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Multi-Project Management in the R&D area

Final master thesis

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Abstract

At present, technological changes and digital transformation are triggering continuous changes in companies in a technical, social, and market competition context. In order to deal with it and have successful projects, companies are using practical project management, specifically in multi-project environments with shared resources, where managers are encouraged to manage programs and portfolios. The thesis deals with how to develop a command of several projects in the R&D area with the collaboration of the "BIBA - Bremer Institut für Produktion und Logistik Gmbh" institute of the University of Bremen. In the most purely theoretical framework, it differentiates between the concepts Project, Program and Portfolio and how to identify each one correctly from some general concepts and then a specific study for the management of Programs and Portfolios will be carried out. Next, a market study of the most up-to-date software for project management will also be carried out because today, companies continue to use outdated programs that do not obtain good productivity from the Project Manager. Next, through the computer programs, guidelines will be carried out theoretically to mount projects, and the management of multi-projects will be applied to manage and optimize the resources and prioritization of projects among many other functions. This thesis can serve as a guide for many multi-project managers as there is a shortage of information and most choose to continue using old methodologies and tools.

Keywords

Project Management, Program Management, Portfolio Management, Multi-Project Management, R&D,

Table of contents

1. Introduction

Two decades ago, project and program management saw a significant growth maturity, mostly through to efforts of various project management institutes and by forums feedback worldwide. Program Management, as opposed to Project Management, differs not in scope but instead in the fundamental management characteristics that have been advanced and well-defined over the past decade (Zein, 2010). Today, there are some misunderstandings still about the roles of the unlike actors in Program Management and Multi-Project Management and Portfolio Management. Multi-Project Management in which projects are interdependent or independent are connected within the program/portfolio is shared inside of all kinds of companies. However, it is not attention enough is given to the skills required to manage current projects at the same time.

Currently, Multi-Project Management is not only related to managing many projects but also it is involved with people who are leading different projects in a specific area. It is crucial to define this concept due to many current project managers are confused about it. Multi-Project Management can be focus on projects but also in people who manage projects. So, it is called a program manager who performs as a planner amid multiple projects at an organization to be sure their benefiting each other and bring into line with global business goals.

1.1. Goals and motivation

On the one hand, the aim of this thesis is creating a guideline for all multi-project managers, especially those who manage small to medium-sized. Also, it explained the most crucial success factors for multi-project management, trying to avoid inefficient scheduling, employee overload, unnecessarily increased costs, and quality problems.

On the other hand, it will be analyzed the organizational structure of the R&D department and the whole process as for Multi-project management according to how it works and how it should be working. The project programming and the connectivity of resources and planning will be carried out in an ideal way, and updated software tools will be provided to take advantage of the tools they provide to be prepared in a constant digital and technological change.

This final project attempts to report information shortage exploring the challenges and opportunities of managing several projects with shared resources and decision making about which one is more efficient within a big graphic associating each one, in case of must choose a few of them due to there is not enough budget.

2. State of the art

Nowadays, companies or institutions are worried about not reaching one of the triple constraints. (Jain, 2018) Triple constraint is assembly by four components: time, scope, cost, and quality. There must on balance among all these components as the change in any will impact the other parts.

Project management is a broad scope, difficult to manage, and even people in charge of projects do not have enough knowledge to carry out work, just using outdated software tools. Industry 4.0 allows that resources, stakeholders, tasks, risks and scope are

connected among them thanks to data collection in real-time and one software up to date to carry it out.

As for the program, it is a set of projects. They are grouped in the same atmosphere, can be more beneficial for companies, and take advantage of wasted resources in one project and use it in another project. Also, if it is had all projects well connected and organized, we can observe which one is profitable and which should get rid of the strategy of the company.

2.1. History

Project Management in the contemporary stage dates to the 20th century. Nevertheless, certain facets of what is currently termed Project Management can be situated from the beginning of civilization. For example, the Egyptian pyramids, the Roman roads, or the Chinese Wall. Regarding all of them, they had a degree of involvement, implementation, and control (Haughey, 2012).

The industrial revolution created a significant change in Project Management were producing goods like cotton operations were interdependent; for instance, the arrival of industrial raw materials, the manufacturing, or the exit of the finished products. Whenever these interdependencies increased, the needed to use tools to plan, implement, and control improved.

According to many authors, the beginning of Project Management is in the 20th century. From this moment, most of the essential milestones can be observed in the next timeline, Figure [1].
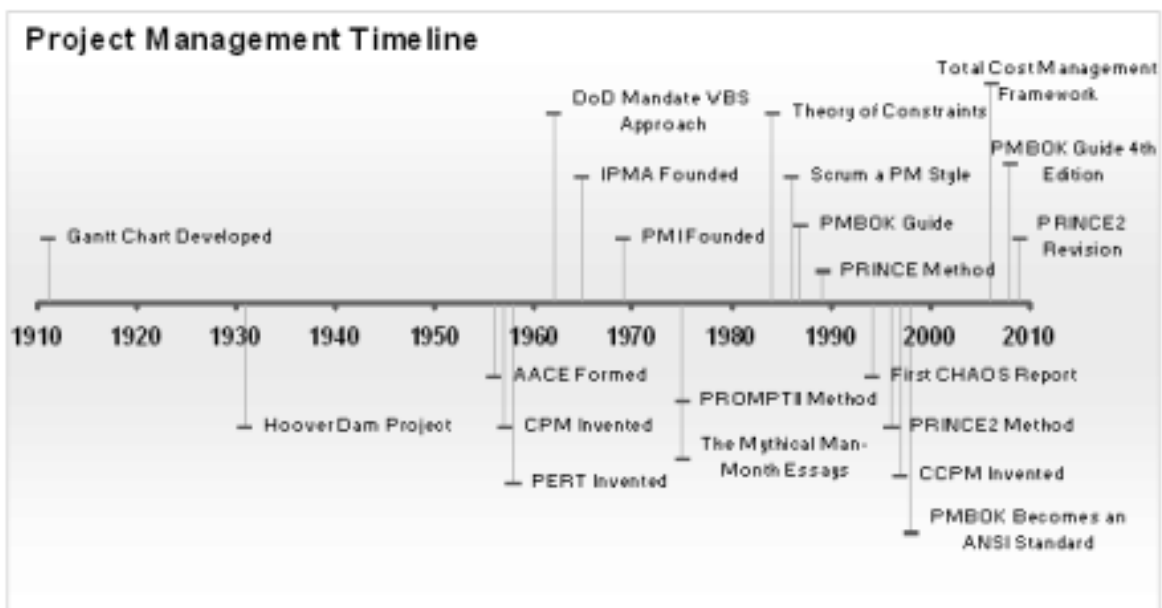
Figure 1. Project Management Timeline (source: Haughey)

Around 1917, the Gantt chart, which works to plan the tasks within a project, was developed by Henry Gantt. It is effortless to visualize even today is still used as a primary tool. In 1956, many professionals from the Project Management established the American Association of Cost Engineering (AACE) to the progress in science and art of cost engineering. AACE carried on its innovative work in 2006, getting the first incorporated process for portfolio, program and project management. In the middle of 1957, the DuPont chemical plant company planned to expand around 300 factories,

which needed many activities, and it could not be accomplished with Gantt charts. The aim was to control and optimize the project operating costs of the actions of a project. In a certain way, the Critical Path Method (CPM) appeared, which provides the likelihood of decreasing the scope of the projects and make more accessible the following up through focus on what is essential. (Haughey, 2012)

Concurrently to the origin of the CPM also appears Program Evaluation Review Technique (PERT) but in the military field. It was created at the Office of Special Projects of the US Navy to implant in the Polaris ballistic missile program. A research team was developed for PERT progress to solve the challenge of planning, programming and control. After years, in 1965, the International Project Management Association (IPMA) was instituted in Switzerland, through the name of IMSA (International Management Systems Association). The organization is currently active and is devoted to the growth and sponsorship of Project Management; in fact, it is one of purpose the certification of competencies in project management. In 1967, the Project Management Institute (PMI) at present the leading international non-profit organization, dedicated to Project Management. The main activity, mostly in the creation of standards of Project Management and certifications to professionals. In 1987, Project Management Body of Knowledge (PMBOK) was published for the first time by the PMI. It is a highly recognized worldwide standard in Project Management. (Haughey, 2012)

Just a few years later, in 1989, it showed up Projects IN Controlled Environments (PRINCE) be converted into the UK standard for all government information systems projects. CCTA published around 1996 PRINCE2, the development was contracted out but insured by a virtual committee among 150 European organizations. In 1998 PMBOK was developed into a standard by the American National Standards Institute (ANSI) and just one the following year by the Institute of Electrical and Electronics Engineers (IEEE). During 2008 the fourth edition of PMBOK was renewed by PMI that improved highly excellent in project management within a well-organized standard and easy to implement with consistency and better clarification. Lastly, the fifth edition of PMBOK was published in 2012, which supports guidelines, rules, and characteristics of project management accepted as great practice in the profession. Exists an updated version that introduces a 10th knowledge area called "Project Stakeholder Management" and additionally incorporates four new planning processes. (Haughey, 2012)

Thanks to globalization market are changing, and it is necessary to be up to date as for products and services. Projects turn out to be larger, more complex, and gradually challenging to manage. No doubt new techniques and better methods will emerge, and institutions must be ready looking forward to a better future and with it will come improvements to manage projects.

2.2.   What is a project?

At the end of the twentieth-century and initially twenty-first century, project management was one of the most booming disciplines where entities developing their operations and strategies for projects have increased considerably. Likewise, the projects add to achieving the objectives of the organization regularly when they are aligned with the plan. (Kerzner, 2009)

The project concept has several definitions; some of these are the next:

- "*Temporary effort has a defined beginning and end, which is carried out to create a unique product, service, or result.*" (PMI, 2017)

- *"Temporary effort that is carried out to create a product, service, or result, that consumes resources and operates under terms, costs, quality, risks, and human factors."* (IPMA, 2009)
- *"Temporary organization that is created to deliver one or more commercial products according to an agreed business case."* (PRINCE2, 2009)

As it is known, these definitions are not precisely equalling due to most of the organizations create their project definition. Nevertheless, the vast majority have the following characteristics (MyMG, 2019):

- **Temporary**. Each project requires a finite start and finite end. The project ends upon reaching the endpoint, meaning all objectives have been accomplished.
- **Unique Deliverable(s)**. Independently projects aim to generate some deliverables, which can be a service, product, or a result. It can be summarized in the triple constraint that is a four components group (scope, time, cost, and quality). Several types of results can be distinguished:
  - Product: component of an element, improvement of an element, or the element itself.
  - Service or capacity to carry out a function.
  - Improvement of existing product lines services.
  - Result, conclusion or document
- **Progressive Elaboration**. Take advantage of customer feedbacks and learning lessons to follow continuous investigation and improvement.

Projects are carried out at all levels of the organization within the involvement of a single person or more than a few, an organization unit, or numerous units of different organizations.

2.3. Conceptual relationships

2.3.1. Project, Program, and Portfolio

A **portfolio** refers to a set of projects, programs, sub-portfolios, and gathered operations to facilitate the effective management of the work and meet the strategic objectives of the business.

The **programs** are grouped into a portfolio and are composed of subprogrammes, projects, or other work that is managed in a coordinated manner to support the portfolio.

Individual **projects** that are within or outside a program are also considered part of a portfolio. While projects or programs within the portfolio do not have to be interdependent or directly related, they are linked to the strategic plan of the organization through the organization's portfolio.

Most organizations use Project, Programme, and Portfolio in day to day language, although there is a misunderstanding among the meaning of these terms. The following photo shows a graphic description of the differences between project, program, and portfolio from the general point of view. Through this image, it can be applied to any organization regardless of its size.
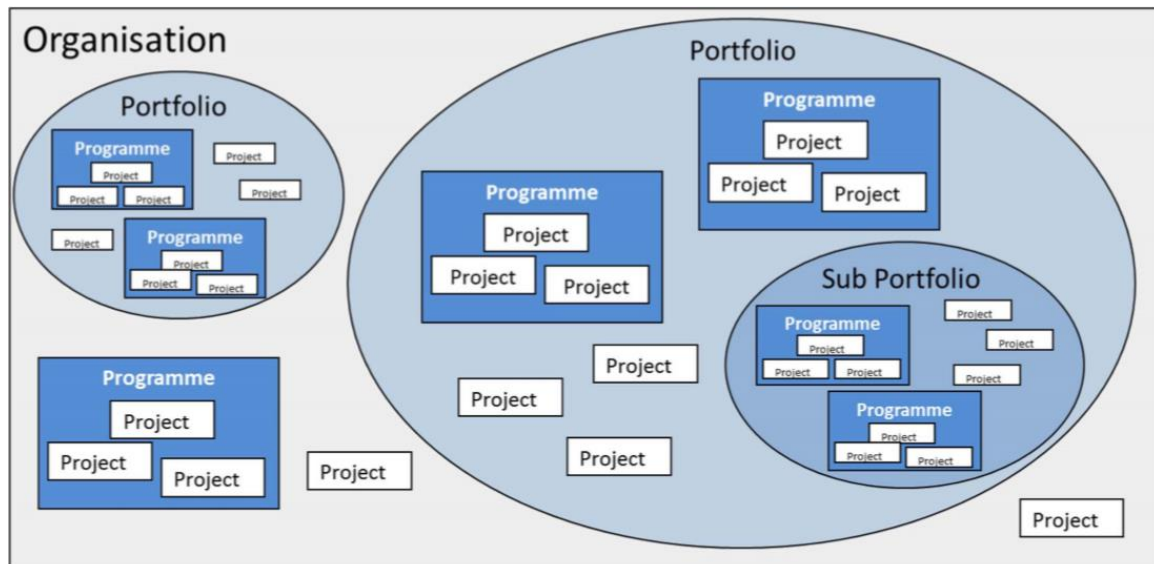
Figure 2. Diagram based on differences among Project, Programme, and Portfolio. (Source: PMBOK)

2.3.2. Project Management, Programme Management, and Portfolio management

According to the Project Management Institute (PMI), a project is a temporary effort that takes place to create a unique product, service, or result. The characteristics of the project are (PMI, PMBOK. A Guide to the Project Management Body of Knowledge. (Sixt edition), 2017):

- **Projects are temporary activities**. A project involves a staff organization, material, equipment, and facilities that all together to achieve a goal. The goal is within a specific timeframe with a beginning and end.
- **Every project is unique and with a definite purpose, end-item, or result**. It can be a product or service. Generally, it is stated in terms of cost, scope, and performance requirements.
- **Accomplish a goal.** It is usually deliverable, or deliverables or these are part of the objective.

As for the program, it consists of a group of related projects, subprogrammes, and program activities, whose management is carried out in a coordinated manner to obtain benefits that would not be achieved by proper management. The characteristics of the program are (PMI, The Standard for Program Management (Fourth edition), 2017):

- **Set of related projects**. Guarantee that the individual project objectives align with business goals. May contain sub-programs.
- **Profits**. Managing and directing projects within a program has more significant benefits than doing it separately.
- **Temporality**. Being a set of projects, it also has a temporary existence.

Regarding portfolio is a group of projects and programs that are not explicitly related, that are grouped for the use of the organization's resources and to achieve its strategic objectives, while minimizing the risk. The characteristics of the portfolio are (PMI, The Standard for Portfolio Management (Fourth Edition), 2017):

- **Long term**. It exists for a longer-term within new projects rotating into it. So lacks a defined beginning and end.

- **Strategic goal**. Must be linked to organizational strategy and aligning organizational priorities. May contain sub-portfolios.
- **Measure value/benefit.** Make investment decisions. Also, it is managing portfolios: Resources, communication, and risk.

There are many differences regarding the nature of the objectives. In the next photo, it can see how the aim varies as the hierarchical level increases applying a random example. The portfolio takes part on top of the pyramid, followed by a program and project.
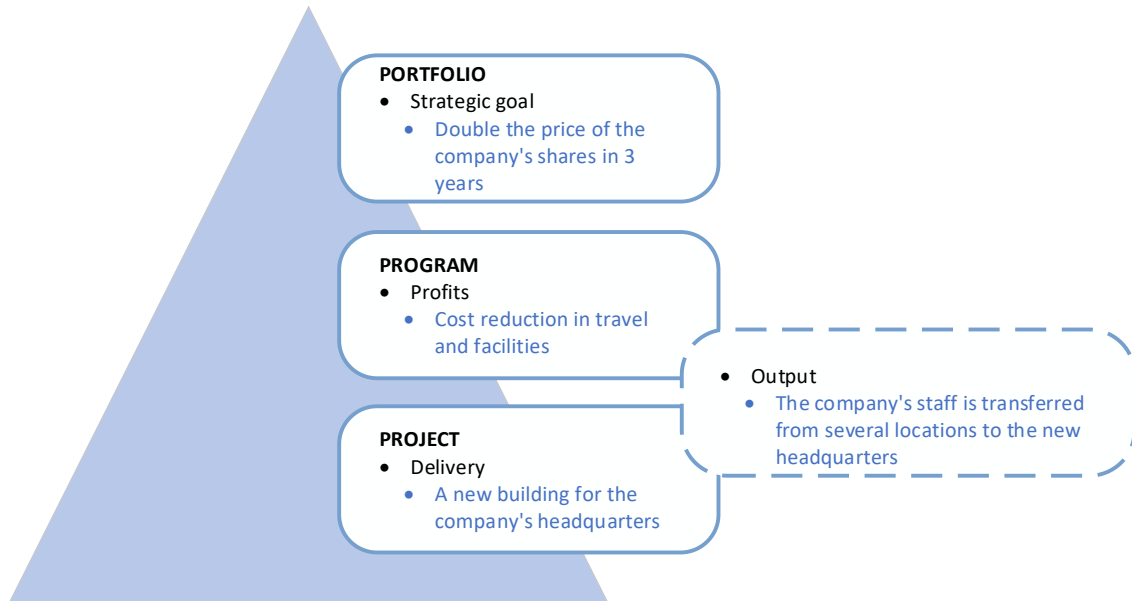

Figure 3. Differences between Project, Programme, and Portfolio regarding goals. (Source: PMI)

Not only exists a difference among this characteristic, but also it is included more for corporate profits, scope, cost, and strategic organizational. The following Table [1] summarizes all these characteristics depending on the type of distribution.

ITEM	PROJECT	PROGRAM	PORTFOLIO
Goal	To produce deliverables	To achieve strategic change	To coordinate, optimize and align with the strategy
View and strategic	It relates through the preliminary evaluation of a draft	It materializes through a program	Align and are controlled in the portfolio
corporate profits	Are substantially excluded in a project	Are significantly included in a program	Are significantly excluded in a portfolio
Organizational change	Is often excluded from a project	Is usually included in a program	Is excluded from the portfolio

scope, costs	It defines in a previous evaluation of the project and must be managed in the project	It describes briefly within the strategy; it breaks down into individual projects within the program	It bases on priorities and strategic objectives of the portfolio

Table 1. Differences between Project, Programme, and Portfolio depending on each characteristic (source: PMBOK)

The strategies and priorities of the organization are linked and have relationships between portfolios and programs, and between individual programs and projects. Organizational planning affects projects through the prioritization of the project based on risk, financing, and other relevant considerations for the strategic plan of the organization.

Organizational planning can accomplish resource management and support for component projects based on risk categories, specific business lines, or general types of projects, such as infrastructure and process improvement.

2.3.3. The life cycle of Project, Program, and Portfolio Management.

The life cycle explains the inter-related stages of a project, program, or portfolio and makes available a structure to govern the development of work. (APM, 2017) All projects, programs, and portfolios are planned to achieve objectives. The life cycle exemplifies the different phases that take a starting idea, develop it into detailed purposes and then deliver them.

Mostly life cycles ensue the same high-level generic sequence, although it can be expressed in very different ways. Life cycles contrast between various industries and corporate sectors. The long-life cycle is the most common type is the (linear sequential model or cascade method). There are also life cycles in parallel, spiral, agile, etc.

Phase well organized and structured make more comfortable the design of governance and feedback mechanisms:

- **Stage review**: Task is subdivided into subphases to be authorized stage by stage.
- **Gate reviews**: it will be carried out at the end of a phase, stage, or tranche. Senior management will consider performance to date and plans to plan for the next phase, stage, or tranche before determining whether it is viable.
- **Post project reviews**: Learning lessons are a crucial factor in maturity to use in the future through post-project and program review documents.
- **Benefit reviews:** it measures the success of benefits against the business case.

PROJECT

Several projects belong to part of a program and will only deal with the delivery of outputs (the traditional life cycle of the project). Other projects integrate change management and realization of benefits (prolonged project life cycle). (APM, 2017)

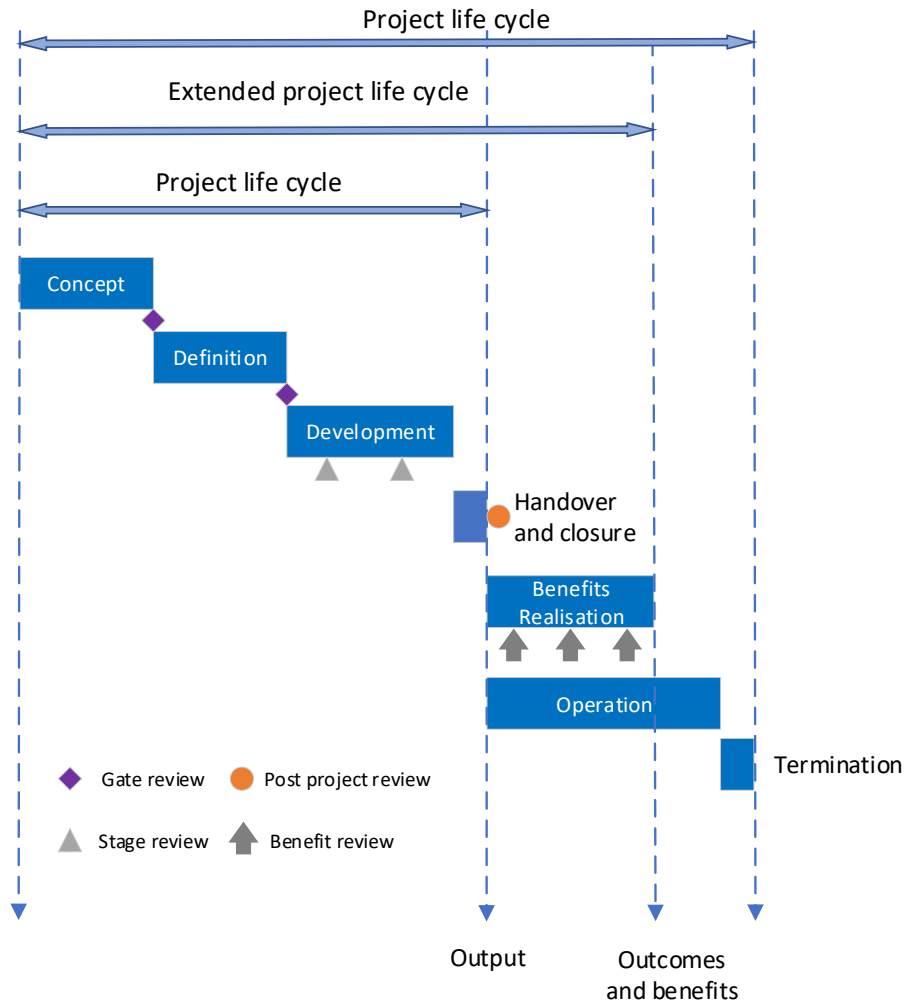The phases of the project life cycle are shown in Figure [4] below:

Figure 4. Linear Project life cycle. (Source: APM)

A. **Concept**. A business case, schedule, and stakeholders are created in this phase. Likely senior manager analyses whether the project to be viable or whether it is worth it to invest.
B. **Definition**. Develop a project management plan. This phase creates Scope Statement, Work Breakdown Schedule (WBS), Milestones, Communication Plan, and Risk Management Plan.
C. **Development**. It is the phase where deliverables are developed and finished. Also, project managers will make use of Key Performance Indicators (KPIs) to find out if the project is on track.
D. **Handover and closure**.
E. **Benefits realization.**
F. **Operation**. Maintenance and support constantly
G. **Termination**. The end of useful project life.

PROGRAM

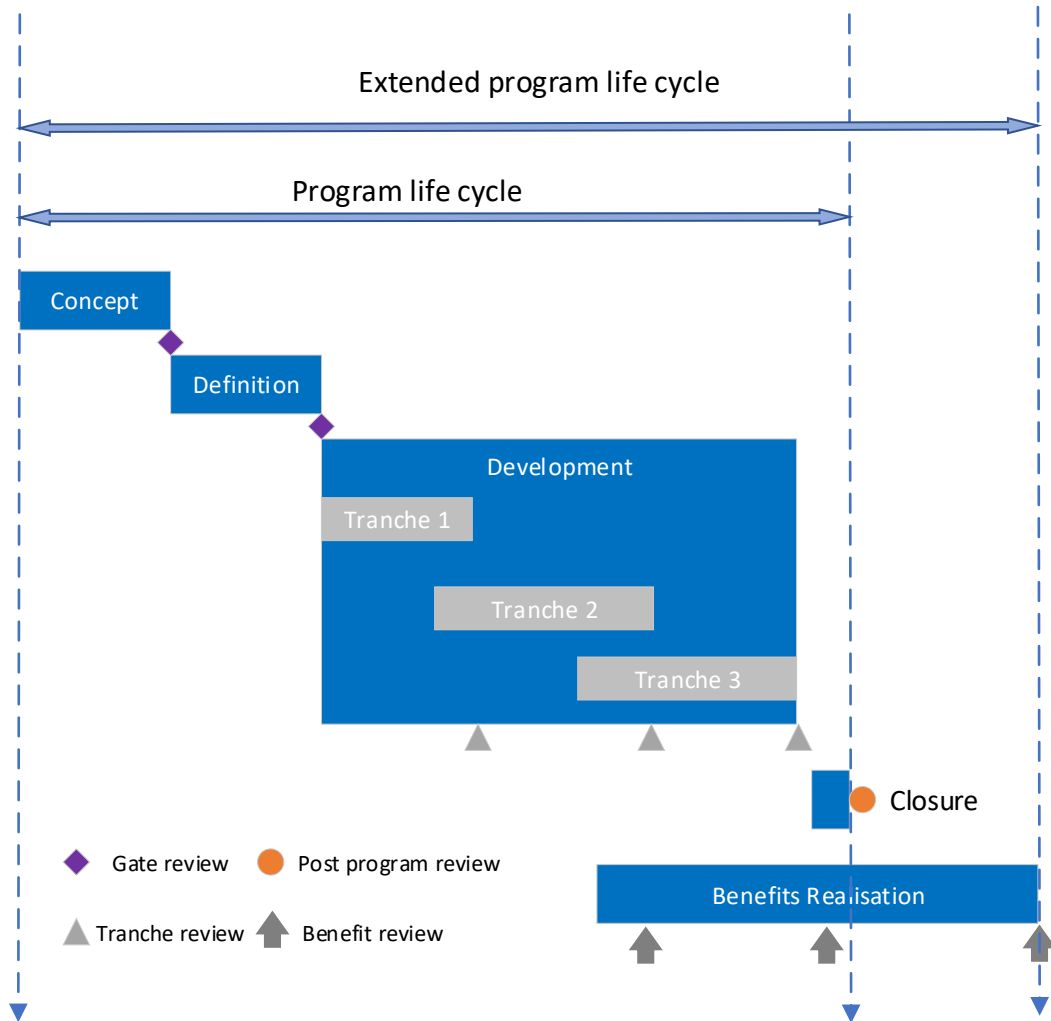A standard program life cycle is shown in Figure [5] below (APM, 2017):

Figure 5. Linear program life cycle. (Source: APM)

A. **Concept**. Vision and outline business are set up regarding the program. It details. It details expected benefits, and initial program-level documentation is planned. Likely program sponsor must make two decisions according to analyses whether the project to be viable or whether it is worth it to invest.

B. **Definition**. Complete project planning, set-up communication networks, define clear objectives and agree to roles and responsibilities with the team. As for outline plans and business, the case is hardly established more so that the stakeholders can make decisions to carry on with the program.

C. **Project delivery**. Mostly this phase is separated into groups of projects termed tranches that offer beneficial changes. Tranche is evaluated at the end of each one to the ongoing viability of the program.

D. **Benefits realization**. Benefits will be measured and contrasted to the baseline in the business case. Usually, the benefits realization phase goes ahead after the closure of the program due to ensure that benefits are accomplished as demanded by the business case.

E. **Closure**. Close the last projects, budgets expiration, and dissolution of the program management team.

PORTFOLIO

As opposed to projects and programs, portfolios do generally not have a specific beginning and end. Portfolio Management is a continuous cycle that coordinates projects and programs. Nevertheless, it may be limited by a strategic planning cycle that reviews the strategy for a specified period. For example, if an institution has a strategic planning cycle of 5 years, the portfolio cycle will start and finish with that period (APM, 2017).
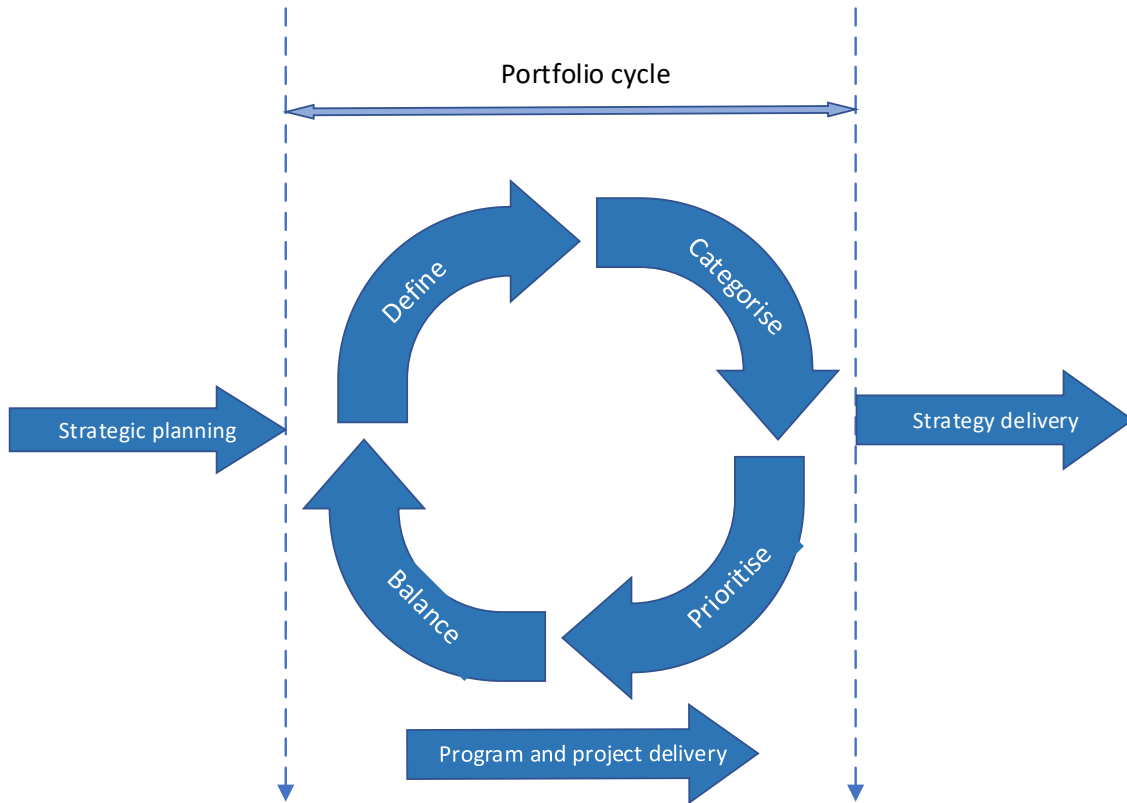

Figure 6. Portfolio life cycle. (Source: APM)

The portfolio aims to succeed with the objectives which are established by strategic planning. It is unlikely that phases of the life cycle are lineal.

A. **Define**. Projects, programs, and how to work to achieve strategic objectives are identified and assessed in a selection process. Furthermore, it maximizes the efficiency of the portfolio.

B. **Categorize**. Projects and programs can plan in sub-portfolios that share some characteristics, for example, alignment towards specific strategic objectives.

C. **Prioritize**. There are different ways to prioritize projects and programs among some possibilities, and it can be prioritized by strategic objective, return on investment or any other chosen metric provided that any organization has enough resources to accomplish everything it wants the prioritization process establishes the basis of the next phase.

D. **Balance**. To balance the portfolio, it focusses on risk, resource usage, cash flow, and impact across the business.

2.4.   The organizational structure of Project, Programme, and Portfolio.

The organizational structure will be explained not only types of structures, but also a correlation between the project organization and that will be useful to identify the

organizational structure of the R&D area and analyze if it is correct well organized, including advantages and disadvantages of the matrix.

Depend on how is structured an organization affects both is managed and run the project, program, and portfolio. It may also impact if the authority is high enough as a project manager. (Harrin, 2019)The types of standard organizational structures are Functional, Matrix (Weak, strong and well-balanced), and by projects.

Functional Organizational Structure

Role as project manager usually takes the place of a functional manager. In a functional organization structure, which Figure [7] is shown in the picture below, the functional manager work in the same company division.
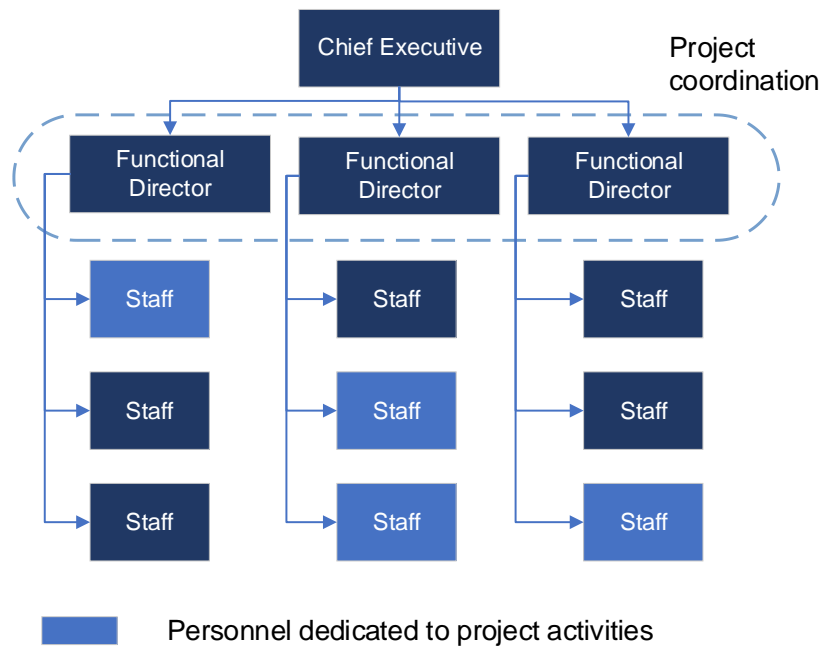

Figure 7. Functional organization structure. (Source: Harrin)

Moreover, in Table [2] summarizes the advantages and disadvantages of this type of structure.

Advantages	Disadvantages
Improvement of the use of human resources	Dilution of responsibilities among departments
It requires less technical personnel	Coordination problems
It offers the staff a greater variety of work, getting involved in different projects	More attention is given to technical problems to the detriment of coordination and planning
The group of specialists allows sharing and transferring experiences	Slow response
	The objectives of the department take precedence over the overall project

Table 2. Advantages and disadvantages of Functional Organizational Structure (source: PMBOK)

Project Organizational Structure

Project organizational structure, which Figure [8] is shown in the picture below, stand out due to specified teams are put together to work on projects. Usually, the project manager, who, in this case, has a high authority, must guide and take responsibility for the project team members. (Harrin, 2019)
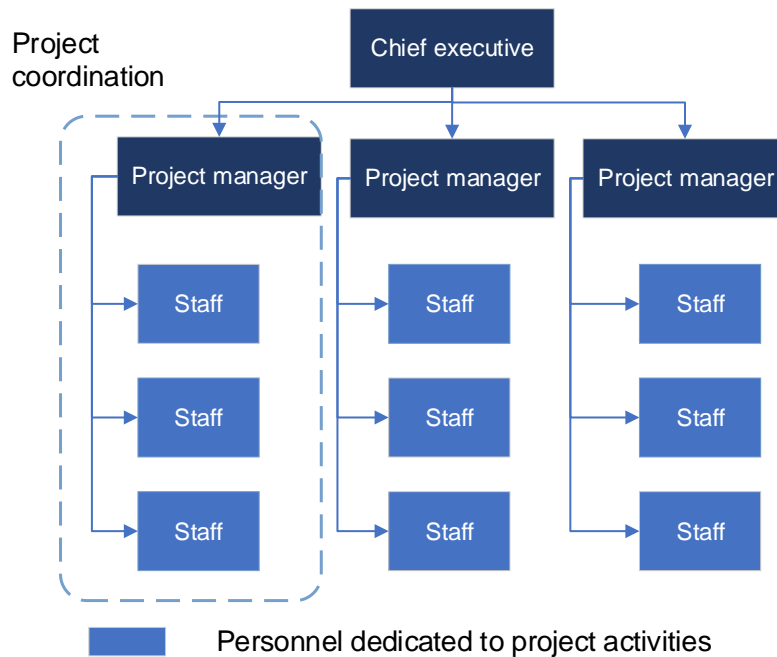

Figure 8. Project Organization Structure. (Source: Harrin)

Besides, Table [3] summarizes the advantages and disadvantages of this type of structure.

Advantages	Disadvantages
Direct control overall project activities	Increase in costs due to duplication of functions
Reduction of coordination problems	Need for additional staff
Responsibilities defined and centralized in the project manager	Specialists assigned to a very long project may be technologically outdated
The project manager has always updated information	It is difficult to replace a team member since they have particular knowledge

Table 3. Advantages and disadvantages of Project Organizational Structure (source: PMBOK)

Matrix Organizational Structure

One characteristic of the matrix structure is that resources are shared across both usual work and project work. It can have two managers not only respond to a project manager but also the team manager. As for the authority, it is divided between the functional manager and the project manager (Harrin, 2019). There are three kinds of structure inside this section: weak (Figure [9]), strong (Figure [10]), and well-balanced weak (Figure [11]).
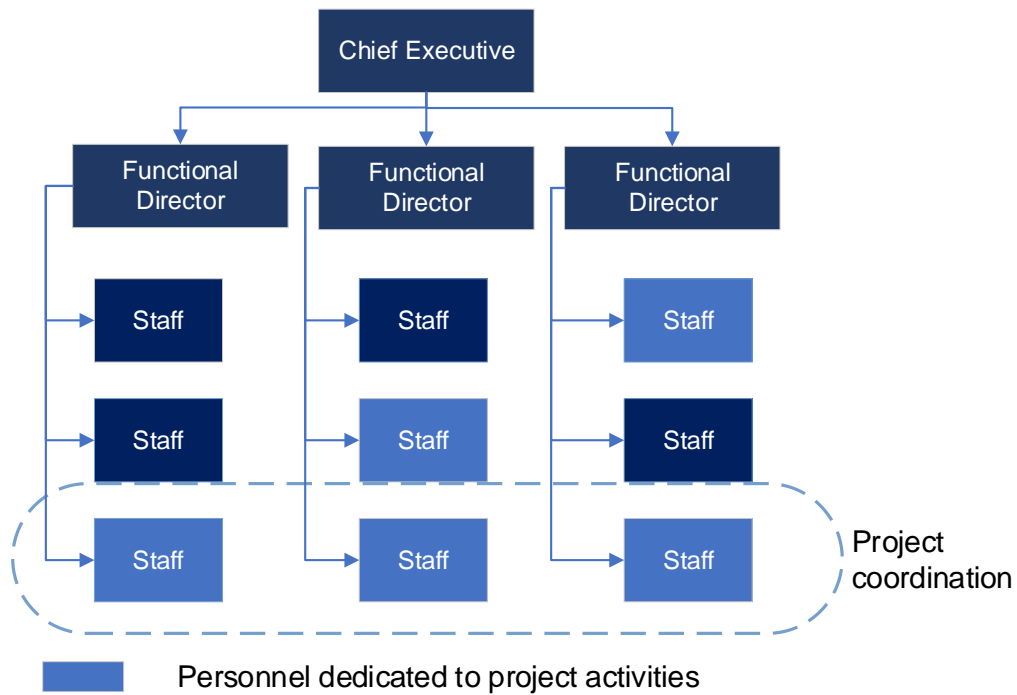
- **Weak Matrix Organization**

Figure 9.Weak Organization Structure. (Source: PMBOK)

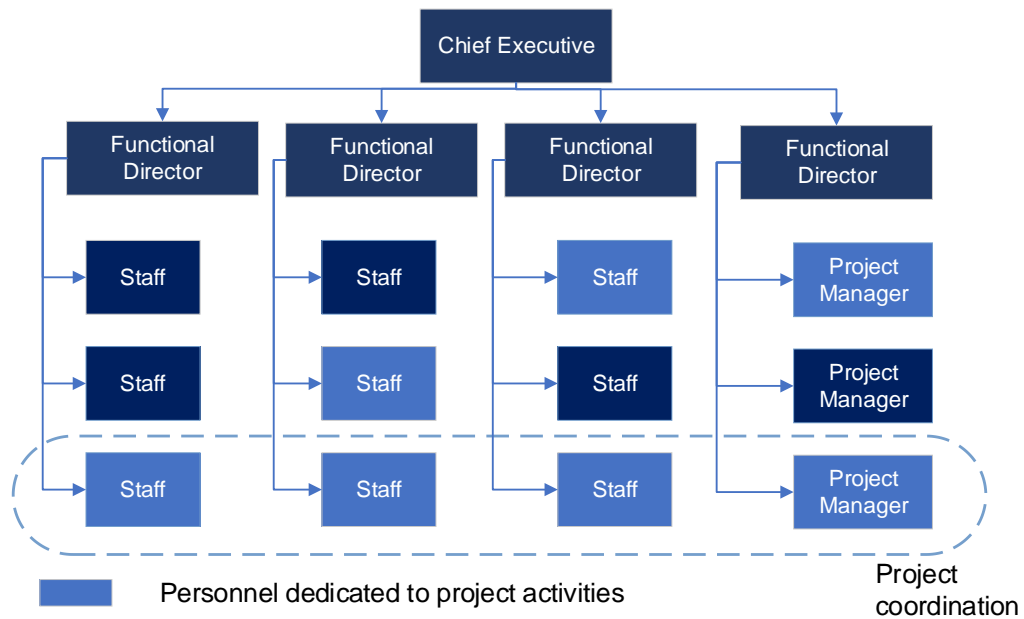- **Strong Matrix Organization**

Figure 10. Strong Organization Structure. (Source: PMBOK)

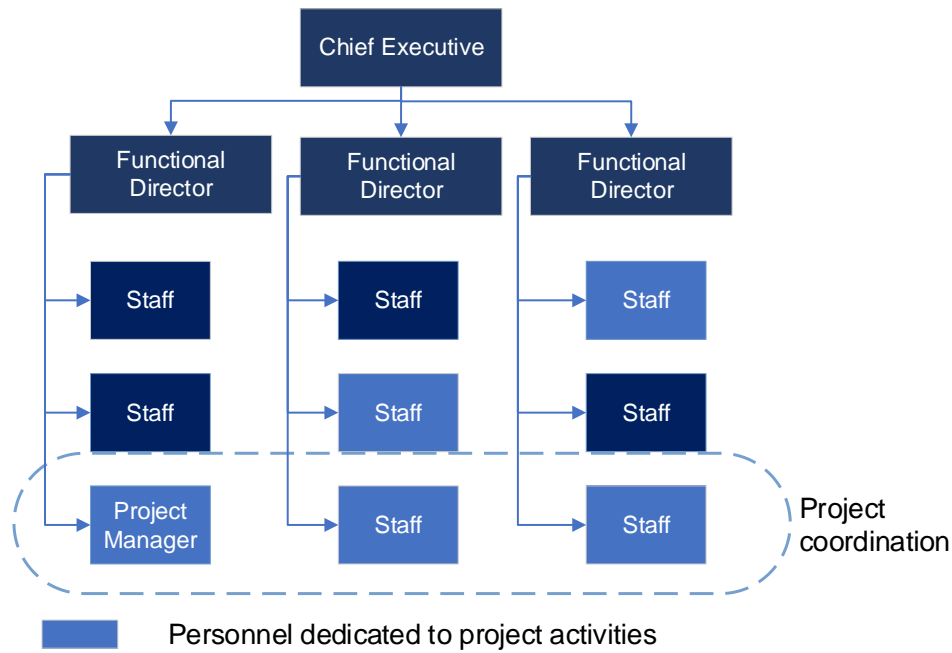- **Well-balanced Matrix Organization**

Figure 11. Well-balanced Organization Structure. (source: PMBOK)

Also, in Table [4] summarizes the advantages and disadvantages of this type of structure.

Advantages	Disadvantages
The separation between the technical management and the administrative management of the project	It requires a higher level of management to arbitrate in disputes that may arise between the two sources of authority.
It allows us to have a reserve of specialists in the functional groups	It needs a useful information and communications system to avoid adopting the solutions of the head that has a higher weight in the organization.
The existence of a fluid communication allows quick responses both to the client's wishes and to the needs of the organization	We must balance the cost and term objectives (project manager) with those of technical quality (functional director)
Prevents staff remain out of date in their field while expanding their knowledge of other fields	

Table 4. Advantages and disadvantages of Well-Balanced Matrix Structure. (source: PMBOK)

2.5.   Software Project, Program, and Portfolio Management.

De software tools of project management aim to support managers' plan, execute and control all phases of the project management process. Nowadays, companies' personnel are over-saturated, and the software tools help to balance staff workload for optimal time management due to efficiency resources and project scope are improved by project management tools, notably when it comes to large and complex projects. (Trencher, 2017).

The main objective would be to visualize the project life cycle. Also, it must make more natural planning and monitoring with tools such as Gannt diagram or resource management tools. Also, one aspect to consider and many companies are not implementing it is the integration of the different departments and alignment of the

processes with the organizational strategy that consequently it will improve information, communication and collaboration management. Easy access to the historical archives of learning lessons is precious for continuous improvement. (Trencher, 2017).

It must be emphasised that at present, no software allows the three different types of management in their maximum effectiveness, so there will be conditions in which the program where the project is created is different from where the program or portfolio is managed. However, the software that is going to be exposed next allows us to take advantage of the files of other programs and to improve the connectivity.

2.5.1. Project Management software analysis.

The Project Manager website invited members of the PM community on LinkedIn in 2015 to do a unique survey. This research project attempts to evaluate real-world usage of projects tool thoroughly of industries and roles. (ProjectManager.com, 2016). After carrying out the survey, the following points were highlighted in Figure [12]:

.07 **KEY FINDING 1:**
Nearly half of all survey respondents are unhappy with their current project management tools.

.08 **KEY FINDING 2:**
Lack of integration is a major pain point for many project managers and software users.

.09 **KEY FINDING 3:**
Collaboration features are much more unused than most project managers typically expect.

.10 **KEY FINDING 4:**
The majority want simpler tools!

Figure 12. Four key findings after the survey (source: ProjectManager.com)

Most users are dissatisfied due to the four points discussed above. Over 23% of all the ones polled are using three or more project tools regularly so that no software tool can satisfy all the needs at the same time demanded by project managers (ProjectManager.com, 2016).

Additionally, a study was made on which project management tool was the most used by project managers, in short, as shown in Figure [13], the most used tools with 75% use by users are "Excel" in addition to other tools. Nearly 40-60 % use "MS project Server" or "MS Project Online" (ProjectManager.com, 2016). Likely there is a lack of information in the Project Management tool; therefore, people end up abandoning and opt for a more leisurely route such as Excel, whose characteristics and functionalities in

project management are scarce. On the other hand, project management tools are not useful enough to meet customer needs as the survey highlights (ProjectManager.com, 2016).
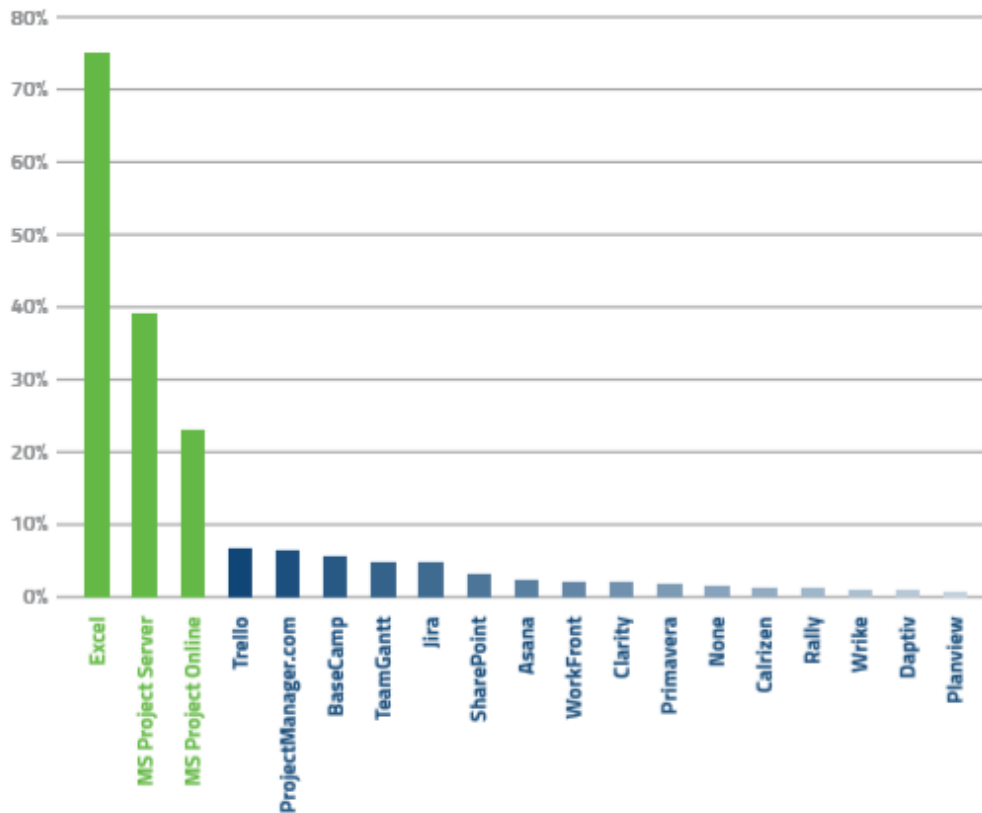

Figure 13. The most used project softwares by users. (source: ProjectManager.com)

Whereas "Excel" is a leading tool for use in project management, nowadays, some new tools are increasing outside of Microsoft products such as **Trello** which come to adoption in the market recently, as well as the rise of online project management software like "**ProjectManager.com**" or "**Wrike**." Tools online have started to confront Microsoft Project's dominance in the market.

2.5.2. Program and Portfolio Management software analysis.

Both Program Management and Portfolio Management have been added in this section because after investigating much Software, everyone has tools for both options, and the big leap is at the next level from Project Management. In addition, for a company, if it is believed in terms of saving costs, it makes more sense if it invests in one software instead of two.

In recent years, digital trends are introducing some apparent challenges to the Project & Portfolio Management (PPM). New approaches are growing in terms of strategic planning, and a much more innovative PPM technology is required. For example, one of the essential digital technology challenges is the "*strategy–to–execution alignment and management"* or *"supporting the sift from project-based management to digital-product-based management"* (Daniel Stang, 2019)

DANIEL STANG (2020) points out that such research suggests a magic quadrant assesses PPM providers offering technology to support these activities. Magic Quadrant can observe in Figure [14]. Some of the most critical capabilities that the research considered are: *"Time Management, Resource Management, Resource Capacity Planning, Project Portfolio Management, Program Management, Integration and Usability"* (Daniel Stang, 2019). However, Risk Management is also critical capabilities, but they are not exactly considered as important items.

Figure 14. Magic Quadrant for Project and Portfolio Management. (source: Gartner)

As for Gartner's research, the companies are distributed in four quadrants, where the axis of abscissa is the ability to execute, and the axis of strings is the complete vision. The PPM software in the leading quadrant meets many of the functionalities of the PPM application and process automation requests (Daniel Stang, 2019):

- **Leaders** can offer both high-performance features in order to project execution level customer and portfolio level customers. Leaders also can work services to small and midsize businesses offering cloud-based instead of hosted-based; it would be a perfect option for small workgroups or customers with a reduced budget.

- **Challengers** have been working in the market for years or more and are overconfident on their stable global existence and longevity in the PPM market. Nevertheless, it would be necessary for these vendors to invest in PPM products, which will create strong vision brands focusing on a commercial strategy. Some also do not take advantage of the constant change in the technological epoch and not finish adapting. Challengers can concentrate on necessary skills, but their products

may also be missing recent innovations, so the pace of improvement is slower compared to the other suppliers.

- **Visionaries** focus on innovative standpoints *"such as collaboration, social networking, mobile device support, interoperability with third-party data sources and group-specific collaboration"* (Daniel Stang, 2019), in this latter can include PMO. PPM service providers in the visionary's quadrant benefit from steady and increased growth in customers. Other visionaries are looking to approach more broadly and with different options such as free trial and various flexible contracts. However, these vendors have limitations in some functionalities, both customer support and influence on product development. Sometimes they might struggle to price high-quality efficiency for customers who want to implement several licenses.

- **Niche** Players mainly can offer a basic set of PPM functionality; they can provide more than one product. His approach differences it is more specific than the rest of the market, so they are close to the customer to fully understand what type of improvements must be done to their products immediately in the short-term to keep their customers satisfied. As Challengers, Niche players have a lack of innovation, among other essential areas in the PPM market, unfortunately.

To sum up, leaders would be the correct choice to invest because, as for financial terms, they are currently stable financially and investing in human capital to innovate in data science, intelligence artificial, or machine learning. Therefore, as can be seen in Figure [14], the PPM software included in the leader quadrant are the optimal ones after the evaluation, which are: **PLANVIEW, CLARITY PPM, PLANISWARE, AND CHANGEPOINT.** In addition, DANIEL STANG (2019) also points out the strengths and precautions of each vendor in case it is necessary to compare software or synthesize quickly if the main characteristics of one are sought. Then, in Figure [15] a comparative graph of the software PPMs of the leading quadrant and their functionalities will be shown, the results of which are shown through a Pie percentage Chart, legend is: Fully Present (100%), Partial Functionality (75%), Minor functionality (25%), Feature Absent (0%) (CLARITYPPM, 2019).
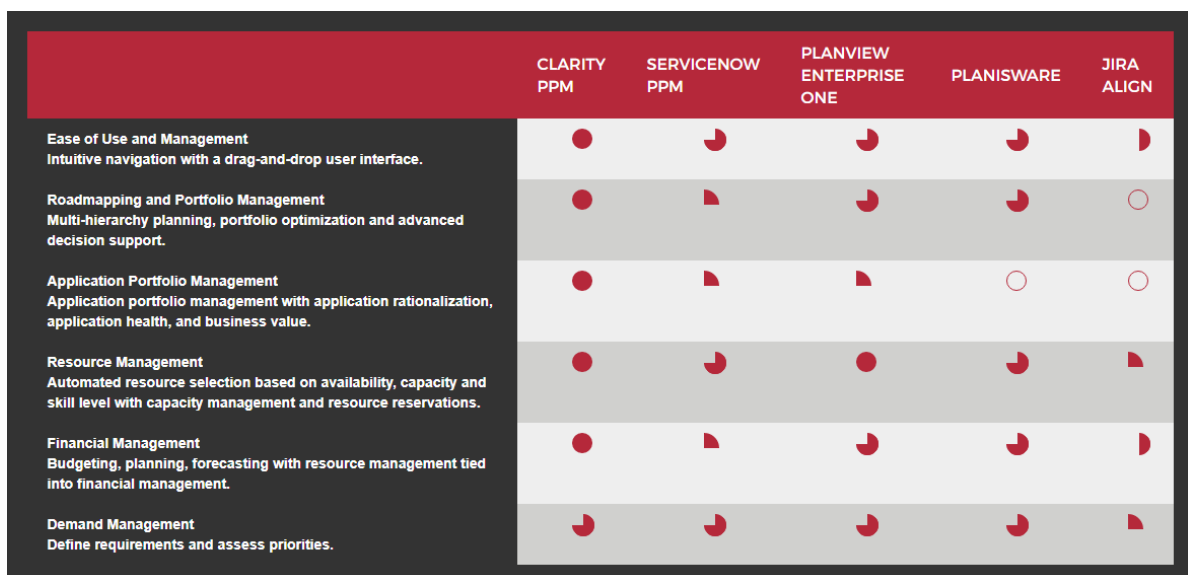
	CLARITY PPM	SERVICENOW PPM	PLANVIEW ENTERPRISE ONE	PLANISWARE	JIRA ALIGN
Ease of Use and Management Intuitive navigation with a drag-and-drop user interface.	●	◕	◕	◕	◑
Roadmapping and Portfolio Management Multi-hierarchy planning, portfolio optimization and advanced decision support.	●	◔	◕	◕	○
Application Portfolio Management Application portfolio management with application rationalization, application health, and business value.	●	◔	◔	○	○
Resource Management Automated resource selection based on availability, capacity and skill level with capacity management and resource reservations.	●	◕	●	◕	◔
Financial Management Budgeting, planning, forecasting with resource management tied into financial management.	●	◔	◕	◕	◑
Demand Management Define requirements and assess priorities.	◕	◕	◕	◕	◔

Figure 15. Clarity PPM comparing with the competition. (source: Clarity PPM)

2.5.3. Conclusion

Nowadays, no software has excellent characteristics and is efficient in the three types of management. As far as Project Management Software is concerned, there is an overall dissatisfaction with MS Project and its lack of integration and collaboration, because of this, workers in the sector are looking for better and simpler tools. Alternatives to **MS Project** and **Excel** are emerging as tools that allow more flexible forms throughout the organization and collaborative teamwork. Project managers are finding emerging online tools such as **ProjectManager.com** or **Trello** that can meet integration needs, inspire collaboration, and do not need the training to deploy on their teams.

Regarding the Project Portfolio level, choosing a PPM software at this level allows the clients of the project organization, project managers, program, and resource a secure communication and collaboration during the planning and decision-making stage of medium and high levels of projects and resources. The research also points out the strengths and precautions of each vendor. In addition, the study based on the evaluation of criteria weighted by the ability to execute and completeness of vision, all distributed in 4 quadrants where vendors are catalogued in a general way. In summary, there is software that focuses more on the ability of long-term vision such as **One2Team** and others on the ability to execute as is **Microsoft,** although the software that combines these two capacities is the Leaders quadrant and among them **Planview**, **Broadcom** (CA Technologies), **Planisware** and **CCLAhangepoint**.

If the graphs of sections 2.5.1 and 2.5.2 are compared, it can be seen that Planview took the last position for Project Management and the first position for Program Management. This means that in general there is no software on the market that notably covers all three types of management and there is still much room for improvement.

As a general conclusion, the digital transformation must force suppliers to develop complete software for all levels of the company. One of the biggest frustrations is that different areas use different tools, which may have a little clear visibility throughout the organization of workload and resources, therefore, in the case that a specific tool or feature is sought, it is more useful by the user.

3. Program Management.

3.1. Functions of Program Management.

Sometimes, the role is not defined correctly in most organizations, so basically, one person supervises the management of programs and portfolios at the same time. These role distributions are not the most efficient because they are generally divided into both specializations, and thus, the resources of the institution are optimized. However, the Multi-Project Manager is considered responsible for the management of programs. Therefore, it is advisable to distinguish in the following section between the functions of the Program and the Portfolio, considering that there are often some cases in which the employee must deal with both roles as most of the small and middle-size companies.

In Figure [16] is shown the Program Structure, where it is worth pointing out that the Sponsoring Group is located at the top of the diagram. The Program is derived by The Sponsoring Group that provides necessary endorsements and approving a financial statement. Regarding the Senior Responsible Owner (SRO) is the middleman between the Sponsoring Group and the Program Board that is responsible for interacting with each independent project via a Project Manager who can be a project sponsor or executive (MSP, 2020).
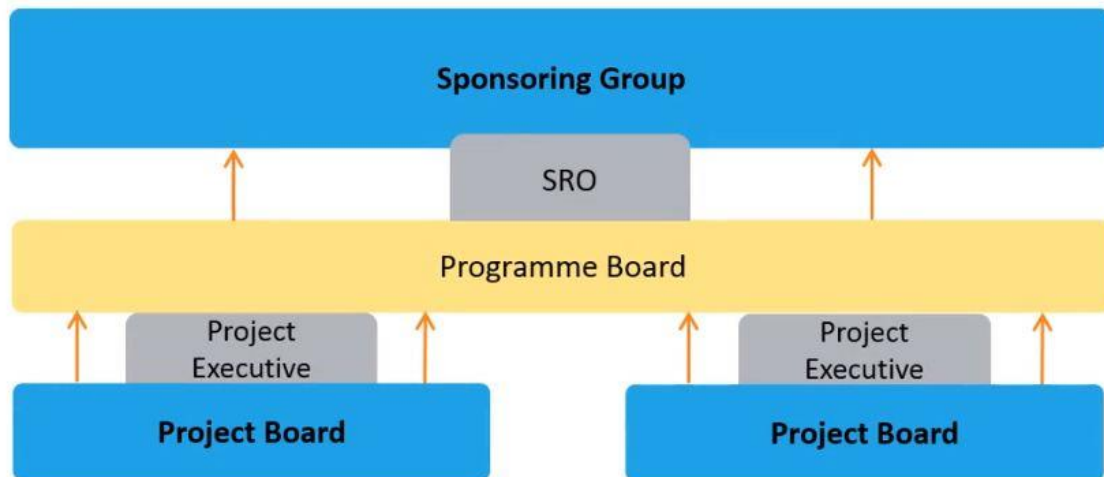
Figure 16. Program structure. (Source: MSP)

Before it gets into the functionalities, skills, and tools of the Program Management, it is essential to note that participants of the Program Board are independently responsible to the SRO. In general terms, the Program Board is based on the Business Change Managers and the Program Manager, and SRO leads it as Figure [17] is shown below.
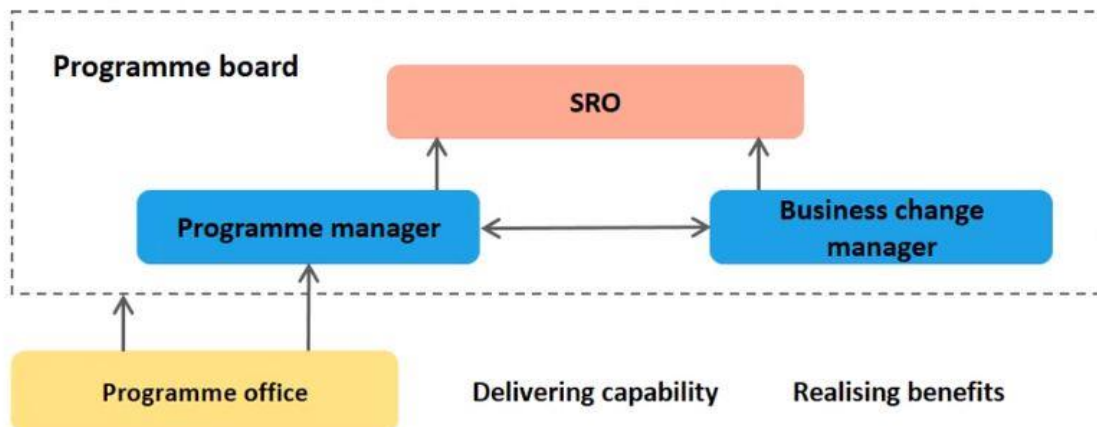

Figure 17. Program board structure. (Source: MSP)

Program Manager will be responsible for developing programs to provide for the organization's strategic direction in terms of achieving long terms goals. Although the understanding of the business is essential, the Programme Manager oversees planning and governance, supervising the program's output. Mostly Program Manager must have expertise in having been a Project Manager for significant and complicated projects. Some of the following responsibilities are required to work as a Program Manager (Zein, 2010):

- Day-to-day Program Management during the whole program life cycle.
- Governance must be defined by the Program Manager.
- Monitoring process and planning the total program.
- Manage the program's budget.
- Risk management and take corrective actions.

- Manage the project's coordination and their interdependencies.
- Distribute and managing resources throughout projects.
- Administrate stakeholder communication.
- The program's outcome must be aligned with deliverables and be helped business change managers.
- Administrate the essential program documentation.

	Effectiveness	Coordination	Efficiency
Prior to project execution	Identification of business opportunities	Resource planning	Resource selection
Project execution	Identification bad projects	Participation in steering groups	Project reviews
		Coordination of projects	Coaching project managers
		Collection and aggregation reports	Issue handling
			Process improvement

Table 5. Roles of Program Manager.

Also, there are some skills and attributes that any Program Manager should achieve, for instance, strong leadership, finding out innovative in order to tackle the problems, and an excellent understanding of the program's objectives.

3.2.   Tools for Programme Manager.

Program management is unlike project management from there are several projects managed at the same time. It must be emphasized that if it wants to get the right tools, first, it must know what kind of program management involves. If the components of the process are known, it is easier to determine which tool can help as the progress of the tasks (Westland, 2019):

- **Governance**: *"Combination of individuals filling executive and management roles, program oversight function organized into structures, and policies that define management principles and decision making"* (Sardesai, 2014).
- **Alignment**: vision and goals of the program.
- **Assurance**: the program is verified and validated.
- **Management**: the program is reviewed and reported
- **Integration**: the whole program must be optimized for performance.
- **Finances**: follow-up costs of the program.
- **Planning**: a roadmap for the program.
- **Improvement**: program performance must be assessed.

As for tools can help program managers to improve job in terms of efficiency and productivity, are the following:

THE DASHBOARD

The dashboard is handy for taking a quick look at how things are going. One of the advantages of a dashboard is to register the status of multiple projects without switching screens to check the program process, as it is shown in Figure [18]. Additionality will work even better if the dashboard is online and share of a cloud-based system. It is noteworthy that the changes, which are made by team members, updated their statuses independently of the location, are immediately updated to the dashboard. The dashboard can be customized to prioritize exactly what is needed, for instance, as information on the health, progress, workload, tasks, cost, or any other attribute of the program. Generally, it can be summarized that the Dashboard is a time-saver, that is, the one-stop frame for all needs in the program (Westland, 2019).

Figure 18. Dashboard in Project Management. (source: Westland)

GANTT CHART

A Gantt Chart provides essential information when it comes to checking the schedule. Besides, some program management software is including a new innovative method such as an online Gantt chart. The application of this method gives program managers extra comfort because they do not have to deal with the complexities of manually updating the Gantt chart. Changes will be reflected on the Gantt chart when team members update their tasks, which makes it easier to improve program performance. Also, when a Gantt Chart contains several projects, it is advantageous because of the following points (Quiambao, 2019)

1. **It can be established dependencies thanks to the obtention of visibility of superposed tasks.** As planned, online Gantt charts allow making these decisions and create dependencies among projects, among related tasks, so having enough time to complete the tasks in the correct order is guaranteed.

2. **Likely Bottlenecks and workload overload can be avoided.** Generally, it is complicated for project managers to completely assimilate the work that needs to be accomplished and how to find out that the team members correctly assigned to the proper tasks at the appropriate time. So, considering multiple projects through a single Gantt chart view facilities critical path analysis and determining if a team member has too several essential tasks assigned across the projects.

Additionally, this will help to visualize how the workloads will appear in multiple projects and to be assigned, and with a straightforward drag and drop, it will be able to reallocate the proper people to the suitable tasks. An example is shown in Figure [19], where red cells mean a workload overload of resources across projects.
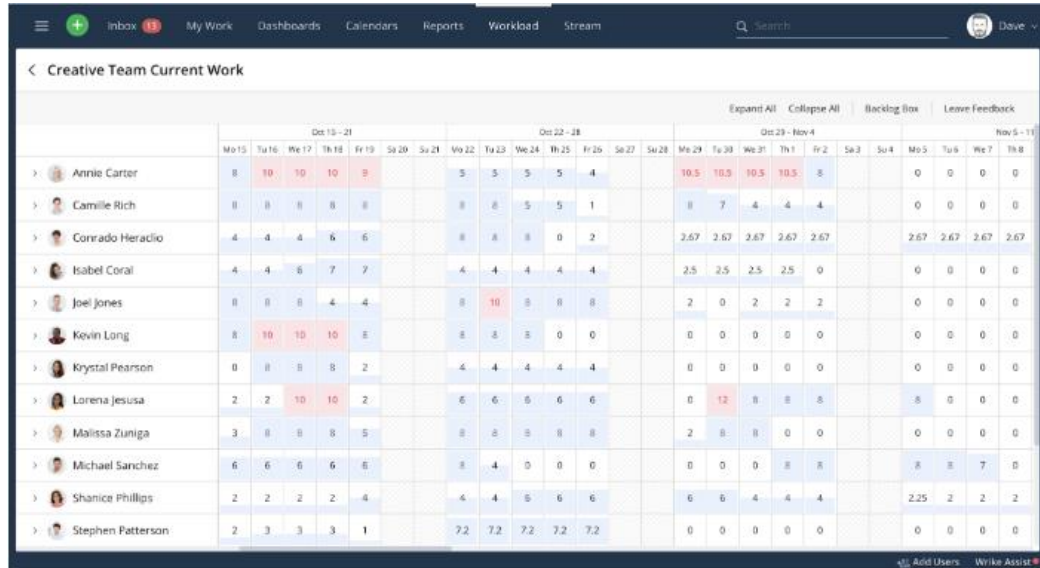

Figure 19. Resources calendar as for workload (source: Quiambao)

3. **Roadblocks and adjust tasks can be detected rapidly to keep the alignment.** It is a reality that in some fields as construction, less common in IT or R&D projects, it is known that delays are guaranteed. Nevertheless, not only the construction field but also around 27% of professional teams said that the most difficult challenge is keeping projects on time and without cost overrun. Also, it is said that approximately 97% of projects being delayed. (Quiambao, 2019). The point is that within an online Gantt chart, it is got a panoramic view of the multiple projects including color-coded bars displaying the recent task status as it is shown in figure [20]. So, when delays or bottlenecks appear, it will be possible to identify the impact on other related and dependent projects. Drag and drop commands eliminate the tedious task to reschedule everything.
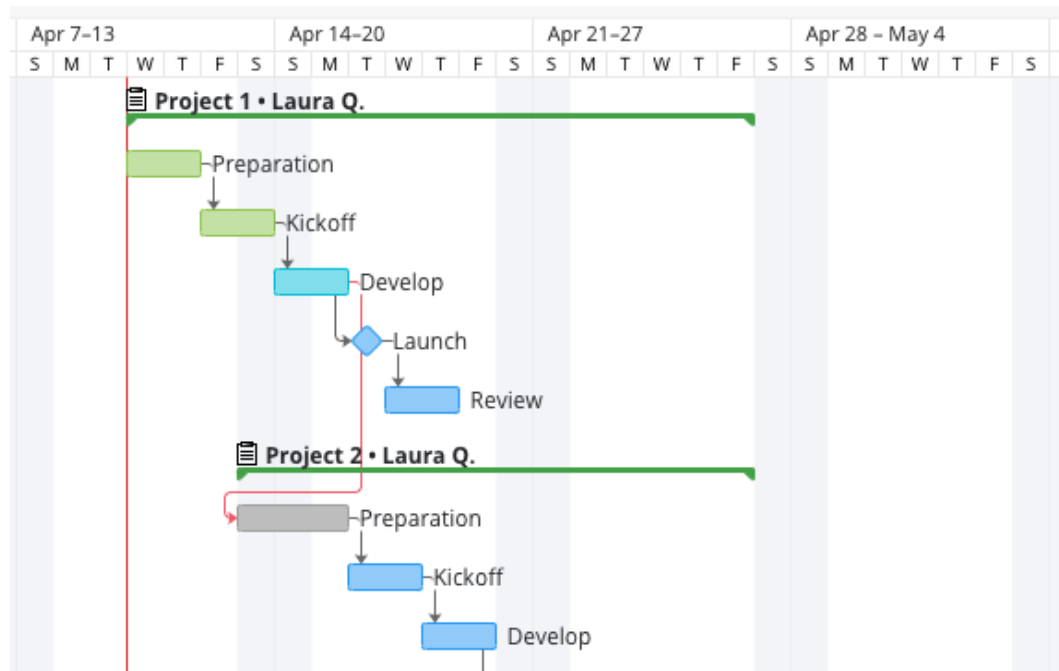
Figure 20. Cross projects tasks (source: Quimbao)

TASK MANAGEMENT

A Task Management tool is excellent for program managers in the tracking of their task list or team members to know their stand in the tasks. In recent years most companies are trying to cut off the waste of paper, so this tool can be used and updated anywhere and on any device. In addition, it can add notes, files, and links that might be associated with those tasks (Westland, 2019). Other useful tools inside of Task Management are shown in figure [21]:

Task Lists
View, manage & prioritize work in personal and team task lists.

To Do Lists
Add personal to do lists and mark complete in one click.

Calendar Sync
Sync tasks with Google calendars to keep up-to-date everywhere.

Collaboration
Share tasks and assignments with anyone to get work done faster.

Gantt Charts
View & manage task progress with interactive Gantt charts.

Reports
Track task and project status with one-click reporting.

Dashboards
See real-time views of task and project performance.

Alerts
Set up automated alerts when tasks are due or overdue.

Subtasks
Define subtasks and task dependencies across projects.

Assignments
Create task assignments in multiple places.

Time Tracking
Manage time spent on tasks according to schedule.

Roadmaps
View project and task roadmaps to view work completion rates.

Discussions
Create discussion threads on any task or project or theme.

File Storage
Get unlimited file storage that updates when you attach files to

Import/Export
Seamless importing and exporting of MS Project, Excel or .csv files.

Cloud Based SaaS
Update task status anywhere on any device.

Figure 21. Task Management Tools for Program Management. (source: Westland)

REPORTING

One of the most tedious things in program management is to deal with reviews and reports on it is progress. Then you can also automate generating reports through a

click, for example, workload, expenses, etc. It is a handy tool that speeds up the job and helps improve the quality of presentation for future meetings with stakeholders, project managers, etc. As for the quality of presentation, it can be created colorful charts and graphs and share these documents by email or print them, and those reports can be customized in a way that allows us to target the interests. The reporting tool can calculate the planned vs. current progress of the projects automatically as well.

TIMESHEETS

Timesheets support to the program manager to tracking of enterprise-level benefits. It can be detected how the time of assets impact in results, then it will be having access to historical data and how it influences in the balance sheet. With the tracking time, the program manager can make decisions more self-confidence. First, it is helped what was and was not is worthwhile or not, and second, modifying the projects in order to become more profitable.

On the other hand, this tool can be used in terms of negotiation so that it will be shown to the stakeholders, demonstrating to them that the team is satisfactorily working.

RESOURCE MANAGEMENT

It is essential to note that Resource Management gives control over the tasks of several teams whose purpose is to make sure there is no work overload, that is, too many tasks assigned to a team member or others are idle waiting for work. Throughout the execution phase, program managers need software that is capable of reallocating tasks according to the needs that arise in each of the projects. Tracking one or more projects, identify and classify teams, categorize suppliers, equipment, and any other resource that has been used. Figure [22] shows that the best tools for Resource Management.

Plan Resources
Plan resources with task lists, kanban boards and Gantt charts.

Assign Resources
Assign resources and see team workload in one view.

Organize Teams
Create departments and teams in the software.

Track Resources
Use the dashboard to track resources across your project or portfolio.

Secure Timesheets
Teams can log hours and submit with ease.

Automate Costs
Automatically calculate actual costs and compare against planned costs.

Incorporate Holidays
Always know where holidays land, whether locally or globally.

1-Click Resource Reports
Get automated reports on tasks, availability, workload and timesheets.

Figure 22. Tools for Resource Management.

CALENDAR

Moreover, an online Calendar is a member of integrated program management working on across projects with quite deadlines and deliverables. It will be allowed filtering by assignee; task name, and it can be managed straightforward from the calendar view.

3.3.   Guideline for successful Program Management

A program contains multiple interdependent projects. Which all of them work to accomplish a general objective. In short, according to the PMI, a program is a master project with several subprojects.

On the contrary, it should be noted that the term multiple project management is defined as a synonym for projects of an organizational unit implemented simultaneously when some points for multi-project management will be explained later, but not in this section (Strasser, 2020).

A. Set Up a Program Office

Intensive control is required in the programs due to its difficulty and scope; one of the factors that are achieved is the support of a centrally responsible agency: The Program Office.

In general, several office members compose a program since, typically, a program administrator alone cannot manage the requirements. It must also be emphasized that it will depend on the size of the company in question if it is profitable to invest in a program office. Some of the functionalities of the program office can include (Strasser, 2020):

- Qualifying the project managers explicitly for the corresponding program.
- Back the project managers in terms of project administration.
- Guarantee the quality of project data
- Editing of reports for diverse steering committees
- Development of scenarios, safeguards, and corrective actions in challenging cases.
- Preparation and holding of state meetings.
- …

Next, Figure [23] is shown a flowchart of the processes where the Program Office is involved.
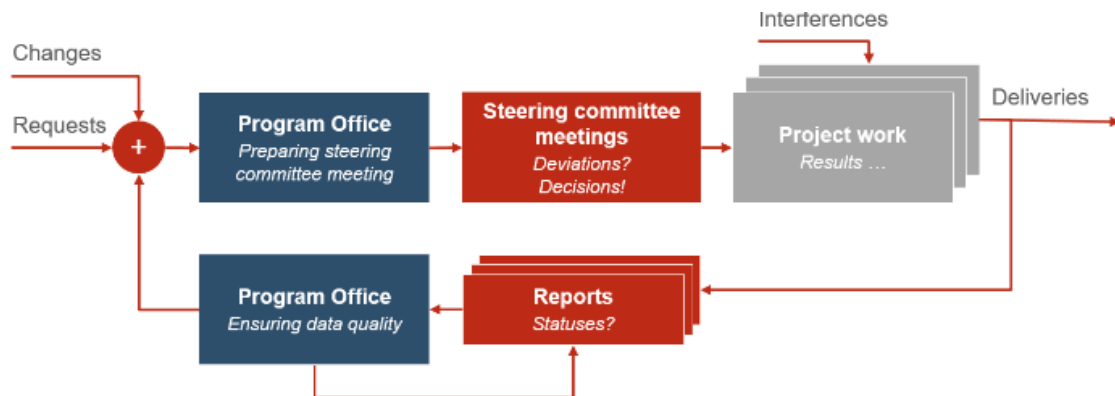
Figure 23. The Program Office's involvement in the processes. (Source: Strasser)

B. Define the control processes.

It is important to note that for a successful program, first, it must be made sure that individual control of the projects works. Before starting to program monitoring, there are some prerequisites such as process a large amount of project information at the same time, so it makes complex the preparation of steering committee meetings because it needs more dedication than usual and normal projects.

Therefore, it is essential to define regular intervals for the steering committee meetings, prepare the necessary information of high quality and at the right time. In addition, the intervals equivalent to the total program time should be determined, as

shown in Figure [24], where a flow chart of the communications among those involved is defined; this flow should be set among all of them and strictly adhered to (Strasser, 2020).

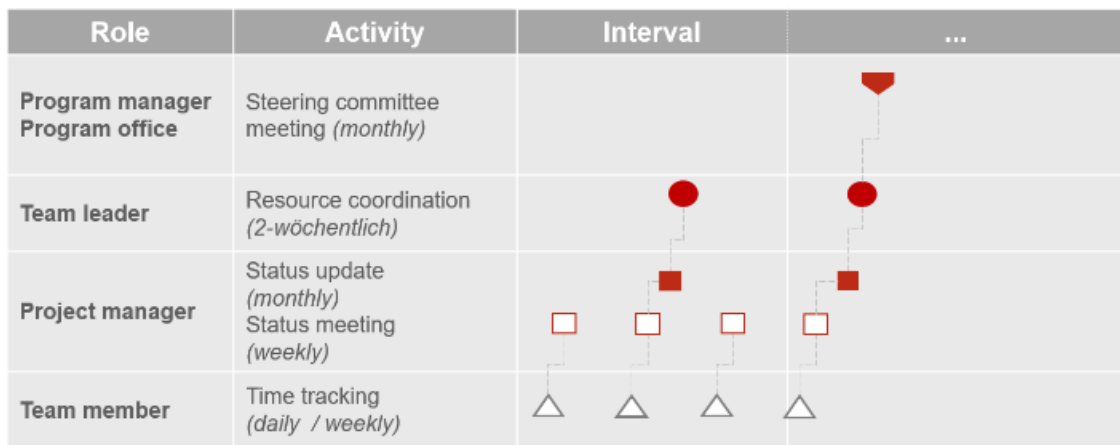| Role	Activity	Interval	...
Program manager **Program office**	Steering committee meeting *(monthly)*		▼
Team leader	Resource coordination *(2-wöchentlich)*	●	●
Project manager	Status update *(monthly)* Status meeting *(weekly)*	■ □ □ □	■ □
Team member	Time tracking *(daily / weekly)*	△ △ △ △	

Figure 24. Probable intervals for planning committee meetings by roles involved. (Source: Strasser)

C. Determine a Suitable Work Breakdown structure

The work breakdown structure must enable the program to transmit content and time dependencies among the projects, defining the crucial milestones in each project. Those milestones will then be used to monitor the program. It is also advisable to create a separate master project for the program to contain all the general control information necessary for efficient program management; thus all interfaces or partial deliveries must converge and be controlled from there (Strasser, 2020). All this means that the steering committee can open and edit a project plan, which makes more straightforward both the general description and the management.

D. Define the interface among the projects

Throughout a program, the steering committee is issuing the objectives based on intervals whose goals have a high connection with the milestones in the interfaces. Therefore, they are assigned to the corresponding projects, that is, from top to bottom, as shown in Figure [25]. Whereas Project Managers are responsible for implementing those objectives. Simultaneously, the current dates of the milestones are collected regularly, that is, from the bottom up. It must be noted that the differences between time and years are real in the interface, thus improving connectivity between managers. (Strasser, 2020)
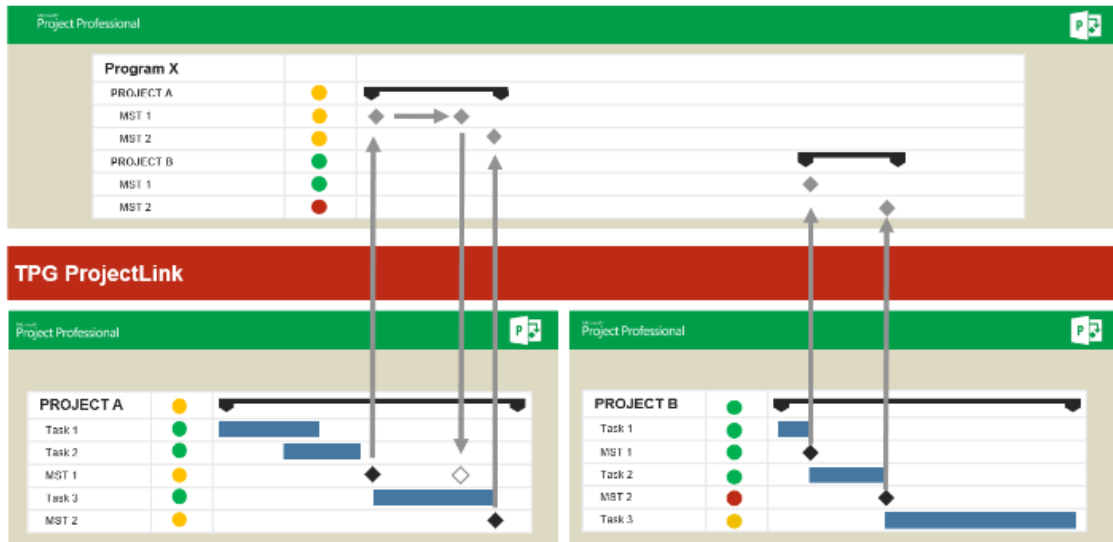
Figure 25. Bottom-up and top-down control between program plan and individual project (Source: Strasser)

E. Get a capable PM system

It will be feasible to run complex programs with the help of efficient software. Nowadays, there are many suitable products on the market, as seen in point 2.6.2, which in recent years have become increasingly capable, innovative, and effective in terms of professionalism. To manage successful programs, establishing a link between projects and making changes in real-time would be a measure recommended by each program manager.

F. Automatic interface synchronization.

In the case of postponing project deadlines, much time would be saved if it is automatically synchronized with the program plan. The ideal situation would be to open the program plan and immediately see the real status of each milestone next to the plan value. In the case of having many interfaces, a solution like this can save quite a time. As a program manager, the data collection process would become obsolete and more time could be spent controlling the program.

G. Launch an Early-Warning system – Milestone Trend Analysis (MTA)

Performing the programming control of the interface using the actual dates reported is not an appropriate solution. Strasser (2020) points out that Milestone Trend Analysis (MTA) is a great tool to warn of the most urgent deliveries; for example, it will be reported if dates are rescheduled frequently. In the MTA, the objectives of the program plan are used as actual dates for the significant milestones of the projects, which allows identifying the critical effects of the postponement.

The Milestone Trend Analysis tool (MTA) specializes in scanning the story and projecting the milestones of chosen projects. This tool is mostly used to illustrate time-related discrepancies graphically. So that when the milestones are updated, the end dates are projected according to the project's progress. If the interrelated symbols are connected, a curve is produced, as in Figure [26], the progression over time is visibly shown. A horizontal line represents the end of the most significant case of the initial plan.

When this line goes up, it means a delay in the timetable; on the other hand, a downline implies that it will finish it earlier than expected. (Dixon, 2020)
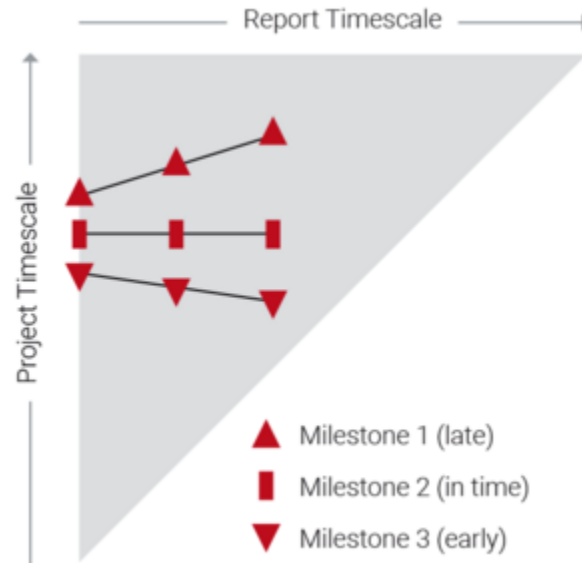

Figure 26. The curve of the milestone progression over time (source: Dixon)

Some of the benefits that MTA introduces in Program Management are:

- Accurate visualization of the history and projection of important milestones.
- Implement preventive actions of bottlenecks on the deadline, including periodic updates.
- The awareness of deadlines among stakeholders is improved.

Therefore, after the research of DIXON (2020) commented that TPG MTA Client is an independent and precise product that manages the MTA. It is a complementary product that can be installed in MS Project and used from a click on a button. One of the main advantages of TPG MTA Client is that the data is saved within the project file in MS Project, that is, a single file is not created for the MTA and, additionally, information is easily manageable in the project file, and it is directly accessible to more TPG MTA Client users. Figure [27] is shown a graphical example of a clear overview of the development of projects over time made by TPG MTA Client.
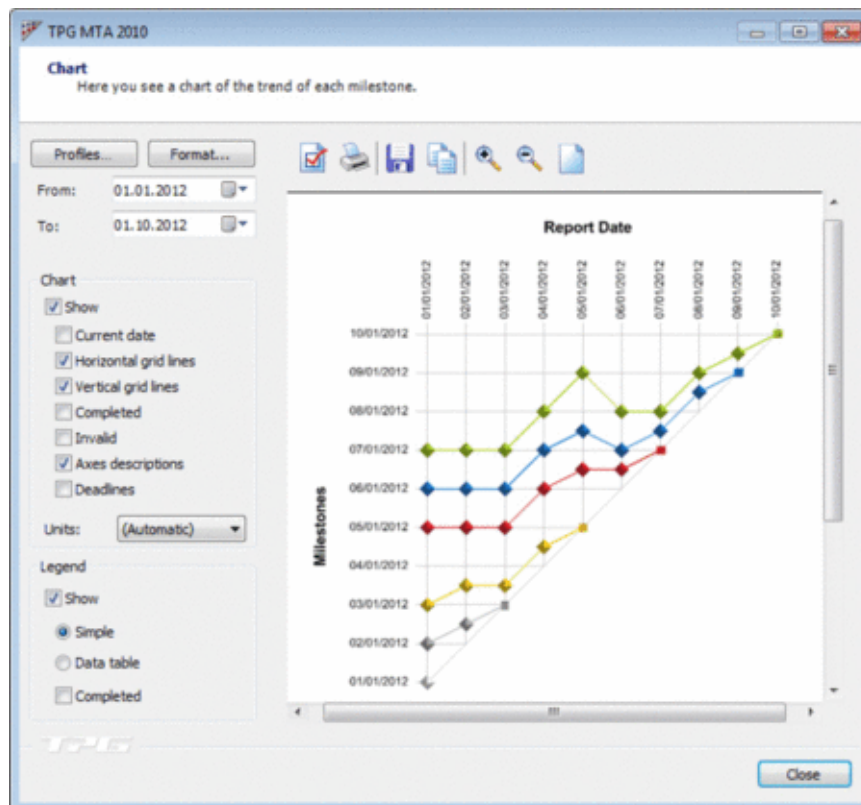
Figure 27. Summary of the development of the projects over time by TPA MTA software (source: Dixon)

4. Portfolio Management.

4.1. Functions of Portfolio Management.

Achieving the objectives of the organization through the completed projects is the job of Portfolio Management. Therefore, a portfolio manager must take action to improve the investment environment, as well as Project Portfolio Management. However, the difference between them is that the portfolio manager knows what the value of the portfolio is and how the portfolio has changed since the last report. Project portfolio managers usually lack much crucial information, such as those mentioned above. Therefore, an organization without PMO must assign someone in the role of the project portfolio manager, instead of the ideal solution, have a PMO (Al-Arabi, 2008).

It may be that in some cases, the projects chosen are adequately completed in terms of budget and scope of the project but do not come close to achieve the objectives of the organization. Therefore, the Portfolio Management process is failing. In general terms, the Portfolio Management role has these responsibilities:

- Achieve a viable project that can meet the objectives of the organization.
- To achieve a balance of the portfolio to guarantee a combination of projects that balance in the short term vs. long term, risk vs. reward, research vs. development, operation vs. project, etc.
- Monitor the planning and execution of the chosen projects.
- Evaluating portfolio performance and implement continuous improvement.
- Evaluate new market opportunities compared to the current portfolio.
- Provide information, lessons learned, and recommendations to decision-makers at all levels.

Portfolio managers often find it challenging to implement knowledge, which is why they make strategic management become dysfunctional and create a gap between strategic planning and implementation. Then we proceed to explain some connector links that are essential to achieve an integrated and high-speed application. This way, the gap that is essential to maintain a committed advantage is closed. However, today many companies lack several integrative links (Al-Arabi, 2008)

	Effectiveness	Coordination	Efficiency
Prior to project execution	Project Selection	Resource planning	Project / program plan view
	Business planning	Resource procurement	
Project execution	Identification bad projects	Participation in steering groups	Initiate reviews
		Prioritization of projects	Handling of issues
		Collection and aggregation reports	Coaching of project managers
			Improvement of process

Table 6. Roles of Portfolio Manager.

Before focusing on the main tools for portfolio management, the first step is to explain the different levels of maturity within a PPM (Roach, 2020). Maturity in an institution evaluates the effectiveness of an organization in executing projects and establishing the extent to which an organization has improved or progressed towards incorporating best practices in project management as an effective way of working. (PMI, The Standard for Portfolio Management (Fourth Edition), 2017) According to the Gartner model study, from less maturity to more maturity:

- **Level 1: Reactive**: It has no formal PPM roles or tools. Utilization of worksheets and sometimes a project planning tool.
- **Level 2: Emerging Discipline**: It evolves towards a more process-based method, although isolated systems and inconsistent data block business practices — utilization of a primary PPM tool and maybe a PMO.
- **Level 3**: **Initial Integration**: A more global approach to PPM. In terms of planning and decision making, they are carried out at the organizational level. Portfolio functionality and primary resources are operational. PPM dashboards provide data.
- **Level 4**: **Effective Integration**: Focus on delivering industrial value. Industrial PPM functionality is automated that allows consolidated reports, a business portfolio, and strategy execution.
- **Level 5**: **Effective Innovation**. Innovation is fully integrated organizational processes. Business programs lead to quick execution of the strategy. A business project management office has been implemented and with possible external contracting for innovation support.

Regarding assign the maturity level of one institution, most of them are in level 2. As for attaching the maturity level of an institution, According to ROACH (2020), he points out that most of them are stuck at level 2: *"Competitive pressures and changing market conditions are forcing organizations to reach Level 3, and most organizations are not yet ready to leap."* Many companies find it challenging to make the switch to more agile and company-focused activities than Level 3 and digital demand.

4.2.   Tools of Portfolio Management.

It is chosen tools from the PLANVIEW (2020) as it is pointed out in Section 2.5.3, which was the best punctuation of Garner's research. This software has different application depending on the type of hierarchy such as:

- **IT demand management and Portfolio Management**
- Program management and road mapping
- IT resource management and capacity planning
- IT Project Management and Planning
- Financial Management
- IT Analytics and Reporting

As far as are this section is concerned, it can be focused on IT Demand Management and Portfolio Management Tools which tools are as follows:

1. **Oversee the flow of IT demand against capacity.**

Using this IT demand software, the demand for new projects and route requests can be analysed through a centralized admission process. Another function is to prioritize and plan a portfolio that can be delivered according to capacity (planview, 2020). The applications of this section are as follows, and these applications can be shown in Figure [28]:

- Stakeholders will have the ability to request new projects quickly and verify the status of work.
- It can be added to the Planview Ideation Management extension and cost-effectively promote innovative projects in the pipeline.
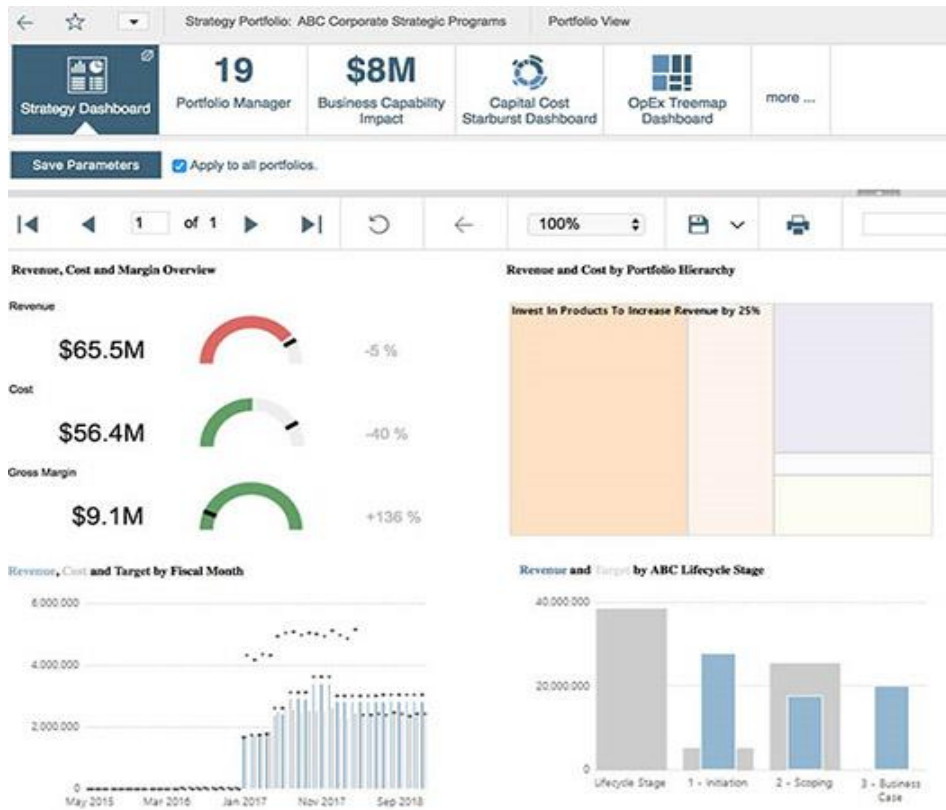
Figure 28. Screenshot of IT demand software (source: Planview)

2. Take advantage of top-down planning to interpret and prioritize demand

Focusing on prioritization is one of Planview Enterprise's bets that optimizes the scope, so demand is instantly evaluated and then modified based on detailed estimates and real data (planview, 2020). The applications of this section are as follows:

- Financial resources and needs are defined rapidly without a comprehensive project plan
- Portfolio managers can enhance classification and improve prioritization through objective and repetitive methods that serve to quantify the value of the investment.
- Through estimates, data from other projects, and resources, the plan is getting better.

3. Make use of the theoretical analysis to manage the impact of the change.

Through a reliable analysis of hypothetical scenarios, which is the Planview Enterprise software, the trade-offs to optimize the portfolios is facilitated (planview, 2020). The applications of this section are as follows, and these applications can be shown in Figure [29]:

- The reallocation of resources and funds in the entire portfolio can be modified so that impacts and balance trade-offs are understood.
- If scenarios are compared directly, alternative approaches can be considered to meet the objectives of the project and the portfolio.

- In terms of agility, rapidly finalize and communicate portfolio decisions throughout the company.

Figure 29. Analysis to manage the impact of change (source: Planview)

4.3.   Guideline for successful Portfolio Management

Portfolio Management's main objective is to work with projects from the business point of view. Instead, the Multi-Project Management aims to manage both resources and budgets that tend to be requested by several projects at once. This section provides some support for decision making and to be able to meet the basic requirements of Portfolio Management, such as it works, and it is accepted. In addition, it will teach how to select the right projects to implement through an optimal combination of projects in the portfolio.

A. The criteria for the projects will be defined.

Defining evaluation criteria for projects will serve to manage the operational part better. A company can be a project, so the analysis of the solvency of the project can determine from what point a company should be treated as a project. An applicable example, as in Figure [30], can be to differentiate projects according to the type of project (minor/standard/major project), which will allow defining the methods that will be used (Schmidt-Sibeth, 2020).

Criteria	Operation	Minor project	Project	Selection
Number of areas involved	1 area	up to 3 areas	over 3 areas	up to 3 areas
Size of entire project team	2-5 people	over 6 people	over 12 people	over 6 people
Resource requirements	10-30 man-days	30-100 man-days	over 100 man-days	30-100 man-days
Capital expenditure	under €10,000	€10,000-50,000	over €50,000	€10,000-50,000
Duration	1-3 months	4-10 months	over 10 months	4-10 months
Inherent complexity	low	medium	high	high
Novelty for project team	low	medium	high	low
Quality risk	low	medium	high	medium
External effect	low	medium	high	low
			Recommendation	Minor project

Figure 30. The project-worthiness analysis determines from what point an undertaking is to be treated as a Project (source: Schmidt-Sibeth)

It must be emphasised that only projects from the project portfolio selection process will be added. When designing the individual project value analysis depending on the established requirements, these are some criteria that can help:

- Number of departments implicated
- Project team size.
- Personal expenses
- Investment amount
- Duration
- Inherent complexity
- Innovation within the project team.
- Quality risk
- External effect

B. Define the process to start the project.

Today projects are incorporated into the portfolio very frequently. Therefore, it is essential to define a uniform process for all projects. It is necessary to use a standardized central system that contains tasks, ideas, project requests, that is, a portfolio management software tool. It can specify a method that includes workflows, permissions, criteria for approval steps, etc. (Schmidt-Sibeth, 2020).

C. Define a periodization method.

Prioritization is not a fixed activity, so circumstances can generally be changed, and priorities must be adapted to the current state. The strategic relevance of the projects can be determined by assigning business drivers that are independent of each other, among them, SCHMIDT-SIBETH (2020) points out:

- Increasing product quality.
- Get customer satisfaction.
- Increase in staff satisfaction.
- Achieve greater profitability.
- Expansion to new markets.

It is noteworthy that drivers must have a strategic perspective, as it is the main objective of portfolio management. Afterward, the importance of the drivers between them must be defined. It is also advisable to choose less than three drivers, but less than ten, which ensures proper handling and a significant overview on a reasonable basis.

D. Start with a full overview of the running projects.

First, all projects must be registered in the specialized software database, as seen in Section 2.5.3. Project information entered the database must include at least: start, finish, effort, cost, sponsor, project manager, etc. The crucial strategic business drivers are then assigned to each of the current projects. Then check if the most considerable effort goes towards the most important projects (Schmidt-Sibeth, 2020). As can be seen in Figure [31], the most excellent attempt does not always go to the most crucial project as observed with Driver B.

	Priority	Driver A	Driver B	Driver C
Project	1	3		1
Project	2	2	3	
Project	3		3	2
Project	4	1	2	1
Project	5	1	2	
Project	6		1	2

Driver A
Driver B
Driver C
■ % Importance
■ % Effort

Figure 31. Prioritize procedure according to the drivers (source: Schmidt-Sibeth)

After this procedure, it should be identified which projects are best to be stopped in time so that resources and effort can be released for more critical projects. It should be noted that the previous example is super-simplified, but it is difficult to calculate the financial value of a project that does not produce direct income. Therefore, from the portfolio manager, a great indicator is the resulting amount of the strategic drivers, and the resulting information can always be complemented later with financial indicators for a hypothetical future meeting with the executive committee.

E. Contrast the planning of new projects with the remaining capacity and the available budget.

The aim is to compare the effort of the new projects and the planning in terms of costs with the remaining capacity and the available budget. In short, it is about anticipating when a project could start. To be able to lower the effort, the focus must be maintained on the skills of the resources, not on the people. Without a doubt, the new strategic drivers' projects must be assigned because otherwise, it will be complex to prioritize the new projects with the strategic contribution. Also, it is advisable to include only small projects with a low strategic input in the final stages so that it can fill in the gaps (Schmidt-Sibeth, 2020).

F. Constantly monitor Project and Program Management.

The work of the Portfolio Manager not only ends with the selection of projects that will be initiated but must also guarantee without a doubt that the projects are regularly updated and reported to the central system. Current data is necessary to start future

projects, as they provide vital information; the term of project management is called: lessons learned. Besides, it is essential for monitoring the portfolio constantly and verify the priorities of the running projects. If the project is not in line with the strategic goals, it can be discarded (Schmidt-Sibeth, 2020).

G. Close projects with a standardized project closure process.

It is important to note that in each final review, the original objectives should be compared with the final costs and results. Besides, it is essential to communicate and archive the lessons learned and the project itself. After that, it is known that a project has come to an end, and the staff, which at the closing stage, will be scarce, can be assigned to other projects (Schmidt-Sibeth, 2020).

Today, closing a project successfully, that is, without any challenge or cost overrun, is difficult, so if this milestone is achieved, the motivation of the project managers for future projects can be increased.

5. Guideline for Multi-Project Management software in the R&D area.

5.1. Differences between Program Management and Multi-Project Management.

Multiple Project Management (MPM) is tactical and operational, like Program management. Among the main challenges are resource management and project prioritization. Multi-Project Management is responsible for managing all parallel projects of an organizational unit, which is based on the same resource group. The difference with the management of multiple projects is that the projects within a program are interdependent and serve to achieve a common general objective. Programs generally have their own Program Office that coordinates all projects within the program. In short, the MPM can be differentiated in general terms with Program Management as follows (Staden, 2020):

- In Program Management, projects fulfil a common general objective.
- The MPM includes all the projects of an organizational unit.

In the case where it is working in a Multi-Project Management environment, it should be familiar with implementing many projects in parallel based on the same resource pool. Also, the MPM environment is very complicated, and proper operation is impaired by the circumstances of the MPM environment (John, 2020):

- The projects are implemented in different departments or geo-locations.
- The resources of different departments must be coordinated
- The strategic priority of the projects may change
- Some isolated projects may be interdependent.
- Internationalization may affect the project environment.
- Reporting requirements become increasingly complex
- Decisions must be made in a short space of time.
- Accurate information is required in the project

So due to this complex environment and additionally to management issues such as wrong decisions and priorities, unprofessional management, unrealistic planning, and

missing overview of all projects can appear, such as rescheduling, resource conflicts, costs increase, and alterations in quality.

5.2. Introduction of R&D area.

5.2.1. Institution

The intuition chosen is "*Bremer Institut für Produktion und Logistik*" (BIBA), which is in Bremen, Germany. BIBA is a research institute focused on engineering science. It was set up in 1981 as one of the starting affiliations institutes of the University of Bremen, and his facilities are more significant than most of the rest of the institutes in the federal state of Bremen. It involves two divisions: *"Intelligent Production and Logistics Systems"* and *"ICT applications for Production."* (Uni-Bremen, 2019) In addition, according to different fundamental research, BIBA accomplishes applied and contract analysis, both on a national and international level, in fields of production and logistics for significant industries as logistics, automotive, aviation, and wind energy.

The Program and Portfolio Manager will be the middleman of the top of the hierarchy institute, as it is shown in the fellow Figure [32]. So, it oversees both thoracically incorrect roles, but it happens worldwide due to the lack of resources or even the lack of information on the functions of each role or also causes the chief has other tasks to take into account and cannot tackle it. However, whether it is based on the way according to standards like PMBOK, it is more efficient to tackle within different roles, as Programme and Portfolio are divided.
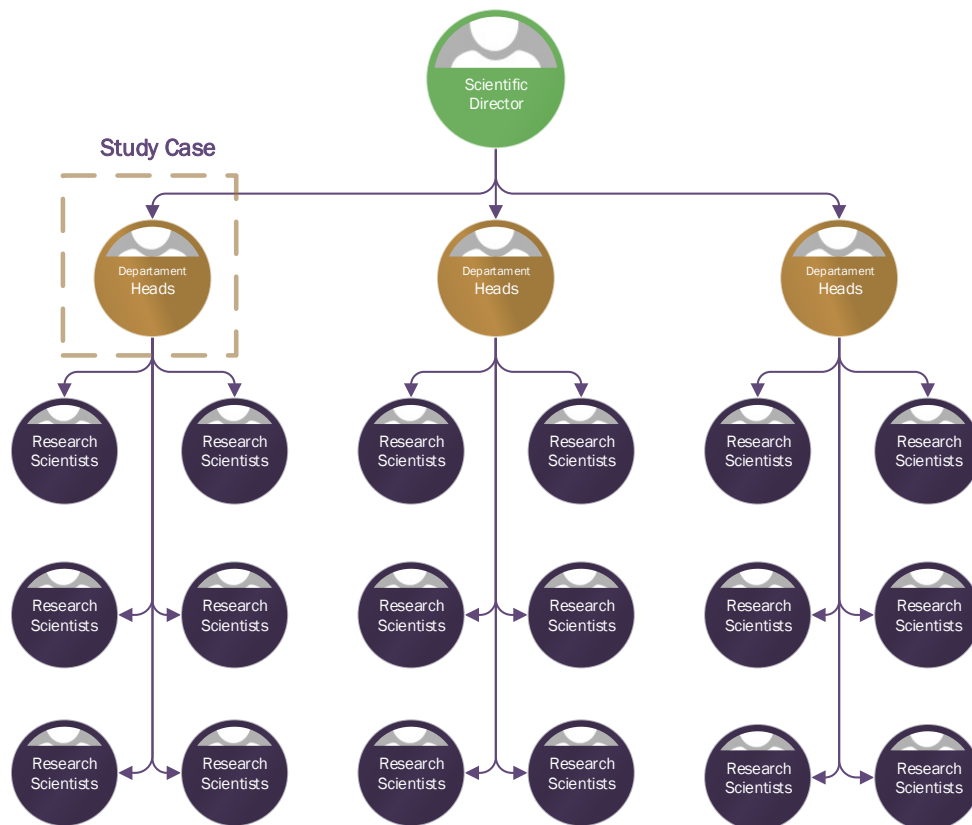

Figure 32. Hierarchy of the BIBA Institute of the R&D area (source: oneself)

Figure [32] is simplified because the top hierarchy of the institution is shared with two scientific directors and administrative director. Besides, there are positions downstream

of department heads apart from research scientists like the technical staff and student assistants.

5.2.2. Projects in the R&D area.

The multi-project manager takes care of organizing programs and activities following the mission and goals of the organization. Furthermore, the program manager oversees and analyzes program risks, producing accurate and timely reporting of program status throughout its life cycle, most of them managing for long-term goals.

As shown in Figure [33], the blue vectors are the connections between the project and the project manager. On the other hand, the orange vectors symbolize the links of the program manager with both the project managers and the distribution of resources between projects among other things
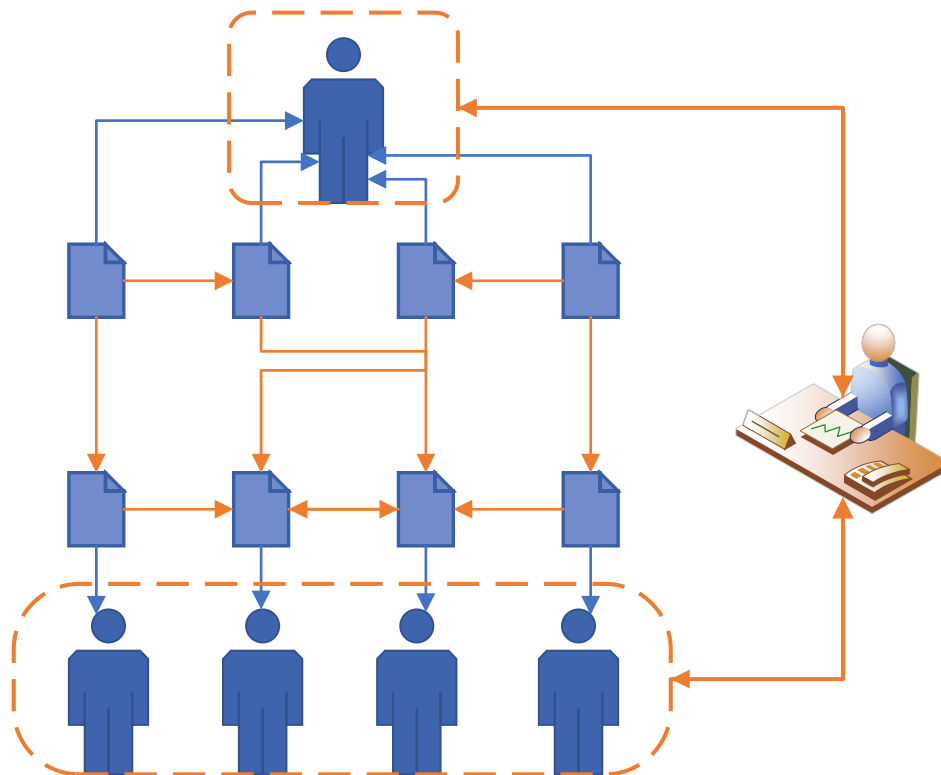

Figure 33. Flowchart map of the Program Manager functions. (source: oneself)

Challenges in the R&D and Product Development area.

In some product development programs such as appliances, vehicles, pharmaceuticals, or technology, they usually contain an R&D area and a Development area. Nowadays, challenges in R&D and Product Development, there are some inconveniences, such as those that will be explained below (Johann, 2020).

- Excellent coordination and planning requirement due to numerous and complex projects
- Planning can be stressful because, in the field of research, the result is unknown, and the estimation of effort can be complicated because of hardly based on empirical data.

- Many of the projects are not defined because the research results are uncertain, and some discoveries may be strayed into different directions or additional projects.
- The specifications of a product depend on technologies that are in constant technological development.
- For small and medium-sized companies in a competitive environment, it can be challenging to invest in research and development. In other cases, it can be simple despite the high costs due to large amounts of production.
- Bottlenecks may appear when there is a shortage of resources in the development team or costly test environments.

JOHANN (2020) suggested that following-up on development costs in the ERP system supplies more control in Program Management. Based on the type of product and the production output, development costs usually can be shown later in the final price of the product. Therefore, many industries need meticulously control R&D costs in order to avoid project cost overrun.

Generally, the budgets which are managed by the ERP system are successful. It is essential to keep automatic synchronization between the ERP and the Program Management system due to high demand and data exchange between the two systems. Through this set, cost structures can be created, and it should be noted that different currencies and conversion factors can be processed. In general, to transfer costs to the ERP system, two steps will have to do be done in the program management system, as shown in Figure [34], where SAP and MS PROJECT have been used, such as an example through TPG PSlink.

1. The master data such as cost center, type of activities/costs are synchronized.
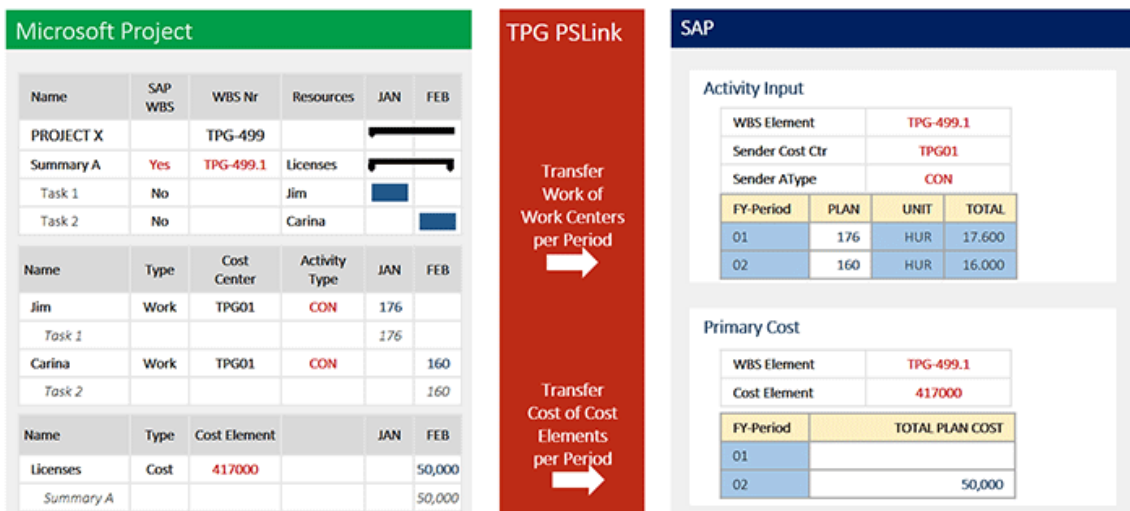2. Allocation of master data to resources

Figure 34. Allocation of planned work and cost from PPM to SAP (source: Johann)

As shown above, the registration and periodic updating of R&D costs are essential today for nearly all companies, so it must have accessibility to the costs and that these are updated in the ERP system.

5.3.   Set up projects.

In this chapter, a guide will be created for the programming of the projects and the program using a Project/Program Management Software as it was discussed in Section 1.5.1 and 1.5.2. Firstly, projects are set up following the next structure:

5.3.1.   Define each Project.

First, the project will be set up programming the project start date and general work schedule considering working days, days-off, and holidays.

The following information is required to programming the first stage of the project:

- Project Start Date.
- General work schedule, including exceptions such as off days and holidays.

5.3.2.   Define the tasks of individual projects.

The tasks that form each of the projects will be created within durations, precedence relationships, necessary resources, and how much time spend the resources doing the task between them. The following information is required in order to programming the second stage of the project:

- **Duration of the tasks.** The duration can be in hours (h), days (d), or weeks (w).
- **Precedence relations.** It can be Finish-Start (FS), Finish-Finish (FF), Start-Start (SS) and Start-Finish (SF)
- How much time spend the resources doing the task?

Example**:** Basic process engineering, 30 days, [process technician (75%), and process engineer (100%)].

5.3.3.   Define and allocate resources.

The resources employed in each of the projects will be defined and assigned to the various activities, for instance, the number of resources available full-time, which company is working for and the rate of each resource [euro/h]. As for over-allotment, problems generated will be resolved within the portfolio. The following information is required to programming the third stage of the project:

- **Amount of resources.**
- **Type**: Work, material, or cost.
- **Maximum capacity**: Resources available in percentage. Unit equivalent to 100%.
- **Standard rate:** Normal work payment rate.
- **Overtime rate:** Payment rate for overtime work performed by a resource.
- **Cost/use:** Specifically, as for a job is the cost that accumulates each time a resource is used. Instead of materials, it shows the value that accumulates each time regardless of the units.
- **Calendar**: Shows the base calendar for the resource calendar.

Example**:** Process technician, work, 100% 1, AIRBUS, 45 euros/h

5.3.4.   Solve the resource conflicts.

When there is an over-allocation of resources, specialized software warns the user visually and clearly. Over-allocation occurs when a resource has been assigned more tasks than it can execute in the work calendar or as planned at the beginning of the project

A. Over-allotment methods automatically by a Software.

In the case of MS Project, the calculation occurs instantly when modifying tasks or resources. If the program is configured to resolve over-allocations, it will never change the % allocation of resources. The program is limited to:

- o Displacement of tasks (depending on the margin of delay or freely, depending on what is indicated) so that they do not overlap, and over-allocation occur
- o Split tasks (if it is allowed).
- o If there are several resources in a task, it can be delayed the start of the work of any of the resources (if it is allowed) may cause a modification of the duration of the task.

In order to understand the leveling process, it is shown in Figure [35] the leveling options of MS Project for solving the resource conflicts. There is software that allows us to solve the over-allocation of resources automatically or manually.
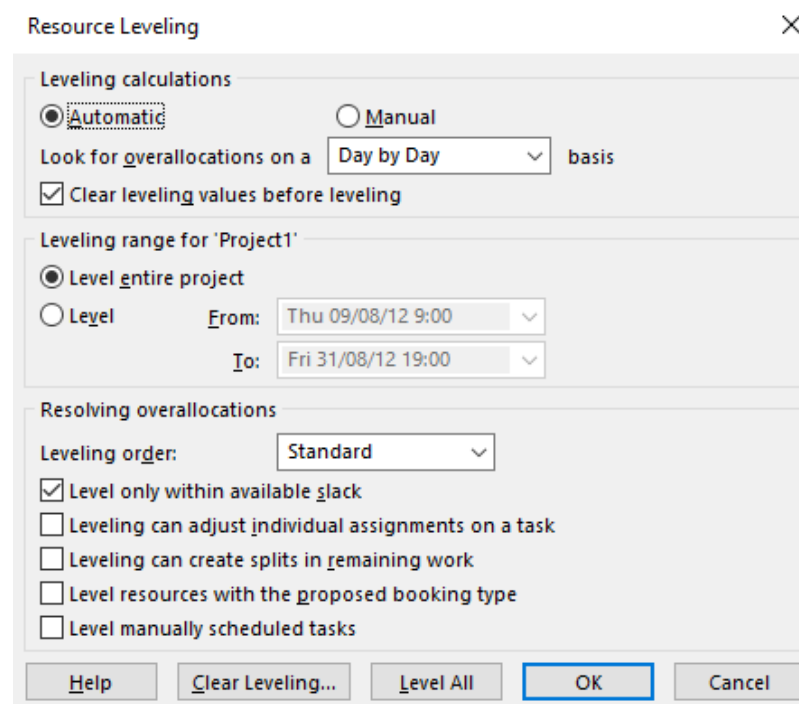

Figure 35. Resource leveling screen of MS Project (source: oneself)

Resource leveling options are followed in Figure [35], and each of them is explained below ((Microsoft), 2020):

- o **Automatic.** It occurs instantly when modifying tasks or resources, provided the automatic leveling mode. The Clear leveling values box must be deactivated before redistributing, and otherwise with this box checked, MS Project redistributes all tasks. Instead of that, redistributes new assignments that have not been previously redistributed. Therefore, automatic redistribution will slow down with it active.
- o **Manual.** Manual redistribution only occurs when clicking *Level all* or when the redistribute resources dialogue box is opened and click redistribute now
- o Below the **Leveling range for**, it can choose between redistribution of the full project or a specific time interval.

- o In the **Leveling order**, the redistribution order is selected within these options:
  - ➢ **ID only:** tasks are distributed in ascending order according to ID numbers.
  - ➢ **Standard**: the dependencies of precedence, the margin of delay, dates, priorities, and restrictions are first evaluated to detect if tasks should be redistributed and how to carry out this action.
  - ➢ **Priority**, **standard**: the preferences of the tasks are evaluated first, and later, the standard criteria are examined.

As far as resolving allocations are concerned, are the next one:

- o **Level only within available slack:** it prevents that the project end date from being delayed. Nevertheless, the error message can appear because there is not enough slack.
- o **Leveling can adjust individual assignments on a task**. The distribution is changed to a resource that works in a task-independent of the rest of the resources that work in the same task.
- o **Leveling can create splits in remaining work**. Interrupts tasks through creating divisions in the remaining work of tasks or assignments.
- o **Leveling resources with the proposed booking type.** It includes tasks using suggested resources and confirmed resources in the redistribution process.

B. Over-allotment methods manually by the Project Manager.

Manual mode does not mean activating the option, as shown in Figure [35]; otherwise, it must focus on tasks and resources and modify it to achieve optimal scenarios. It must always be considered when changing the data, and it is made an alternative option in terms of project duration, total work hours, and project budget. Among the methods that can be used, the following are recommended:

- o **Increase the maximum capacity of the resource.** It is used by adjusting the maximum hours and not leaving the resource underused on some dates.
- o **Remove the resource if it is not essential for the task.** Quickly go to the task and eliminate the resource. The most important thing is to know the type of task that we must have previously set (Fixed Duration, Fixed Units, or Fixed Work) since depending on the choice, the program will recalculate the other data.
- o **Replace the over-assigned resource with an underused resource.** Go to the task and selecting the resource we want to change, and in the drop-down, choose the resource that will replace it. It is important to note that what resource is available on those dates.
- o **Modify the allocation units.** Going to the task in question and reducing or increasing the percentage of the allocation units. The most important thing, in this case, is to know the type of task that we must have previously set (Fixed Duration, Fixed Units, or Fixed work) since it depends on the choice the program will recalculate the other data. Besides, it is necessary to consider if this change may affect the planning tasks (overlapping with other tasks if reducing the allocation units lengthens the task in question).
- o **Modify the duration of the task.** It should be noted that this option and the previous one is quite similar but differ in an important aspect. If we modify the duration of a task in which several resources participate, and that task is Fixed

Work, then the program recalculates the % of allocation units of all the resources involved in the task. Whereas, if we modify the units of allocation of a resource in a task, being this one of the Fixed Unit, then the duration of the task may be changed, but the program does not change the % of the allocation of the other resources that participate in homework.

- o **Decrease the amount of work assigned to the resource**. If the amount of work assigned to a resource is decreased and the task is of Fixed Duration, then the program recalculates the % of allocation units. Furthermore, if the task were Fixed Units, then the program recalculates the duration of the task, or rather the days that the resource in question works (it does not modify the work of the other resources involved in the task).
- o **Adjust the dependencies or limitations of the tasks**. It is always possible to check the relationships among tasks and modify them.
- o **Split tasks.** The concept of splitting tasks can be used when a resource works during a period in two tasks in parallel. For example, if it wants to tell that it must first be done a part of a task, then continue with the second task, and when it finishes, restart the first task again.
- o **Modify work profiles.**
- o **Add extra hours.**
- o **Adjust the calendar to extend the working days and hours of the project or resource**

It must be emphasized that the most profitable option is the manual one, but much time is spent programming and modifying the durations, units, etc.

5.3.5. Assign global resources and local resources.

In this section, the part of the program will be configured according to the projects. With the set up individual projects which belong to each one of the projects in the program, the appropriate changes are made in terms of resources, distinguishing the global or shared resources from local or each own project. Each of the projects and / or in the general information of the program, the specifications will come among the local resources that can be assigned only to a specific project. On the other hand, global ones can be attributed to any of the projects.

The main current problem of MS Project 2016 does not allow working with interdependent projects, that is, within a Program and any online ability. MS project works with a „POOL" of resources, which are simply resources that can be shared among several projects, so MS Project considers that all the resources in the „pool" are global. The project works with a 'group' of resources, which are simply resources that can be shared among several projects, practical effects, Project considers that all the resources of the group are global, but not global and local.

Therefore, a file must be created, which can be called „POOL" that will contain all the resources of the program (regardless of whether they are local or global). In this file, it will only work in the resource tab view. Initially, global resources will be added, that is, those that are shared among several projects. The name assigned to them in the POOL must be equal to that given to them in the individual projects. The next thing will be to open the individual projects one by one and link them to the resources POOL. In this way, they will use global POOL resources as it is shown in Figure [36]. To add them, Resource de Resource group compart Shared resources
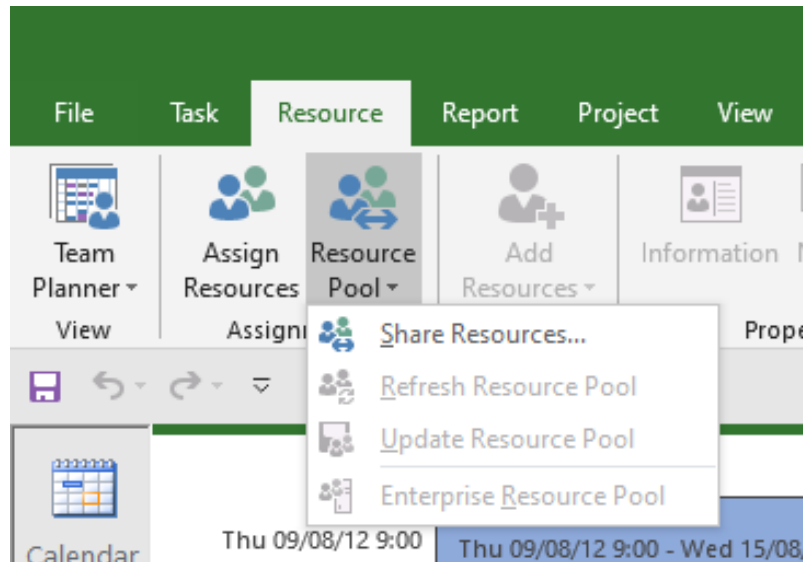
Figure 36. Process for sharing resources with another Project file (sourcce: oneself)

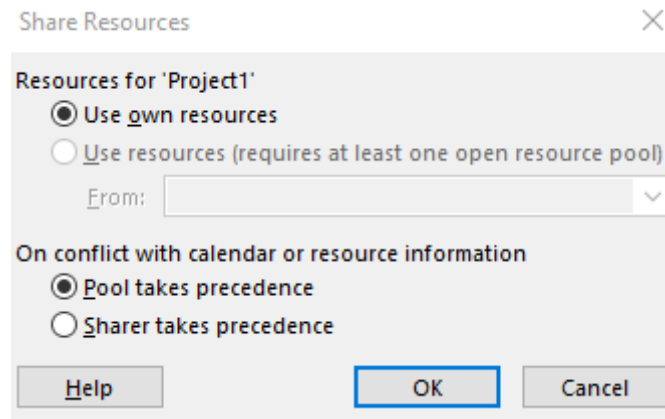Following a pop-up window is opened it looks like the figure [37].

Figure 37. Dialog box "Share resources

The POOL file will be completed with the local resources of each individual project. The names of the local resources of each project must be different, so that the POOL does not treat them as if they were the same. The capabilities of the global resources that will appear in the project's resources tab will be as indicated in the POOL.

That is why it was recommended in Section 1.5.2 a series of programs that, when it comes to Multi-Project Management, have more scope than the MS Project. Also, each software specialized in Multi-Project Management has a different way of defining what resources projects will share. It can then be exported from the MS Project file to any other computer program.

5.3.6. Create a program.

A master file will be created that will represent the program formed by all the previously programmed projects. Project will consider each of the projects that make up the portfolio, which are tasks within a project. A new Project file is opened, and in the Gantt Chart view, a task is created that identifies the portfolio, for example PORTFOLIO.

Next, the PORTFOLIO file includes the projects or programs that compose it. To do this, click on the row next to the cell where the portfolio has just been named, and on the Project tab as it is shown in Figure [38] and [39], in Subproject.
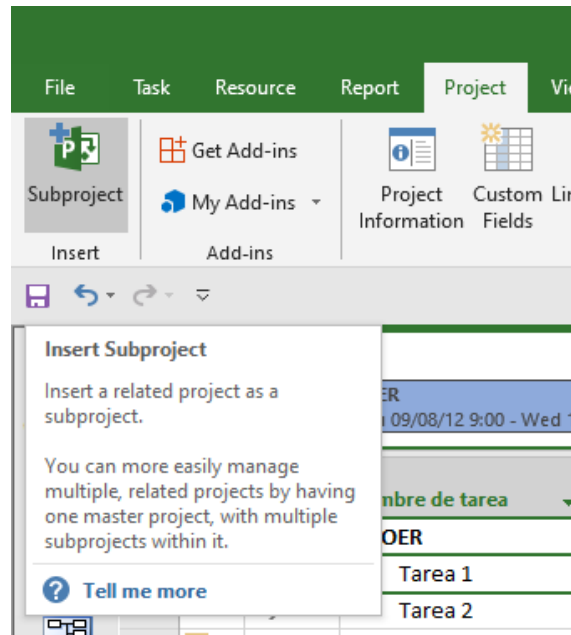

Figure 38. Subproject tab of the Project Tab

Figure 39. Indentation from Program projects.

The program selected for program management will consider each of the projects that make up the program, which are tasks within a project. Once the projects are incorporated into the portfolio, they are linked according to the available information.

5.3.7. Redistribute resources.

After defining the global resources and creating the project program, over-allocated resources will inevitably appear. The problem must be addressed, as explained in Section 4.3.4. Besides, in general, some factors to be successful in resource planning will be described below.

5.4. Tips for Multi-Project Management after setting up projects.

5.4.1. Be strategic in Resource Planning

Strategic resource planning is also recognized as capacity planning, which has one objective: to assign employees predictively with the required skills. Employees must also be certain that they are available at the right time to carry out projects strategically. Usually, the lack of strategic resource planning can trigger risks such as (John, 2020):

- Shortage of completion of projects on time because of insufficient allocation of resources
- If the appropriate resources are not used, the costs can be increased.

- Lack of agility and innovation when exploiting new market opportunities because there is no time to develop the required skills.
- Excessive coordination efforts by the Multi-Project Manager to resolve resource conflicts.

Successful strategic resource planning can provide a variety of advantages, and it can even be vital to have a solid PMO with the support of senior management. In addition, it needs an appropriate tool environment, such as the one shown in Figure [40] where you can see that a predictive plan of the new projects and the necessary resources is realized. There is a split of tasks as seen in Section 4.3.4. which is a tool to resolve resource over-allocation conflicts.
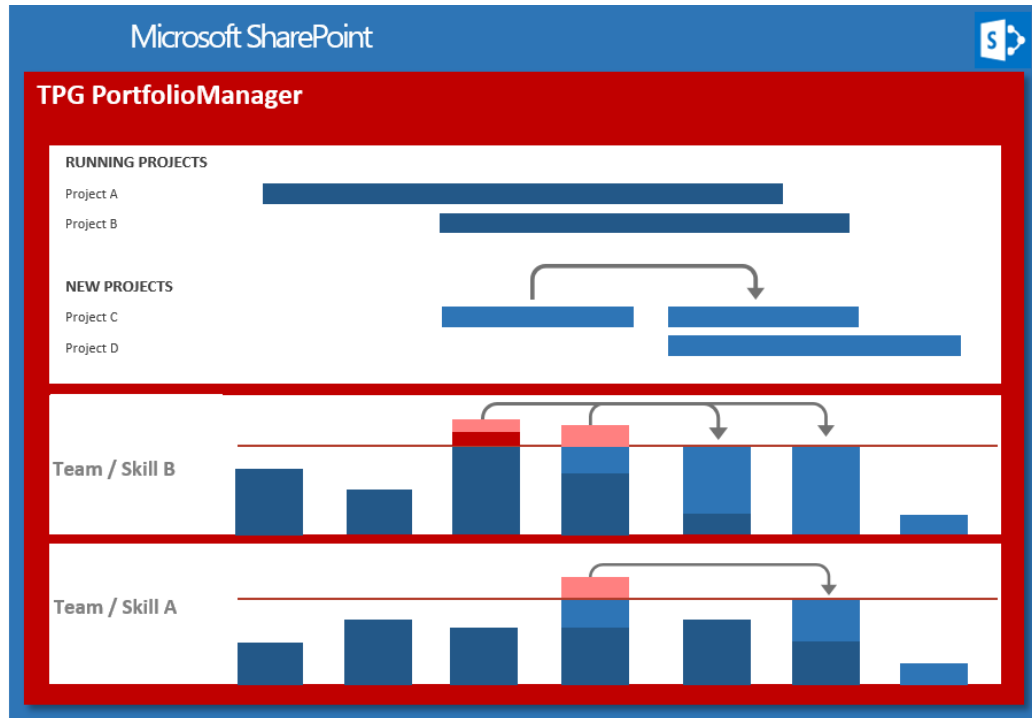

Figure 40. Tool for solving the over-allocation resource problem. (John)

So, it is worth pointing out that there are some tips to implement proper strategic resource planning (John, 2020):

- Reserve and ration out resources for the most critical projects.
- Creating a complete description of all resources, along with their assigned tasks, will inform the project stakeholders of their use.
- Be able to recognize bottlenecks on time and be able to react quickly through the corporate strategy.

5.4.2. Optimally help tactical Resource Planning

The Multi-project Manager and Team Leader usually coordinate resource planning. Resources are assigned to project tasks by the Project Manager, but where Team Leader has the authority to say who is assigned in the respective tasks. So, the coordination among them sometimes will be complicated because of (John, 2020):

- A lousy estimate of efforts depending on what is required
- Team members are not versatile in jobs as planned.
- Unexpected changes in project scope and delivery dates

- Unintended casualties due to illness or other issues.

An example of how essential it is for a Multi-project Manager to count on time off work and individual operations is shown below in Figure [41] because there is a big difference between resource capacity and project availability. Therefore, communication between the two must be coordinated, effective, and transparent.
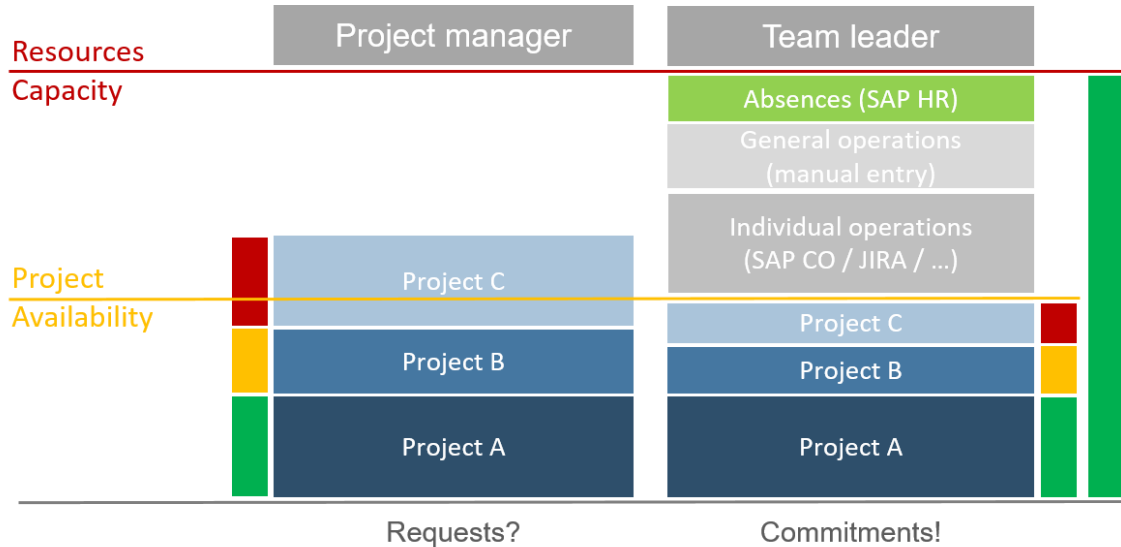

Figure 41. Coordination resource planning between the Project manager and Team Leader. (source: John)

Some of the following points are recommended by author JOHN (2020) to improve resource planning:

- The planning is marked as complete when the absences, operations, and project assignments of each team member have been recorded.
- Team leaders should help project Managers because they are the ones who can plan them thoroughly.
- Project availability is defined by calculating capacity minus absences and operations.
- The allocation of planning projects differs between line and matrix organizations.

6. Conclusion

At the beginning of the thesis, the current demand for project management is explained due to digital transformation and dynamic environments in which organizations exist. Organizations need to adapt, and organizational changes quickly because changes in the climate occur continuously. The differences between the project, program, or portfolio concepts have also been explained and how each of them has different objectives for the organization. For example, there is a strong relationship among the strategies carried out by the organization and the portfolio management of the project since it needs to align itself for its correct operation and carry out useful adaptations to the environment. In addition, guidelines have been explained to know how to differentiate between Project, Program and Portfolio depending on the concept, management, organizational structure and cycle life.

During the information search stage, it has noticed that there is much software that provides useful and practical tools beyond the typical Microsoft software. Many vendors are emerging with more exceptional ability to execute and completeness of vision that

bets on innovation and remains in continuous improvement in a continually changing market. Besides, the study carried out by Gartner verifies that the Magic Graphic Quadrant will be updated based on both new start-ups and obsolete companies that are out of the market.

Next, the Program and Portfolio management have been deepened because today many people do not know how to differentiate between the two fields, therefore, the roles, the different management tools that the software offers for each type of management have been distinguished and some guidelines with tips and processes to succeed. A program manager is different from a project manager, both useful tools that coincide and have the function of facilitating the work. Otherwise, with the lack of these tools, the portfolio or the online program and ensure that everything goes according to plan. Regarding the guideline sections, they help define, improve, and implement both strategies and planning and execution.

In the section more focused on the implementation of Multi-project Management in the area of R&D, it was essential to highlight the small differences between Program and Multi-project Management, which was defined basically that the management of multi-projects includes the resources of the same pool. On the contrary, Program Management may be interdependent projects. It also explains the type of organization and its hierarchy chosen to implement the management of multiple projects. Also, some challenges that may occur in the area of R&D and product development have been explained, since it is an area that maintains constant growth.

Regarding the setting up of the projects, it should be noted that it is not applied empirically in real projects, simply a theoretical basis is made of how to set up the projects and even with screenshots of programs such as MS Project, even so, it is this guideline utility is useful because it can serve as theoretical and organizational support for multi-project managers.

To sum up, this thesis overall provides much up-to-date information in both software and guidelines on how to set up, manage, and improve multiple projects. Besides, Portfolio Management information has also been added because it is convenient to be clear about the three types of management in order to analyze, evaluate and classify the type of management of each person who has doubts in their workplace.

7. Bibliography

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