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IT PROJECT-ORIENTED COST MANAGEMENT

COST MANAGEMENT ORIENTED TO IT PROJECTS

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Summary

The importance of using methods, techniques and tools in project management is increasingly recognized in all areas of human activity. The relevance of project management activity is recognized by organizations, the community and people; both in the public and private sectors. In the area of software and information technology (IT), the subject takes on greater importance every day. This is due, in part, to the understanding that a significant part of failure in software projects is related to poor project management or, sometimes, a complete lack of management. Within the context, this work presents a detailed study of Cost Management oriented to IT Projects according to the PMI methodology (*Project Management Institute*), covering conceptual aspects, methods, techniques and tools used to solve cost estimation problems.

Key words: Projects, Cost Management, Estimates, Tools.

Abstract

The importance of the use of methods, techniques and tools in the project management is each more recognized in all areas of the human activity. The relevance of the activity of Project management is recognized for organizations, communities and people; as much in the public sector as in the private sector.In the area of software and information technology (IT), the subject assumes greater importance day by day. This is caused, in part, by the agreement of that a significant part of failure in software projects is related to a bad project management or, some times, by a complete absence of anagement.Inside of the context, this work presents a detailed study of the Management of the Costs in Projects of IT in accordance with the PMI methodology (*Project Management Institute*), approaching conceptual aspects, methods, techniques and tools used to solve problems of estimates of costs.

Keywords: Projects, Management of Costs, Estimates, Tools.

1. Introduction

The Information Technology (IT) sector has historically presented a major disadvantage in relation to other areas of our economy. For example, one of the sectors that has been working on project management in a formal and organized way for the longest time is civil construction, where it is very common for projects to take place within the expected deadline, within budget and not fall apart after completion.

One of the known reasons behind this fact is due to the time spent on details of the project's design before its construction. The design has to be stable at a certain point so that it can be built. Flexibility for changes, although admittedly existing, is less during its development.

For information technology projects, this logic is not necessarily the same. Even due to the constant changes that the business environment imposes; the reality of corporations and the speed of evolution that IT had to present to accommodate these changes in a more flexible way. There is no other sector that has developed and evolved as much and at such a devastating pace as technology.

For this reason, this scientific work will present a detailed study of IT project cost management, covering the main concepts of planning, estimating and cost control.

In chapter I, the fundamental concepts and characteristics of Project Management are covered according to the PMI methodology (*Project Management Institute)*, an international reference institute for project management, which uses the PMBOK (guide of good project management practices). The PMI methodology has nine areas of knowledge aimed at project management, which are: scope, time, cost, quality, HR, communication, risks, acquisition and integration.

Chapter II explains the concepts and phases of cost management for Information Technology projects. Cost management is the monitoring of resources and costs so that the project budget is met as expected. It is important to quantify the value added to the solution and not simply focus on cost control. In any case, in IT projects this cost control must be precise, as the constant addition of innovations due to technological change or the need to compete with similar solutions generates cost increases throughout the project.

In Chapter III, the application of Microsoft Project 2003, a project management software, is of paramount importance for everyone involved.*(Stakeholders)*in projects, with this computational tool it is possible to plan, manage and control the entire project management process. And a case study will also be demonstrated about a project in which I participated in the city of Vitória/ES in 2005, called "SEDU

– ES - Access to the Future", serving as a practical example of how to use the PMI methodology in projects in the IT area.

The desired result of this research is to create subsidies that can serve as a basis for the development of new techniques and specific tools for analyzing and managing costs in Information Technology projects.

2 IT project management

2.1 Concepts

According to Martins (2005; p. 4) "Project means enterprise, it is work that aims to create a product or perform a specific, temporary, non-repetitive service that involves a certain degree of uncertainty in implementation".

Every project needs good planning so that the activities developed by people and/or resources can be completed within the stipulated deadline and at the budgeted cost so that the end customer is satisfied with the product delivered, be it a civil construction project or even a of software development. All these activities need to be planned, programmed and, during execution, they need to be controlled.

According to PMBOK (2004), Project Management "is the application of knowledge, skills, tools and techniques to project activities in order to meet project requirements".

2.2 Project Life Cycles

Project management is made up of five management processes, as shown in figure 1.1, according to PMBOK, which describes and organizes project activities. The processes are organized into five groups:

- **Initiation Processes:**is the initial milestone of the project and ends with authorization formal for the execution of the project. At this stage, a feasibility study and authorization for initiation are carried out.

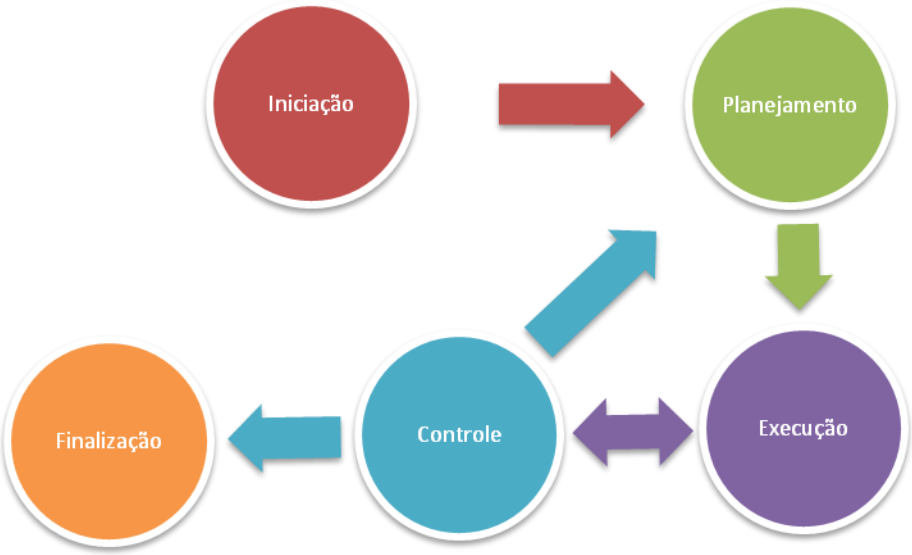
- **Planning Processes:**is the phase of defining objectives and strategy implementation, in this process the product scope is detailed, the project scope is defined, the team is assembled, the deadline and costs are estimated and the risks are identified, and the form of communication is established. All the*Stakeholders*come together and commit to developing the activities described in the planning.

Execution Processes:phase of executing the project plan and coordinating the resources and people involved.

- **Control Processes:**has the purpose of measuring progress, comparing the expected carried out and make the necessary corrections to complete the project.

- **Finalization Processes:**is the phase in which the product is finalized and delivered to the client.

Fig.1.1: Project Management Processes

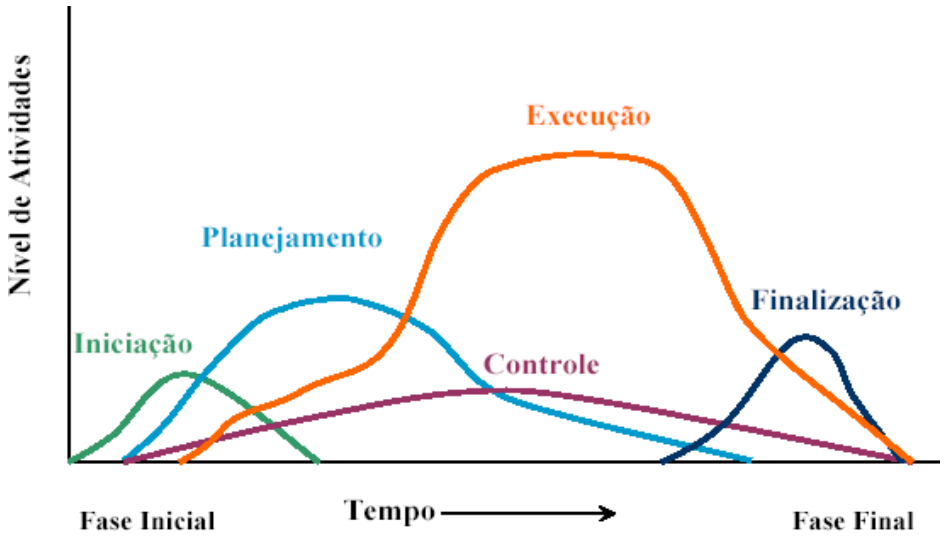


According to figure 1.1, all processes are interconnected by the results they produce. In the initiation process, the objectives and main assumptions and restrictions for the planning phase are defined. This provides the execution of the project plan and at the same time the control process of the entire project is carried out, with risk analysis,

scope verification, control of budgeted costs, quality control and preparation of team performance reports. After the control phase, the project is completed with the delivery of the product to the end customer.

Figure 1.2 shows the project life cycle as previously described in the project management process phases.

Fig. 1.2: Project Life Cycle



Source: Martins, 2005.

2.3 Objective Definitions

The objective is the fundamental point of the project, it is where the effort and actions should be directed. Only after it has been defined clearly and unequivocally should one think about the planning, phases and life cycle of the project. According to Valeriano (1998, p.185): "[...] A project, like any other undertaking that does not have a well-defined objective to guide its steps, will certainly go around itself or take an erratic path, which, not infrequently, it has happened [...]".

Therefore, a project must have only one objective so that it can be conducted with more certainty and more solid definitions regarding the desired results. Even so, if multiple objectives arise, it will be necessary to set only one as the main one and the others as secondary. But how to separate the main from the secondary? According to Valeriano (1998,

p.186) "you just need to know which objectives can be sacrificed or modified and which ones must be maintained at all costs".

The importance of clarity and knowledge of the objective by everyone involved is so valuable that in several studies already carried out on the critical factors for the success of a project, this aspect almost always comes to the top of the list, ahead of important factors such as support from the senior management, planning and monitoring, among others.

The objective cannot be written in a simple statement, it must be written with all the necessary rigor. For this reason, some recommendations may be useful for good objective writing. Therefore, the wording of the objective must contain the components mentioned below, as proposed by Valeriano (1998, p.187):

> • "[...] Action: defined by a verb, preferably in the infinitive, and which must begin the statement of objective: design, develop, build, etc.; Object: on which the action is carried out and/or from which it results: a bridge, equipment, software, etc.;
> • Additional requirements, restrictions or conditions: performance, time, quality, etc. [...]".

It is important to emphasize that the objective of the project is what will be accepted by the client, therefore it is essential to avoid mistakes, such as indicating what may apparently be the objective, when in fact it is the means to achieve it.

2.4 Benefits of project management

There are several strategic benefits that project management offers to organizations, Vargas (2000) highlights some of these benefits:

> "[...] Avoids surprises during work execution;
> It allows the development of competitive advantages and new techniques, since the entire methodology is being structured;
> Adapts work to the consumer market and client; Makes budgets available before spending begins;
> Optimizes the allocation of necessary people, equipment and materials; Documents and facilitates estimates for future projects [...]".

Other benefits of project management according to Vieira (2003, p.18) are:

> "[...] Better financial and human resources control of the project; Improvement in customer relations;
> Shorter implementation time; Lower costs; Higher profit margins; Increase in productivity; Better team coordination [...]".

Companies that adopt project management practices benefit and become increasingly competitive in the market, and demonstrate to their clients that they use internationally recognized methodologies, such as PMI, to carry out projects with the expected quality and fulfill within the scheduled time according to the budgeted cost.

2.5 About PMI

The PMI (*Project Management Institute*) is a non-profit institution, founded in 1969 in Philadelphia - United States, with associated members around the world, whose objective is to regulate project management, prepare professionals and maintain forums that deal with this subject. And its mission is to foster professionalism and ethics in project management.

PMI uses a methodology of good project management practices, documented in the international reference guide called PMBOK, which addresses nine areas of knowledge that will be described in topic 1.6. More information about PMI is available atwww.pmi.org .

There is a PMI certification program called**PMP***(Project Management Professional)*aimed at project management professionals. The PMP is the most recognized certification worldwide in the area of project management, and is increasingly being required by companies as a prerequisite for hiring project managers.

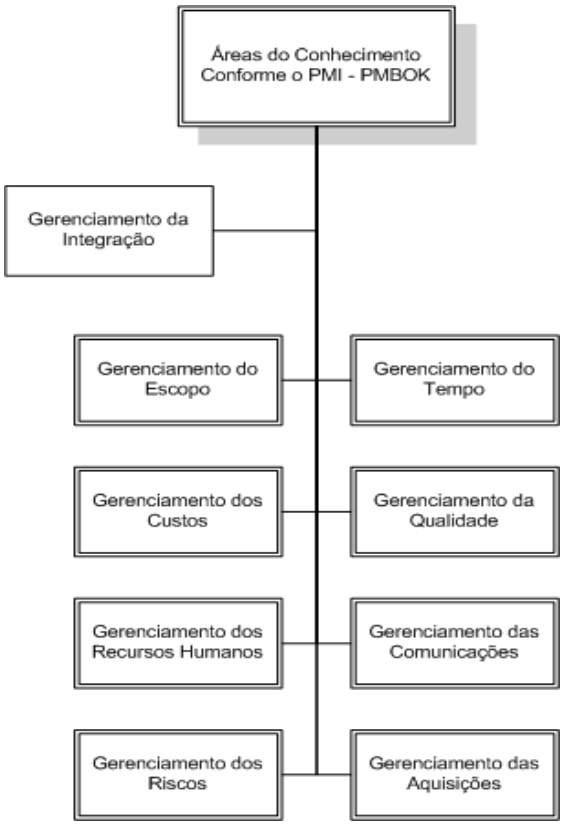
The certification**IT Project+**from the*CompTia*is another certification recognizing professionals in the area of project management, little known in Brazil, but with greater recognition in the United States and other countries. This certification is aimed at the IT project management area, and for non-project manager professionals there are other interesting certifications from*CompTia,*such as: A+, E-Biz+, Security+, CDIA+, HTI+, Linux+, Server+, CTT+, i-Net+ and Network+. Certification information*IT Project +* is available on the website:www.comptia.org .

The PMI emerged in Brazil at the end of the 1990s, due to the advancement of project management in the country, there was a new initiative to establish a national entity focused on the topic. The first Brazilian state to implement the PMI was São Paulo in 1998.

2.6 Areas of Knowledge

According to PMI, the areas of knowledge for study and application in project management, regardless of their size and area, are described as in figure 1.3:

Fig. 1.3: Knowledge area according to PMI – PMBOK



Source: VIEIRA, M. Information technology project management. Rio de Janeiro: Elsevier, 2003.

A project must be developed following processes distributed across the scope areas, time/deadline, cost, quality, communication, risk, human resources, acquisitions and integration. Furthermore, it is important to follow strict ethics and principles of professional responsibility.

In the next topics, the nine PMI knowledge areas aimed at IT projects will be covered with a global vision.

2.6.1 Scope Management

Scope management considers the decomposition of the scope in order to generate a clear definition of what is expected at the end of the project, that is, the product or service that will meet the customer's expectations (explicit and implicit). The biggest problem is that in projects it is difficult for the client to have an exact idea of what they need. The project manager must then be proactive and look for needs that the client has not directly revealed.

These types of problems typically occur in IT projects, where communication failure between the project team and the client is common, especially in software development projects. The client has an erroneous view that it is easy to change any component of the system, be it visual or implement new functionalities that were not foreseen in the scope of the project.

Every change has an impact on the project, so it is necessary to spend more time in the scope planning phase than correcting possible changes to the project. The client needs to be aware that once the scope of the project is defined, it is not interesting to keep changing the scope during the project, because these changes will directly impact the time and cost of the project.

It is up to the project manager together with his team to better define the entire scope of the project, this means an increase in the quality and delivery of the final product, in addition to optimizing the deadline, costs and allocation of resources necessary to execute the project.

2.6.2 Time Management

In deadline management, the activities that must be sequenced and estimated are determined in order to produce a realistic schedule. This is the area where the greatest conflicts occur, as systems generally have short deadlines and are developed in organizations that compete for resources, the lack of which leads to delays. The solution involves dividing the scope into smaller, more easily manageable units and implementation in phases, progressively increasing functionalities, in order to increase the project's chances of success.

Some types of conflicts that lead to most information technology projects not being successful are due to problems in projecting the estimated time, which can be for a number of reasons, including a lack of understanding of the system user's requirements. So the project manager needs to understand all the requirements needed for the

development of the project, so that it ends within the stipulated deadline within the budgeted cost and with quality in the final product.

2.6.3 Cost Management

Cost management is the monitoring of resources and costs so that the project budget is met as expected. In any case, in IT projects this cost control must be precise, as the constant addition of innovations due to technological change or the need to compete with similar solutions generates cost increases throughout the project.

This subject will be addressed in chapter 2, with a more detailed study on cost management, covering concepts, characteristics, impacts, and possible solutions in information technology projects.

2.6.4 Quality Management

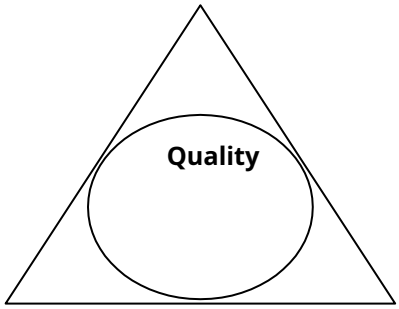
In the view of PMBOK (2004), project quality management: "[...] includes all activities of the executing organization that determine the responsibilities, objectives and quality policies, so that the project meets the needs that motivated its achievement [...]".

Customer satisfaction and meeting their needs are objectives of quality management **.**The rush and anxiety of customers to get their business "on the air", combined with a lack of definition regarding the ideal standards of the product, can generate dissatisfaction with the result. In the systems area, the concept of quality tends to be quite subjective. Therefore, it is important to talk a lot with the client and allow them to follow the development of the system, otherwise their reaction at the end of the project may be a surprise.

So the quality of the project is directly related to the scope, time and cost estimated during the planning phase. Figure 1.4 shows the relationship between these areas.

Fig.1.4: Iron Triangle

Scratchs



Source: Martins, JCC Managing software development projects with PMI, RUP and UML. 2. Rev. ed. Rio de Janeiro: Brasport, 2005.

It is concluded that the highlighted variables (deadline, cost and scope) are directly associated with each other. For example, the scope of the project is expanded, consequently the deadline is stretched and the cost increases, but on the other hand, if the deadline is reduced then the scope is compressed or the cost is increased. The other variables are defined depending on the deadline, scope and cost of the project.

2.6.5 Communications Management

About 90% of a project manager's time is spent on communication, whether in meetings, counseling, preparing reports, etc. Communications management encompasses determining what information should be distributed, to whom, at what time, and through what medium, as well as keeping project information consistent. The advent of the Internet provided a major advance in this area, as it is now possible to make information available and access in real time, democratizing access to information.

According to Vieira (2003, p.67), one of the biggest threats to the success of IT projects is when there are communication failures, three of which deserve to be highlighted: "[...] Non-involvement of the user in all stages or phases from the project; Lack of support from senior executives; Gathering inconsistent requirements [...]".

It is extremely important to create a communications plan in order to determine responsibilities, coordination and how communication will be carried out between everyone involved in the project.

According to PMBOK (2004), the communications plan must consist of the following information:

> "[...] Details of the information to be collected and the respective storage methods.
> Definition of an information distribution structure, indicating recipients and distribution methods.
> Description of the information, including its format, content and level of detail.
> Communications schedule.
> Methods of access to information, once stored, and access control scheme.
> Method for reviewing the communication plan [...]".

2.6.6 Risk Management

According to Martins (2005, p. 49), Risk Management: "[...] is the means by which these uncertainties are systematically managed, allowing the assessment and confrontation of risks, avoiding the avoidable, controlling the controllable and minimizing the unpredictability [...]".

An activity generally relegated to the background, but fundamental to the success of the project, is risk management. In IT projects, with generally very short deadlines and the use of less mature technologies, the risk of a project failing is considerable. It is important to apply techniques to determine, qualify, quantify and act on risks, taking advantage of previous experiences and the organization's history of knowledge.

It is important to develop a project risk management plan, which documents the strategy and procedures that will be taken for risks that will occur throughout the project. In IT projects there are three types of common risks, which are:

- Market Risk: it is feasible to carry out market research even before start an IT project.
- Financial Risk: the question of whether the organization is able to sponsor the entire project and whether the project will bring financial returns to the organization.
- Technology Risk: whether the project is possible to be carried out, whether the hardware, software and the network will be functioning properly throughout and at the end of the project.

These types of risks need to be identified, analyzed and have a contingency plan in case unexpected situations occur within the organization responsible for the project.

2.6.7 Human Resources Management

Team monitoring, leadership, motivation, training and conflict resolution are part of the actions to be developed under human resources management. It is important to know the needs of individuals in order to understand them.

According to Martins (2005, p. 41) "The human resources planning process basically involves three activities: composition of the project team, responsibility matrix and people management".

Project teams can be made up of three different structures, depending on the company's environment, which are:

- Functional;
- Task force or projects;
- Matrix.

In the functional structure, teams are organized around the primary functions of the organization, for example, marketing, finance, engineering, etc. these teams are managed by functional managers.

The task force model is ideal for projects, as it is oriented towards the tasks to be performed by the project team, unhindered by restrictions imposed by the external organization, protecting the team from business conflicts. While the matrix model is the combination of the two models mentioned above, it has three different versions: functional, project matrix and balanced matrix.

In the functional matrix, the functional manager has greater influence over the project than the project manager. The project matrix is similar to the task force model, using members subordinate to functional managers from other areas. The balanced matrix model distributes decision-making power and influence equally between the project manager and functional managers.

In IT projects, it is important to document the lessons learned and the knowledge acquired by the team, as this information can be used in the future to minimize risks, costs and scopes of projects with similar technology.

Another factor that must be considered by IT companies is professional satisfaction in the work environment, because satisfied people tend to perform their role better, directly impacting the quality of the product/service that will be delivered to the customer.

2.6.8 Acquisition Management

According to PMBOK (2004), “project procurement management includes the processes for purchasing or acquiring the products, services, or results needed from outside the project team to perform the work.”

IT projects are highly outsourced and the specialization of this activity has become very important for the success of technology projects. Negotiation, knowledge of contracts and the market are important. Acquisition management aims to provide subsidies for the acquisition of external goods and services that are fundamental to the project.

According to Vieira (2003, p. 69), “due to the fact that outsourcing is a constantly growing area, it is essential for project managers to understand the importance of managing project acquisitions”.

Many companies are moving to outsourcing in order to: and • Reduce fixed costs recurring;

- Allow the organization to focus on its core business;
- Gain access to skills and new technologies by hiring consultants

outsourced workers with extensive experience and specialized skills;

- Team flexibility, avoiding wear and tear and relocation of internal teams;
- Increase supplier accountability through well-written contracts. The success of

IT projects that use external resources is generally due to good acquisition management. The project manager must make correct decisions based on the unique needs of projects and the organizations' business priorities.

According to PMBOK (2004), Project Integration Management: “[...] includes the processes and activities necessary to identify, define, combine, unify and coordinate the various project management processes and activities within project groups. Law Suit [...]".

In IT projects, project integration management becomes more complex due to constant technological changes, a fact that currently occurs constantly. Furthermore, there is an essential characteristic of any project, of any nature: uncertainty. It means that a unique product/service will be created, never done before, and,

consequently, it is expected to encounter changes and challenges during planning and throughout the project.

Project integration management is considered by many to be key to overall project success. In the IT area, good management is a critical factor for the satisfaction of everyone involved, which is why it is important that the project manager carries out effective planning so that the project achieves the expected success.

2.7 Information Technology Projects in the organization

Information Technology Projects managed by an organization are divided into three groups: Strategic, Infrastructure and Software Development.

The)Strategic Projects: These are projects that provide processes necessary for align information technology with the organization's priorities, needs and business objectives. Examples of these projects are:

- *IT Governance:*Objective: Establish priorities so that IT resources are managed to effectively support the organization's objectives.
- *Business Process Modeling:*It is the process of driving improvement in organization's business processes, optimizing the use of its resources and allowing it to create conditions to monitor its performance and achieve its goals.
- *Business Process Vision:*Objective of obtaining the structuring of the organization's business in accordance with the vision for developing its products and services.
- *Process Management:*The objective is to provide an effective method for managing the flow of information in the process, establishing appropriate control items and measurements.
- *Pre-ERP:*It is a powerful option for organizations that want to build a system integrated information system.

B)Infrastructure Projects: These are projects that work directly by monitoring the most critical and vital layer through which all corporate, confidential and strategic information of organizations travels: the network.

Examples of some solutions:

- Hardware and Software Inventory;

- Information restoration systems;
- Help Desk Systems;
- Remote control systems for server and station administration;
- Server monitoring systems in general; security systems and antivirus;

w)Software Development Project: These are projects related to the development of a computational product, that is, software. The process starts from the data modeling phase, through data administration to organization by internal development teams. For example:

- *Data administration:*This project guarantees the necessary instruments to obtaining quality information, such as mapping data structures, identifying their location and concept, as well as ensuring proper reuse, integration and integrity.

- *Integration and customization of CASE tools:*It aims to help development teams to have a more productive and efficient work environment, promoting complementary tools for IT administration.

- *Migration between CASE tools:*This project allows organizations to adopt new technologies, preserving information and all investments already made, and making technologies compatible quickly and safely.

- *Modernization of legacy systems:*The objective of this project is the modernization of legacy systems, that is, mainframes and low-platform ones, for distributed systems and E-Business environments.

2.8 Successes in IT Projects

Success in Information Technology projects can be achieved by several factors depending on the complexity of the project. There are four primary factors that need to be evaluated, they are:

- Scope: project delivered or not all expected specifications;
- Costs: project within the expected budget or not;
- Time: project within the expected schedule or not;
- Quality: project delivered or not with expected quality.

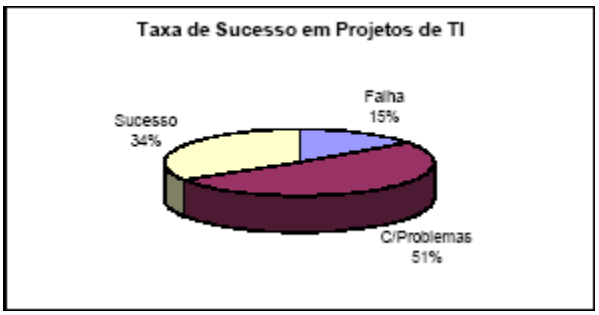
But none of this is of any use if it doesn't also add to the customer's satisfaction and their vision of how the project was delivered. Interestingly, the above four factors can be achieved without the project being considered a success from the customer's perspective. And the opposite is also valid: some of the points above may not be achieved, but the client can still consider the project a success.

In terms of comparison, for example, an engineer could think that a certain project was technically successful, while the finance department could think that the project was not satisfactory in terms of its financial result. The human resources manager could think that there was a lot of wear and tear on the team involved while the company director could interpret that the project was a success because it added value in relation to its strategic objectives.

In other words, measuring success is not trivial and largely depends on who is analyzing the project. Furthermore, success can be seen differently depending on the time and moment in which it is being analyzed. These and other measurement characteristics suggest that success metrics are strongly dependent on variables that are often difficult to analyze and far beyond traditional measurement involving: scope, time, cost and quality.

According to research carried out by *Standish Group (2003)* the success rate in information technology projects is still low. Of the 600,000 projects analyzed, only 34% of those initiated were successful between 2001 and 2003. An improvement of 100% in relation to the same report in its previous version, but still considered insufficient due to the total number of projects in the sample. In the same survey, more than half of the projects were somehow presenting problems related to deadline, scope or budget, as can be seen in figure 1.5.

Fig. 1.5: Success Rate in IT Projects



Source: The Standish Group (1994)

According to the study of*Standish Group (2003)*, some factors can be considered critical for the project to achieve the expected success. It is important to note that according to their report, the simple presence of these factors does not guarantee success in itself, but it tends to increase its chances. A summary of these success factors can be seen in table 1.1:

Table 1.1: Success Factors in IT Projects

Success factors	Percentage
User Engagement	**17%**
Executive Support	**15%**
Experienced Project Manager	**14%**
Clear business objectives	14%
Detailed scope	12%
Agile requirements process	7%
Standard infrastructure	6%
Standard methodology	5%
Reliable estimates	5%
Efficient team	5%

Source: Standish Group (2003)

An analysis of each factor presented leads us to believe that an IT project, like any other project, is extremely dependent on people. Therefore, the first three critical success factors point directly to one of the most difficult variables to control: human beings (user involvement, executive support and experienced project manager).

Other factors that were also raised in the research indicate that clear objectives, scope, requirements, infrastructure, methodology, estimates and team efficiency are also vitally important for the success of projects. The combination of these factors in an IT environment can be characterized through the level of maturity that this environment presents. The greater the maturity, in theory, the greater the probability of success in projects.

In other words, a more mature environment presupposes the presence of certain controls and procedures that make a difference and can help increase the success rate in IT projects.

2. Cost management in IT projects

This chapter covers the concepts, characteristics and importance of cost management in information technology projects, as well as the processes, tools and techniques used to manage the costs of a project from the PMBOK perspective.

2.1 Concepts

According to PMBOK (2004), Project Cost Management: "[...] includes the processes involved in planning, estimating, budgeting and cost control, so that it is possible to complete the project within the approved budget [...]".

Project cost management essentially consists of the costs of resources necessary to implement project activities. It also considers the effects of design decisions on the cost of using the resulting product, known as life cycle cost.

Costs are typically measured in monetary amounts, such as reais or dollars, that must be paid to acquire goods, goods and services. Because projects cost money and redirect resources that could be applied to other areas, it is very important for project managers to understand cost management.

Cost management for information technology projects is even more critical, especially if it is based on cost estimates where the requirements and scope are not yet completely clear. When recalling the considerations made in topic 1.6.1 about scope management, it can be concluded once again that cost and scope are strongly

related, and which depend on a clear understanding of user requirements to be estimated more accurately. Poorly defined scopes due to poorly understood requirements problems also generate cost problems in estimates at the beginning, planning, execution and control of the project; and, consequently, costs at the end of the project will tend to increase a lot and exceed the expected budget.

Another reason for cost variation in information technology projects is when they involve new technologies. Any new technology that has not yet been thoroughly tested brings with it legacy risks. Ideally, you should not provide any information about the project cost to the client without first fully validating the understanding of the requirements and scope with the users and without first evaluating the technologies currently available. This process must involve the project manager, the project team, and the user. Failures in estimates, variations and cost surprises can be minimized in information technology projects if cost management processes are used, as structured in the PMBOK.

2.2 Main Features

In project cost management, several important points need to be analyzed, as follows:

The project is executed under an approved and limited budget; The main focus is on the cost of the resources needed to complete the activities; The estimate must be based on the EAP; The estimate must be carried out by whoever will carry out the work; Historical information is extremely important; A base cost must be estimated and approved, and can only be changed under authorization; Corrective actions must be taken to ensure cost during execution.

2.3 Basic Principles of Cost Management

The information technology (IT) project manager needs to be linked to some concepts related to business finance. Everyone involved in the project development process has a strong interest in the financial aspects of the project,

including the client who normally pays for the project. The company's senior management and the project manager need to be prepared for possible financial risks that may occur throughout the project.

Some basic cost management concepts and principles that will help the project manager in planning, executing and controlling the project cost:

Profit:means income minus expenses. To increase profits on a project, the company can reduce expenses or increase revenue, or a combination of both.

Profit margin:serves to measure the financial benefits of a project. For example, if a revenue of ten million reais generates a profit of one million, then the profit margin was 10%.

Project cost life cycle:allows you to have an overview of the project cost, considering two aspects such as: total cost of ownership (TCO) and support costs for a project.

Cash flow analysis:is a method for determining estimated annual costs and benefits for a project and the resulting cash flow, determining the net value of the project.

Tangible Costs: These are costs that can be measured in monetary terms.

Intangible costs: These are costs that can hardly be measured in monetary terms. For example, the hours spent on research and preparing the project problem analysis report.

Direct costs: These are costs directly related to project resources, such as: personnel, materials, software, hardware, etc.

Indirect costs: These are costs indirectly related to project resources in terms of staff, travel, training, software, hardware, etc.

Learning Curve Theory: This theory explains that increasing the production of items tends to reduce production costs. This theory can be used for project cost estimates when large quantities of items are produced.

Reservations: It is a very important item in project management, which are amounts of money included in cost estimates for possible risk situations. In IT projects, the following margins are adopted: minimum of 5% and maximum of 20% of the value.

The next topic will cover the phases of the cost management processes, in accordance with the PMI methodology, demonstrating the concepts, techniques and specific tools so that project costs are within standards.

2.4 Cost Management Processes

Project cost management includes essential processes to ensure that the project does not exceed the approved budget until completion.

This process must be used at a different time: initially, after initial time estimates are made, initial cost estimates are generated, still with a macroscopic view. And subsequently, the estimates made are detailed and, if the time and effort estimates are revised, the cost estimates will be as well.

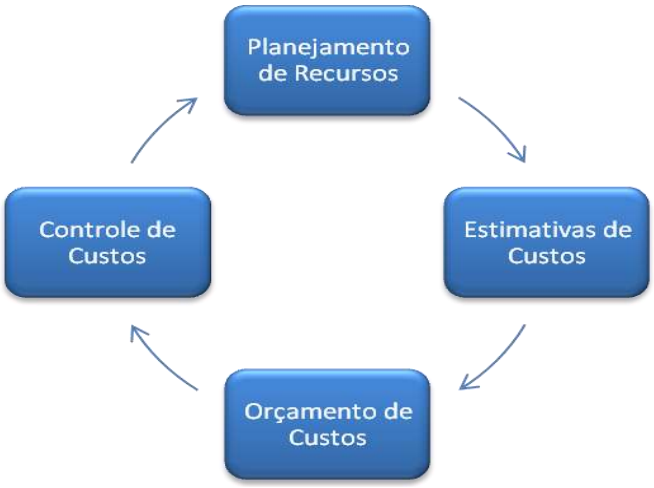
The processes with their respective descriptions can be seen in table 2.1, as shown below:

Table 2.1: Processes for Cost Management

Process	Description
Planning Resources	Determine which resources and how much of each should be used to perform project activities.
Cost Estimation	Develop an estimate of the costs of resources required to implement project activities.
Cost Budget	Allocate global cost estimates to individual work activities.
Cost Control	Control changes to the project budget.

Despite being displayed separately, these processes interact mutually with each other and with processes from other areas of knowledge. These processes generally occur at least once in each phase of the project. As shown in figure 2.1.

Fig. 2.1: Cost Management Processes



2.4.1 Resource Planning

Resource planning*(Resource Planning)* is the process involved in determining the resources used in the project. It is also in this process that the moment of use of these resources (people, equipment and consumable materials) is defined, together with the necessary quantities, according to the carrying out of the project activities.

Figure 2.2 displays a simplified model of the tools and activities used to execute this process. As can be seen, this process is closely linked to experience and understanding of the activities and scope of the project, which is why expert evaluation is often necessary so that the final result of the process is correct.

The end result of this process is a list of the resources required to ensure the successful completion of the project.

Fig. 2.2: Cost Planning Processes

According to figure 2.2, the first input variable is the EAP or WBS, according to Martins (2005, p.26),

> "[...] the Project Analytical Structure *(WBS – Work Breakdown Structure)* is the main source for planning the costs of a project, identifying all parts of a project and the associated tasks, and as such, it:
>
> - Presents the final products that will be delivered to the customer; Provides a detailed illustration of the project scope;
> - Creates an activity schedule and allows you to monitor all progress;
> - Shows detailed cost of equipment, labor and materials;
> - Assists in assembling the team and distributing tasks; It facilitates the identification of risks [...]".

Historical information from other projects serves as a database for cost planning, the project scope statement is also used, as well as the table of resources that will be used within the time estimate of each project activity.

The cost planning phase is fundamental to the other phases of the cost management process, which is why the project manager needs to have more time to prepare the entire cost plan. If this does not happen, the results may be negative, with cost estimates being exceeded and project time being compromised.

At the beginning of the project, a preliminary cost estimate is made, with an accuracy between - 25% and + 75%. As the project evolves, estimates become more accurate around - 10% and + 25%, while the definitive cost planning estimate is around - 5% and + 10%, due to greater knowledge about the work that will be developed.

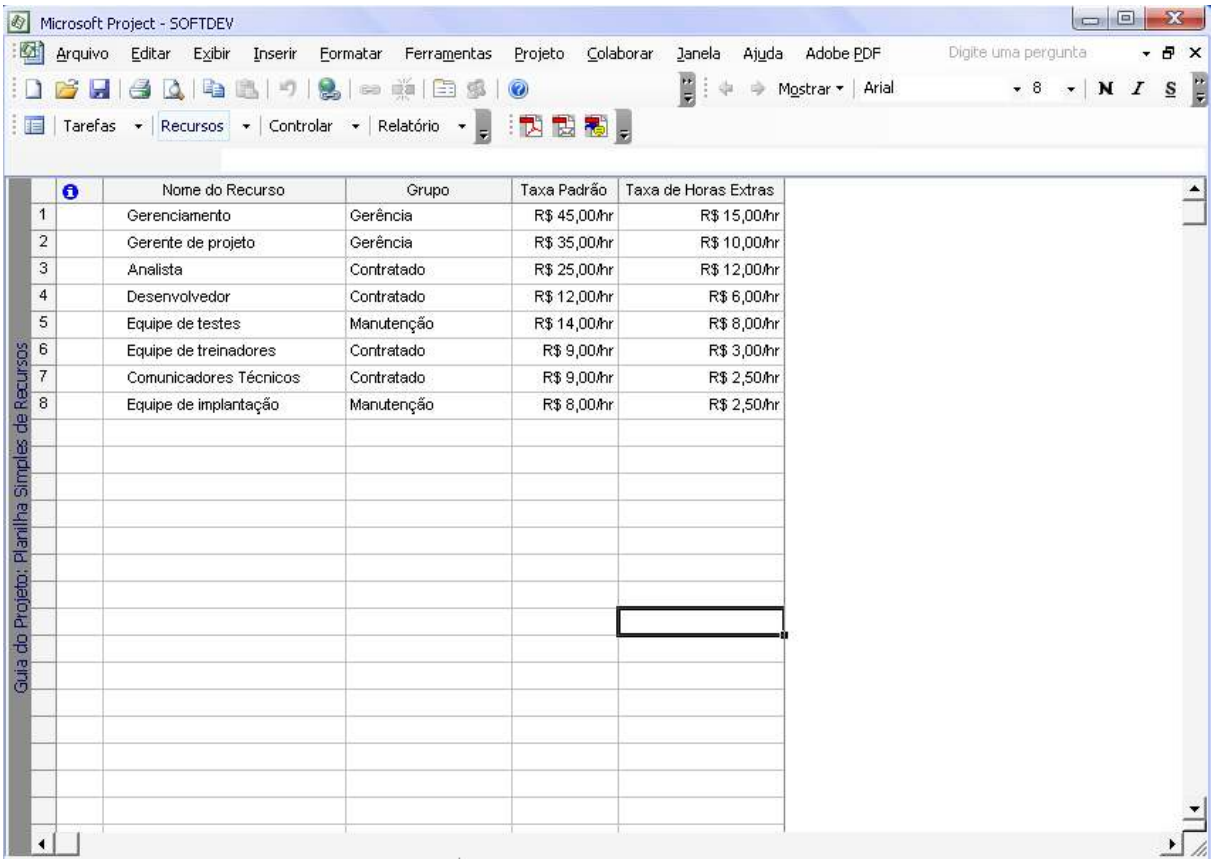
Expert assessment serves as a cost planning analysis tool, this occurs a lot in information technology projects, where planning is

developed using Project Management Software, e.g.*MS-Project 2003*. This software will be discussed in chapter 3 of this work, as an example of a project management tool.

In MS-Project 2003, there is a tool to assist in planning the resources that will be used in the project, it is the**Resource Sheet**, which is shown in figure 2.3 and is used to:

Enter and edit information about resources; Analyze the number of working hours assigned to each resource; Analyze resource costs; Define the type of resource (work resources or material resources).

Fig. 2.3: Example of MS-Project 2003 Resource Spreadsheet



	Nome do Recurso	Grupo	Taxa Padrão	Taxa de Horas Extras
1	Gerenciamento	Gerência	R$ 45,00/hr	R$ 15,00/hr
2	Gerente de projeto	Gerência	R$ 35,00/hr	R$ 10,00/hr
3	Analista	Contratado	R$ 25,00/hr	R$ 12,00/hr
4	Desenvolvedor	Contratado	R$ 12,00/hr	R$ 6,00/hr
5	Equipe de testes	Manutenção	R$ 14,00/hr	R$ 8,00/hr
6	Equipe de treinadores	Contratado	R$ 9,00/hr	R$ 3,00/hr
7	Comunicadores Técnicos	Contratado	R$ 9,00/hr	R$ 2,50/hr
8	Equipe de implantação	Manutenção	R$ 8,00/hr	R$ 2,50/hr

And finally, the output of the resources that will be required for each activity within the project scope, as well as the duration of each activity and the value of each resource that will be used, serving as input for the project cost estimates.

2.4.2 Cost Estimation

According to PMBOK (2004), cost estimates for schedule activities

> "[...] involves developing an approximation of the costs of the resources needed to complete each activity in the schedule. When approximating costs, the evaluator considers possible causes of variation in cost estimates, including risks [...]".

Another definition, this process is designed to develop an estimate of the costs of resources necessary to implement project activities.

It is important to emphasize the distinction between estimated costs and price. Cost estimation involves preparing a quantitative assessment of expenses for the organization producing the project. The price is the amount charged for the product. This pricing is a business decision that uses cost estimates as one of several considerations.

The cost estimate*(cost estimation)*includes identifying and considering various cost alternatives. For example, an additional expense can be considered during the design phase so that the cost can be reduced in the production phase. The cost estimation process must verify whether cost savings will occur at the end of the project.

To assist in cost estimates, the following variables are used as input data:

- WBS;
- List of resources;
- Activity duration estimates (directly affect cost estimates); Historical
- information (project files, business database about

cost estimates, knowledge of the team itself);

- Chart of accounts (company accounting accounts);
- Risks (may impact cost estimates).

Figure 2.4 shows the entire cost estimation process, the inputs, techniques and tools and the outputs.

Fig. 2.4: Cost Estimation Processes

2.4.2.1 Sub-activities

Another important aspect in cost estimates is the*ub-activities*which will determine which cost elements and values will be consumed in the project that are:

- Record cost elements;
- Assign value to cost elements.

Recording cost elements means identifying which resources will be needed to develop the project. For example, in the Software Development Process Plan, the *Hardware*It is*Software*necessary to develop the project, and the Human Resources Plan indicates the people necessary for the project.

In this sub-activity, the already identified cost elements are recorded in the Cost Plan and the project manager identifies those that have not yet been identified, such as energy, water, telephone and rent.

Examples of these elements are direct and indirect costs. Direct costs or ABC cost[1]are fully allocated to the project, i.e. the labor and materials allocated directly to a project activity, while indirect costs refer to resources shared simultaneously across multiple projects, e.g. the services provided by finance staff and administration of the company responsible for the project.

Some examples of cost elements for IT projects, such as:

a) Direct Costs

[1]*Activity Based Cost*–Task-based costing

- Equipment (software and hardware, including maintenance);
- Trips;
- Training; Consultancy; Labor (Project Manager, Analyst, Developer, Network Engineer and Designer, System and Network Implementation Technician, etc.).

b) Indirect Costs

- Operating Costs (Water, electricity, telephone, Internet, rent).
- Administrative and Financial Personnel (Secretary, Accountant, Driver, Assistant Cleaning, Receptionist, etc.).

After listing all the cost elements of the project, the next step is to assign values to the cost elements. During this sub-activity, the project manager determines quantitative and financial values (unit cost, quantity and total cost) for the project cost elements. The total cost of each identified element will be the product of its unit cost by its quantity used and the time spent. For example, a systems analyst works at a unit cost of R$30.00/hour, spending 20 hours to perform the task. So the total cost was R$600.00. The equation to calculate the total cost of each resource is:

Total Cost = unit cost x quantity x time

For human resources and other resources linked to the execution of specific project activities, the quantity used can be obtained through analysis of project schedule data.

The cost related to the use of Hardware is calculated by the depreciation of the equipment, which normally, the depreciation time per use is three years. See the formula to calculate equipment depreciation costs.

$$Cost_{HW\ Depreciation} = (v/36) = x * t$$

Where: v: Monetary value ($) of Hardware x: Partial result t:

Project time (month)

To illustrate the formula for calculating the HW depreciation cost, for example: a computer was purchased at a value of R$ 2100.00, for a project with an estimated duration of six months, so the depreciation cost of this equipment was R $350.00.

2.4.2.2 The Price Proposal

The Price Proposal for a product/service can be obtained through several factors, which must be considered when negotiating with the customer, they are:

- Classical approach: Price = total cost + profit
- The price charged for the product (Software) must be taken into account some factors:
  - Market opportunity (competition);
  - Forecast uncertainty in the estimate;
  - Contractual terms;
  - Renegotiation;
  - Financial situation.

The classic approach is the most used, but it is not always the best option, because it depends a lot on external factors such as, for example, the competition's market price, financial situation and other factors. It is important when closing the negotiation with the customer, to evaluate the proposal that most satisfies the parties involved: balanced product price.

The difference between competing companies in the market is the one that offers a low-cost product with the quality expected by the customer.

2.4.2.3 Methods and Tools

There are methods and models that help with cost estimates, depending on the need for precision required for the project, which are presented below:

The)**Top-down**: According to (MARTINS, 2003) this methodology is

> "[...] used in the initial phases of the project, when the information available is quite limited. In this method, a single estimate is prepared for the entire project, and this value is then apportioned between the elements of the WBS [...]".

B)**Analogous estimate:**According to PMBOK (2004)

> "[...] making an analogous cost estimate means using the actual cost of previous similar projects as a basis for estimating the costs of the current project. Analogous cost estimating is often used to estimate costs when there is a limited amount of detailed information about the project (for example, in the early phases). Analogous cost estimation uses expert judgment [...]".

Analogous cost estimating generally costs less than other techniques, but it is also generally less accurate. It is most reliable when previous projects are

truly, and not just apparently, similar and the people or groups preparing the estimates have the necessary expertise.

w)**Parametric estimation:**It is a technique that uses a statistical relationship between historical data and other variables (for example, square feet in construction, lines of code in software development, labor hours required) to calculate a cost estimate for a resource in a schedule activity. This technique can produce higher levels of accuracy depending on the sophistication and also the amount of resources and underlying cost data incorporated into the model. A cost-related example involves multiplying the planned amount of work to be performed by the historical cost per unit to obtain the estimated cost.

d)**The Bottom-up method:**is the most used model to estimate costs, which consists of in obtaining the total value of each work package based on the individual value of each activity that composes them. In this model, cost estimates are defined for the lowest-level elements of the WBS. The advantage of this model is accuracy, while the main disadvantage is the time and effort required in the cost calculation process.

It is)**PERT**: It is a probabilistic technique, used when there are uncertainties in the calculation of project costs, is also used in time estimation. The formula for calculating the estimate is:

Optimistic Cost + Pessimistic Cost + (Probable Cost * 4) 6

f)**Project Management Software:**Project management software, such as cost estimating software applications, computerized spreadsheets, and statistical and simulation tools are widely used to assist with cost estimation. These tools can simplify the use of some cost estimation techniques and therefore facilitate a quick analysis of various cost estimation alternatives.

The outputs of this process should result in project cost estimates, supporting details, and a cost management plan. The cost estimate will serve as input for the cost budget process, which consists of comparing the estimated costs x actual costs consumed in the project, resulting in the Curve*Baseline*project disbursement.

The supporting detail encompasses a description of the techniques for developing the estimate, an indication of the range of variation for the estimates, and a description and scope

of the estimated work. The cost management plan describes how variations in cost will be managed.

2.4.3 Cost Budget

Cost budgeting involves allocating overall cost estimates to individual activities or work packages to establish a*Baseline*[two](Cost Baseline) to measure project performance. During this activity, all cost elements and their respective values, identified/recorded in the activity*i,*must be included in the project budget, comparing the estimated costs with the actual costs consumed in the project.

Figure 2.5 shows a simplification of the tools and techniques used in this process. One of the important inputs to this process is the project schedule, with the start and end dates of the activities, as this will be used as a reference for allocating costs in the period in which it will actually occur.

Fig. 2.5: Cost Budgeting Processes

The work breakdown structure provides the relationship between all project components and project deliverables. While cost estimates aim to record and assign values to the cost elements of each project activity.

Cost estimation tools are also used in this process, with the purpose of preparing cost budget spreadsheets.

[two]Cost Baseline is the reference budget that will be used to measure and monitor project cost performance. It is developed by totaling cost estimates for periods.

The end result of this process is the curve*Baseline (S-Curve)*of disbursement to control project costs.

One of the tools that can be used to prepare a cost budget is the use of electronic spreadsheets, which are used to calculate the estimated costs and the actual costs consumed in the project. The result of this spreadsheet is the S-Curve (Disbursement Baseline) graph, which makes a comparison between the estimated costs and the actual costs, to check whether they are within the proposed budget.

Another helpful tool is the*MS Project 2003*(Project Management Software), which has broader functions and covers almost all project management processes.

For a better understanding of the subject presented, below is an example of a cost budgeting spreadsheet model for software development projects, which includes costs for: Systems Development and Systems Operation.

System development costs involve: personnel, hardware, software, training etc. While operating costs encompass fixed costs[3]and variable costs[4], as shown in tables 2.2 and 2.3.

Table 2.2 refers to a systems development cost budget spreadsheet*Helpdesk* of a large company, with an estimated duration of three months, while table 2.3 shows the system's operating costs.

Table 2.2: Cost Budget Spreadsheet Systems Development

Budget Spreadsheet

Items	Qty.	Time		Unit cost (R$)		Total cost (R$)	
	Resources	Hours/Month	Months	Estimated	Real	Estimated	Real
	Development Costs			nto do So	tware		
Guys							
Project manager	1	60	3	40.00	38.00	7,200.00	6,840.00
Systems Analyst	1	60	3	30.00	27.00	5,400.00	4,860.00

[3]Fixed Costs: occur at regular intervals, but at relatively fixed rates.
[4]Variable Costs: occur in proportion to some usual factor, and vary over time.

Developer	two	60	3	15.00	17.00	5,400.00	6,120.00
DBA	1	20	two	35.00	37.50	1,400.00	1,500.00
Web designer	1	30	two	15.00	18.50	900.00	1,110.00
Implementation Technician	1	30	1	15.00	17.00	450.00	510.00
Instructor	1	30	1	15.00	16.00	450.00	480.00
Hardware							
Computers (Depreciation)	5		3	69.45	76.40	1,041.75	1,146.00
Dell Server (Purchase)	1		3	3,200.00	2,900.00	3,200.00	2,900.00
Laser Printer (Purchase)	1		3	749.00	719.00	749.00	719.00
Software							
Microsoft Windows XP Professional	1			1,100.00	950.00	1,100.00	950.00
Microsoft MS-Project 2003	1			599.00	485.00	599.00	485.00
PHP Server	1			0.00	0.00	0.00	0.00
MYSQL	1			0.00	0.00	0.00	0.00
Macromedia STUDIO MX	1			495.00	525.00	495.00	525.00
Training							
Courseware	5			30.00	25.00	150.00	125.00
Room Rent	1	20		300.00	350.00	300.00	350.00
Datashow Rental	1	20		670.00	700.00	670.00	700.00
					Subtotal:	**29,504.75**	**29,320.20**

Table 2.3: Systems Operation Cost Budget Spreadsheet

Budget Spreadsheet

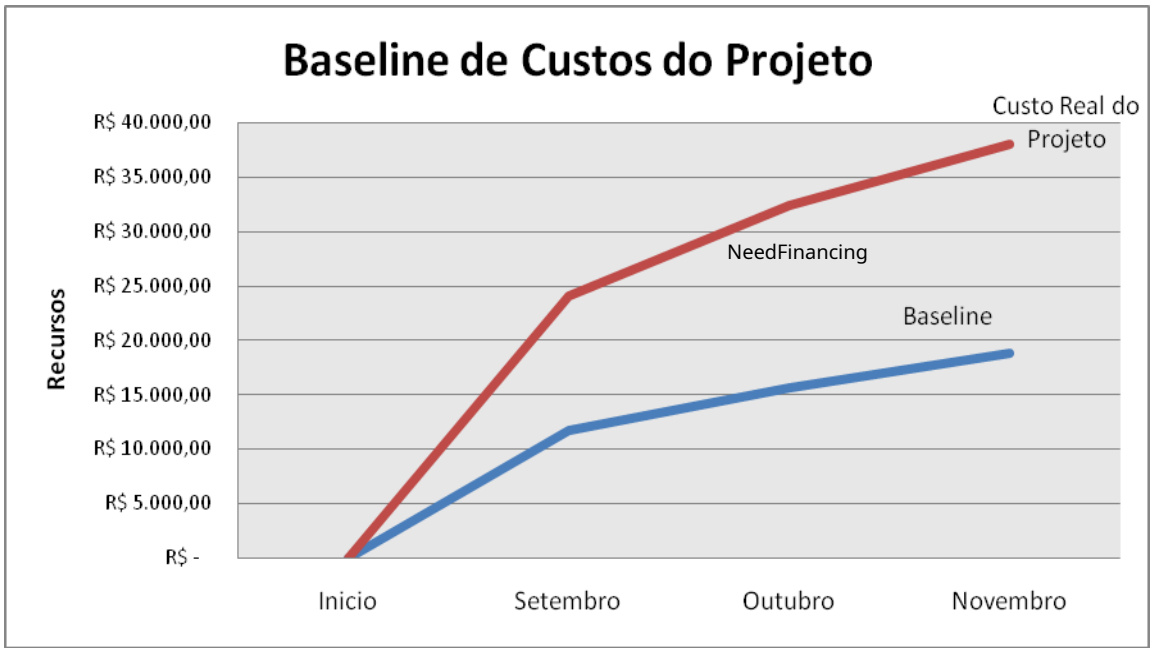
Items	Qty.	Time (Hours/Month)		Unit cost (R$)		Total cost (R$)	
	Resources			Estimated	Real	Estimated	Real
Systems Operating Costs							
Fixed Costs							
Technical support	1	10	6	15.00	18.00	900.00	1,080.00
Office Rent from the project	1		3	1,000.00	1,100.00	3,000.00	3,300.00
Internet Provider (Business)	1		3	350.00	400.00	1,050.00	1,200.00

Vehicle Rental	1	3	500.00	550.00	1,500.00	1,650.00
Variable costs						
A4 Paper - Box	1		110.00	120.00	110.00	120.00
Toner for printer	two		90.00	110.00	180.00	220.00
Cartridge (Color/Black)	6		30.00	34.50	180.00	207.00
CDs 700 MB	50		0.75	0.80	37.50	40.00
DVDs 4.7Gb	25		1.30	1.45	32.50	36.25
Office Supplies	1		80.00	95.00	80.00	95.00
Water Expenses	1	3	35.00	42.00	105.00	126.00
Expenses with Electricity	1	3	140.00	220.00	420.00	660.00
Expenses with Telephone	1	3	450.00	750.00	1,350.00	2,250.00
				Subtotal:	**8,945.00**	**10,984.25**
Budget Subtotal (Table 2.2 and Table 2.3)					**38,449.75**	**40,304.25**
Unforeseen costs - reservation						
Add 20%	**Maximum Risk**				7,689.95	8,060.85
Budget Grand Total					**R$46,139.70**	**R$48,365,10**

The result of the budget spreadsheets can be seen in figure 2.6, where a graph of the project's Cost Baseline is shown, which proves a gradual increase in financial resources spent between the periods from September to November, that is, the real cost consumed in the project was 5% more than the initially estimated cost. 20% of the total cost was also reserved for risks that may occur during the project phases.

Observe the actual cost curve in relation to the Baseline curve, it was above the budget foreseen for the project, that is, there was a cost overrun. An alternative to this is to finance the project, to cover all excess project expenses.

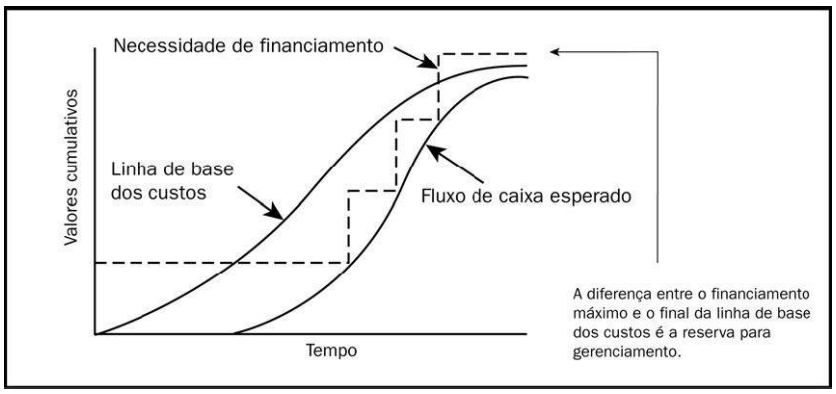
Fig.2.6: Project Cost Baseline Chart



The financing need, total and periodic (for example, quarterly or monthly), is derived from the Cost Baseline and can be defined as having an excess, usually a margin, to provide for a faster start or cost overruns. The total financial resources required are those included in the Cost Baseline plus the reserve amount for management contingencies. A portion of this reserve amount can be gradually included at each financing stage or funded as needed.

Although Figure 2.7 shows the amount of the management reserve at the end of the project, in reality, the Cost Baseline and cash flow lines (actual cost) increase when a portion of the management reserve is authorized and when it is spent. A gap at the end of a project between the allocated financial resources and the baseline cost and cash flow values indicates the amount of management reserve that has not been used.

Fig. 2.7: Cash flow display, cost baseline and financing



Source: PMBOK (2004).

2.4.4 Cost Control

During project development, the budget must be compared, analyzed, revised whenever necessary. Cost control involves identifying and documenting the reason for variations, both positive and negative, and adapting the budget to them.

Cost control aims to:

The)Influence the factors that create changes in the cost target to ensure that these changes are beneficial;

B)Determine changes to the cost target;

w)Manage actual changes as and when they occur.

The project manager must be aware of possible changes to the cost management plan. This phase is the most important and requires stricter control, because the risks are constant and require control plans.

According to PMBOK (2004), Project cost control includes:

- "[...] Control the factors that create changes in the cost baseline;
- Monitor actual changes as and when they occur;
- Ensure that possible cost overruns do not exceed the funding authorized periodically and in total for the project;
- Monitor cost performance to detect and understand variations from the cost baseline;
- Accurately record all appropriate changes to the cost baseline;
- Prevent incorrect, inappropriate, or unapproved changes from being included in reported costs or resource utilization;
- Inform appropriate stakeholders of approved changes;
- Act to keep expected cost overruns within acceptable limits [...]".

All factors mentioned in the PMBOK have a direct impact on cost control, and need to be controlled efficiently, so that costs do not exceed the limits of the financial resources allocated to the project. If they occur, provide emergency measures so that excess costs remain within the acceptable limits of the project.

Cost control must be tightly integrated with other control processes (scope, schedule and quality changes). For example, an inappropriate response to cost variances may cause quality or schedule problems, or produce an unacceptable level of risk later in the project.

Figure 2.8 shows the phases of the cost control process, as well as the inputs, outputs and techniques and tools for measuring cost performance.

Fig. 2.8: Cost Control Processes

The Cost Baseline shows both positive and negative variations in costs during a project period of time, and also serves as an instrument for analyzing cost control.

Performance reports provide information about cost performance such as which budgets are being met and which are not. Performance reports can also alert the project team to issues that could cause problems in the future.

Change orders may include modifications to the cost clauses of the contract, the project scope, the cost baseline, or the cost management plan. These changes may require an increase in the cost budget or allow it to be reduced.

The cost change control system defines the procedures by which the Cost Baseline can be changed. Includes the forms, documentation, tracking systems, and approval levels needed to authorize changes. The cost change control system must be integrated with the general change control system.

Computerized tools such as project management software and spreadsheets are often used to track planned cost versus actual cost and to predict the effects of cost changes.

Another technique is performance measurement analysis that helps to assess the extent of variations that will invariably occur. The earned value (AV) technique compares the cumulative value of the budgeted cost of work performed (aggregate) in the original allocated budget amount with the budgeted cost of scheduled work (planned) and with the actual cost of work performed (actual). This technique is one of the most used methods for measuring performance, and serves to assist the project management team in evaluating project performance.

According to Martins (2005, p.83) the added value (VA) technique involves the calculation of four important collected values, which are:

> The) "[...]**Value of projected work**(*Planned Value* –**PV**): is the budgeted value of the costs of activities that are scheduled to be carried out during a certain period of time.
> B)**Real cost**(*Current Cost* –**B.C)**: corresponds to the real value of the costs of activities carried out over a certain period of time.
> w)**Budgeted cost of work performed**(*Earned Value* –**EV**): corresponds to the budgeted value of the costs of the activities that were carried out over a certain period of time.
> d)**Total cost**(*Budget at completion* –**BAC**): corresponds to the total expected cost of the project, at its completion [...]".

The values to be calculated are:

> **The)**"[...]**Cost deviations**(*Cost Variance* –**CV**): represents the difference between the value of the work performed and the actual expenses incurred in execution. A positive value indicates a good result, showing that less was spent than expected.**CV = EV - AC**
>
> B)**Schedule deviations**(*Schedule Variance* –**SV**): is the difference between the value of the work performed and the value of the work initially projected. A positive value indicates a good result, that is, that more work was carried out than expected.
> **SV = EV – PV**
>
> w)**Cost Performance Index**(*Cost Performance Index* –**CPI**): shows the percentage of the expected cost for the work already carried out in relation to the actual cost. If the result is greater than 1, then the project is spending less than expected.
> **CPI = EV/AC**

*d)***Schedule Performance Index**(*Schedule Performance Index* – **SPI**): shows the percentage of the expected cost for the work already carried out in relation to the cost of the projected work. If it is greater than 1, then the project is ahead of schedule. **SPI = EV/PV**

It is)**Estimate for completion**(*Estimate at completion*–**EAC)**: shows the expected cost to complete the project, using the current cost performance index as the current cost performance index.
EAC = BAC / CPI

*f)***Cost estimate to complete the project**(*Estimate to complete* – **ETC)**: corresponds to the expected cost to complete the project from the current point. **ETC = EAC – AC**[...]".

Based on the calculations presented previously, the graphs in figures 2.9 and 2.10 show some analyzes resulting from comparisons between the performance analysis variables.

Fig. 2.9: Performance analysis graph I

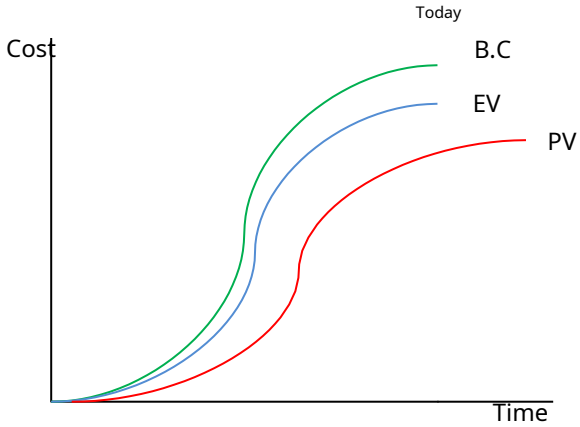
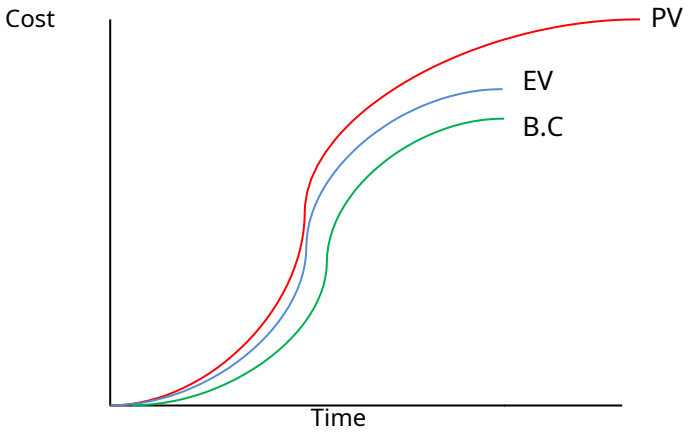


Figure 2.9 shows that the project cost budget was higher than projected, as shown in the AC > EV graph, that is, the actual cost was higher than the budgeted cost. And the project is ahead of schedule, so EV > PV.

The result shown in figure 2.10 corresponds to the cost budget that was below what was projected and the project is also behind schedule.

Fig. 2.10: Performance analysis graph II

Today



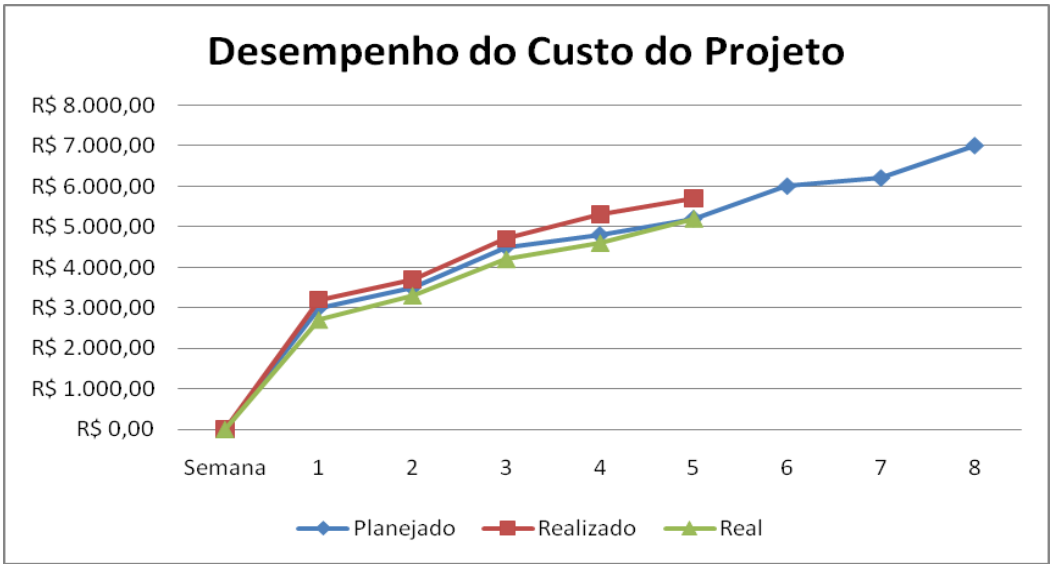
For a better illustration of the results presented so far, it is shown in the table 2.4 an example of a project cost control performance report.

Table 2.4: Cost Performance Report Table

PERFORMANCE REPORT TABLE

	Planned		**Accomplished**		**Real**	
Week	PV		EV		B.C	
1	R$	3,000.00	R$	3,200.00	R$	2,700.00
two	R$	3,500.00	R$	3,700.00	R$	3,300.00
3	R$	4,500.00	R$	4,700.00	R$	4,200.00
4	R$	4,800.00	R$	5,300.00	R$	4,600.00
5	R$	5,200.00	R$	5,700.00	R$	5,200.00
6	R$	6,000.00				
7	R$	6,200.00				
8	R$	7,000.00				
	R$	**40,200.00**	**R$ 22,600.00**		**R$**	**20,000.00**

Fig. 2.11: Cost Performance Report Result Chart



The graph shown in figure 2.11 represents the weekly variation between the cost variables: planned, realized and actual. Based on these variables, it is possible to calculate the following deviations and project performance indices, see the results in table 2.5: Schedule Deviation (SV); Budget Deviation (CV); Schedule Index (SPI); Cost Index (CPI); Total Cost Estimate (EAC); Estimated Remaining Cost (ETC).

Table 2.5: Calculation Table of deviations, indices and Cost estimates

	Deviations		Indexes		Cost Estimation	
Week	Timeline	Budget	Timeline	Costs	Total	Remaining
1	R$ 200.00	R$ 500.00	1.0667	1.1852	R$ 33,918.7500	R$ 31,218.7500
two	R$ 200.00	R$ 400.00	1.0571	1.1212	R$ 35,854.0541	R$ 32,554.0541
3	R$ 200.00	R$ 500.00	1.0444	1.1190	R$ 35,923.4043	R$ 31,723.4043
4	R$ 500.00	R$ 700.00	1.1042	1.1522	R$ 34,890.5660	R$ 30,290.5660
5	R$ 500.00	R$ 500.00	1.0962	1.0962	R$ 36,673.6842	R$ 31,473.6842
6	R$ -	R$ -				
7	R$ -	R$ -				
8	R$ -	R$ -				

Final considerations

It is concluded that this chapter covered the main aspects relating to cost management, focusing on the area of Information Technology (IT) projects, which is

an area that is difficult to manage, due to the constant technological changes that occur in the current market, bringing great financial risks to projects under development. It is up to the project manager and the company's senior management to follow standards that can guarantee the quality of the product or service being developed and also satisfy the customer's needs, within the deadline and budgeted cost.

The PMI methodology has advantages over other methods, as it has processes that contribute to cost and time estimates, techniques and computational tools that help calculate and manage the entire project.

To exemplify the concepts studied so far, chapter 3 will demonstrate a case study of project management in IT, and the application of project management software (MS Project 2003).

3. Application of ms project 2003 in IT projects

This chapter will explain the use of the MS Project 2003 tool[5]for project management, focusing mainly on IT project costs, examples will be shown of how to manage and control the costs spent on each resource allocated to the project. A case study of a computer network implementation and infrastructure project will also be covered, serving as a practical example of how to use the PMI methodology in Information Technology projects.

3.1 Overview

According to Figueiredo (2003, p.61) “Microsoft Project is today the project management software with the largest installed base in its category worldwide, reaching more than five million users according to Microsoft”.

Microsoft Project 2003 was designed to meet the needs of people and work management, that is, it serves to plan, manage and communicate information for your project.

Launched in 1990, MS Project is today in its 9th version based on the Windows operating system, the current version is MS Project 2007, but for the purposes of the study it will be

[5]MS Project 2003: Microsoft Project 2003 – Project Management Software

demonstrated in this chapter to the version of MS Project Professional 2003, which caters to all types of project management company sizes.

Project 2003 has some benefits over other project management software, such as:

- **Intuitive planning:**It has a step-by-step tutorial on how to organize a project, manage tasks and resources, monitor the project and report pertinent information.
- **Full integration:**offers greater integration with other Microsoft programs, such as MS Office, SharePoint Server, MS Visio.
- **Interface with Office:**the interface is more intuitive and familiar, similar to Office applications.
- **Ease of use:**With the help of new wizards, you will be able to simplify the process of setting up and tracking project schedules.
- **Permanently updating a project's status:**constant updates about the project monitoring.
- **Multiple reference parameters:**monitoring the progress of the project, monitor differences between predicted and actual results.
- **Simplified resource allocation:**ease of allocating resources to each task from the project.
- **Better presentation of information:**better view of monitoring project, in the form of diagrams and spreadsheets.
- **Better project cost control:**insert, calculate and better control costs consumed in the project.

In addition to the MS Project Professional 2003 version, there are two more versions intended for different users, which are: Project Server 2003[6]and Project Web Access[7]. All of these versions are designed to work together creating a management solution

[6]MS Project Server 2003: This version is intended for publishing projects on the Intranet or the Internet.
[7]MS Project Web Access: This is a Web browser-based interface that project team members can use to access and update stored information.

(EPM) that allows you to optimize resources, prioritize tasks and align projects as a portfolio with general business objectives.

There is other software that helps with project management, whether corporate, medium or small. The most important are:

Primavera TeamPlay:www.primavera.com WBS

Chart Pro:www.criticaltools.com Task Tracking:

www.tasktracking.com.br MindManager 2002

Enterprise:www.mindjet.com PMOffice:

www.systemcorp.com

Open Project System (SAP):http://service.sap.com/ps

PS8:www.sciforma.com

Rational Project Management:www.rational.com/products/proman.jsp

3.2 Project Management with MS Project 2003

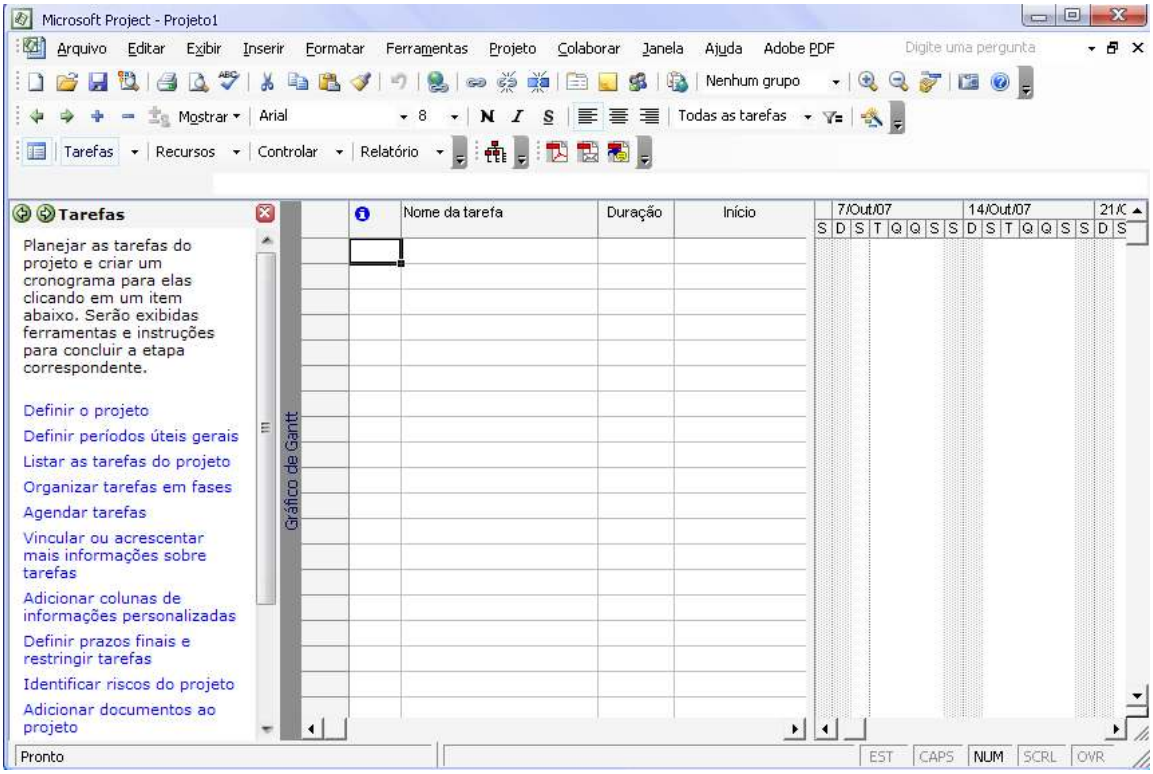
MS Project 2003 has three manageable factors for project development, which are: project scope, time and resources.

These factors are interdependent and subject to changes throughout the process, without this meaning a break between planning and execution. The management of these variables is done from the point of view of a mathematical model, where it is assumed that changing the value of one of them will have a predictable impact on all the others. This means that often the reduction, for example, of the time variable will result in an increase in the resource variables or will imply the change of some product specification. Furthermore, whatever the change regarding the variables, the project manager must have a model that allows quick decision-making to correct the change in course, ensuring the continuity of the process.

It is also important to remember that any and all changes to the content of the variables above must be negotiated, in general, with the client and suppliers internal and external to the project.

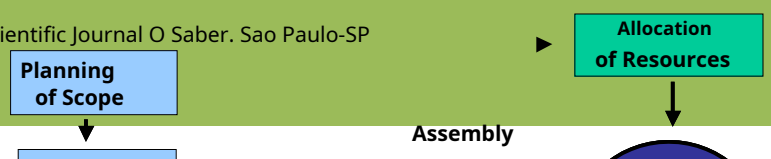
Figure 3.1 shows the main screen of the MS Project 2003 application, the Gantt chart, which displays information regarding the tasks to be performed in the project such as: task name, duration, start, end, predecessor, name of resources, among others. variables.

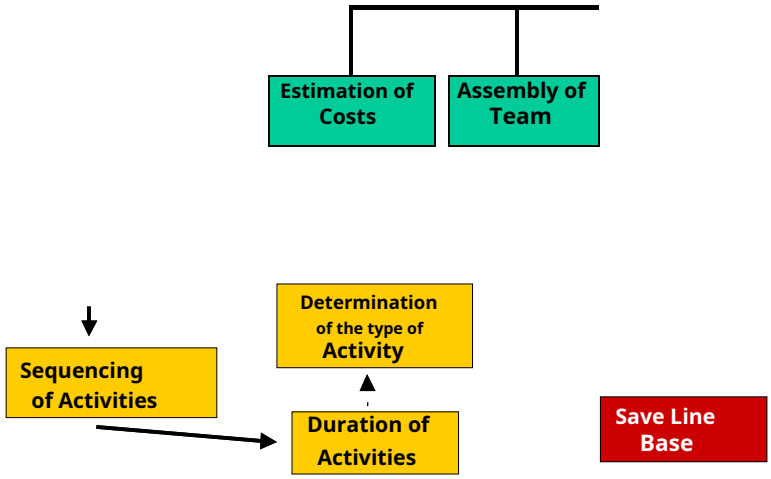
Fig. 3.1: MS Project Professional 2003 Gantt Chart



For the planning process, some steps must be followed in MS Project 2003 to prepare the project scope and define the schedule, as shown in figure 3.2.

Fig. 3.2: Essential steps for Project Scope in MS Project





Analyzing the steps in figure 3.2, it can be concluded that they are all essential for defining the project schedule. The steps are briefly described below:

- Scope Planning: These are the objectives, assumptions, resources and tasks.
- Initial formatting of the Project: Collecting the main information from the scope of the project project and insert it into Project.
- Definition of Activities: Through the Scope WBS, define the activities (tasks) that makes up the project.
- Activity Sequencing: Determine the sequence and relationship between activities activities.
- Activity Duration: determine the duration time for each activity: days, months.
- Determine the type of activity: whether it is fixed units, fixed duration or fixed work.
- Resource Planning: involves the resources that will be allocated to each activity, as well as the time and cost consumed by each resource, whether work resource or material resource.
- Cost estimation: Estimate the real (monetary) values for each resource.
- Team Assembly: Relate all human resources to the project schedule project.

- Resource Allocation: Determine which resources will be allocated to each schedule activity (task).
- Schedule Definition: is the result of the previous steps, as shown in figure 3.2. The entire project will be monitored through the schedule.
- Saving the Baseline: This is important because it determines the key estimates originals about the project. Information about tasks, resources, assignments, and costs entered into the project plan.

3.2.1 The Different Types of Resources

Resources, from the perspective of project management in MS Project 2003, can be of four distinct types, as described below:

- **Labor:**These are the human resources necessary for the project, that is, they are the resources whose cost is accounted for by the number of hours worked.
- **Machine/Equipment:**These are renewable resources or depreciable assets that can be reused in more than one task of the same project or different projects.
- **Consumable material:**Represent consumable resources or goods not depreciable, those that are extinguished during the execution of the task or become useless for reuse.
- **Contractor:**These are the resources, generally external to the executing organization, that They work under a contract system for a fixed price, that is, the cost is independent of possible variations in the duration of the task during its course or in the amount of work.

3.2.2 Costing Methods

In MS Project 2003, another important point is to know the types of costs used in project cost management. So every resource is allocated a cost. There are four types of costs, each applicable to certain types of resources.

Cost per Hour: Used in labor resources, where it represents the man/hour value and in machine/equipment resources, where it represents the depreciation value, such as fuel or energy consumption, insurance, etc.

- **Cost per Use:**Used in consumable material type resources, representing the market value to replace a unit of material.

- **Reapplication Cost:**When a resource is encumbered with a certain cost, the entire once it is reemployed, regardless of the quantity or time to be used, it is also known as mobilization cost and can be applied to resources such as: labor, machinery/ equipment, consumable material.

- **Fixed cost:**Used to represent costs that do not vary over time or quantity to be used in the task, is generally associated with contractor-type resources and has its value defined directly in each task in which they participate.

In addition to the types of costs used in MS Project, it is also important to highlight the ways in which costs are allocated in relation to the proportion of the quantity allocated during the execution of a task.

There are three different ways of appropriating costs, indicating the moment of execution of the task at which the costs will appear.

- **Prorated:**Costs are appropriated in proportion to the schedule of use of the resource, being calculated by multiplying the unit value by the number of working hours or units consumed to be used in the unit of time and presenting the result within a time scale. It is the most used type in MS Project, it is associated with work type resources.

- **At the Start:**The total cost of executing the task is assumed as soon as the task starts, as indicated by the start date. This form of cost appropriation is generally associated with consumable material resources.

- **At the end:**The full cost of performing the task is incurred when the task ends, as indicated by the end date. It is associated with resources of the consumable material type, the finished product subtype, or the contractor type.

3.2.3 Application in Cost Management

The application of MS Project in cost management helps the project manager in planning, controlling and making decisions regarding the costs consumed in the project.

To exemplify cost management in MS Project, you must first define the scope of the project, that is, the resources, the duration of each activity and the interdependence between them and then estimate the costs consumed by each resource allocated to the project.

Figure 3.3 shows a simplified example of a Help Desk System development project in MS Project 2003. The cost spreadsheet shows the following columns: Task Name, Duration, Total Cost[8], Baseline[9], Variation[10], Real[11].

Fig.3.3: Help Desk Project Cost Spreadsheet in MS Project 2003

Microsoft Project - Cronograma do Projeto Help Desk

Arquivo Editar Exibir Inserir Formatar Ferramentas Projeto Colaborar Janela Ajuda Adobe PDF

Projeto Sistema Help Desk

Gráfico de Gantt

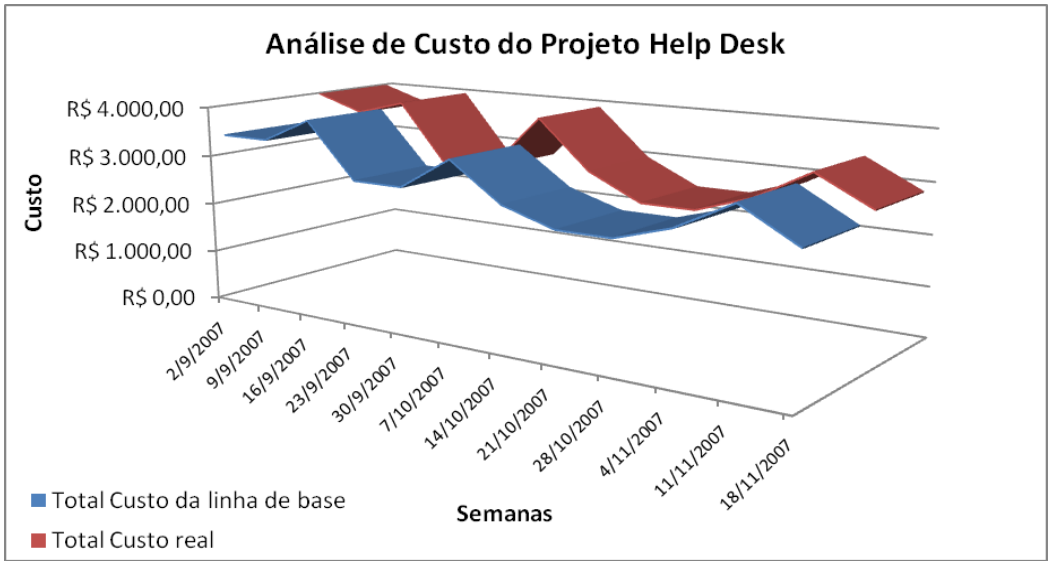
	Nome da tarefa	Duração	Custo total	Linha de base	Variação	Real
1	**Projeto Sistema Help Desk**	**60 dias?**	**R$ 37.985,00**	**R$ 35.920,00**	**R$ 2.065,00**	**R$ 37.985,00**
2	**Estudo de Viabilidade**	**13 dias?**	**R$ 6.380,00**	**R$ 5.400,00**	**R$ 980,00**	**R$ 6.380,00**
3	Entrevista com o Cliente	2 dias	R$ 600,00	R$ 480,00	R$ 120,00	R$ 600,00
4	Análise do Problema	3 dias	R$ 1.800,00	R$ 1.320,00	R$ 480,00	R$ 1.800,00
5	Definição Inicial dos Requisitos	2 dias	R$ 580,00	R$ 480,00	R$ 100,00	R$ 580,00
6	Projeto Inicial do Sistema	5 dias	R$ 2.500,00	R$ 2.200,00	R$ 300,00	R$ 2.500,00
7	Reunião	1 dia?	R$ 900,00	R$ 920,00	(R$ 20,00)	R$ 900,00
8	Finalização	0 dias	R$ 0,00	R$ 0,00	R$ 0,00	R$ 0,00
9	**Análise**	**13 dias**	**R$ 3.055,00**	**R$ 3.120,00**	**(R$ 65,00)**	**R$ 3.055,00**
10	Elicitação de Requesitos	2 dias	R$ 450,00	R$ 480,00	(R$ 30,00)	R$ 450,00
11	Modelagem conceitual do sistema	6 dias	R$ 1.350,00	R$ 1.440,00	(R$ 90,00)	R$ 1.350,00
12	Avaliação de especificação de Requisitos	3 dias	R$ 735,00	R$ 720,00	R$ 15,00	R$ 735,00
13	Documentação	2 dias	R$ 520,00	R$ 480,00	R$ 40,00	R$ 520,00
14	Finalização	0 dias	R$ 0,00	R$ 0,00	R$ 0,00	R$ 0,00
15	**Projeto do Sistema**	**7 dias**	**R$ 3.050,00**	**R$ 2.400,00**	**R$ 650,00**	**R$ 3.050,00**
16	Projeto de Interface Web	5 dias	R$ 1.200,00	R$ 1.000,00	R$ 200,00	R$ 1.200,00
17	Projeto de Conteudo e Arquitetura	5 dias	R$ 1.350,00	R$ 1.000,00	R$ 350,00	R$ 1.350,00
18	Documentação	2 dias	R$ 500,00	R$ 400,00	R$ 100,00	R$ 500,00
19	Finalização	0 dias	R$ 0,00	R$ 0,00	R$ 0,00	R$ 0,00
20	**Codificação**	**17 dias**	**R$ 3.250,00**	**R$ 3.040,00**	**R$ 210,00**	**R$ 3.250,00**
21	Geração de Código	10 dias	R$ 1.700,00	R$ 1.600,00	R$ 100,00	R$ 1.700,00
22	Incorporação do conteúdo	5 dias	R$ 850,00	R$ 800,00	R$ 50,00	R$ 850,00
23	Documentação	2 dias	R$ 700,00	R$ 640,00	R$ 60,00	R$ 700,00
24	Finalização	0 dias	R$ 0,00	R$ 0,00	R$ 0,00	R$ 0,00
25	**Testes**	**6 dias**	**R$ 2.450,00**	**R$ 2.280,00**	**R$ 170,00**	**R$ 2.450,00**
26	Integração dos Módulos	3 dias	R$ 500,00	R$ 480,00	R$ 20,00	R$ 500,00
27	Teste do Sistema	3 dias	R$ 1.950,00	R$ 1.800,00	R$ 150,00	R$ 1.950,00
28	Finalização	0 dias	R$ 0,00	R$ 0,00	R$ 0,00	R$ 0,00
29	**Implantação**	**4 dias**	**R$ 600,00**	**R$ 480,00**	**R$ 120,00**	**R$ 600,00**
30	Instalação do Sistema	2 dias	R$ 300,00	R$ 240,00	R$ 60,00	R$ 300,00
31	Instalar e configurar a Servidor WEB	2 dias	R$ 300,00	R$ 240,00	R$ 60,00	R$ 300,00
32	Finalização Entrega do Projeto	0 dias	R$ 0,00	R$ 0,00	R$ 0,00	R$ 0,00

Observing each task individually in figure 3.3, it can be concluded that there were variations in the costs of some tasks, that is, there was a cost overrun. The initially estimated value for the cost was R$ 35,920.00 (Baseline cost), but it was spent on

[8]Total Cost: Sum of the fixed cost and probable cost of each resource.
[9]Baseline: It is the target cost, planned, entered or calculated.
[10]Variation: Difference between the total cost and the target cost (Baseline).
[11]Actual: Actual cost calculated in monitoring.

project period R$ 37,985.00 (Actual cost). Analysis of the graph in figure 3.4 clearly demonstrates the expected result of the cost overrun.

Fig. 3.4: Weekly Cost Analysis Chart consumed in the Project



Another way to analyze the results obtained from the cost spreadsheet in MS Project is to use Cost Reports. Table 3.1 shows the main types of reports available in MS Project.

Table 3.1: Types of Cost Report in MS Project

Cost Reports

Cash flow	Weekly cash flow on an accrual basis (economic budget), indicating weekly cost per task.
Budget	Budget on an accrual basis, pointing out for each task fixed cost, total cost, method of appropriation, cost target, variation between total and target, actual cost and remaining cost.
Tasks with budget overrun	Tasks with a total cost above the target cost, indicating fixed cost, total cost, method of appropriation, target cost, variation between total and target, actual cost and remaining cost for each task.
Features with budget overrun	Resources with actual cost above target cost, pointing out probable cost, target cost, variation, actual cost and cost remaining.
Accumulated value	Crossing of actual and target costs.

3.3 Case Study

The Digital Inclusion Project called **"SEDU-ES - Access to the Future Project"** as shown in figure 3.5, its main objective was to implement computer networks in 160 schools in the state network of the State of Espírito Santo. In 2005, the first phase of the project began, the result of the dream of a better future that was envisioned by the Government of the State of Espírito Santo and implemented by ISH Tecnologia.

Fig. 3.5: SEDU-ES Project Logo

Source:www.sedu.es.gov.br (2005)

The Access to the Future project was created with the aim of developing pedagogical actions to modernize and use Information Technology in the teaching and learning process of students in the state network, enabling the computerization of almost 300 schools.

In the first phase of the project, the Government of the State of Espírito Santo invested more than 4 (four) million reais, with the implementation of computer rooms in the 160 state schools in the education network.

"The challenge began with the acquisition of thousands of computers, preparation of logical, electrical and internet network infrastructure, distribution logistics, assembly, installation, configuration and training of professionals to use the equipment, counting on the successful partnerships of ISH Tecnologia and CABLE Redes Estruturadas Ltda." Explains Everson Teixeira Moreira, former IT manager at SEDU-ES[12]who followed the entire process during the project implementation.

The logistics generated in the implementation of the Access to the Future project involved a complex production arrangement, with more than 21 suppliers of all the necessary material. Furthermore,

[12]SEDU – ES: Secretariat of Education of the State of Espírito Santo

more than 100 direct and indirect jobs were created. There were 74 municipalities covered, 300 laboratories and 6,300 computers installed in a network and made available to students in the state public network.

A complete structure with suites, routers, VPN firewall appliance, internet and laser printers.Figure 3.6 shows the map of the state of Espírito Santo covered by the Access to the Future project.

Fig. 3.6: Map of the State of Espírito Santo

Source:www.guianet.com.br/es/mapaes

CABLE Ltd. went to the company responsible for managing the project and installing the electrical and logical networks of the computer laboratories in all the schools included in the project. While ISH Tecnologia was responsible for installing and configuring machines (clients and servers) in schools and training professionals.

I participated in project management, in which I performed several important functions, such as: planning and control of the schedule (MS Project 2003), EAP preparation (MS Visio 2003), preparation of project documentation (MS Word 2003), dissemination of results on the web (Windows SharePoint Services[13]) and in the development of a system

[13]Windows SharePoint Services – System for creating Web sites that allows information sharing and document collaboration.

information for project management and control, called**SGP**[14]**SEDU LAB 2005**.

The objective of the project was to provide a viable solution for implementing 160 computer rooms in the state education network in 74 municipalities in the state of Espírito Santo. For this implementation, it was necessary for the project to include the feasibility of transport, checking, configuration, testing of equipment and the installation of the physical infrastructure (logical and electrical network). 21 computers were made available in each room, as well as tables for forming the bench and the necessary equipment for the logical and electrical network.

The proposed deadline for carrying out the 1st phase of the project was 4 (four) months. SEDU (client) released the amount of R$ 4,616,000.00 (Four million six hundred and sixteen thousand reais) for the 1st phase of the project to cover all expenses incurred during this phase. The costs consumed in project management, according to CABLE, were:

- Teams (hired personnel);
- Technical consultancy;
- Purchase and Acquisition of Materials;
- Project Management Office; Purchase
- of Hardware and Software;
- Team Travel Expenses, including Vehicle Rental; Training and Technical Support;
- Between others

The following tools were used in the project to analyze the estimate and control costs: MS Excel 2003 and MS Project 2003.

The quality obtained in the project is due to the use of the PMI methodology, the team's experience, as well as the specialized consultancy of professionals from CABLE and ISH Tecnologia.

Another important point was the main deliverables of the project*Access to the SEDU/ES Future*, table 3.2 shows a general summary of the project scope (the phases, the main results and the milestone of each phase).

[14]SEDU LAB 2005 Project Management System – Access 2003 Database System for control and management of the project team.

Table 3.2: Main deliverables of the Access to the Future Project

PROJECT DELIVERIES		
PHASES	**KEY RESULTS**	**MARCH**
Inspection Service	Document verifying the feasibility of starting work at the inspected school.	Completion of the Technical Inspection.
School Product	Materials collected from computer rooms	Finalization.
ISH Product materials	Acquisition of tables and of infrastructure	Completion of delivery of tables and infrastructure materials. Completion of the Infrastructure service.
Infra Service	Installation of conduits, electrical network and cabling finished.	Completion of delivery of new equipment.
SEDU Product	Document set originating from receipt of products purchased by SEDU.	
SEDU Service	Documents accepting the completion of work.	Delivery of Documentation.
IT Service	Equipment assembled in laboratories and user training.	Completion of IT service and staff training.

Source: Project Scope Documentation – CABLE

The result of this project was a great success, according to SEDU, it directly benefited more than 250 thousand students from the state education network in 74 municipalities covered by the project. The second phase began at the beginning of 2006 with the implementation of another 132 new schools.

Conclusion

The consumer market is increasingly demanding in relation to product quality and its needs require increasingly complex solutions. Furthermore, fierce competition, a result of globalization, allows increasingly smaller margins of time for the production process of a product from the moment the idea is conceived. This challenging environment requires systematization of the production process in order to meet these restrictions. This systematization takes place in the form of projects. In addition to these difficulties, others inherent to the production activity itself such as communication, expense control, commitment to the schedule and Stakeholders, lack of a clear definition of the final objective, among others, make the project management activity fundamental.

If dealing with all these variables wasn't enough, the tendency is for organizations to sustain themselves through the development of several projects happening simultaneously. Given this context, the allocation of human and financial resources becomes even more complicated. In such an environment, traditional project management techniques and tools are inefficient, especially if we take into account the reality of IT (Information Technology) companies, which work with abstract products and have a much more dynamic nature than most companies. other areas of knowledge.

As a result, project management companies today need to follow technical management standards to guarantee the delivery of the product with the quality expected by the customer. Then, throughout this work, the PMI methodology was presented, serving as a basis for managing projects in the area of information technology.

The main objective was to demonstrate a more detailed study of cost management, which is one of the foundations of project management, showing the techniques and tools used by the PMI methodology, and practical examples of how to estimate, calculate and control the costs consumed in the project, and also the risks that these costs can bring if they are not controlled.

It is concluded that this work can serve as a basis for the scientific study of developing new techniques and computational solutions to manage project costs in the area of Information Technology.

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