PN-493-E
Rev. 11/2015

A Project Management Methodology

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Project management is as old as the Earth since its genesis may be considered the first project ever. Probably, that is why many people consider project management to be a matter of common sense and experience. However, why then do so many projects fail to comply with their schedules, budgets and objectives? How can we improve the way we manage our next projects to increase their chances of success?

Given this challenge, the main purpose of this technical note is to offer a project management *methodology* that managers can use as a guide. The note therefore aims to be used mainly as a reference document. The methodology we present covers the main phases of the *project life* cycle and has been successfully used in industrial practice. We supplement the methodology with *tools* that can be useful in the various phases of the project life cycle and we offer practical tips for implementing the methodology successfully in companies.

1. Project vs. Process: Key Definitions

Conceptually speaking, the activities that take place in a company can be classified in two fundamental categories: processes and projects. A process can be defined as a sequence of interconnected activities with a repetitive nature and prolonged execution over time—i.e., activities that are performed again and again in the same way for a considerable amount of time. In contrast, we would call it a project if the activities are performed only once in a particular way and, after the project objective has been achieved, the operating system is dismantled.[1]

[1] This does not mean that the resources (for example, employees) are no longer operational, but simply that the project team that was responsible for the project no longer maintains the specific configuration that was intended for that specific purpose.

This technical note was prepared by Professors Philip G. Moscoso and Jaume Ribera. October 2013. Revised in November 2015.
All of the material contained in this document has been developed by the authors unless otherwise stated.
This technical note was written with the support of the Eurest Chair of Excellence in Services, IESE.

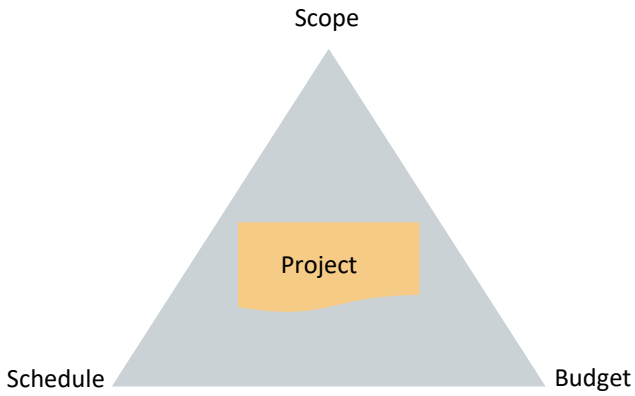
Last edited: 8/6/22

A project is therefore defined as having:

- A specific and unique *objective* or purpose, which the sequence of activities is intended to achieve.
- A fixed *duration*, with planned start and finish dates.
- Limited *resources*, including both material resources and labor or economic resources.

A project has three main aspects: (1) a *scope* (what is included in the project and what is not, as well as its quality and specifications), which should be achieved within (2) a *schedule* (maximum duration) and with (3) a fixed *budget* (execution cost) (see Figure 1).

Figure 1
Main Aspects of Project Management



In practice, these three aspects of management tend to be in competition with one another. For example, project execution can be expedited either by reducing the scope or by increasing the budget (more resources). As we shall see later, the project manager's job therefore involves striking the right balance between these three aspects in each case. We shall therefore define project management as follows:

> "The application of knowledge, competencies and management techniques to the execution of projects. First, it involves deciding which projects should be carried out (generally, in order to achieve the organization's strategic objectives). Second, it involves organizing and managing resources in such a way that the objectives (scopes) of the selected projects can be reached within the given time and budget constraints."

This definition generally takes for granted that *project management* aims to ensure:

- customer satisfaction and a positive impact on project participants (satisfaction, retention, personal and professional development, etc.);
- positive business results (ROI, growth in market share, profit growth, etc.) or results that will benefit the company's future (development of new technologies and competencies, etc.).

Although every project is different, in Exhibit 1 we present a number of classifications that we consider to be useful in that they define certain characteristics that have an effect on how projects should be managed. For different types of projects, it may therefore be advisable to assign different manager profiles, to use different types of methodologies, techniques or procedures, or to simply adjust the buffers (time and money), for example.

2. Why Do We Need a Project Management Methodology?

Most managers will have managed projects during their professional career; in fact, some managers spend most of their time managing projects. Yet many people manage projects without being fully aware of it, because, for example, they may not explicitly follow any methodology. In fact, it wasn't until the 1950s that systematic and specific methodologies for managing projects were defined, drawing on existing practices in civil engineering, industry and the military context. As in other areas of management, over time it has come to light that there are strong arguments in favor of using a project management methodology (although, as in other areas of management, there is no consensus as to *which* methodology is best).

As we said earlier, projects are different from processes in some respects, and project management must take these particularities into account. In a project, for example, we are doing things for the first time. Luckily, the fact that each project is unique in its configuration does not mean that there are no similarities among them. The main benefit of using a project management methodology, therefore, is that it focuses on similarities and on finding opportunities for improvement that can be generalized for use in other cases.

The scope of the potential for improvement in project management can already be suspected based on the fact that most projects come to an end without meeting the initial established requirements in terms of scope, schedule and budget. The construction of the Eurotunnel under the English Channel, for instance, was completed two years later than planned and cost $17.5 billion, whereas the initial budget was $7.5 billion. As we will show, there are many reasons for such deviations, but very often they are attributable to a lack of methodology and systematization in project management. As we shall explain later, the adoption of a methodical, systematic approach is not necessarily incompatible with the exercise of creativity or autonomy by project participants.

A further argument in favor of following a project management methodology has to do with the way in which many companies are traditionally organized. Whereas companies tend to be divided into functional departments, projects often require cross-functional cooperation and coordination. A clear methodology, backed by management, will usually help overcome this type of barriers.

Another related aspect that benefits from the use of a methodology is the interconnection of activities. This interconnection may be more complex or less well-known than it is in the case of processes; as such, a methodology helps improve planning and the coordination of efforts. Along these lines, good communication—both internal and external—is important in project management, and a methodology can help make it stronger and more systematic. Likewise, a methodology usually also improves the monitoring of how a project is progressing, both for team members and for company management.

A last point in favor of using a methodology has to do with project results. Most projects are meant to bring about a change in the company with, for example, a new product, an upgrade to software applications or a process change. But without a good management methodology that encompasses everything up to a project's successful completion, there is a greater risk that the project will fail to bring about the desired change.

2.1. Implementing a Project Methodology

If a company decides to implement a project methodology such as the one described here, we recommend doing it in stages. First, it is generally not a good idea to attempt to redirect projects that are already under way so that they adapt to the new methodology; it is preferable to reserve the new methodology for projects that begin after the date that has been set for its implementation.

Second, it may be advisable to begin with two or three pilot projects in order to fine-tune and consolidate the new methodology. This will also make it possible to spread management knowledge throughout the organization little by little.[2] However: after this initial phase, it is best to establish and announce a deadline for the generalized application of the new methodology so that there will be clarity and unity in the organization with respect to its use.

Third, we recommend beginning with a simple methodology, which can be made more sophisticated later, as required. Attempts to implement a project management methodology often fail due to methodologies that are too ambitious (and "bureaucratic"), which are rejected in the organization because of the amount of additional work they entail. It is important to make sure that future users of a (new) project management methodology are aware that it will benefit not only the company as a whole but project managers themselves as well, since the extra work that any methodology implies at the outset will be more than offset by the improvements in project management effectiveness and efficiency.

Although, ideally, the methodology should be more or less uniform throughout the organization, in some cases it may be useful, all the same, to distinguish between a (limited) number of project types, in order to facilitate the implementation and to cut down on the associated organizational effort. For example, projects that affect only one organizational unit may be distinguished from projects that involve several departments. Or projects that exceed a certain cost threshold may be differentiated from the rest. Based on this differentiation, a reduced version of the methodology may be developed for projects that do not require full deployment.

In companies that do not migrate completely to a project-based organization, it is often helpful to appoint "experts" in project management for each department or functional area (like "power users" in IT or "black belts" in quality management). These experts will be responsible for overseeing the compliance with the chosen methodology, resolving methodological queries and ensuring that the information related to the department's projects is kept up to date.

We often advise organizations that want to improve their project management capabilities to set up a *project management office*, (PMO). A PMO can be anything from a single full- or part-time person to an entire department, with plenty of resources, that features prominently in the company's organization chart: it all depends on the PMO's mission, the scope of its authority and its functional dependency. The PMO's goals can usually be categorized into three broad groups: (a) reduction of project risk; (b) productivity improvement; and (c) strategic alignment of projects. Whereas a "lightweight" PMO will usually be limited to delivering methodological support to project teams, without actually managing any of them, "heavyweight" PMOs will have direct management control over all the company's major projects.

[2] As professors, logically, we recommend combining implementation with employee training, both on general project management issues as on the specific methodologies to be implemented in the company. This training may be directed differently toward two groups: those who will regularly work as project managers (or at least as project team members); and all other employees who will be "affected" by project management.

Within this range of possible PMO setups, the critical functions of a PMO can be classified into two broad areas:

1. Functions aimed at specific projects: for example, making up for project management knowledge gaps among members of the various teams, mentoring less experienced project managers, or providing occasional consultancy services on specific aspects of the project (for example, hiring external services).

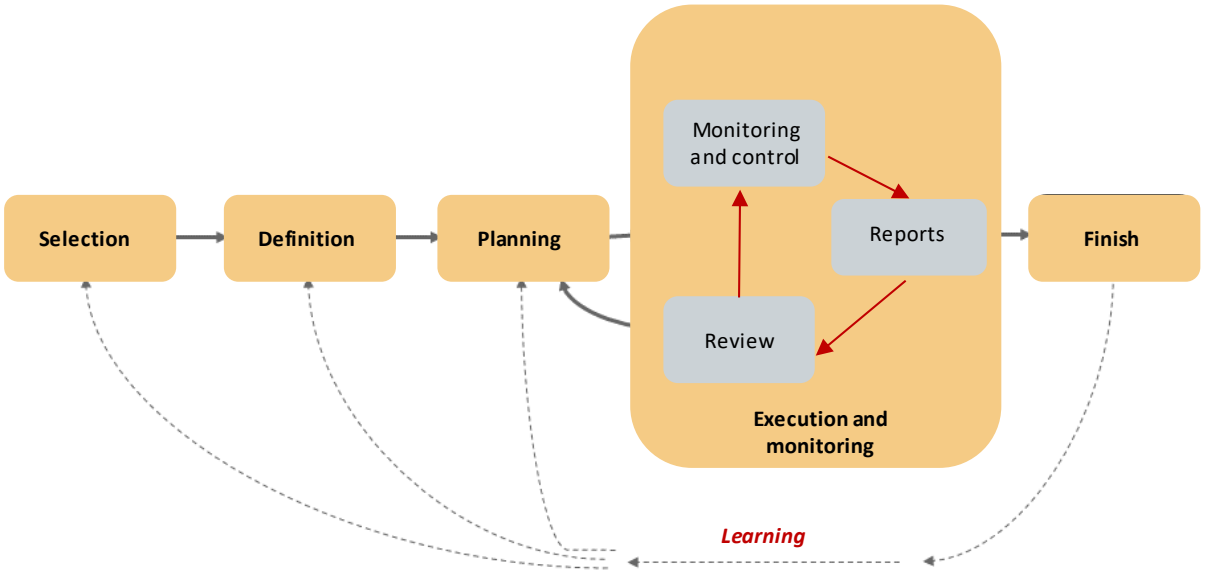
2. Functions aimed at the management of projects throughout the company in general, such as promoting a culture of managing by projects, filing information about previous projects, cataloguing lessons learned, teaching best practices, defining procedures and guidelines, or providing project management training.

Very often, when a company decides to implement a project methodology, it will consider the suitability of implementing project management software tools as well. In our opinion it is not an essential requirement, but there is no doubt that when these tools are used properly they can translate into major benefits for management, including improved project planning, greater visibility and depth of information, and enhanced communication and knowledge sharing among projects (for in-depth information on the use of software tools in project management, see other technical notes).

3. The Project Life Cycle

There are projects of all kinds, from the most simple, such as organizing a child's birthday party, to the most complex, such as building a rocket for space tourism. All projects are alike, however, in that they develop conceptually throughout a life cycle which encompasses the start of the project up to its completion and progresses through a series of similar phases (see Figure 2).

Figure 2
The Project Life Cycle



That is why the most widely used project management methodologies focus on project management throughout these phases. There are, however, other methodologies with somewhat different approaches, such as so-called lean project management, SCRUM and PRiSM ("projects integrating sustainable methods"), which focus on particular aspects of management (such as calculating the duration of activities) or which take into consideration particular requirements of certain industries (such as software development). These other methodologies can be combined with the methodology presented here.[3] Below we will discuss how to address each of the main phases of the project life cycle, and what management tools (for example, diagrams) can be of help.

As we shall see, the first three phases of the methodology presented here are actually concerned with the preparation for project execution. This is due to the fact, corroborated by numerous studies, that insufficient or inadequate preparation is the main reason for project failure—even more than errors made during the execution itself.

3.1. Project Selection[4]

The first phase consists of selecting the projects to be carried out (and therefore also the ones that will be rejected). In order to make this selection, we first need to identify all the company's current projects (take an inventory), since there are often many projects that are not formally catalogued as such and, as a result, they are not subject to selection or elimination and of course consume resources.[5] Making the selection based on a consideration of all the candidate projects at once is always more efficient than sequential selection, where projects are presented one after another and we must decide whether each one should be carried out or not, without any knowledge of which other projects will come up later.

The final selection of projects has to fall to top management, since it implies deciding which initiatives will be provided with resources and which ones will not.[6] The challenge usually lies in the fact that there are more project opportunities than those that can be carried out with the available resources. Therefore, efforts need to be prioritized according to the expected (strategic) impact and the resources (money and equipment and people time) that are available.[7] Managing too many projects at once is not advisable for resource productivity or for project deadlines. There is a frequent tendency to take on more projects than are feasible and, in addition, to assign them to a small number of project managers (who have performed well in the past); obviously, this ends up generating problems of resource overload.[8]

Similarly, having too few projects is not advisable either because, as Parkinson's Law from 1955 tells us, "Work expands so as to fill the time available for its completion." In other words, idle assets tend to spend more time than necessary performing their assigned tasks or, in the worst

[3] Even within the life cycle-based methodologies there are differences when it comes to the phases or the nomenclature used.

[4] For a more detailed account, see the technical note by Jaume Ribera, "The Project Life Cycle: Selection," PN-459-E, IESE, February 2011. (Available on IESEP)

[5] Even if a company has a project repository, that is no guarantee that there are not other projects managed outside the "official" system. Often, a good way to identify active projects is to trace the allocation of expenses to activities in order to see which activities incur expenses and may have the characteristics of a project.

[6] That is why people often use the term "project portfolio management."

[7] Internal projects are the main avenue for implementing a company's strategy. As a result, how they are prioritized will depend on their contribution in that regard.

[8] It is useful to remember that, just like when a road is congested with too many cars all of the vehicles will be held back by the traffic jam, when we select too many projects, the delays will not only affect the ones that are "surplus," but all of them.

case, they end up engaging in superfluous activities. It should come as no surprise, therefore, that many of the problems that arise in projects are the result of faulty project selection.

3.1.1 Aspects of Project Selection: Capacity and Impact

As we noted earlier, there are two fundamental issues to be considered in project selection: (1) the expected strategic impact of the project in business terms; and (2) the available capacity for carrying out projects. The challenge lies in the fact that at the end of this phase we have to decide how many projects we can undertake, and assess whether project A should have a higher or lower priority than project B, based on those two dimensions, which are not always easily quantifiable.

Project Impact

Prioritizing projects according to their strategic impact requires defining the appropriate criteria. There are quantitative methods, such as net present value (NPV), for example, and qualitative ones, such as assessment from experts in a weighted matrix. No one method is perfect in itself, which means it is often advisable to combine them. For instance, if project A has a higher NPV than project B, it may be suitable to analyze the numerical values for each one. But project B may also be more interesting if it involves developing new knowledge for the company, or if it has a stronger chance of success. Depending on the method of prioritization, we will often need to first gather information about the projects to be assessed.

Project Availability and Demand

To assess a company's project execution capacity, we will have to identify the resources that may act as a "bottleneck," whether they are material resources (for example, the availability of a particular raw material, such as buildable land in a real estate project), financial resources (to meet working capital requirements over the life of the project) or labor resources (qualified personnel or production teams).[9] We must determine the available capacity of each resource and then translate each project into the needs that it generates with respect to each of those resources.

With regard to labor, it is advisable to express both the available capacity and the project requirements in terms of working hours. Determining the working hours available for projects, on the one hand, and the working hours required, on the other, is not as trivial as it might seem. To begin with, we will need to estimate the number of hours required for an activity that we may have never performed before. In addition, we must bear in mind that people have a tendency to underestimate future workloads. For example, if we ask a colleague to dedicate six hours to a project next week, she is much less likely to say yes than if we ask for six hours in two months' time. But in reality, not only is it very likely that two months from now she will find it equally hard to allocate this time to our project, in addition, the fact that she didn't "set them aside in her capacity" may have led her to promise the same hours to several other projects which will, in turn, cause delays in other requirements.

Another point to consider is that dedicating 30 hours a week to one project can be different from dedicating 10 hours to three different projects. For example, having two or three projects under way simultaneously can improve performance if it gives us the flexibility to allocate our

[9] For more information, see the technical note by Alejandro Lago, Philip Moscoso and Marc Sachon, "Capacity Management in Operations Systems," PN-464-E, IESE, April 2010. (Available on IESEP)

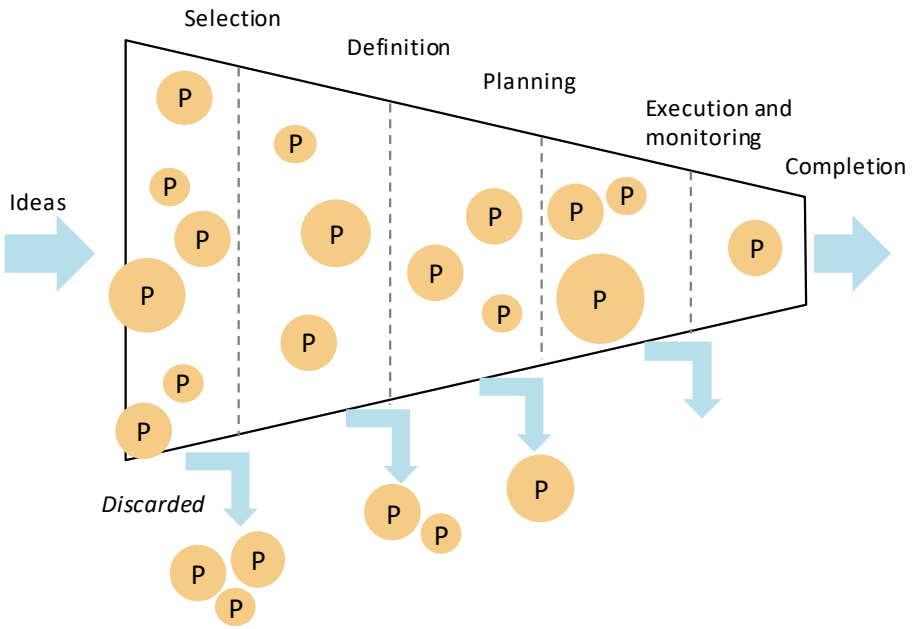
time based on the status of each project. But, in the same way, it tends to imply changeover time, because of repeatedly having to pick up where we left off on a different project.

Given these various sources of uncertainty, generally the aim is not to calculate the exact number of hours needed or exactly when they will be needed, but to make a reasonable, practical estimate. This can be done through aggregate project planning, with a cumulative resource utilization curve which compares resource availability and demand over time, using reasonable time periods (see Exhibit 2 for an example).

3.1.2. Gateways

The selection process concludes with the creation of a portfolio of approved projects. As such, it can be considered to be the first gateway in project management. As a project is carried out, progress may not be as planned, or unexpected events may occur; as such, it is advisable to define gateways at other phases of the life cycle as well, when decisions will have to be made as to whether a project is continued or not. The aim, of course, lies in not putting effort into projects that will not be successfully completed in the end. In these cases, there is an interest in rejecting (or "freezing") projects as early as possible in their life cycle, so that only the number of "active" projects is restricted to the ones that are progressing better (or, at least, the ones that are proceeding according to plan). This is why the project management diagram is usually funnel-shaped (see Figure 3 where the size of the circle illustrates the workload of different projects).

Figure 3
Funnel Resulting From Gateways



The "width" of the funnel will be related to the unit or company's project management capacity, and the shape of the funnel reflects the chosen project strategy. The shape of the funnel will vary depending on the ratio of the number of projects rejected in the selection phase to the number rejected in the definition or other phases, which should also take into account the availability of resources in the company. Companies with a strong focus on R&D, for example, tend to allow

more projects through in the early phases, aware of the high degree of uncertainty involved in their projects. In contrast, companies in other industries, such as construction, prefer to allow only projects that are almost certain to be completed successfully to go through to the definition phase. Furthermore, gateways will need to be defined differently for different types of projects (for example, construction vs. R&D).

3.2. Definition of Projects[10]

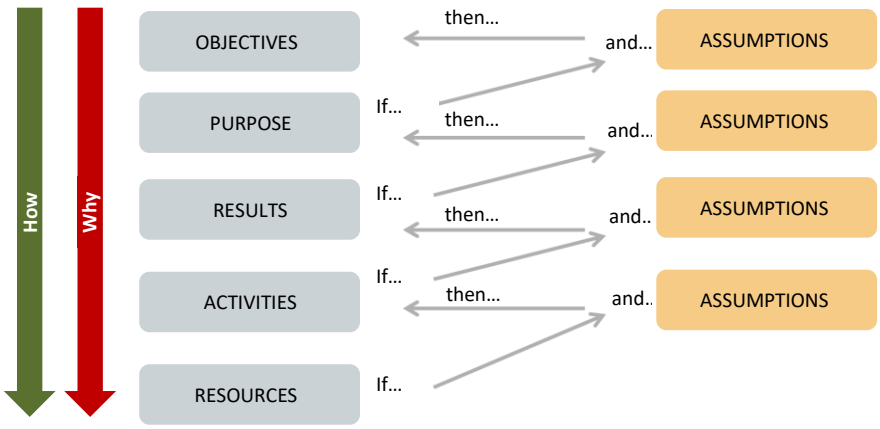
The definition of a project can be understood as the process of drafting a "contract" for the project, covering all the most important issues.

The first step is usually taken in advance to have the basic information for the selection phase. The subsequent steps, taken after a project has been selected, are the ones described in this section.

The initial strategic questions for project definition are as follows: (1) What do we want to achieve with the project, and why are we doing it? (2) How do we measure its success? (3) What external conditions or factors must exist for the project to succeed? And (4) How are we going to do it? A very useful tool for this purpose is the so-called logical framework shown in Figure 4.

On the left of the diagram are the blocks of objectives (the high-level objectives which the project contributes to), purposes (the changes that are expected to come about as a result of achieving the project results), results (what the project is supposed to actually achieve), activities (the tasks that will be performed in the project), and resources (people, materials, equipment, etc. needed to carry out the project activities). Reading these blocks from the bottom up reveals the reason for the project, while reading them from the top down tells us how the project will be carried out. Each upward step can be read as a conditional sentence: "If (…), then (…)." For example: "If we hire a salesperson and assign him/her to sales *(resources),* then we will contact more customers"; "If we contact more customers *(activities),* then our sales will increase *(results)*"; "If sales increase *(results),* then the share price will rise *(purpose)*"; etc.

Figure 4
The Logical Framework of a Project



[10] For a more detailed account, see the technical note by Jaume Ribera, "The Project Life Cycle: Definition," PN-460-E, IESE, February 2011. (Available on IESEP)

On the right of the diagram are the assumptions, i.e., the hypotheses about uncertain external factors that must occur in order for the logical sequences to hold. For example, in the logical chain for a university course, we could establish the following sequence: "If the professor presents the concepts of project management clearly *(activities),* then the participants will learn to use these tools in their projects *(results).*" However, we would also have to add the following assumptions: "…provided there is enough time for practice in class, students are motivated, facilities are available to show the presentation, etc."

The final element of the logical framework is the measurement of success, since objectives tend to be somewhat ambiguous. Only when we agree on how to gauge them and what value we expect to create by carrying them out will the objectives become specific targets. Each level of the logical framework should therefore be translated into a set of quality, quantity and deadline metrics and targets.[11] In short, the framework presented allows us to get the strategic logic of a project down on paper (which more often than not is only in some managers' minds) and assess its validity and coherence.

The definition phase formulates this logic into a document which also serves as a communication tool (within the project team and beyond) to convey what the project is essentially about, providing answers to questions about the project objective, its deliverables, and the roles of each team member. The main sections of the definition are summarized below:[12]

- *Project name:* ideally, the name should reflect the project aim but should also be easy to communicate and not too long. For example: "Project Office."
- *Mission:* this consists of explaining the rationale for the project. It can be built on what was prepared in the selection phase, using the logical framework, and can also sometimes be complemented by detailing what would happen if the project would not be carried out. For example: "Develop and implement the use of the project management methodology in the company."
- *Deliverables:* what the project must produce (outputs or results). They often include tangible results. For example: the project manual, the project repository, etc.
- *Scope:* the limits of the project. It is crucial to clearly define what is part of a project and what is not, since scope creep (unplanned additions to a project's scope) is one of the main causes of failure. For example: "The new methodology will be used in all projects that have a cost of more than €50,000 or that involve two or more departments."
- *Stakeholder:* any person (or group) that will be impacted by, or that could influence, the project's results. Every case is different, but usually there are five general types:
  - Sponsor: the project head in terms of outward visibility, who does not necessarily perform an operational role but who must be kept informed and will help in case of disputes. For example: the director of Finance and Human Resources.

[11] It was Lord Kelvin (William Thomson) who, in very scientific language, expressed the idea as follows: "When you can measure what you are speaking about, and express it in numbers, you know something about it; when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts advanced to the stage of science." More colloquially, we could say, "If you can't measure it, you don't know what you're talking about."

[12] For a more detailed account, see the technical note by Jaume Ribera, "The Project Life Cycle: Definition," PN-460-E, IESE, February 2011. (Available on IESEP)

  - Customer: the beneficiary or user of the project's results. Together with the sponsor, the beneficiary is often the one who finances the project. For example: the project managers who will apply the methodology that is to be implemented.
  - Project manager: the operations manager for the project. The project manager manages the project team and oversees external communication.
  - Area managers: people who control the resources required for the project and are kept informed about project progress.
  - Team: the people who carry out the operational tasks. Its members will depend on the project and may also include subcontracted staff.

- *Objectives:* a detailed version of the project mission. The project mission will not be accomplished if the project objectives are not met. To be able to verify whether the objectives have been met, they must be S.M.A.R.T., i.e., specific, measurable, attainable, relevant, and time-bound.[13]
  - Specific: concrete, relating to clearly defined problems.
  - Measurable: their compliance can be measured in some way.
  - Attainable: if the objectives are not realistic, they will be demotivating to the team.
  - Relevant: important for the project mission (and for stakeholders and the company in general).
  - Time-bound: with clear timetables, for example, in the form of milestones.
- *Success criteria:* the various stakeholders must define and agree on what must happen for the project to be considered a success. If there is no consensus, participants can infer that there is no shared vision regarding the project. The success of a project may refer both to its outcomes (results, purposes and objectives in the logical framework) and to the process of its execution (activities and resources). One way to identify criteria is to imagine the end of the project and try to write a press release about the project, which, in a few lines, outlines why the project has been a success. For example, "the company ZYZ has successfully implemented a new project management methodology that will be used for all new projects starting January 1st" [...].
- *Assumptions and risks:* although we recommend that the assumptions and risks be analyzed in detail during the planning phase, it is a good idea to at least identify them in the definition phase, using the logical framework. It might help to group risks by type using, for example, a tool such as PESTEL analysis (political, economic, social, technological, environmental and legal risk).

[13] For more information, see P. J. Meyer (2003), "What Would You Do If You Knew You Couldn't Fail? Creating S.M.A.R.T. Goals," in *Attitude is Everything: If You Want to Succeed Above and Beyond*, Meyer Resource Group.

- *Economic impact*: in a broad sense, this can be a summary of the business case, i.e., a complete economic analysis of the project in question. This often takes the form of calculating the return on investment. Other times, this type of analysis ends up being premature and the definition will be focused on setting a budget and making a preliminary estimate of the impact of the expected results. For example: "a reduction in project expenses as a result of the new methodology").

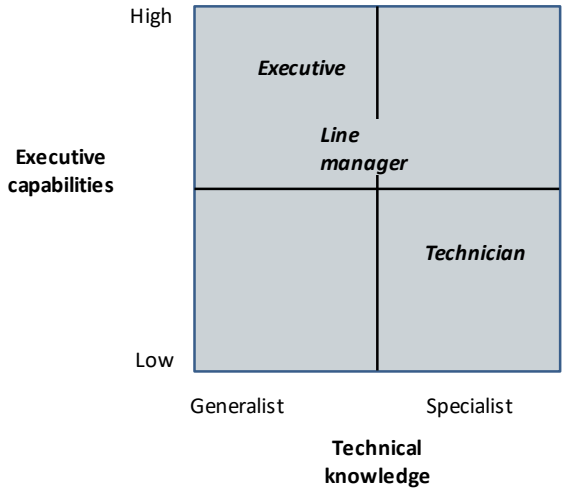
The project definition should not be regarded as final and unalterable. It is perfectly acceptable to make changes to the definition (without letting it become a living document, as that would defeat its purpose), but always on the basis of consensus among the parties involved.

3.2.1. Appropriate Project Mandate and Team

Another result of the definition phase is the possibility of checking whether the project has a clear mandate, so that a suitable team can be put together based on the project's requirements. Having a clear mandate and a suitable team are two crucial issues to ensure the success of any project. Early warning signs that should raise doubts about the project include scope creep (a progressive widening of the project's scope), inadequate top management support or an attitude among stakeholders that the project mission is of secondary interest to the company.

In this phase, we must also identify the main members of the project team who are crucial for its execution. In the same way that we distinguish between knowledge and capabilities (or skills), we must identify the aspects that the project team must cover, given the project's nature and context. It will often be necessary to complement executive and management capabilities (for example, budgeting or people management) with more technical knowledge, such as expertise related to IT applications (see Figure 5).

Figure 5
Project Team Profiles



Likewise, since projects involve teamwork, it is desirable to be well aware of certain behavioral roles to be covered by team members (such as the shaper or the coordinator). See Exhibit 3 for a list of roles that may also be worth reviewing when it comes to putting together a project team.

The end goal is to define, under the supervision of the project manager, the roles and responsibilities to be assigned to each person on the team. Although the amount of time each member will need to put into the project is not going to be determined in detail until the next phase (planning), at this stage it is important to check people's actual availability over the project execution period.

3.3. Project Planning[14]

This phase completes the project preparation. In it we start to specify *how* the project will be carried out, *when* it will be carried out and by *whom.* Before going into the details of the planning phase, it is important to distinguish three types of projects for which the planning tasks should be more or less flexible.

- *Cascade projects*, also known as linear projects, are the sort of project we call "painting by numbers" (see the third classification in Exhibit 1), i.e., those where both the *what* and the *how* are known upfront and therefore all what has to be determined is the sequence of tasks to be undertaken, in order to deploy them as planned. The tasks or work packages will therefore be performed "in cascade," each following more or less linearly from the previous one.

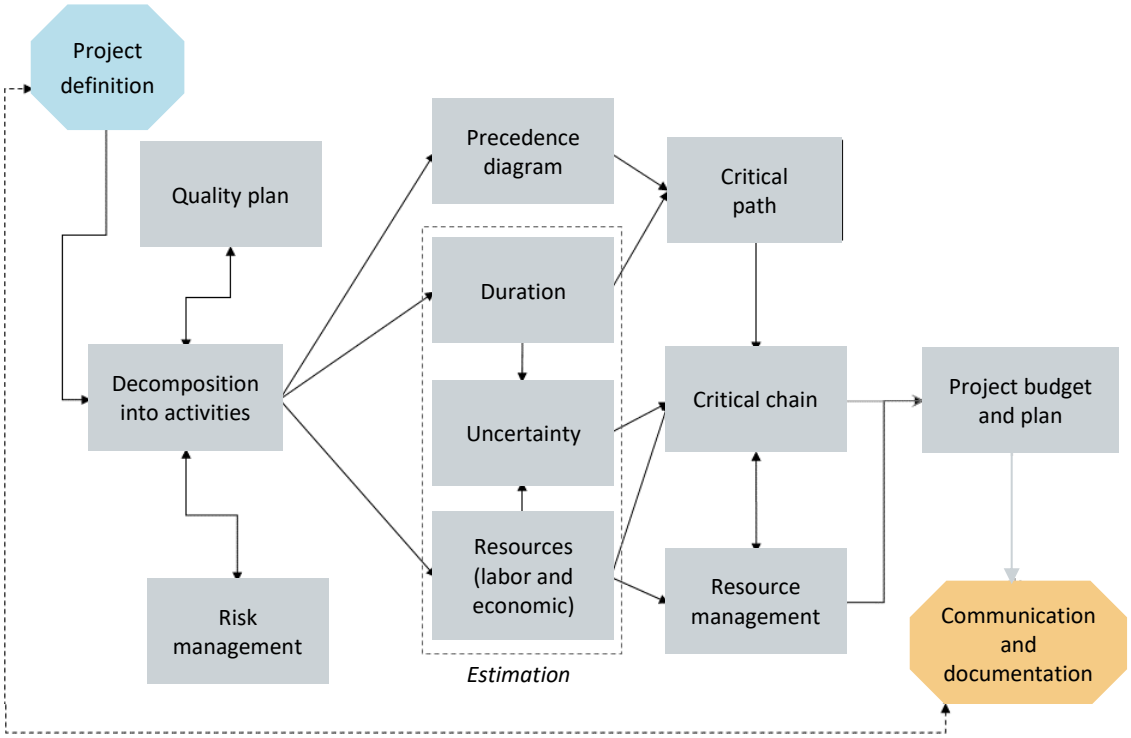
- *Iterative projects* are those where either the *what* or the *how*, or both, are very unclear. In these cases only high-level planning can be done, leaving the details of the various phases until later, as what is done in any given phase and how it is done will depend on the results of the previous phases, or what has been learned to date. Detail planning will therefore only become feasible as the project advances.

- Lastly, *parallel projects* are usually "blitz" projects, in terms of urgency (see Exhibit 1 for the NTCP—novelty, technology, complexity and pace—classification). These are projects which start (nearly) too late. Examples of parallel projects are the operation to rescue 33 miners trapped in a mine in Chile at a depth of more than seven hundred meters, or developing an atomic missile before the enemy gets it first. In such cases, the project is carried out through sequences of redundant and parallel activities, so as to increase the chances that one of them will be successful within a reasonable time frame.

As a rule, in most of these cases we'll be able to (and should) perform most tasks described in this section, although the level of detail and the sequence may vary to some extent. The diagram in Figure 6 summarizes the various stages to be covered in this planning phase, as well as their interdependence.

[14] For a more detailed account, see the technical note by Jaume Ribera, "The Project Life Cycle: Planning," PN-461-E, IESE, February 2011. (Available on IESEP)

Figure 6
Detail of the Planning Phase



Starting from the project definition, the most important tasks in the planning phase are as follows:

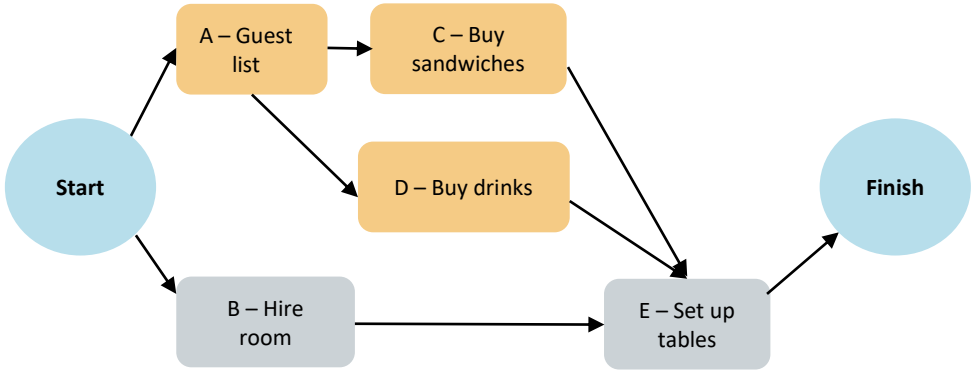
- *Breakdown of a project:* this is done mainly for practical reasons and consists of breaking a project up into more manageable, assignable chunks, so as to facilitate execution and later monitoring. If our project were to write a book, we could break it up into activities such as choosing a title, preparing the index, looking for a publisher, writing the chapters, and so on. As a general rule, the ideal size of the chunks should match the project's "natural pace," i.e., the intervals at which we should monitor project progress. In the case of a civil engineering project, for example, we would not "monitor" progress (or expenditure) hourly, but we certainly wouldn't wait a whole month either. Certain tools, such as the mind map, can assist in the breakdown process (in teams) and ensure greater consistency.

- *Quality plan:* it is often advisable to define a set of specifications for the required quality levels, since usually it is not just a matter of performing certain tasks but performing them to a specified level of quality. It may be useful, as a first quality check, to create tables comparing the activities defined in the project with the deliverables, objectives, stakeholders, etc.

- *Precedence diagram:* the activities resulting from the project breakdown are often interdependent. The dependencies may be logical (for example, you cannot look for a publisher until you know the book's subject), due to resource limitation (if a person must perform two activities, each in a different place, the activities will have to be performed in sequence) or deliberate (the boss prefers to perform A before B, even though it could be done in reverse order). Deliberate dependencies are best kept to a minimum, as they undermine flexibility. All these dependencies can be shown in a diagram, which for complex

projects can be produced using software tools. Figure 7 shows a precedence diagram for the simplified example of a children's party, where each activity is shown as a node and the arrows between them indicate dependencies. Note that the reader may not agree with the precedences as shown. One of the benefits of planning as a team is that points on which people may disagree are set forward and so can be discussed.

Figure 7
Precedence Diagram

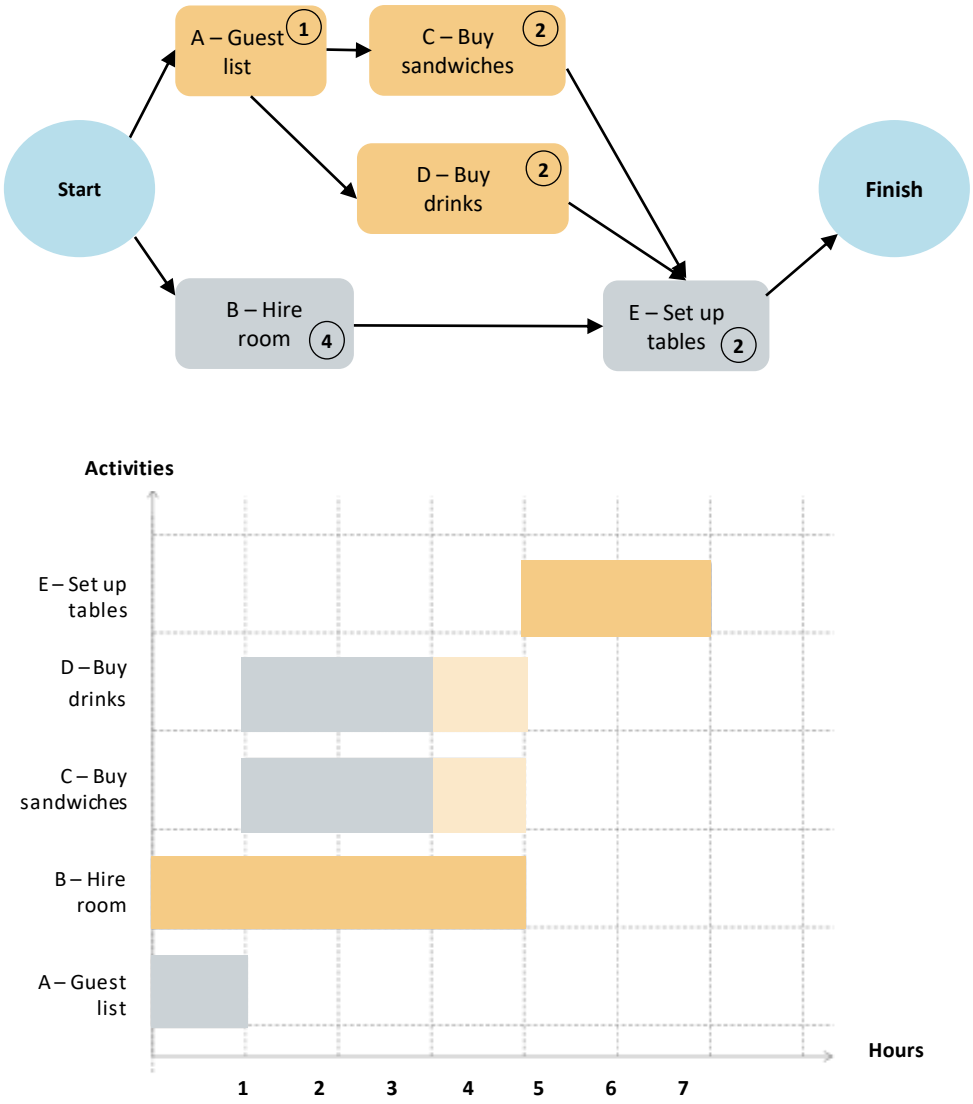


- *Estimates:* to be able to plan the project, we must estimate the duration, cost and resource needs of each activity identified in the breakdown. We often face the additional challenge of not having performed the activity before. In some cases, this will be a matter of setting a target (for the spending budget or the activity duration) rather than making an estimate. The difficulty sometimes lies in managing the interrelationship between duration, cost and resources. There are methods, such as the Delphi technique (for seeking consensus among experts) or the Poker estimation (to avoid one person's opinion dominate the rest of the team) that can help produce reasonable estimates.

- *Critical path and critical chain:* the critical path is the longest path in an activity network and thus will determine the overall project duration. If the duration of one of the activities on the critical path increases, the duration of the whole project will increase by the same amount. The rest of non-critical activities, in contrast, have some slack (until their duration reaches the point where they become critical).[15] Tools such as Gantt charts can be used for this type of analysis. Figure 8 shows the precedence diagram, with the duration of each activity (in the circle, in working hours), and the corresponding Gantt chart. We can see that "Rent room" and "Set up tables" are critical activities (together they form the critical path) and so determine that the project's minimum duration is six hours.

[15] An effect similar to that of bottlenecks in processes (see the technical note by Alejandro Lago, Philip Moscoso and Marc Sachon, "Capacity Management in Operations Systems," PN-464-E, IESE, April 2010). (Available on IESEP)

Figure 8
The Project's Critical Path

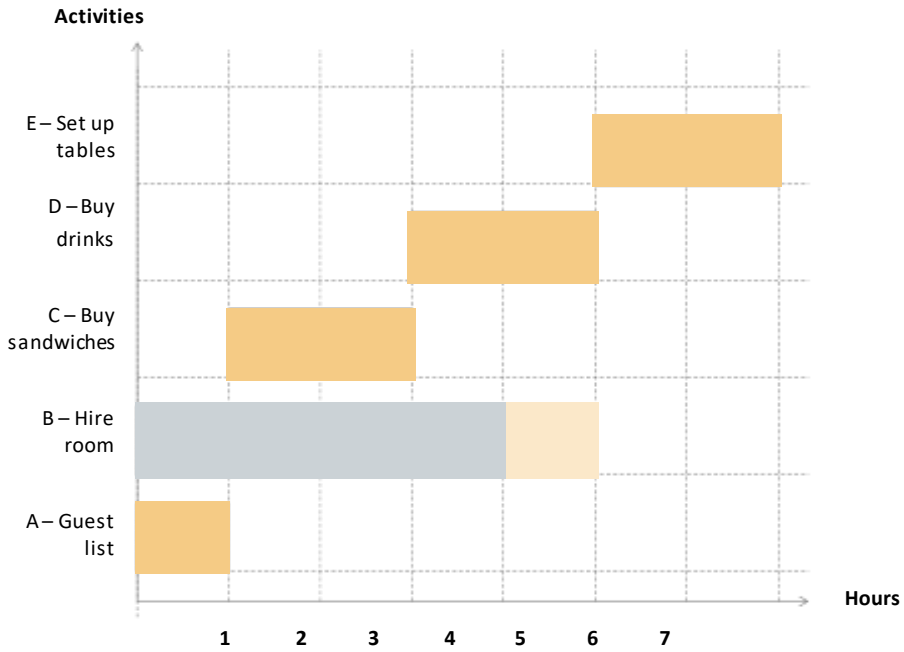


Note that the non-critical tasks (for example, "Buy sandwiches") could be delayed or extended for up to an hour (as shown by the lighter bar in the Gantt chart), without this affecting the overall project duration.

If we also take into account the resources needed to perform each task, there will be cases where the proposed sequence of activities is not viable. When that happens, we will have to remove the resource-use conflict (by leveling resources, perhaps because a particular resource is required for two activities at the same time). The sequence of activities that determines the duration—once precedence and resource needs have been taken into account—is known as the *critical chain.* In the children's party example, if the person who buys the sandwiches also buys the drinks (and the two activities cannot both be done in the same place), the Gantt chart will have to be modified to reflect this new information, taking into account the resource limitation, which would result in a

duration of seven hours and a critical chain made up of the "Guest list", "Buy sandwiches", "Buy drinks" and "Set up tables" activities, as shown in Figure 9. Failing to perform this analysis (or performing it incorrectly) is one of the main causes of project delays.

Figure 9
The Project's Critical Chain



- *Project plans and budgets:* once the conflicts between resources and time have been resolved, detailed budgets and plans (action plans, communication plans, quality plans, etc.) can be prepared.
- *Milestones:* a milestone is an event that marks an important achievement in the project's progress (usually of interest to all stakeholders). Start and finish are key milestones in every project. Milestones also serve as gateways and can be associated with decisions about whether to continue with the project or not, depending on an assessment of milestone achievement (see the section on gateways).

3.3.1. Risks and Uncertainties in Project Management[16]

Every project, however well managed, will be subject to uncertainties and risks that can affect the way it develops. A distinction should be drawn between at least these two phenomena:

- *Uncertainty:* the possibility of changes in known factors, in terms of cost, time, etc. In our example, the density of traffic may affect how long it takes us to buy the drinks. The usual approach to address uncertainty is to include *buffers* in the project plan to absorb unforeseen changes. In our children's party plan, for example, we might want to include a one-hour buffer at the end of the project to allow for possible deviations due to uncertainty, and so plan to complete the project in eight hours.

[16] For a more detailed account, see the technical note by Jaume Ribera, "The Project Life Cycle: Uncertainty and Risk Management," PN-462-E, IESE, February 2011. (Available on IESEP)

- *Risks:* specific events which may occur with a certain level of probability and which, if they do, will have an impact on some aspect of the project (duration, cost or scope). Since risks are specific events, the usual approach is to: (1) identify them; (2) estimate their impact and probability; and (3) prepare action plans for the most significant ones. In our party example, it is conceivable that none of the rooms we know of are available. If that happens, we will have two options: (a) cancel the party; or (b) have it at our house, which would require extra preparation and a clean-up afterwards.

Assessing risks and uncertainties during the project planning phase is very advisable because we greatly improve the chances of success, thanks to being able to eliminate some of the risks, having the time to prepare alternative plans and not having to improvise in moments of crisis.

3.4. Project Execution and Monitoring[17]

This phase includes the actual execution and subsequent monitoring of the project. The execution consists in allocating resources to activities so that each activity is completed within its timeframe (following the work plan) and notifying the person responsible of what other activities and resources are linked to their activity, so that they can be informed if there are any incidents. Monitoring consists in checking that things are proceeding according to plan, on schedule and within budget, and promptly detecting and assessing any deviation from the plan in order to be able to correct the deviation (or the plan if necessary). A monitoring system should: (1) provide fairly complete information to whoever has to make the decisions, without imposing an excessive workload on the people actually carrying out the project; (2) provide warnings sufficiently in advance to allow action to be taken when needed; (3) be accepted by the project team and by top management, providing them with clear information that meets their needs; and (4) provide information that can be aggregated at different levels of detail.

In all projects there will be deviations from specifications (scope or quality), schedule and cost. What matters, therefore, is not finding out whether there are deviations, but whether they are significant enough for the project manager to have to act. The monitoring system should therefore filter out noise from the signal and detect whether the change requires attention or is already covered by the buffers built into the plan. To do this it will be important to identify the activities that could have the greatest impact on the project—because they cause delays, increase cost or trigger changes in quality or scope. Often "traffic light" reports are used, where red indicates project aspects running into difficulties, yellow indicates those that show deviations and might run into difficulties in the near future, and green indicates those that are proceeding according to plan. Sometimes blue is added for sections that are way ahead of schedule, so that they can be studied and lessons can be learned.

3.4.1. Monitoring Mechanisms

It is useful to decide the frequency of monitoring (for example, weekly or monthly) at the outset. The project manager should regularly compile information and report on progress and costs, as well as any incidents and changes since the last report.

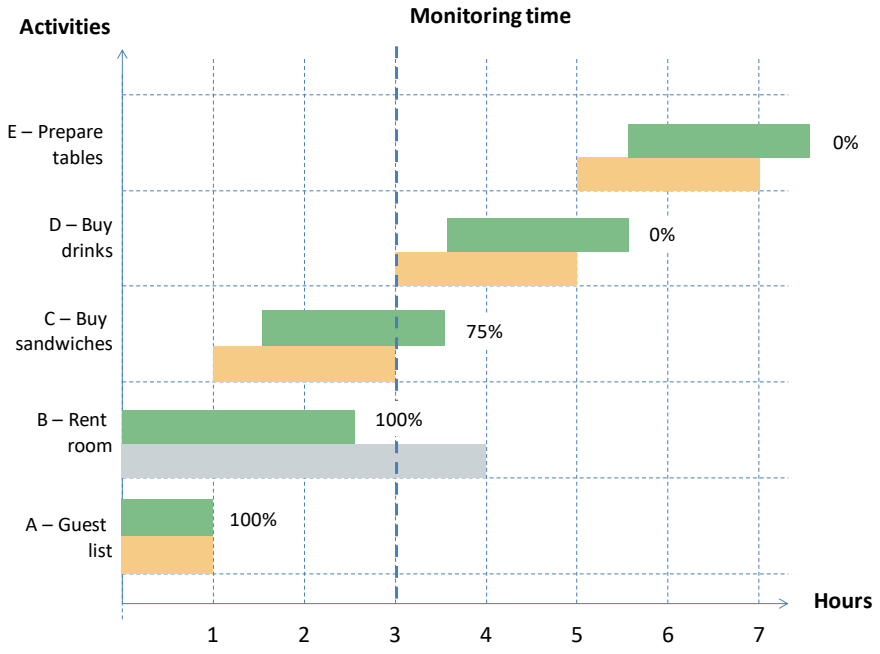
[17] For a more detailed account, see the technical note by Jaume Ribera, "The Project Life Cycle: Monitoring," PN-463-E, IESE, February 2011. (Available on IESEP)

Monitoring project specifications (scope and quality) tend to be a highly technical task that is specific to each project. As already mentioned in the planning section, for parts of the project where there is less consensus or prior experience, it is a good idea to use predefined quality metrics, which can be evaluated at the time of monitoring to assess compliance.

For the monitoring of costs, all activities "contribute" in proportion to their relative weight. When it comes to monitoring project schedules, in contrast, not all activities have the same impact (non-critical activities do not affect project timing). In what follows we describe some tools that can be used for this type of monitoring.

The most widespread tool is the *Gantt tracking chart*, which shows the timing of each activity according to the initial plan and its actual timing (for finished activities) or expected timing (for those that are not finished yet). Figure 10 shows the activity schedule for the children's party project according to the initial plan (solid bar) and status at the end of the third hour (striped bar). We can see that the "Guest list" and "Rent room" activities have already been completed ("Rent room" earlier than planned, although this will have no impact on the project as it isn't part of the critical chain). The "Buy sandwiches" activity, however, which should have been finished by now, started late and is only 75% complete; it is now expected to finish half an hour late and to delay the rest of the activities. At the time of the analysis, therefore, the project is expected to end half an hour late. This analysis not only helps to anticipate events, but also to assess the need for adjustments.

Figure 10
Tracking Gantt Chart

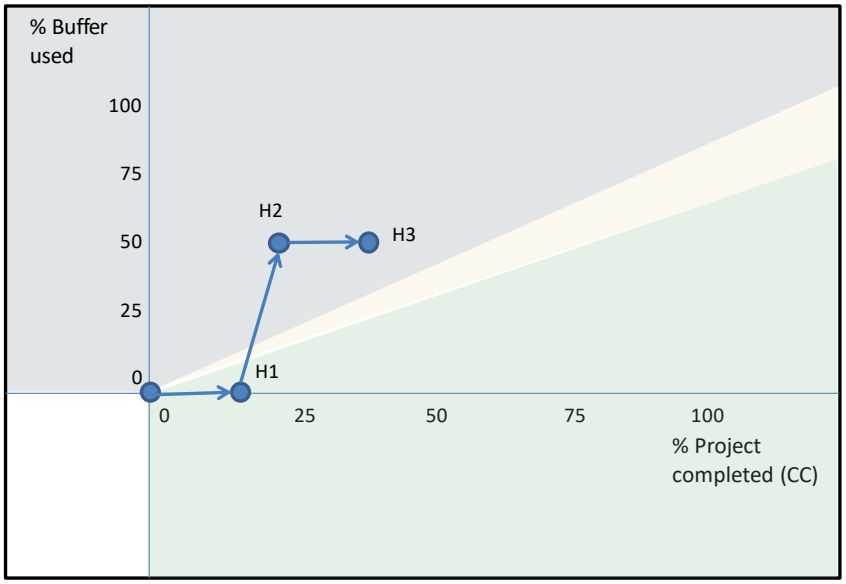


A simplified version of the above mechanism is to monitor *milestones*, defined as events (usually, the start or finish of an important activity) that mark a significant point in project execution. This way, a complex construction project involving thousands of activities can be summed up in a handful of milestones (for example, project kick-off, completion of foundations, completion of roof, etc., all the way to project completion). Monitoring can thus focus on comparing actual

milestone completion with the plan and obtaining the best estimate, at any given time, of when each milestone will be reached (or whether there has been any delay).

Another simple and efficient way of monitoring a project is to focus on the critical chain (or critical path, if resources are not a limitation) and determine, at any given time, (1) the percent completion of the critical chain, and (2) the percent usage of the buffer for uncertainties in activity duration (see Figure 11). Returning to our example of the children's party, at the end of the third hour, 35.7% of the critical chain has been completed (100% of "A", 75% of "C", and 0% of "D" and "E", which represents 2.5 hours of the 7 hours of the critical chain), and we have used 50% of our one-hour buffer (see section 3.3.1). So long as buffer consumption does not exceed critical chain completion, the project as a whole is progressing reasonably well. As shown in Figure 11, using the example of the first three hours of the children's party project, buffer consumption and critical chain completion can be monitored visually by shading the areas in traffic light colors to create a diagram known as a "fever chart."

Figure 11
Fever Chart



For monitoring costs, a similar fever chart can be used indicating the percentage of project completion (in terms of budgeted cost) and the cost buffer used (if one has been defined). In cost monitoring it is also common to have a description by item (for example: wages, material procurement, outsourcing, etc.). At the end of a given monitoring period, budgeted costs and actual costs for the period will be posted for each item, as well as the cumulative amounts to date. It is important to note that what is being monitored here is not project progress, so that budgeted and actual costs might be in line (for example, for external services) but project progress may still be unsatisfactory. To take both progress and costs into account, "earned value" calculations should be used.[18]

[18] For more information about earned value techniques, see the technical note by Jaume Ribera, "The Project Life Cycle: Monitoring," PN-463-E, IESE, February 2011. (Available on IESEP)

In addition to the various project monitoring approaches we have just described, it is advisable to include in the monitoring meetings (or monitoring reports)[19] regular updates regarding the project risks, and any changes to the project definition that may have been agreed upon.

3.4.2. Conflict Resolution

Conflicts can arise in projects for many different reasons, some of which are inherent in the nature of projects. It is very common, for example, for activities to be omitted in the planning phase which later turn out to be necessary. Many conflicts can be avoided, however, through good management and an attitude of honesty and openness towards whatever problems arise. Apart from scope creep, there are certain other common behaviors and attitudes that everybody involved should be aware of in order to be able to avoid them (Exhibit 4 lists some common mistakes in project management).

The main antidote for many of the conflicts that can arise in projects is to hold regular meetings in which each team member reports briefly on the part of the project for which he or she is responsible. Participants in these meetings should be encouraged to be completely honest, on the basis that a problem detected in time and shared with the rest of the team is always easier to solve that one that is kept hidden.

Another source of conflict is the difference between stakeholders' expectations regarding communication and participation and what actually happens. Many managers expect to receive detailed reports on the progress of projects in which their subordinates are involved. If they don't, they may feel passed over and decide to scale back their people's involvement. So it is a good idea to also plan project reporting (to whom, what, when, etc.).

Once a problem has been identified in a project, the recovery options can be one of the following, depending on the seriousness of the problem:

1. Try to get back to the plan set out by repeating the failed activities with more resources.
2. Change project objectives, whether by reducing specifications, increasing the budget or extending deadlines.
3. Abandon the project. This last option (stopping a project before scheduled completion) should be more common than it is in practice, because once the initial uncertainty has been dispelled, the facts may suggest that a given project should not be carried out. And yet, there are numerous factors that make it difficult to abort a project. First, there is the motivation of the people involved and the social pressure to not be seen as "people who don't finish their projects." Added to this is the fact that many projects cannot be stopped without incurring high costs, and also the failure to consider sunk costs.

3.5. Project Completion

We mentioned earlier that every project has one natural milestone, which is its finish date. In practice, however, the finish date is followed by yet another phase, which is very important not only for the success of the project in question but also for taking away lessons for future projects.

[19] Reports may be only one page, as C. Campbell and M. Campbell (2013) suggest in *The New One-Page Project Manager,* John Wiley & Sons, New Jersey.

All too often, however, this concluding phase is cut short as managers are in a hurry and take methodological shortcuts, giving priority to new tasks.

The first thing to be done in this final phase is to review the results in depth and compare them with the objectives agreed with stakeholders. We must jointly assess whether the objectives are still valid and to what extent they have been achieved. Sometimes this joint review can lead to restoring a project in the eyes of the customer, for example, by allowing a detailed explanation of changes in scope, schedule or cost. At the same time, however, the project team must not let the customer take advantage of this review to add requirements to the project definition that were not agreed at the outset.

Following this review, there are usually three ways of closing a project:

1. It is agreed that the project has not met objectives and all activities are halted (as already mentioned, this can happen at any stage in the project life cycle). This may mean that the project results are not implemented in the organization or that new products are not developed.

2. The project team "transfers" the project results to itself and uses or sells them (for example, for new products or services it has developed).

3. The team transfers or integrates the results in the company's operational area. This option, in turn, may involve a large number of activities, which will have to be carefully managed. For example, if a new administrative process has been defined in the project, it is in this phase when we need to manage the transfer and implementation of the process in the department concerned. The scope is sometimes so large that these activities are best understood from the outset as a separate phase of project execution.

Third, this last phase offers the opportunity to sum up *lessons learned*, which should:

- Cover all aspects of the project, both in terms of content and management. The lessons learned must therefore be reviewed from the perspective both of the business case and of the management methodology used as well as the performance of the project team.

- Be undertaken fairly soon after project completion, so that the project is still fresh in everybody's mind. In the case of very long projects, it may be advisable to review lessons learned at intermediate stages during the project.

- Take into account, to a certain extent, the opinions of all stakeholders, allowing them to contribute their opinions and learnings.

- Catalog the lessons learned in a way that makes it easy to pass them on to others in the organization.

Lastly, when the project is considered to have met its objectives, we recommend closing the project with a *celebration.* Even where not everything has come out perfectly, if the team has worked hard they deserve some kind of recognition. Celebrating success creates a hunger for more success and encourages people to do a good job next time, while also sending a positive signal to other teams.

4. Improving Project Management

We will conclude this technical note with some additional ideas on principles of operational management that may help to improve project management, as a complement to the specific ideas and tools presented in the previous sections. Let's not forget that projects are one of the ways in which companies organize their operations and, therefore, they can benefit from the *lean* techniques for continuous improvement that have been developed in the field of operations management.

4.1. Eliminating Waste

One of the key concepts in lean management is the elimination of waste (*muda*, in Toyota's original Japanese nomenclature). Those activities that take up time, effort or cost but do not add value for the project client are regarded as *muda*. In order to carry out this identification, we must determine what it is that the customer values and what he doesn't, so that we can see whether certain activities can really be eliminated. Broadly speaking, we can classify project activities into four categories:

1. Those that add value to the project: in the children's party project, buying sandwiches adds value, since sandwiches are a desired part of the project result.

2. Those that are necessary but do not add value: in the children's party project, traveling from the sandwich store to the drinks store may be necessary, but it does not add value to the project.

3. Those that are neither necessary nor add value: wrapping the sandwiches individually in the store, when we are just going to have to unwrap them again and put them on a tray for the party, adds time and cost but adds no value for the end customer (children).

4. Waits between activities: having to wait fifteen minutes once we get to the store for our partner to call us and tell us what type of sandwiches to buy would, ideally, be something to avoid.

We can identify and classify the activities in a project into these four categories, and then we can determine what can be done to (a) eliminate type 3 and 4 activities; (b) eliminate, or at least minimize, type 2 activities; and (c) promote type 1 activities, so that they add more value or reduce costs and time.

A useful exercise in a company may be to have project participants draw up a specific list (or classification) of the types of *muda* that occur in project management. Since the lists are drafted by the very people who work on the projects, they are more likely to identify the *muda* and take action to prevent it.[20]

[20] In this vein, it is worth mentioning the *Manual contra el despilfarro* ("Handbook against Waste") commissioned by Rafael del Pino y Moreno for Ferrovial in 1962 with the aim of helping the group's top and mid-level managers in the identification and elimination of waste from their projects. A republished version may be consulted online at https://www.ferrovial.com/.

4.2. Reviewing the Assumptions

Another way to improve project management is to check that a project's implicit assumptions are logical and assess possible alternative approaches. For example, standard practice in construction projects is to draw up specifications stating exactly what is required, when, and at approximately what cost. Based on these specifications, companies prepare bids that meet the requirements at the lowest possible cost, given that, unless a bid is recklessly low, the contract will be awarded to whoever undertakes to complete the project at the lowest cost. This leads to what is known as the "winner's curse," as the supplier who wins the contract does so at a cost which other bidders consider unrealistic. This usually leads to one of two situations. Either the project ends up costing more than initially established (the contractor will doubtless find justification), or it will fail to meet the agreed specifications. Additionally, when the budget is reduced to a minimum, any unexpected event is liable to lead to disputes between the customer and the supplier over who is to bear the cost, usually resulting in litigation and delays.

In the construction of the new Terminal 5 at London's Heathrow Airport,[21] the British Airport Authorities (BAA) adopted a different approach it called the "T5 Agreement," in which the client would pay suppliers the costs incurred plus a profit margin.[22] With this format, the client, BAA, assumed the risks and worked in collaboration with first-tier contracting teams to create innovative solutions that would reduce turnarounds, improve performance and reduce costs, without threatening suppliers' margins. Managing risk in this way helped avoid confrontation and created incentives for teams to work together to solve problems, rather than looking for ways to claim additional payments or engaging in litigation over changes in scope.

Using similar approaches, based on a change of principles, Visteon (car supplier) in China successfully redesigned the interior of the Buick Regal in record time, and Reson, a Danish manufacturer of underwater sonar systems, cut time to market from three years to three months.[23] A similar change of principles was applied at Novo Nordisk Engineering which went from building pharmaceutical production plants in periods of 30 to 36 months to a record time of 11 months.[24]

When we approach projects by working together to find creative ways of reducing turnaround and improving specifications while controlling costs (instead of confining ourselves to meeting specifications and deadlines at the lowest cost) we get much closer to what generates value for stakeholders. This approach requires taking a new view of projects, as it not only adds more value to the customer but usually also entails more risk for the supplier. This requires defining compensation mechanisms that are satisfactory to the various parties. This type of approach requires a culture of entrepreneurship that encourages all participants to propose new ideas and take calculated risks.

[21] In the T5 example we focus on the construction project, which we consider a success, not on the start-up of the terminal, which was not all that successful, as readers are well aware from the news.

[22] For more information, see the article by A. Davies, *et al.* (2009), "Innovation in Megaprojects: Systems Integration at London Heathrow Terminal 5," *California Management Review;* or the case by N. Gil (2008), "BAA: The T5 Project Agreement," Manchester Business School.

[23] For more information on Reson, see the case by T. Vollman, *et al.* (2000), "Reson: Making Development Teams Accountable for Short Project Cycles," IMD.

[24] See C. Cordon, *et al.* (2006), "Novo Nordisk Engineering: Running for Fast-Track Project Execution," IMD.

Lastly, some critics warn that an excessively sequential and phase-driven systematization of management can limit flexibility and innovation in environments where they are needed (those referred to in Exhibit 1 as "lost in the fog").[25] Personally, we recommend bearing in mind that projects offer a great avenue for organizational learning at a company. We also recommend complementing phase-based approaches with parallel or iterative processes, as well as trial-and-error approaches in more innovative projects. Our experience tells us that being systematic is not incompatible with being creative and innovative.

5. Summary and Conclusions

Project management is an activity to which managers dedicate a great deal of their time but which, unfortunately, has a rather low success rate. In this note we have presented a project management *methodology*. First, we laid out the advantages of implementing a systematic approach in companies. Next, we described the methodology throughout the typical life cycle of a project. We emphasized that the success of a project, to a large extent, is determined before the execution of the project has even begun, i.e., on the basis of the appropriate selection, definition and planning. We also described a number of tools that can make project management easier in each of the phases.

We trust that a methodology such as the one presented here (or variants of it) can help managers increase the rate of successful project completion. Applying a methodology, however, can only serve as an aid to the real key success factor to achieving consistent, sustainable project management success in a company: the development of a strong project management culture.

[25] See the article by S. Lenfle and C. Loch (2010), "Lost Roots: How Project Management Came to Emphasize Control over Flexibility and Novelty," *California Management Review,* 53(1), pp. 32-55.

Exhibit 1
Classification of Project Types

There are numerous project classifications and we will highlight the major ones below. First, we can distinguish between internal and external projects. External projects are projects undertaken for a customer outside the organization who is formally recognized as such. This customer will evaluate what the company delivers and may refuse to pay or may require compensation if scope, schedule or cost requirements are not met. When an external customer is involved, project management tends to be more rigorous, since failure has very tangible consequences. Internal projects, in contrast, are less likely to be managed with the same rigor. We do not recommend using a different management methodology for internal projects, but rather formally establishing the role of internal customer (see the section on project definition).

A second classification, referred to as NTCP (novelty, technology, complexity and pace),[26] takes into account four aspects:

a) Novelty: how new the project is to the organization compared to other projects carried out previously. In this parameter, projects are classified as: (i) *derivative*, i.e., involving the modification of some minor characteristic of an existing product or process; (ii) *platform*, i.e., creating a new generation of products and therefore requiring more extensive prior analysis and research; and (iii) *breakthrough*, i.e., where the initial designs are merely indicative and much of the project will be trial and error.

b) Technology: the type of technology to be used, its availability and the organization's experience with it. In this parameter, projects are classified in three categories: (i) *low-tech*, where the project uses standard technology or new technology in a non-crucial area; (ii) *medium-tech*, where the project uses technology that is not usually used in the organization in an important area of the project; and (iii) *high-tech*, where a new technology, previously inexistent, has to be developed and will be crucial to the project.

c) Complexity: the degree of complexity of the project, the product, the process, the relationships between participants, etc. In this parameter, projects are classified as: (i) *assembly*, where the components (products, departments, etc.) are somehow integrated or were already designed to be integrated; (ii) *system*, where elements and subsystems performing different functions which are not currently coordinated will have to be integrated in order for the project to succeed; and (iii) *array*, where the project needs an array of dispersed systems or organizations that need to be joined to work together toward a common goal that is not necessarily shared.

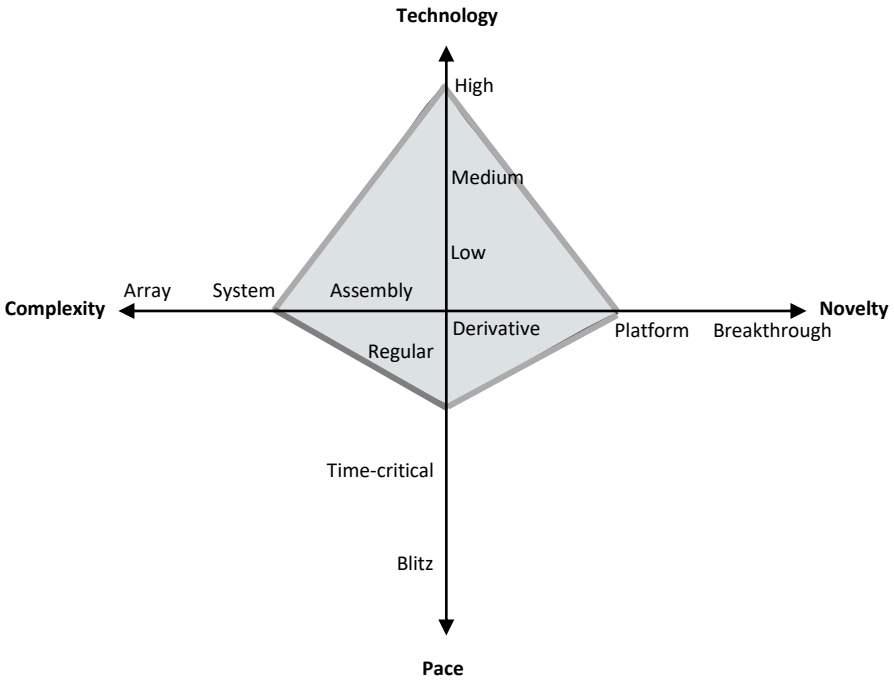
d) Pace: the urgency of the project compared with what would be considered a normal or natural time frame. In this parameter, projects are classified as: (i) *regular*, where the time available for project execution would generally be considered reasonable; (ii) *time-critical*, where timely completion is essential to project success and any delay would represent a major problem; and (iii) *blitz*, where the project represents a serious crisis situation with extremely urgent deadlines.

[26] Defined in D. Dvir and A. J. Shenhar (2007), *Reinventing Project Management,* Harvard Business School Press.

Exhibit 1 (Continued)

Based on these four aspects, we can draw a project diamond, as shown in Figure 12. The larger the area, the more complicated the project management will be, making it advisable to appoint a more expert manager. This classification lends itself to projects aimed at developing new products or implementing new business processes.

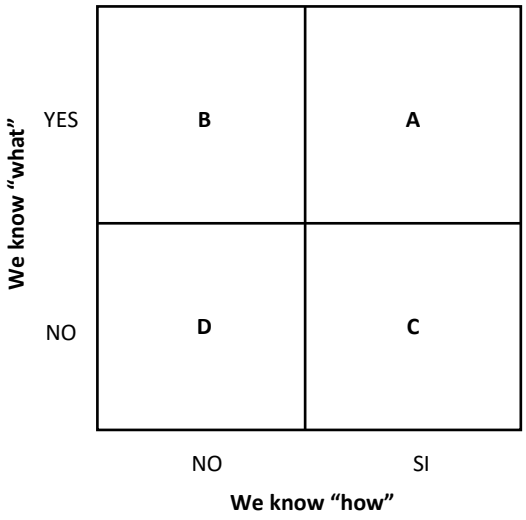
Figure 12
NTCP Project Classification



Lastly, a third classification, which is simple but useful, is the result of considering whether we know from the outset *what* is to be achieved with the project and *how* it is to be achieved, as shown in Figure 13.

Exhibit 1 (Continued)

Figure 13
"What" and "How" Classification



"A" projects are those where the *what* and the *how* are known in advance. They are simpler, as they only require deploying activities which are already familiar, rather like "painting by numbers." "B" projects, also known as "search" projects, are those where the *what* is known but not the *how*. In this case, much of the project involves searching for the best way to achieve the objective. "C" projects—also known as "Hammer Syndrome" projects—are about discovering a potential application for an existing technology or process.[27] These are projects where the "solution" is already available. What is needed is a problem to solve with it, as often happens in R&D and consulting companies. Lastly, "D" projects—also known as "Lost in the Fog" projects—are the most complex type.[28] They require first determining the *what* and then the *how*, or vice versa and entail an iterative learning process in which each phase builds on what was learned in the previous phase. Generally speaking, they are more risky projects.

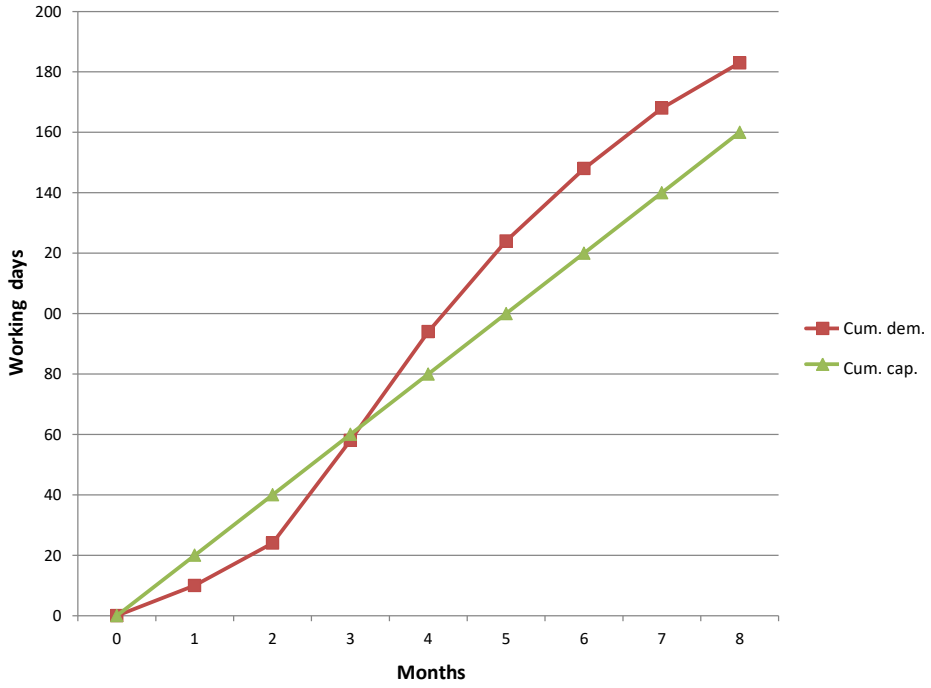
[27] So called because a person who has a hammer (the *how*) will tend to look for nails (the *what*) and will assume that all problems can be solved with the tool at hand.

[28] When we are lost in a field under heavy fog conditions, we do not know what we are looking for. Anything could help us (a road, a person, a railroad track, a farm, etc.) and we do not know how to get out of the problem (turn right, turn left, or stay where we are and wait for someone to find us).

Exhibit 2
Aggregate Planning of the Project Workload. Example

By way of an example, Figure 14 shows the forecasted cumulative project workload (in working days) assigned to a specialized technician over the next eight months. A second curve in the same figure shows the technician's cumulative availability, assuming 20 days per month (we assume the other days are taken up with activities related to the technician's functional responsibilities). We can see in the graph that difficulties begin from month four onward, as the demand curve rises above the capacity curve. This is not a temporary problem, either, as it continues until month eight. This is a clear sign that more projects have been accepted than can be undertaken with the available capacity. Unless something is changed, the projects will be delayed due to the technician's lack of capacity.

Figure 14
Aggregate Workload Planning



It is important to note that if the cumulative curves show the workload to be feasible, this feasibility may disappear if we look at a shorter period (for example, the average workload may be feasible seen over one month, but if all the work is actually concentrated in the first week of the month, it won't be feasible), or if work cannot be done in advance (for example, if work scheduled for February cannot be done in hours available in January).

Exhibit 3
Behavioral Roles in the Team

Over a number of years, Meredith Belbin[29] developed a description of team roles, classifying people into nine behavioral roles (not personality types), that are then divided into the following categories:

Action roles:

- Shaper: people who challenge the team to improve, providing the necessary energy to keep the team moving.
- Implementer: people who are good at getting things done, working systematically and efficiently.
- Finisher: people with the ability to finish projects. They are good at polishing jobs, locating errors and wrapping up tasks to the highest quality standards.

People roles:

- Coordinator: people who are good at chairing meetings, coordinating working sessions and guiding other members toward achieving goals.
- Teamworker: people who support the team and ensure that all its members work together effectively; they are good negotiators, diplomatic and perceptive.
- Resource investigator: people who provide knowledge about aspects that are external to the team and who, at the same time, are able to communicate the team's ideas to the outside world.

Thinking roles:

- Plant: highly creative people who are good at solving problems in unconventional ways and who sometimes tend to ignore restrictions or barriers.
- Monitor/evaluator: people who provide a logical outlook, are able to make impartial judgments and weigh the various options dispassionately.
- Specialist: people who have specialized knowledge of what is needed for the project, focusing on their area of specialization.

There are self-perception and self-assessment questionnaires to determine which is the preferred and most appropriate role for each person.[30] It is interesting to note that, in his research, Belbin discovered that all the roles are essential to achieving team success, and that the key lies in striking the right balance. So, when putting together a project team it is important not to limit the analysis to people's knowledge, but also to consider team members' behavior and, if necessary, to reassign certain participants in order to improve the team balance.

[29] This part of the note is based on R. M. Belbin (2010), *Team Roles at Work*, Butterworth Heinemann.

[30] For more information, see https://www.belbin.com/.

Exhibit 4
Main Errors in Project Management

There are countless reasons why a project may fail, and often there are more than one at a time. Here we simply sum up a few major mistakes that are commonly made in project management, and we refer to other technical notes for further detail.

During Project Preparation

1. Lack of precision in the analysis of a project's strategic impact (which leads to selecting projects that are actually unjustifiable in terms of resource consumption).
2. Ignorance or inadequate assessment of the resources available for carrying out the projects (leading to resource overload and project delay).
3. Inability to prioritize projects (which leads to taking on too many projects at once in order to keep everyone happy).
4. Lack of clarity in project definition, without the necessary consensus to avoid scope creep (if the project scope is too broad, it should be split into a number of projects).
5. Mismanagement of stakeholder expectations before, during and after the end of the project (usually due to inadequate communication).
6. Inadequate project team (or other ignored stakeholders) or without clear responsibilities.
7. Poor project planning (for example, durations that are negotiated as opposed to estimated, durations imposed by management, excessive optimism, failure to include buffers, etc.).
8. Non-systematic risk assessment (and failure to differentiate uncertainty).

During Project Execution

9. Delay in the start-up of project activities, stretched as far as the plan will allow ("student syndrome"), effectively eliminating any buffers against uncertainty.
10. Maximum delay in reporting problems (or outright concealment of problems), which means that when the problems are finally discovered, it is already too late to take action and solve them without the whole project being affected.
11. Inadequate project progress monitoring, often coupled with inadequate change management (for project development).
12. Insufficient communication about the project (internally and externally).
13. Insufficient analysis of results before they are generalized (for example, with pilots or prototypes).

During Project Completion

14. Failure to decide to shut down projects until there is no other option.
15. Wrapping up projects inadequately, without the appropriate review of the results achieved or the lessons learned (and without stakeholder approval).
16. Overconfidence that, the next time around, everything will work better (even what did not work this time around and without considering a change of approach).