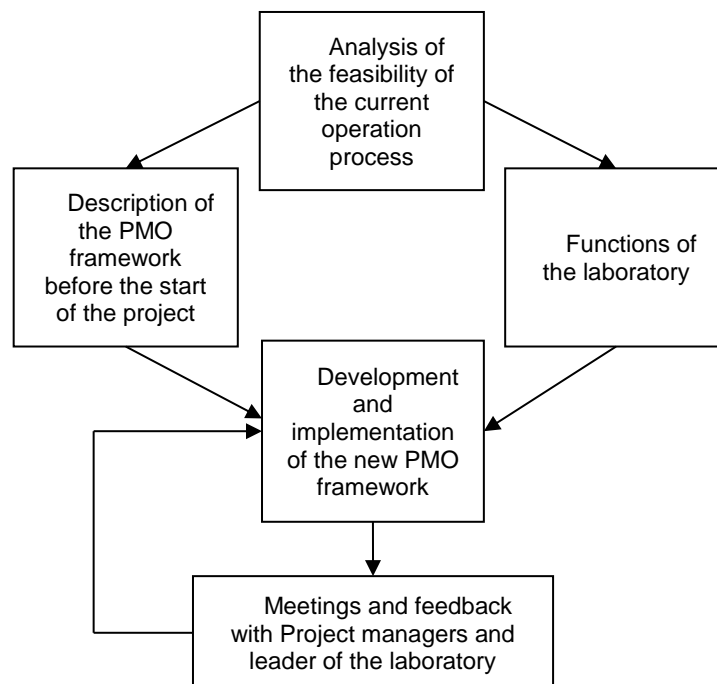


Figure 26. Components for the development

Source: Own Elaboration

Many of the results proceed from diverse meeting ex-change, skype meetings, and interviews made to the leader of the laboratory and with the team.

It is important to mention that the impact of the work made in the automation laboratory will be reviewed with more precision with a longitudinal measurement. The impact will be evaluated in a medium- and long-term future.

The tools implemented for the PMO at the laboratory were elaborated in Microsoft Excel. This program is commonly used by the employees at Siemens, so they feel comfortable using it. They normally work with SAP in their daily operations and download the data directly to excel sheets. Siemens also has access to Microsoft Project, but it has the perception that Microsoft Excel is a more dynamic tool.

They found it helpful to gather information and make statistics that allow the finding of opportunity areas and the improvement of processes. After some skype sessions with the project manager and the team, we have developed nine project documents. All of them were defined as the tools with the more impact inside the laboratory during all the cycle of the projects.

As we reviewed in the literature, we completed the steps that Reddy and Priyadarshini (2016) suggests for a PMO implementation:

1. PMO Initiation: this part was already defined; the team, the location and the roles were already specified. We need to remember that the department already had a stage 1 project office PMO.
2. PMO planning: In the initial meetings with the leaders we selected the methods and standards that were more critical for the development of the projects.
3. PMO Execution: At this point the laboratory adopted the new tools and processes established.
4. PMO Improvement: They used the new tools and standards in a project that was starting at that specific time, from there, they made some suggestions and we reviewed them, afterwards, the adjustments were

made. From now on, we will have to measure the functionality of the improvements in a short and long-term period.

The tools designed and implemented have the purpose to achieve a specific PMO function inside the laboratory.

The collection of information from previous projects was the key to determine the inputs to improve the processes for future projects. Until now, the tools that are having more value to the client are the *project scheduling* and the *project status report*. The feedback was that it is easy to comprehend the current status of the project and gives a quick overview of how the future outcome could be.

The *project scheduling* and the *project status report* are connected, in this way the information introduced in the first one, is automatically feeding the second one. The *project tracking* was designed to do a copy-paste to the status report.

These characteristics save time when reporting to management. Previously they spent an average of 30 minutes to do the client and management reports, now; it takes around 10 minutes to complete the same reports. They did not have a standardized time to send reports; they just did it when somebody asked for them. Now, they send them weekly.

The only document that was not adopted is the *project charter*. They have a template that is of common use inside the company. Therefore, the laboratory will continue using this same template, as long as it does not affect the functionality of the other templates.

The tools and processes are efficient to organize and control the project. 100% of the team members at the laboratory reported that all the changes were favorable. As part of the changes in management strategy, it was essential to maintain an open and transparent communication with all the stakeholders to gain their support during all the implementation stage. Another factor that helped the resistance to change is that the organization has a type of culture where project management is an essential part of the work style.

The team members were key elements when gathering relevant information for the development of this project. When this project started, they had one project manager, two engineers, two technicians and one trainee. Right now, they have an additional project manager. All the seven members reported being guided and supported regarding project management processes.

The processes and tools are currently being used in an easy manner, and work to guide the team. The methodology and tools provided made the management of projects a repeatable process easy to be followed. Before the establishment of the process, they were not sure of which step was first and which one after; they were just reacting to the needs or requests. Now, they clearly understand what the next step is, since they receive a project and follow it until the end.

The new procedures are not only being used by the people who originally began this project. As mentioned previously, they have an additional project manager in the area who no mattering the fact that he was not involved in the development of the project, he was able to understand and follow the new implemented procedures. The management of the projects is now a well guided path intended to end with satisfactory projects.

Before this project implementation, it was difficult for somebody else to take over the activity that someone else started. Now, they do not need to spend a lot of time explaining the current situation of a specific activity or project, because the guidelines for each step are easy to comprehend and help decipher the information.

The fact that the project is still ongoing does not mean that the secondary long-term objectives for the project have not been achieved

- A complete methodology was defined and applied; it was accepted and considered usable by the main stakeholders.

- Templates have been defined and applied to be used in each phase; they were also accepted and considered usable by the main stakeholders.

- Indicators have been developed to recognize opportunities for future improvement.

The tools that we provided keep record of the right information that will allow future accomplishment of the secondary long-term objectives for the project, as follows:

1. Create different statistics to find their opportunities areas and create corrective actions: The templates provided will compile the strategic information for future tools creation.
2. Improvement on the cost and the time consumed on the projects: The statistics created will facilitate the detection of the pain points that cause the time delay and over budget.
3. Development of a tool to have more precise and quicker bids offered to the clients for future projects: The templates provided are the base for the creation of this tool. After they start using the templates in the incoming projects, they will have enough information to create and implement the tool.
4. Manage allocation of resources among the different ongoing projects: with the methods implemented, they now have visualization of the projects where the resources are allocated and can move them around strategically according to the priorities.

It is recommended to do a future evaluation once the laboratory has finished at least three projects.

For future reference and self-improvement, the company has the tool to measure the PMO. It will allow the identification of improvement opportunities. We will also wait for the current project to finish, in order to repeat the initial diagnosis regarding the perception of the project management maturity. Similar to figure 12 in page 55.

6. Conclusion

During this dissertation project, our work has focused on identifying useful project management best practices, and factors that contribute to the improvement of the automation laboratory projects in Siemens Fabrica Monterrey. This section points out what we've done so far and what could be done as future work.

The implementation of the stage 2 Basic PMO in the laboratory of Siemens Fabrica Monterrey accomplishes our main objectives, as follows:

1. Standardization of the project management processes. The laboratory is able to follow a general path. They have a reliable and consistent process that promotes predictability on their actions and tasks; also, it provides higher project efficiency.
2. Implementation of templates for project planning, monitoring and controlling. This PMO function aims to compare the actual project performance with the planned one. In this way the laboratory can take corrective actions on time to achieve the desired outcome for each project.
3. Establishment of strategic reports for management and clients. The reports implemented provide clients and high management the right data about the project's performance. They also support informed decision making and monitor the progress in general.
4. An objective method to prioritize the projects. They can increase the success rates of the strategic projects. Also, they can focus their efforts and best resources in those projects that will have the greater impact; this information will come from the laboratory's standards and metrics.
5. Development of guidelines for PMO tools. These manuals designed as something brief and clear, were adapted to the requirement of the client; something easy to comprehend that makes the tools user friendly. They include the information necessary to perform the tasks, save training time for new team members and serve as reference documents in the work place. They are also useful for team members with experience, in order to clarify any doubt.

With the literature research we have approached the concepts related to project management, the organizational processes and the importance to improve them throughout time. Additionally, we learned how the PMOs have been favorable in companies; they provide the right tools for project, portfolio and resource management. We reviewed the different types of PMO that currently exist, concluding that the best solution always depends on the organization's characteristics. As any other strategy, there are always advantages and challenges when having and maintaining a PMO. After the analysis of both parts, we recognized that the introduction of a PMO can only have a positive impact on the project's landscape.

The Implementation of a stage 2 Basic PMO at the laboratory was the right course to pursue. Not only did the laboratory had the perfect environment for the implementation, (minimal staff and enough time for the implementation) but also, with the improvement made on their processes, now, the laboratory has common tools, repeatable processes, practices designed for their projects type and laboratory's functions, standards and reports that helps analyze the project's performance.

All the changes made to their management of projects were developed and implemented in a period of seven months. With this, they should be able to achieve a Basic PMO full capability within one year. This proofs that the time implementation is accurate.

As we focused on the Business unit PMO, it is important to emphasize that this type of framework and its tools were developed based on the demands and nature of the projects in the laboratory. The framework implemented probably will not be feasible for another department or company without previous adjustments.

By now, this framework has accomplished the three main functions that the study of the PMI refers to. (1) The Project/Program delivery management. The laboratory has control processes that focus on delivering the projects in compliance with the constraints of time, cost and scope. (2) Standards, Methodologies, and processes establishment. They have standards,

methodologies and tools that are available for the different projects developed at the laboratory. (3) Portfolio Management prioritization. They achieved a method of prioritizing the projects, taking into account specific criteria that are critical to the department, as well as allowing allocating the resources in the best way.

The action research methodology that we used for this work, allowed us to have collaboration with the company. We worked together to diagnose the problem and developed a solution. Also, it allowed us to test our hypothesis in a real work environment. The base for this methodology was the data collection gathered by the team, to do improvements on their processes. We did not have any significant problem with this interaction, all the people involved were working for a common purpose. The team at the organization perceived the project as a way to help them minimize their difficulties and in some cases to reduce their work load.

Siemens is a company oriented towards innovation; they have a high maturity of project management on their different facilities, including Siemens Fabrica Monterrey. This feature made it easy to have the collaboration of the team; people were already accustomed to work with project management procedures, it was simple for them to learn the usage of the tools implemented. These tools were adjusted to their specific needs and project types. We have provided the necessary tools to eliminate the critical pains points that were detected during the initial approach.

The PMO implemented has the responsibility to establish and ensure a continued improvement of the standards, conventions, processes, best practices, terminologies and guidelines to support the management of the projects performed in the laboratory.

The PMO supports the development of efficient projects and manages the whole portfolio in a smooth, practical, transparent, organized and standardized way. It also provides optimal resource management, as well as methodological and administrative support for elements in the portfolio.

For future work and according to the vision of the company, the department should gain more clients and projects; consequently, more project managers and staff members will be needed. As the laboratory grows and its needs change, it will be necessary to implement the Stage 3 Standard PMO.

After this project we have a better understanding about the project management information and elements, and how the theory is applied in businesses. Besides a good project structure, it is essential to always have a good communication with all the people involved.

It would be interesting to adapt and implement a PMO in a service company to see if it also generates successful results. Then, we could compare the characteristics and out comings of the PMO in both types of companies.

7. References

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8. APPENDIX

APPENDIX A

Definitions of methodologies used in projects

Waterfall: *“relies heavily on up-front planning and a set of sequential processes that flow into each other like a waterfall. Such development methodologies may, for instance, employ use cases to define user and/or system interactions to achieve specific goals”* (Shashkov P., Khomutov G., Yerokhin A., 2012, p.19).

Agile: *“breaks tasks into Small increments with minimal planning. Generally, the Agile methodology involves short iterations that allow projects to adapt to changes quickly”* (Shashkov P., Khomutov G., Yerokhin A., 2012, p.19).

Hybrid: *“is used for iterative-incremental development of methodologies based on a predefined set of requirements and the knowledge acquired from existing methodologies and process patterns/metamodels”* (Rahimian & Ramsin, 2008, p.2).

Scrum: *“is used at leading edge software companies with significant success. SCRUM is a management, enhancement and maintenance methodology for an existing system or production prototype. It assumes existing design and code which is virtually always the case in object-oriented development due to the presence of class libraries”* (Schwaber, 1997, p.2).

Critical Path method (CPM): *“is a mathematically based algorithm for scheduling a set of project activities”* (Santiago & Magallon, 2009, p.5).

Critical Chain Project Management (CCPM): *“emphasizes focusing on the project schedule. Further, it also reduces project changes and the major source of project cost overruns by improving schedule performance. It accomplishes these results by changing the project plan, the project measurement and control system,*

and certain behaviors by the project team and supporting personnel” (Leach, 1999, p.1).

PRiSM (Projects Integrating Sustainable Methods): *“(Projects Integrating Sustainable Methods) courses enabling project managers to gain a strong grounding on implementing methods within their projects to address their organizations’ strategy for sustainability and addressing the environmental impacts these projects would have” (Porta, 2014, p.1).*

PRINCE2: (short for Projects IN Controlled Environments) *“based on the principles of the PMBOK® Guide, is a process-based, structured methodology that highlights how eight particular components (Business Case, Organization, Plans, Controls, Management of Risk, Quality in a Project Environment, Configuration Management, and Change Control), when understood and effectively addressed, can additionally reduce risks in all types of projects” (Siegelaub, 2004, p.1).*

Kanban: *“is a work scheduling system that maximizes the productivity of a team by reducing idle time. The Kanban system focuses on the reduction of waste in all informs over-production, unnecessary motion, defects, over-processing and waiting. Kanban cards are vital component of this system” (Wakode, Raut, & Talmale, 2015, p.1).*

Six sigma: *“a disciplined method of using extremely rigorous data gathering and statistical analysis to pinpoint sources of errors and ways of eliminating them” (Wiklund, Edgeman, & Klefsjo, 2001, p.3).*

RAD: *“Rapid Application Development (RAD) is an approach to building computer system which combines Computer-Assisted Software Engineering (CASE) tools and techniques, user driven prototyping, and stringent project delivery time limits into a potent, tested, reliable formula for top-notch quality and productivity. RAD drastically raises the quality of finished systems while reducing the time it takes to build them” (Daud, Bakar, & Rusli, 2010, p.2).*

ISO 10006: *“Guidelines for quality management in projects. This international*

standard provides guidance on the application of quality management in projects. It does not serve as a guide in project management itself (Lachapelle, Hundozi, & Ajvazi, 2015, p.8).

APPENDIX B

Interview to Isaac Garcia, Leader of the laboratory at Siemens Fabrica Monterrey

1. Do you feel that you actually have an upgrade of PMO at the laboratory, from Stage one to Stage two? Yes.

2. Why? Because, we were completing our projects, our deliverables and objectives. But there was a part missing regarding the way we managed the projects, the path to follow was not clear. Now, the project manager and team are clear about the process to follow, we have standardized tools and repeatable processes to use.

3. Were the tools understandable and easy to use? They were easy to use and understandable. So further, there is no modification needed.

4. Can anyone use the tools following the given guidelines? The exercise we did was to ask an engineer who is new to the area and that is leading a project to use the tools. There were no comments about it, and the tools were well used.

5. Do you think that English was the right language for the development of the tools? Yes, all our employees are used to use different formats in English. Is how we standardized documents that could be used to share specific information to our partners and clients from different countries.

6. Do the tools contribute positively to project management? Yes, this gives transparency to the project and a standardized and controlled process to follow.

7. Do they help to have a clear vision of the projects? Correct. The only one that we could not use at the time was the one of the changes since in the project that is being developed there are still no changes. We will continue monitoring in the following weeks to see if it is required to document any changes.

8. Does the team involved have a clear vision of what is expected of each one during the project? Yes, the path to follow is clear as well as the responsibilities.

9. What changes or adaptations would you make? For the time being it is fine, we would need perhaps 3-4 more weeks to give a more complete feedback as we are having progress in the project. The feedback from the team is that all the tools are friendly use.

10. Do you think that the methodology implemented in the laboratory could be used in another department? No, maybe with some adaptations. Because we wanted something that was fully adapted to the way that our department works, this is slightly different to the other departments. Due to the fact that is an entity that is not only working to our plant, but also to other clients.