

**Systems and Project Management:
Organizational Structure and Lessons Learned in Large Scale Projects**

by

Sofoklis Karapidakis

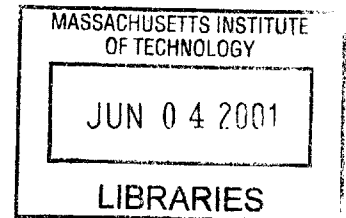
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ABSTRACT

Living in a period where globalization is being taken as an industry norm, we are facing stiff challenge on undertaking projects under increased constraints due to the phenomenal pace of development and competition in industry. Projects now require a large number of individuals and multinational firms scattered around the globe to undertake the task. Due to constraints ranging from cost, schedule, quality, environment and socio/political factors, the complexity of these large-scale engineering projects has also increased dramatically over the last decade, resulting in higher levels of risk. To stay competitive in this environment, the need for project management techniques for handling these projects has become a top priority for organizations. This has also led to demands for increased understanding of the dynamics of the system and the need to put together a project management strategy to effectively manage the effects of all those contextual constraints on projects. This thesis will concentrate on organizational issues that the companies should consider while undertaking projects as well as lessons learned from previous experience and how we apply them to the future projects.

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Introduction

Living in a period where globalization is being taken as an industry norm, we are facing stiff challenge on undertaking projects under increased constraints due to the phenomenal pace of development and competition in industry. Projects now require a large number of individuals and multinational firms scattered around the globe to undertake the task. Due to constraints ranging from cost, schedule, quality, environment and socio/political factors, the complexity of these large-scale engineering projects has also increased dramatically over the last decade, resulting in higher levels of risk. To stay competitive in this environment, the need for project management techniques for handling these projects has become a top priority for organizations. This has also led to demands for increased understanding of the dynamics of the system and the need to put together a project management strategy to effectively manage the effects of all those contextual constraints on projects. In this thesis, system and project management will be applied on different types of projects, programs or portfolios of projects that are either one-of-a-kind, platform or mass production within three organizational levels: strategic, tactical and operational.

PROJECT MANAGEMENT LEVELS

Figure 1 shows the categorization of project management into strategic, tactical and operational levels. The strategic level is the senior management of the company and refers to what needs to be developed and the implications of it to the stakeholders. The strategic project management level is where the strategic decisions for the projects are taken such as the decision to undertake the project and the definition of the scope. Tactical refers to how develop a project. The tactical level in project management is the middle management such as project managers and includes decisions about the implementation process, such as development method. Operational refers to the details of the implementation of the project (i.e. functionality issues). In project management the operational level is related to how to do things such as tracking the quantity of resources, the amount of material, monitoring the hours of operation of personnel or equipment and use of software programs to track the project's progress.

As we move to the upper levels of the pyramid in figure 1 and we increase the authority and the responsibilities, we also have an increased vision of the horizon and as a result we can avoid problems before they happen. Moving downwards the pyramid we meet a more detailed and short range goals that drive the implementation.

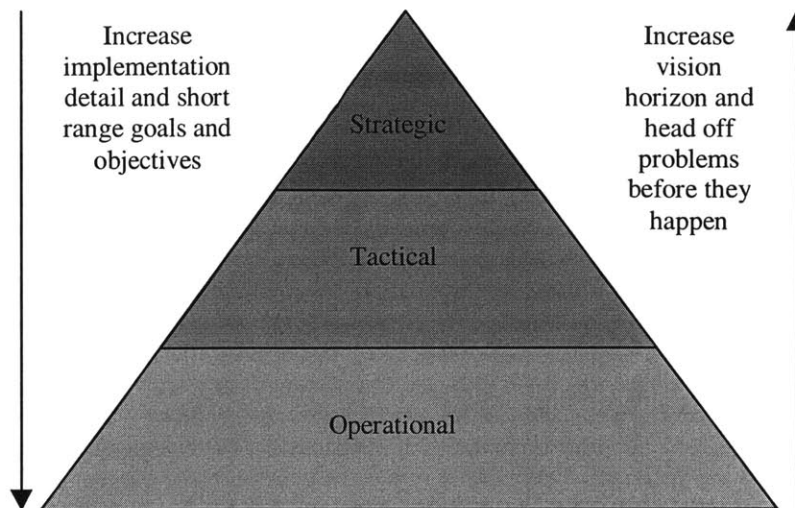


Figure 1: Levels of Project Management

PROJECT TYPES

Figure 2 presents the different types of projects in which project managers may be involved. The one-of-a-kind are those projects that are unique in some or all of their aspects. For example, the construction of a building is a one-of-a-kind project because the planning and the implementation for the specific building are different from any other building. The platform projects, are projects that are based on a common basis and they differentiate themselves in some aspects. Platform projects are very commonly used in the automotive industry. In the automotive industry, there are various models that are being built on the same chassis. The mass production projects are the ones most commonly developed in steady state after the one-of-a-kind or platform project has been developed in manufacturing. The main characteristic is that they are repeated without differentiating their characteristics in the various cycles. An example is the production of Intel Pentium III chip in one plant. The idea here is to optimize the process to increase efficiency. As we move from the one-of-a-kind to the mass production projects, we meet increased ability to learn and improve from the repetition and the application of the lessons learned from the previous projects. In reverse moving to the other direction, we meet more customization and flexibility.

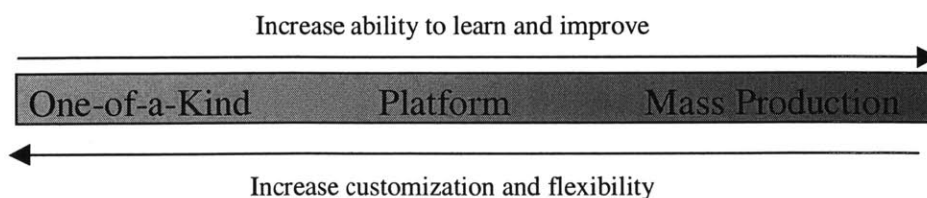


Figure 2: the different types of projects.

Pure projects can range from one project, to a program of related projects, to a portfolio of projects. (Figure 3).

A project is a series of activities required to achieve a goal following a logical sequence, with defined standards of quality (specifications), on a specific budget (cost) and on a specific time within the context of a socio-political environment and in harmony with the natural environment.

A program is a group of related projects managed in a coordinated way to obtain benefits not available by managing them individually.

Portfolio of projects is a series of usually no necessarily related projects managed together from the same company to increase efficiency and learning from one project to another.

Moving from portfolio to pure project, we meet a decreased possibility to have a sense of solutions beyond a decision point. In the reverse direction we understand the usefulness of project management.

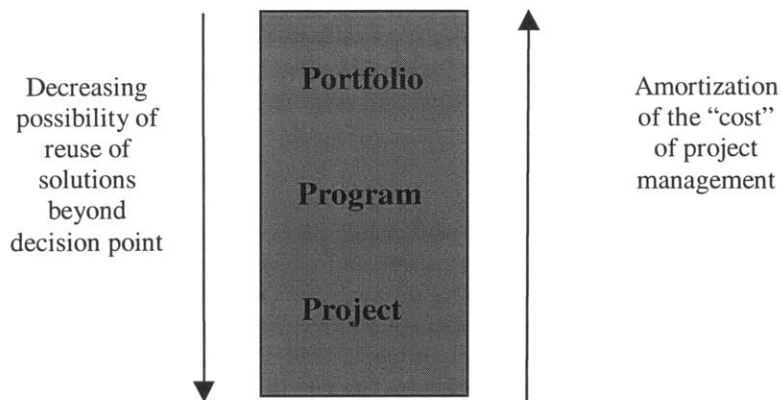


Figure 3. The Project Range.

These projects are developed within a particular content or eco-system. Thus, in the next session we will analyze the five major factors of a project, program or portfolio of projects and the role of each of them in the project development process.

**THE PROJECT
MANAGEMENT
ECO-SYSTEM**

The success of a project depends on how effectively its eco-system is handled. The eco-system comprises variables, which act as a life support to the project. These variables act upon a given scope of the project. How effectively these variables are managed during the project life cycle, will determine the relative success of the project on achieving its objective. These factors are namely the Quality/Performance achieved by the product or the development process, the Schedule to which the project is developed, the Cost/Resources associated with developing the product, the Natural Environment and Socio-Political factors that define the environment in which the project is developed. (Figure 4)

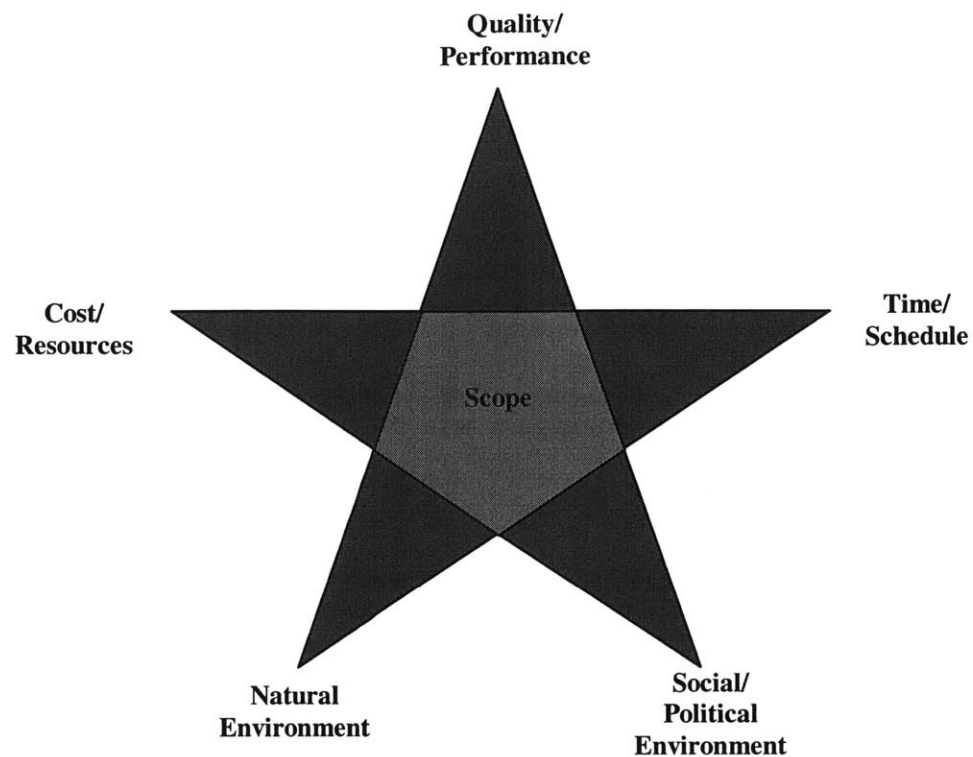


Figure 4. The Five Factors of a Project. Project Eco-System

The scope of the project is generally the project definition and the objectives that it should meet. It characterizes the state at which the project begins, the state at which it ends and the objectives that the project should achieve. The other five accompanying factors characterize the framework within which the project is developed. Quality is used as a criterion for measuring the performance and the quality required before the project is considered complete. It also involves the quality of the process by which a product is developed as well as the performance achieved on that process. This has a direct bearing on the other parameters such as schedule and cost of the project. The cost is the amount of resources that is spent on the completion of the project, or the various phases of it. It may contain fixed and variable costs. These types of cost may include human resources cost, equipment and raw material cost, advertisement, R&D, software development, consulting services, and other professional services. The cost has an initial value that is the estimated or planned cost or bid price and may vary positively or negatively depending on the changes that may take place during the process. The schedule is the time required to complete the project or the different phases of the project. It can also vary from the initial value due to the changes. The cost and schedule parameters are interrelated and an optimum combination of all the parameters could be determined to achieve the project objectives.

The Project Management Eco-System is the life support of a project.

Although the above factors constitute the main framework for project success, the environment and socio-political factors cannot be overlooked. The stability of the political and social environment of the area in which the project is being executed can add a new spin and dimension to the implications it has on the cost and schedule of the project. More often it either leads to hastening the project schedule or cutting short the budget of a project or limiting the availability of critical resources or the use of certain techniques, which will result in decreased quality, or premature termination of the project. An example is the construction of a highway that affects the socio-political and economic environment of a region. The new construction will spur development and

growth but also will increase the traffic congestion and the air pollution in the area. The environmental impact many times has a high impact in the project operations. An example is the construction of a petroleum pipeline that passes by areas with rare species of animals. The protection of the natural eco system in this case should also be taken into consideration.

With the advent of the Information Technology age, the eco-system of the project described in the previous session also now heavily relies on IT tools to optimize the performance of the project development. IT allows the quick flow of information among all the levels and all the segments of the project. This means better coordination, better control and more effective use of the lessons learned from the previous projects, programs or portfolio of projects. Although tools are now commercially available, they are not used within the framework of the entire project eco-system. For example, the most common implementation of IT tools in the proposed eco-system framework is in the costing and scheduling of projects. There is very little integrated effort in using IT on directly improving the quality of the project or addressing issues relating to environment and socio-political factors. However, it is only a matter of time before it becomes equally popular within the whole eco-system. This is the future; information technology would be used at every stage of the project development process and by local or global personnel. Local would include all the personnel collocated in a project and global may include the geographically dispersed support team members for a project.

**PROJECT
MANAGEMENT
LIFE-CYCLE**

As we have seen, reengineering, change management and operation cycles are the main characteristics of today's industry in order to improve the time to market, reduce the costs and increase the quality of the projects. The main and most important tool used for these processes is project management. In this thesis, we will present project management using a framework integrating the life-cycle of a project with its eco-system. Project life-cycle is the different stages of the project in sequential time order beginning from the initiation until the mature stage of the project. Despite many people's belief that project management is just scheduling through some software tools, project management follows the project in each stage of its life-cycle both before and after scheduling.

The life-cycle of a project or product consists of the following six phases: strategic planning, system design, detailed design, development, operations and lifecycle support and divestment (Figure 5).

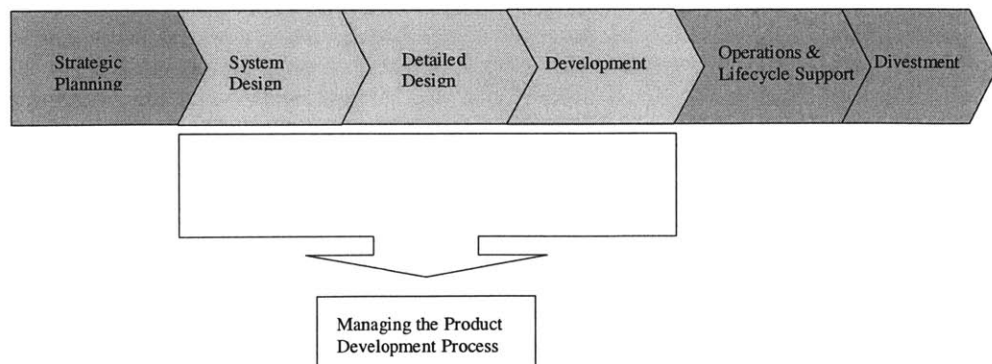


Figure 5. The life-cycle of a project.

The first phase in this model is the strategic planning of the product; that is a preliminary investigation carried out to cover feasibility studies, market analysis, financial studies, engineering risk benefit analysis and environmental/social impact studies of the product.

The second, third and fourth phases, constitute the actual design and development process, and are namely system design, detailed design and development respectively. These phases cover aspects of system optimization and engineering, system architecture and engineering as well as risk benefit analysis.

The fifth phase represents the operations and lifecycle support. Operation and maintenance are covered in this session.

The last phase is the divestment of the project. This is when the project has reached its intended design life period and the need for proper retirement of the product comes into the picture. Methods and processes of safe disposal of the product components need to be outlined, such that they comply with the appropriate regulations and standards.

The second, third and fourth phases in which this thesis focuses, deal with “managing the product development process”. This process starts after the strategic decisions for the project have been taken and the preliminary scope is defined and finishes with the delivery of the project. They describe the management of the implementation process of the project. This process is described by as OPMCL (Organization, Planning, Monitoring, Control and Learning) model framework. These phases come right after the project proposal and the contracts. The design of the organization, the definition of the project organization, the team formation, and the hiring of the project manager are included in the first of the five phases, which is the “Organization phase”. Planning, monitoring and controlling are the next three phases. Planning includes all the project designing phases as they are described in the work breakdown structure, the work definition and the specifications justification. Monitoring, which belongs to the implementation stage, refers to the project performance tracking. Controlling includes the essential corrections to bring the project back on track when necessary. Thus, this is the main framework that is followed in the thesis for projects from the concept and ending at their completion phase (Figure 6).

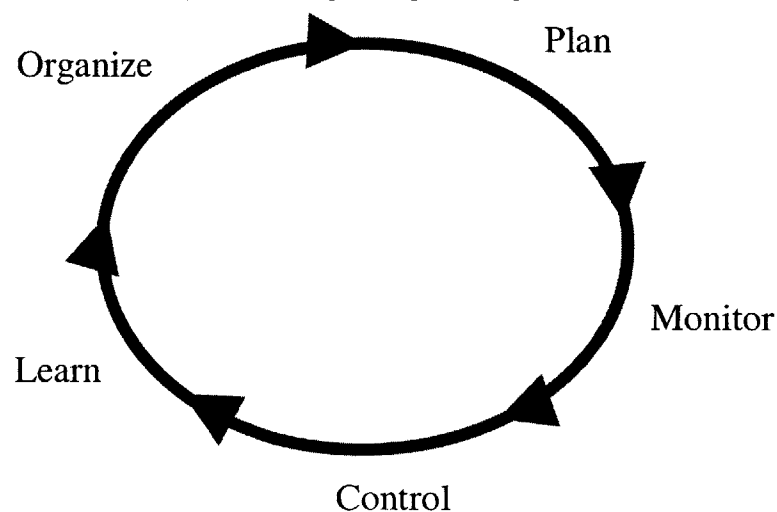


Figure 6. The project cycle and the thesis framework.

More detailed, the organization of this thesis is based on the framework shown in Figure 7. The material is divided into five major sections: project organization, project planning, project monitoring, project control, and post-project learning. In what follows, we describe, in some detail, the material covered in each major section of the thesis.

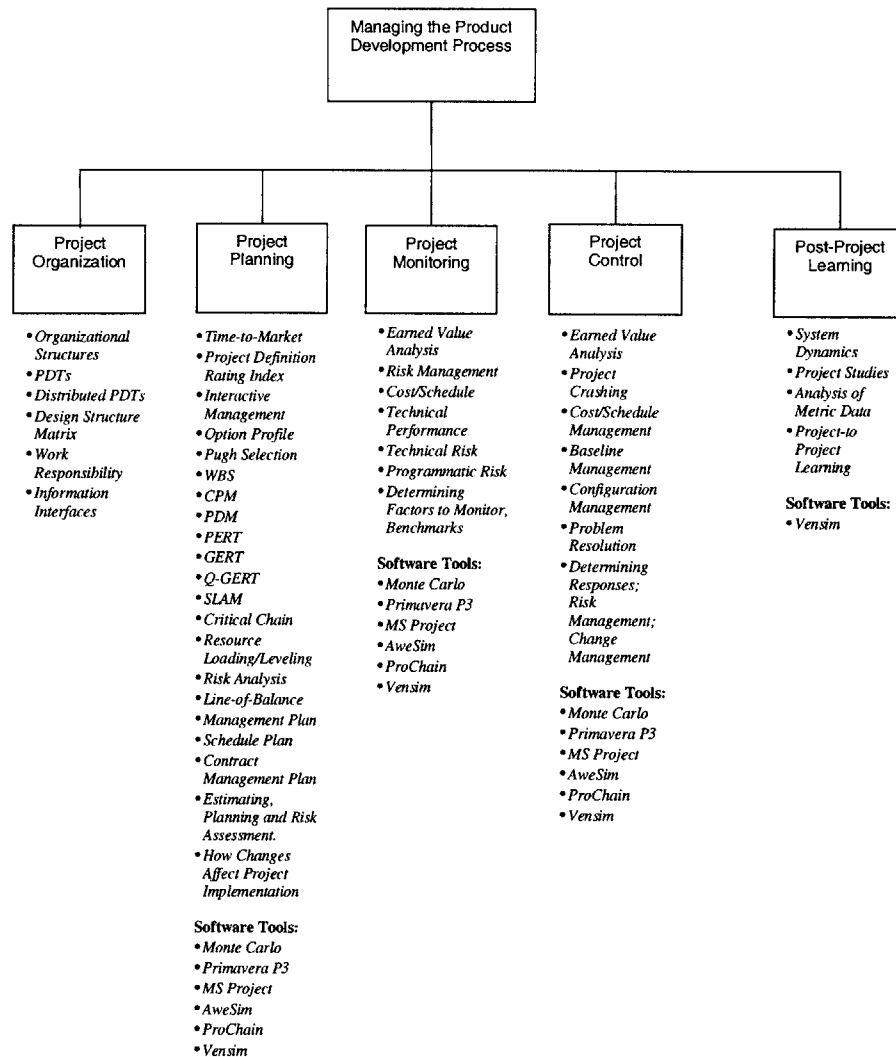


Figure 7. The OPMCL Framework.

Project Organization

Project organization involves selecting an appropriate project organizational structure and establishing the Organizational Breakdown Structure (OBS) for the project. In this phase the hierarchy, the responsibilities and the reporting channels are determined as well as teams are formed and assigned to the tasks. The project organizational structure should be selected due to the company's culture and experience, the environmental issues, the degree of project complexity and the conflict resolution mechanism. The project should be staffed, the project manager should be selected according to his/her skills and the project requirements and the environment in which the project operates.

Specific methodologies for this phase include: Organizational analysis and characteristics, culture of organization, environment domain, organizational requirements, types of organizational structures, organizational design, project manager and teams characteristics, conflicts and negotiations and software programs used for project organizational design.

Project Planning

Project planning involves establishing the Work Breakdown Structure (WBS) and mapping this structure to the established OBS. Furthermore, a project budget and Cost Breakdown Structure (CBS) are developed and mapped to the OBS and WBS. The planning phase also includes establishing an appropriate timeline for the project within the context of organization resource constraints.

Specific methodologies for this phase include: Project Definition Rating Index (PDRI), Interactive Management (IM), Option Profile, Pugh Selection, Critical Path Method (CPM), Line of Balance (LOB), Precedence Diagramming Method (PDM), Program Evaluation and Review Technique (PERT), Graphical Evaluation and Review Technique (GERT), Queue Graphical Evaluation and Review Technique (Q-GERT), Simulation Language for Alternative Modeling (SLAM), Management Plan, Schedule Plan, Contract Management Plan, Estimating, Planning and Risk Assessment, Resource Loading/Leveling, Critical Chain Planning and How Changes Affect Project Implementation.

Many software tools such as MS Project (Microsoft Inc.), Primavera and Monte Carlo (Primavera systems, Inc.) are available to the project manager to help plan the project as well as provide performance reports for Project Monitoring (see Project Monitoring below).

In addition, all projects include some level of risk: schedule risk, cost risk, technology risk, and the like. Thus, during the planning phase of a project, risks must be identified, quantified, and plans to manage the risks must be established. To help manage project risks, this thesis will consider various quantitative techniques.

Project Monitoring

Project Monitoring refers to the system used to monitor the progress of a project throughout its life. Particular questions of interest to the project manager, which are addressed in this chapter, are: Is the project progressing according to the schedule? Will the project be completed within the allocated budget? Will the product perform as expected?

Earned Value Analysis is one project management tool that could be used to help answer these questions. In addition, reports based on the organization and reporting structure established previously as well as focused and scheduled review meetings could be greatly beneficial.

Specific methodologies for this phase include: Earned Value Analysis, Risk Management, Cost and Scheduling, Technical Performance, Technical Risk, Programmatic Risk, Review Methodologies, Determining Factors to Monitor Benchmarks.

Project Control

Based on the information gathered through the Project Monitoring system, corrective action may be required to keep a project on track. The Project Control chapter describes techniques to help realign projects that have gone awry. Corrective action may be needed in many areas such as project scope, product performance, project schedule, and project budget. Thus, Project Control also requires a clear trace as to when and how changes are made to baselines as well as a clear understanding and documentation of product configurations. To provide exposure to these techniques several case studies are used.

Specific methodologies for this phase include: Earned Value Analysis, Project Schedule Crashing, Cost and Scheduling Management, Baseline Management, Configuration Management, Problem Resolution, Determining Responses, Risk Management and Change Management.

Project Learning

Post-Project Learning is an important area for future projects. Through a post-mortem analysis, the project manager may identify areas to be emphasized or more closely managed in future projects.

Such areas include: project audits, project termination and learning on projects. In the project audits and the project termination chapters, we will present the characteristics of these issues and their importance on the post-project learning process. In the learning process, we will analyze the systems thinking and the application of system dynamics.

In recent years, simulations have been used as a valuable methodology for learning in management. In this chapter, we will introduce the System Dynamics simulation methodology through the use of the Vensim software tool to help project managers understand more about the behavior of projects.

Thesis Organization

The organization of the thesis offers different ways of approaching the subject of project management. The concepts can be studied separately or as a whole. The software applications are an extension of the theory and the case studies give the chance for more detailed and applied learning.

This thesis is intended for professionals, project managers, educators, students and organizations that are either already implementing project management or intend to introduce it to their practices. The benefit is that this thesis follows a structured and inclusive approach unlike other publications that are specialized on only some of the subjects. Professionals will approach systematically project management by recalling and systematically organizing their knowledge with the help of the thesis framework (Figure 8). Students will have the ability to start from the thesis framework and deepen their knowledge as they go through the detailed and condensed theory and the real examples given by the case studies. Organizations will have the ability to evaluate the contribution of project management to their operations and either adopt it if they have not done so yet, or enhance it.

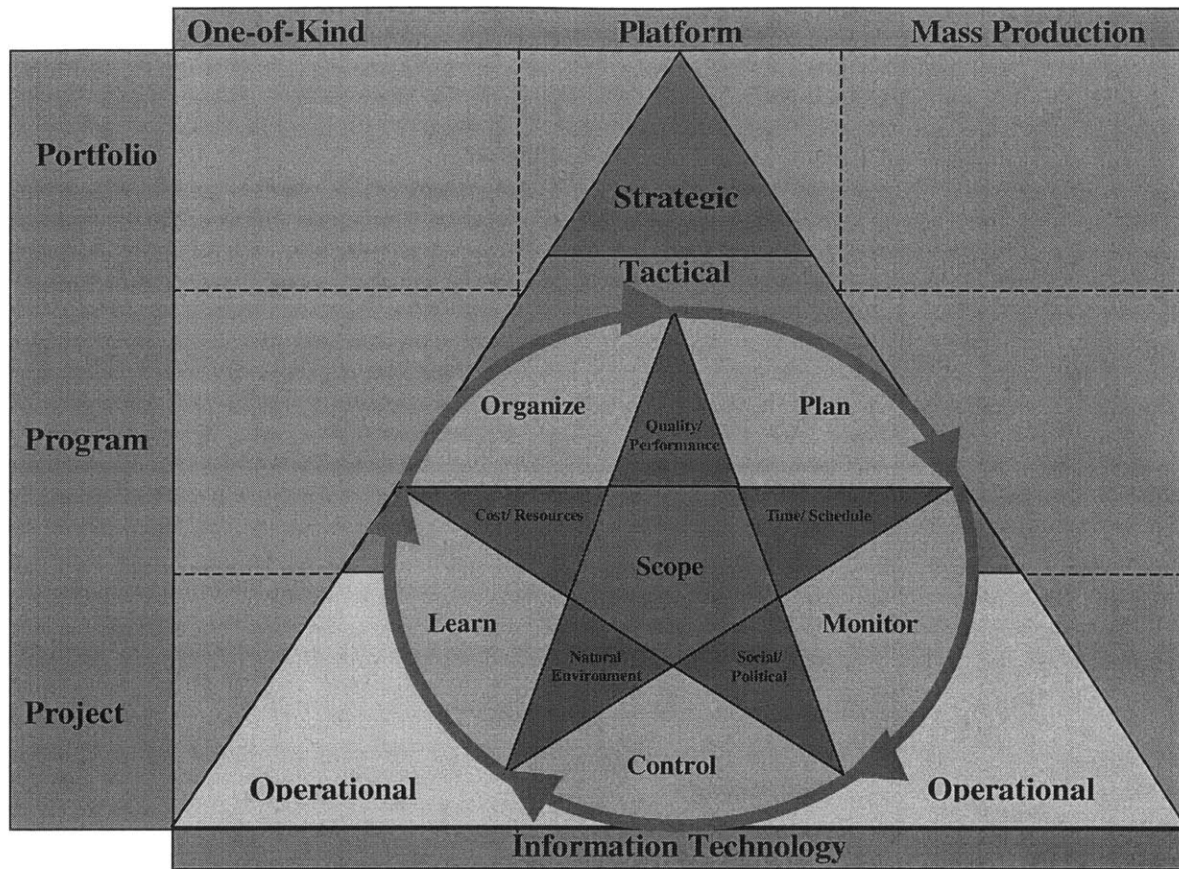


Figure 8. System and Project Management.

PART I

DEFINITIONS

DEFINITIONS

CHAPTER

1

The purpose of this thesis is to make the reader understand the principles of Project Management as they apply to complex projects. In Part I, we will present the definitions of the main components of a project management framework in the various managerial levels and within the project ecosystem. We will define the different types of projects, the life cycle of a project, the managerial levels that influence the development of a project, and finally the thesis perspective on system and project management.

1 THE DEFINITION OF A PROJECT, PROGRAM AND PROJECT PORTFOLIO.

A project is a series of activities required to achieve a goal following a logical sequence, with defined standards on quality (specifications), on a specific budget (cost) and on a specific time within the context of a socio-political environment and in harmony with the natural environment.

A program is a group of related projects managed in a coordinated way to obtain benefits not available by managing them individually. These benefits may include the use of the economy of scales, the better utilization of the human resources and the knowledge transfer among the various projects. Usually the smaller projects are part of the “big project”. An example coming from the automotive industry is the development of the various parts of a new model. Here the subprojects are: the development of the motor, the electrical system, the design of the chassis. All these subprojects contribute to the program that is the development of the new car model.

Portfolio of projects is a series of usually non-related projects managed together from the same company to increase efficiency and learning from one project to another. These projects may vary as of geographic location, scope and many times by the nature of work. As in economics, the portfolio allows for a wide range of projects with different characteristics and risks usually non-correlated. For simplification reasons in this thesis we will analyze the core unit of these three categories that is the project. Then where some conclusions do not apply to all the categories, they will be highlighted and explained on how it applies to a program or a project portfolio.

THE PROJECT MANAGEMENT ECO-SYSTEM

Companies or teams undertake projects with a specific function to be performed by each member depending on the scale of the project and the major objectives that need to be met on the project. For example, the production of a new car requires the design of the mechanical parts by the design engineers, the delivery of material from the suppliers, the financing and the market analysis from the business personnel, the distribution network analysis and the production chain by the logistics department. Thus, there are many factors that play a very important role in the implementation of a project. The main five parameters that every project has to meet are the quality, the cost, the schedule, the environment and the socio-political factors. Figure I-1 shows the five dimensional objectives of a project. We will call this simplex of project factors “the eco system of the project”. Many professionals put weight on the cost, the schedule and the quality

underestimating the other two variables, the natural and the socio-political environment. This perspective may lead to wrong conclusions and decisions for the project that may impact negatively its progress. Let us now concentrate on the nature of a project.

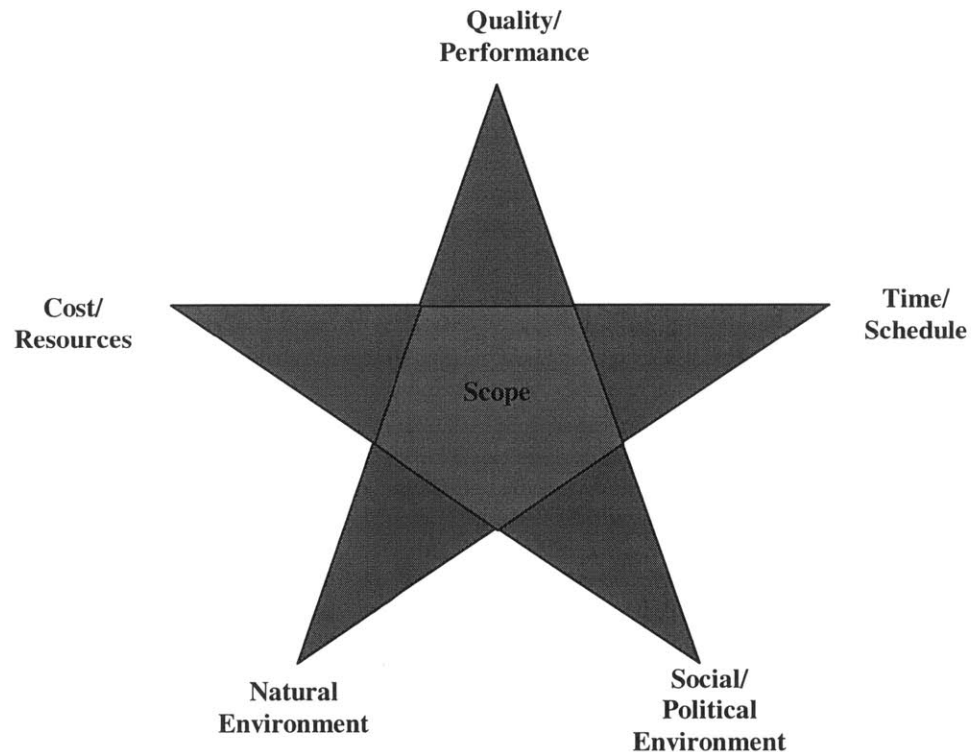


Figure I-1: The Five Factors of a Project. Project Eco-System

A project aims at developing a product or process, which sometimes are unique, and needs to be developed within a certain amount of time. Projects may be unique even in the case of two projects that have exactly the same characteristics, specifications and outputs, they may take place in different time frames or they may be executed by different people or even by the same people with a greater experience from the previous project. Of course there is often a difference in the price of the raw material or the wages. Projects are temporary endeavor since every project has a beginning and an end even if it lasts for a long time. One of the key issues is that when the aim is achieved, the project team is reorganized and reallocated to other projects. Thus, that task needs to be planned for in order to achieve the best learning possible for the organizations.

Projects are temporary endeavor

THE TYPES OF PROJECTS

Projects exist in every industry even if the industry is not project driven. In previous years when we talk about projects, aerospace, defense and construction projects come to mind. Now, projects are formed in every industry from management, financial to software, manufacturing or construction. Those can be categorized into the following three categories:

- *one-of-a-kind,*

- *mass production*
- *and platform.*

One-of-a-kind are the projects that are custom to each occasion, for example construction projects. Each project has its own structure, design, and methodology. The next project may have similarities and the same methods used but it will also be a unique project. Mass production projects are these that are repeated in many cycles (routines) or are generated as a derivative of another project; for example, car improvements after original job/ production in the automotive industry. The same process is followed in cycles. Platform projects are these that share some of their functions and structure; for example, different car brands made by different manufacturing companies using the same chassis. In the next session we will define the project management as a tool for the better implementation of the projects.

2 THE DEFINITION OF PROJECT MANAGEMENT

Project management is the application of knowledge, skills, tools and techniques to project tasks in order to achieve a successful project implementation that complies with the customer needs and provide rewards and profit for the people and organizations involved. It includes organizing, planning, monitoring and controlling the organization's resources. The three objectives that a project manager should have are: to meet the specific performance of a product or process within the budget, time and environmental (social, political and natural) constraints.

This definition stresses that project management is a branch of management that deals with projects. As we will see further, project management deals both with the strategic, tactical and operational management of projects. Strategic because the project manager or the head of the organization sets the goals and the missions of the organization and the projects. Tactical because the assistant project manager or the supervisors set the way the tasks will be executed and what resources will be allocated to each of the tasks. Operational because the engineers make decisions about the operations of the teams and the systems that are used in the project for an efficient and effective implementation.

Project management as a tool for a better implementation of projects involves:

- | | | |
|---------------------|---------------------|-------------------------|
| 1. Scope definition | 7. Scheduling | 13. Change control |
| 2. Team building | 8. Monitoring | 14. Negotiation |
| 3. Planning | 9. Task execution | 15. Conflict resolution |
| 4. Cost Estimating | 10. Problem solving | 16. Decision making |
| 5. Innovation | 11. Communication | 17. Leadership |
| 6. Meetings | 12. Controlling | 18. Learning |

The project manager will meet most of these processes during one project, depending on its duration and its scale. In this thesis, we will cover all of the above

factors and we will see what kind of performance is needed in each of them as to have excellence in project management and successful projects.

The quality of project management on a project is one of the most critical factors for the project success. By the term successful project we mean the project that will be completed on time, within budget, at the desired level of quality, meeting the environmental and socio-political constraints and also be accepted by the customer. Top companies have also another criterion for successful projects. The customer has not only to accept and approve the project, but also refer the company to other potential customers. Thus, creating a reputation for repeated business is also important.

3 LEVELS OF PROJECT MANAGEMENT.

Project management can be categorized into three levels: the strategic, the tactical and the operational. There are two points of view, the company perspective and the project perspective.

In the company perspective, the strategic level is the senior management that can be the vice president of the division developing the projects, while the tactical level is the project managers that are accountable for the projects. At the operational level the assistant project managers, the schedulers and the engineers make the decisions on how the project is developed. Figure I-2 shows a typical project management hierarchy from the company's perspective for a construction company.

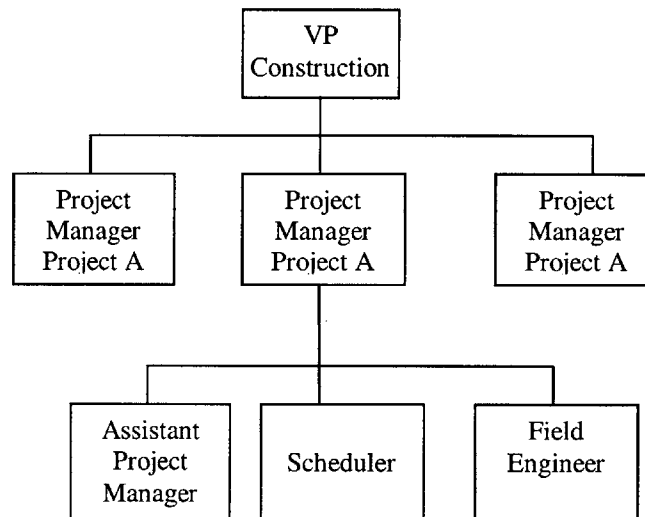


Figure I-2. The levels of project management from the company's perspective.

From the project's perspective, we shift one level down. The reason for that is the boundary settlement. In the project perspective, the strategic level is the project manager that makes the strategic decisions for the project development. As an example we mention the project manager decision not to have any accidents during the project implementation. The tactical level belongs to the schedulers and the supervising engineers who make decisions on the approach to be taken to achieve the objectives.

Then at last is the operational level, which belongs to the engineers who run the day to day operations for developing the project. Figure I-3 shows a typical project management hierarchy from a construction project perspective.

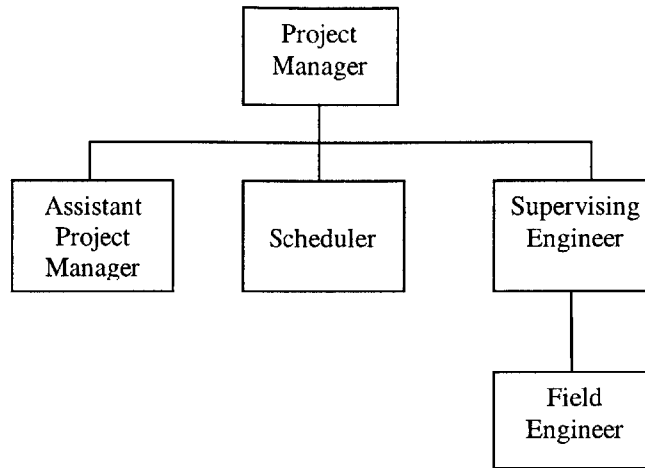


Figure I-3. The levels of project management from the project's perspective.

3.1 The Strategic level

The word strategy has been the center of discussion since Michael Porter came with the five forces concept in 1980's. Strategy is the first step in all of our actions. In the project's environment, strategy involves the scope of the project and reflects the mission and the objectives of the organization for which the project is being implemented. There are many tools and frameworks that have been developed for analyzing and promoting strategic issues. For example, the five forces of Porter's framework could be used for analyzing the strategy that a company or a project should follow in order to penetrate or expand to a new market. This framework includes a spherical analysis of the environment that the potential project will act. The five forces include the barriers to enter including all the difficulties that the company or a potential competitor will face in order to undertake the project or a similar project, the customers' power that is a measurement of the degree of the customers' negotiation power, the suppliers' negotiation power, the substitutes that include other solutions that might skip or alterate the nature of the project and at last the internal scrutiny of the specific company. Adopted to the project management, the five forces compile the environmental scan that is the assessment of the environment that the company or the project will perform. The environmental analysis includes the natural and socio-political environment, the industrial situation, the degree of market fragmentation, the legislature and the market trends. The *barriers to entry* is the evaluation of how difficult is for a new company or a potential competitor to enter the specific area of the market. These barriers may include the overhead, special machinery or the know how of expertise. The *customers' and the suppliers' power* is the degree that these parties can negotiate their buying or selling position. The *substitutes* include similar products that may prevent the initial project to be chosen for execution as they may present similar characteristics or features. The *internal scrutiny* is the company's assessment as of the strengths and the weaknesses. In terms of a project the five forces could be applied to the introduction of the output of the project that may be a product or a service into the market. The five forces could be used to define the scope and the objective of the project and an evaluation of the company's strengths and weaknesses in the various areas. Figure I-4 shows schematically the five forces framework.

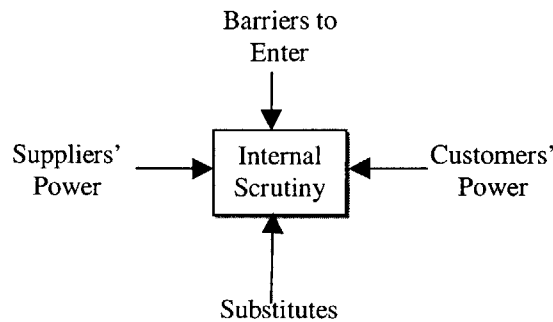


Figure I-4. The five forces framework.

Pena Mora (Information Technology planning framework for Japanese general contractors), has adopted the previous framework in IT project planning concentrating on four steps: The environmental scan, the internal scrutiny, the project management diffusion analysis and the project management investment modeling. The environmental scan includes the analysis of the industry structure and the economic environment and the analysis of the project management situation in the industry. The Internal scrutiny includes the analysis of the organization and the information flow of a firm, the determination for the need of project management and the analysis of projects applying project management in the firm. The project management diffusion analysis includes the way and the speed by which project management will be applied in the company's practices and depends mostly on the levels of training within the firm. The project management investment modeling includes the investment in hardware, software and project management personnel. This framework leads to the strategic planning for project management projects.

As conclusion, the strategic planning sets the objectives of the firms and the projects, defines the scope of the projects and provides the roadmaps for the next levels of management. In the next session we will see the tactical level of the project management.

3.2 The Tactical level

This level of management refers to the middle management. Middle management is the people that support the projects and set the goals for their right implementation. The difference from the previous level of management is that the tactical level does not set the objectives neither conducts the feasibility studies for the projects. The decisions that the tactical managers are making are limited within the already set scope of the project and refer to the optimization of the project performance. An example comes from the construction industry. The strategic level of management has decided after conducting the strategic analysis for a project that they want to bid on the construction of a bridge as a profitable solution for the company. The tactical level of management in this project is limited to the decisions about value engineering or method that will be followed. The middle management will decide whether it will be used steel or concrete for the construction or whether the concrete will be poured on site or will be ordered prefabricated.

The tactical level involves decision making about the execution of the project in contrast to the strategic level that involves project scope issues. In the next session we will see the operational level of the project management.

3.3 The Operational level

This level of project management involves the lower levels of management and is related to decisions about specific parts of the project. The operational level covers the areas of reporting, of scheduling and controlling the project. In this level belongs the field engineers and the schedulers. It is the actual implementation force for the project.

The Balanced
Scorecard

In the past, the connection between the three levels of project management have been difficult. Usually the strategic direction that sources from the strategic management does not pass through all the levels and as a result it can not be fully implemented. One method developed by Kaplan and Norton to address this issue is the balanced scorecard as a strategic management system. The balanced score card penetrates all the three levels of management from the top until the bottom making everybody familiar with the vision of the company. The balanced scorecard relies on four processes to bind short term activities to long term objectives. These are the translation of the vision, the communication and linking, the business planning and the feedback and learning. (Figure I-5)

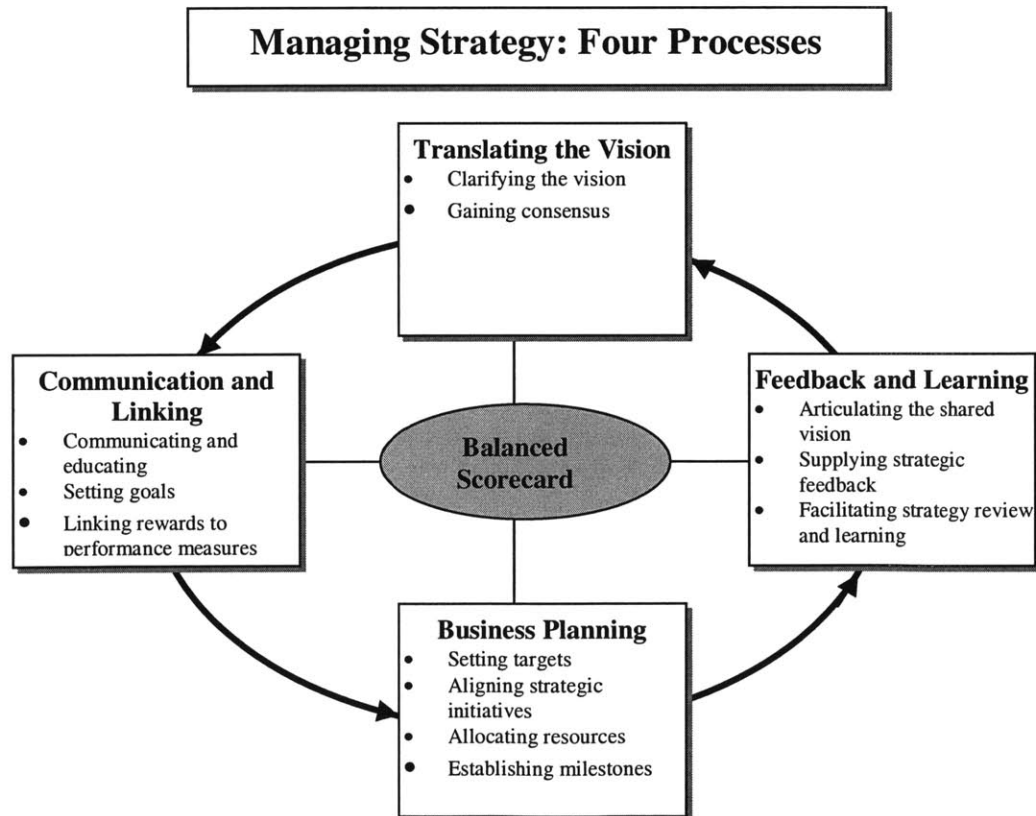


Figure I-5. The four processes of the Balanced Scorecard

In the project level these could be explained as the translation of the project vision/mission, the communication between all the levels of the project management, the

project planning where the most influential drivers are identified and the milestones are set and finally the feedback and the lessons learned that help the organization to adjust its theories or hypothesis or heuristics about the cause and effect relationships. (Figure I-6).

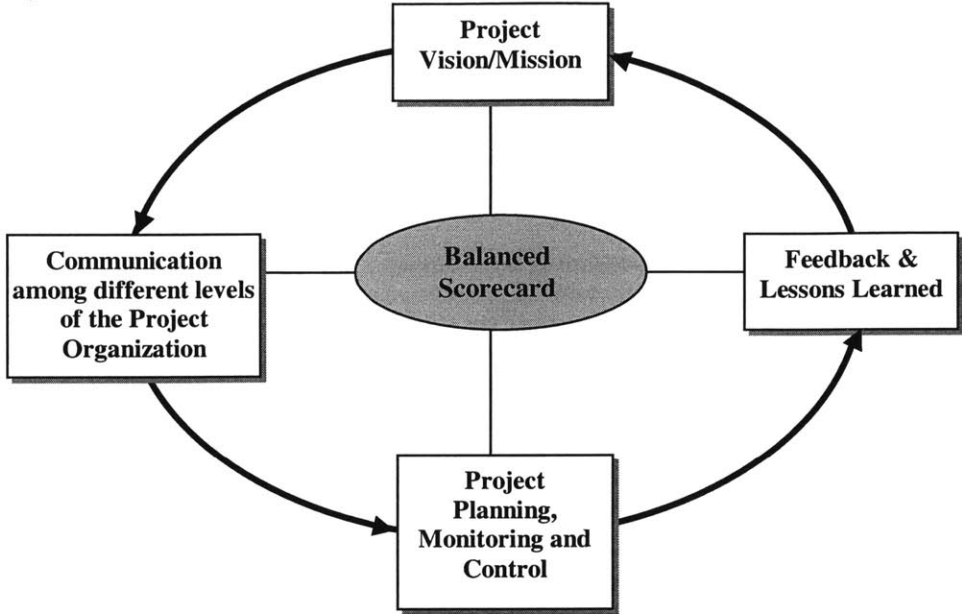


Figure I-6. The adoption of the four processes of the Balanced Scorecard in Project Management.

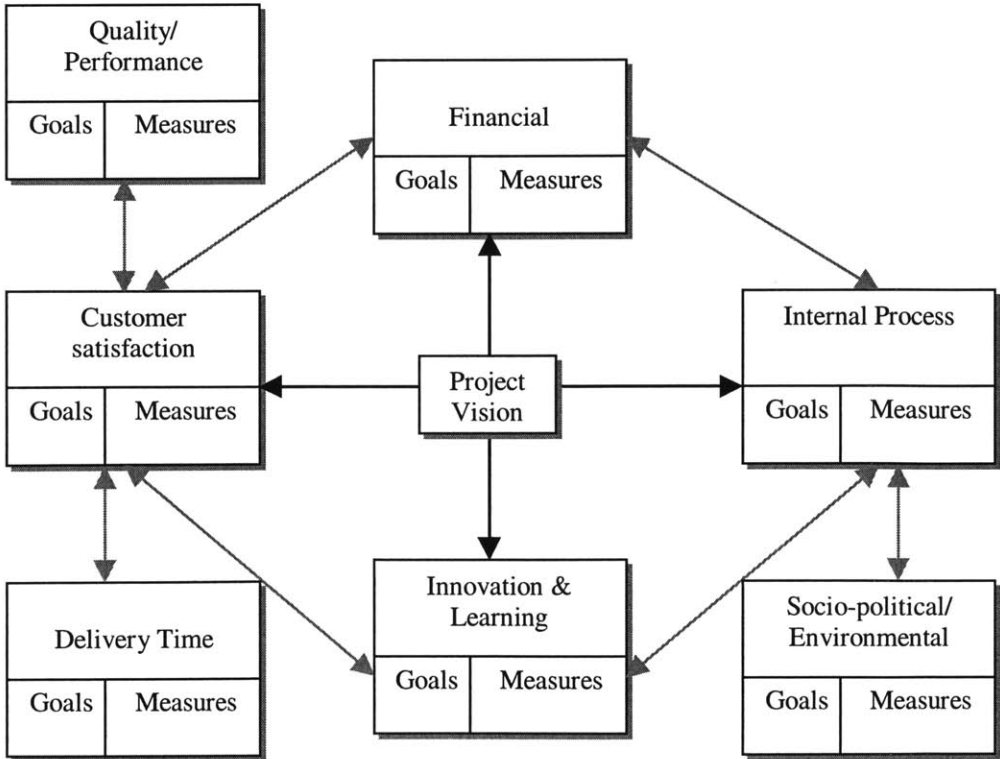


Figure I-7. The Balanced Scorecard in Project Management

In a further analysis, the project vision can be divided into operational and financial segments. The operational measure the customer satisfaction, the internal processes, and the innovation and the improvement activities. Figure I-7 shows the four segments of project vision in a balanced scorecard.

The customer satisfaction is nowadays an important criterion for project excellence since the projects are customer or market driven. This segment of the balanced scorecard should be kept as a measurement criterion all the way down the hierarchy of the value chain for the project. Internal business is the measurement of the internal processes that should be followed for the final result of the project to satisfy the customers and the stakeholders. Innovation and learning is the measurement of the opportunities for the company to grow and the application of the feedback in the to policy making based on the cause and effect relationships. The balanced scorecard makes everybody in the organizational breakdown structure aware of the above issues that the company had set as goals. Of course each level of management has different focus on the project objectives but these are compiling the overall picture. In these cases the personal scorecard should be applied. (Figure I-8)

The Personal Score Card															
Corporate Objectives															
<ul style="list-style-type: none"> • Double the corporate value in seven years • Increase the earnings by an average 20% a year • Achieve an internal rate of return 2% above the cost of capital • Increase both production and reserves by 20% in the next decade 															
Corporate Targets					Scorecard measures					Business unit targets	Team/Individual Objectives and initiatives				
1998	1999	2000	2001	2002	Financial					1998	1999	2000	2001	2002	1.
					Earnings in millions of dollars										
					Net cash flow										2.
					Overhead and operational expenses										
					Operating										3.
					Production cost per widget										
					Development cost per widget										4.
					Total annual production										
Team/Individual Measures										Targets		5.			
1.															
2.															
3.															
Name:															
Location:															

Figure I-8. The Personal Scorecard.

The balanced scorecards are being used successfully by many companies and the bottom line of this method is that the project objectives should flow unbiased through all the organizational levels. In the next session we will analyze the reasons that the projects fail and we will assess the usefulness of project management

4 WHY PROJECTS FAIL?

The word failure is a very heavy definition and has to be well analyzed and documented before it is used. We say that a project failed to meet its requirements. Someone may say that means that a person, or a team or the managers made mistakes or did not have sufficient experience to manage the implementation of the project. This is the one side of the facts. What about if the project goals were not achievable, or could not be met in the specific environment or even an unpredictable change put the project in this category? It is a very common place to make erroneous estimations of the budget, the schedule, the resources required, the quality of work and the socio-political and natural environment. Also there is another category of projects, especially the research and development (R&D) that have not a defined objective as there are great levels of insecurity in the process. Teams working in such projects do not know when the project finishes as they do not know where to stop and what to deliver. Also the customer may have a different perspective of the deliveries and all of this situation creates an interests conflicting environment.

Let us assume that the project scope is clear and that we know the project goals and requirements. These can be from developing a product, remanufacturing an existing one or reducing the operations cycle of a production line. As we will see in Part II, projects involve risk in various forms. Human resources risk, technical risk, change order, social and political risks, natural impact risks, financing risk, market risk are some of the most popular forms of risk in projects. These risks have to be well calculated and taken into account at the planning phase of the project otherwise they may lead to project failure.

Management efficiency and experience is another critical factor that may lead the project into failure. The skills of the managers, the systems they use for project management and the ability to take successful decisions, define the project status. Inexperienced project management in projects that involve high risk could be fatal. Utilizing the resources, human and material is also very important for success. Although we describe here how the project manager should be, we should also mention that project managers belong to the middle management and most of the times they do not have enough authority. The successful project manager should in these situations use his/her influence to get things done.

Conflicts that may arise in various stages of the project or unresolved matters from previous stages may suspend the project or even cancel it. There are many cases that small disputes and differences that were underestimated by the team members, led to litigation with all the consequences of loss of money, delays and bad reputation for the company.

In the next chapter, we will present the life cycle of a project that is the physical cycle from the time that the project is conceived, until its completion. It is very important for the project manager to understand the life cycle process of the project so that he/she will be able to manage it better.

5 THE LIFE CYCLE OF A PROJECT

Like human beings, projects have a beginning and an end. These two segments of time may be very close, but also they may be very dispersed.

The development phases of a project work plan can be represented as in Figure I-9. First, we have to define the project. The *project definition* includes the feasibility studies to establish if the project will be useful to the owner by adding value or bringing a satisfactory return on investment (ROI). It also includes the project manager's initial review if he/she is already involved in the project at this initial stage and the owner's orientation meeting in which the process, the relationships and supplementary requirements will be discussed. At last this phase includes the definition of the project scope and the setting of the budget and schedule under which the project will be implemented. The clearer the scope is the less conflicts and problems the project team will face on the way.

The second phase, *project framework*, includes the breakdown structures. These are the charts that show definitions, relationships and sequence of the tasks and the teams or individuals involved. The work breakdown structure shows the tasks to be done, the sequence and the prerequisites needed. The Organizational breakdown structure shows the physical members involved in the project, the lines of responsibility and command, and the channels of communication between them. The cost breakdown structure shows the analysis of the costs and which are the major costs in the project process so that the coordinating people can watch them more closely. In this phase, we also have the project team that has already been selected and assigned the responsibilities.

The next phase, the *project scheduling*, includes the very important issue of organizing the tasks, the resources and the cost in an optimal way for the company and the project.

The fourth phase is the *project tracking, evaluation and control*. *Tracking and the evaluation* of the project are examining the degree that the plans have been followed. The process includes the tracking and the record keeping of the work that has been done, the time in which has been done and its cost. It also includes often evaluations of project status, a continuous analysis of project trends that may not be constant until the end of the project and a forecasting of cost and schedule remaining until the completion of the project. The project control includes the corrective actions that are taken in order to bring the project back or close to the planned way.

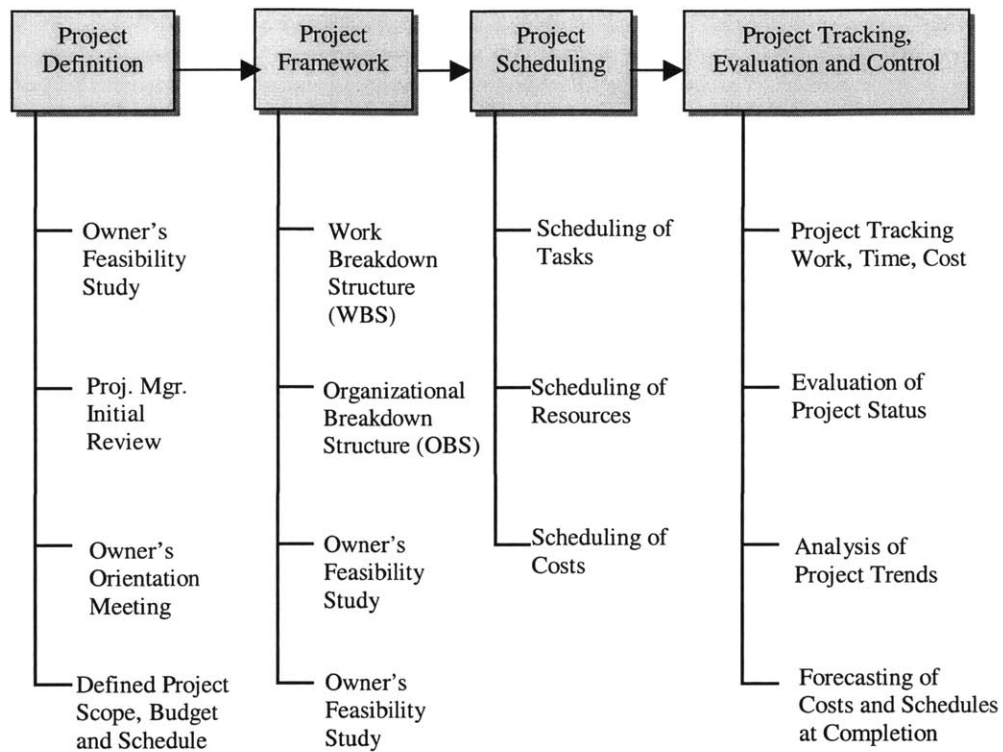


Figure I-9: Phases of Development of Work Plan.

This framework defines well and with a lot of detail the phases of development of work plan. However it does not include the whole ecosystem of the project but it concentrates only on the cost, time and resources matters leaving outside the very important issues of quality control, natural environmental and socio-political affects due to the project development. In addition, in terms of process it doesn't include the usability and the benefits from the lessons learned by examining the cause and effect relationships and applying the policies to the next project phases or to future projects.

Another approach for project management is the one recommended by the Project Management Institute on its PM Body of Knowledge (PMI 1996). The Project Management Institute defines processes as being able to be partitioned into five main process groups: initiating processes, planning processes, executing processes, controlling processes and closing processes. Figure I-10 shows how these project management process groups are interrelated.

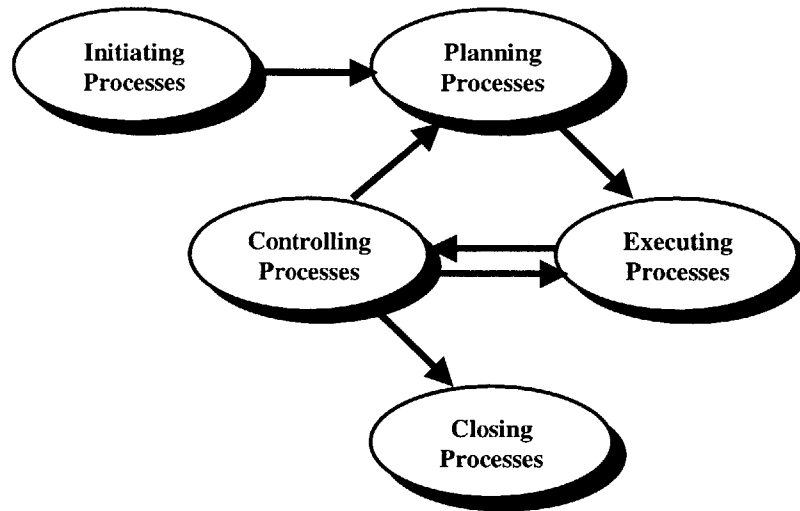


Figure I-10: Links among Process Groups in a Phase (PMI 1996)

Relationships between the process groups illustrate how the outcomes of a process affect another process. Planning, controlling and executing processes are constantly affected by each other's results. Hence, planning, controlling and executing processes occur concurrently (concurrent engineering). This happens when we want to reduce the total time of the project by starting the executing processes and the controlling ones before the planning processes are totally finished. In contrast, initiating processes just provide inputs for planning processes, and closing processes solely receive outputs from controlling processes. Thus, initiating processes occur at the beginning of the project life cycle, while closing processes occur at the end. This is a more comprehensive approach for project management in terms of phases, however it is more general. In Session 5.1 we will present the different stages of the life cycle of a project and the percentages of the project completion that correspond to each of the phases.

5.1 The different stages in the life of a project

To illustrate how project management processes succeed each other during the project life cycle, Figure I-11 shows a representative construction project life cycle according to Morris (1981). Morris includes the whole project cycle from the born of the time the idea is born, the project gets its "go" decision, the project is initiated, executed and in full operation.

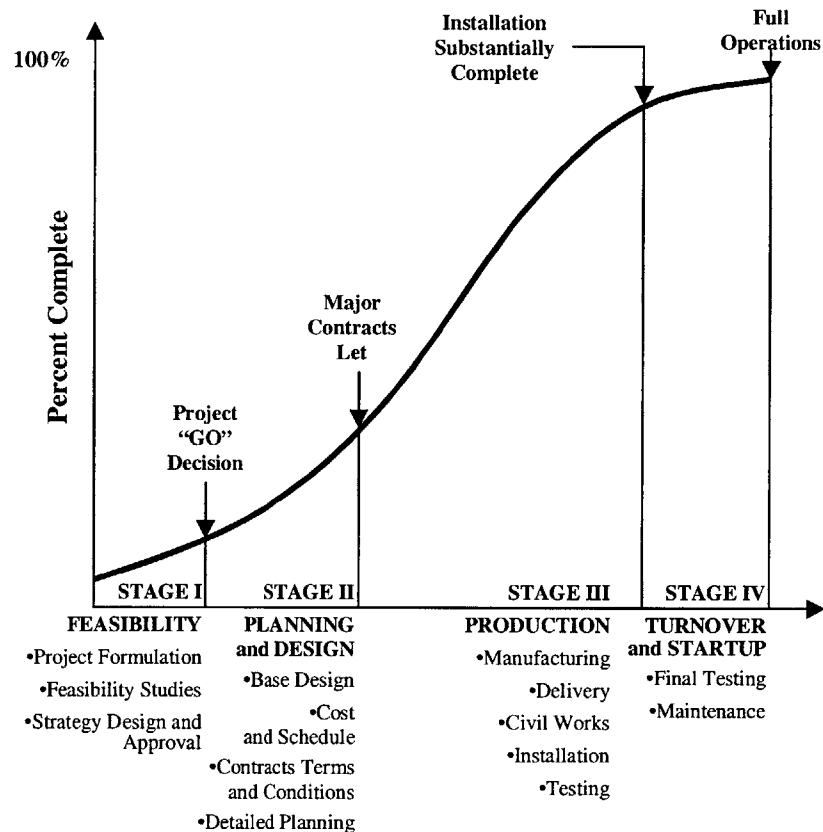


Figure I-11: Representative Construction Project Life Cycle (Morris 1981)

Figure I-11 relates to the PMI processes such that Stage I corresponds to the initiating processes. Stage II initiates the cycle of planning, executing and controlling processes. The beginning of Stage III represents the first move from planning processes to executing processes. Then, as production progresses, controlling processes use outputs from executing processes to provide new inputs to executing processes. Eventually, major changes may require going back to planning processes and cycle again around the loop of planning, executing and controlling to lead the project to its termination. Eventually, Stage IV corresponds to closing processes.

Another more detailed and comprehensive approach to the project life cycle steps is presented in figures I-12 and I-13. They give us more detailed descriptions of project management processes. The representation of the Project Management model from Adams et al. (1999) on Figure I-12 is specifically designated to incorporate the five process groups defined by the Project Management Institute Body of Knowledge (PMI 1996, Figure I-10). More specifically the dotted line shows the boundaries of the project process. Outside, from where these are the different kinds of management needed for each process. These are communication, human resources, risk, procurement and quality management. Inside, there are the five process groups as described before in Figure I-10. The *initiating process* that takes place always at the beginning, includes the request for proposal, the data collection, a rough estimation of the scope, the schedule and the cost of the project and a preliminary definition of the tasks and the formation of the group. The *planning, controlling and executing phases* come after the initiating one. They can take place one after the other or simultaneously as we described before. The *planning process* includes the complete definition of the scope, and more accurate and complete definitions of schedule, tasks and cost. The executing phase includes the implementation of the

project tasks under the time, quality and schedule constraints. The third process of this group, controlling, comes during the executing one and includes reports and evaluation of the status of the project. The reports show the progress of the project, and whether the quality, schedule, the cost plans are being followed. The report is then evaluated, the results translated to delays or budget overruns, and proper action taken to bring the project back on schedule. The last process, the closing or termination, includes the close out of the project, the evaluation of the difficulties and the solutions and provides lessons learned for future projects for the company.

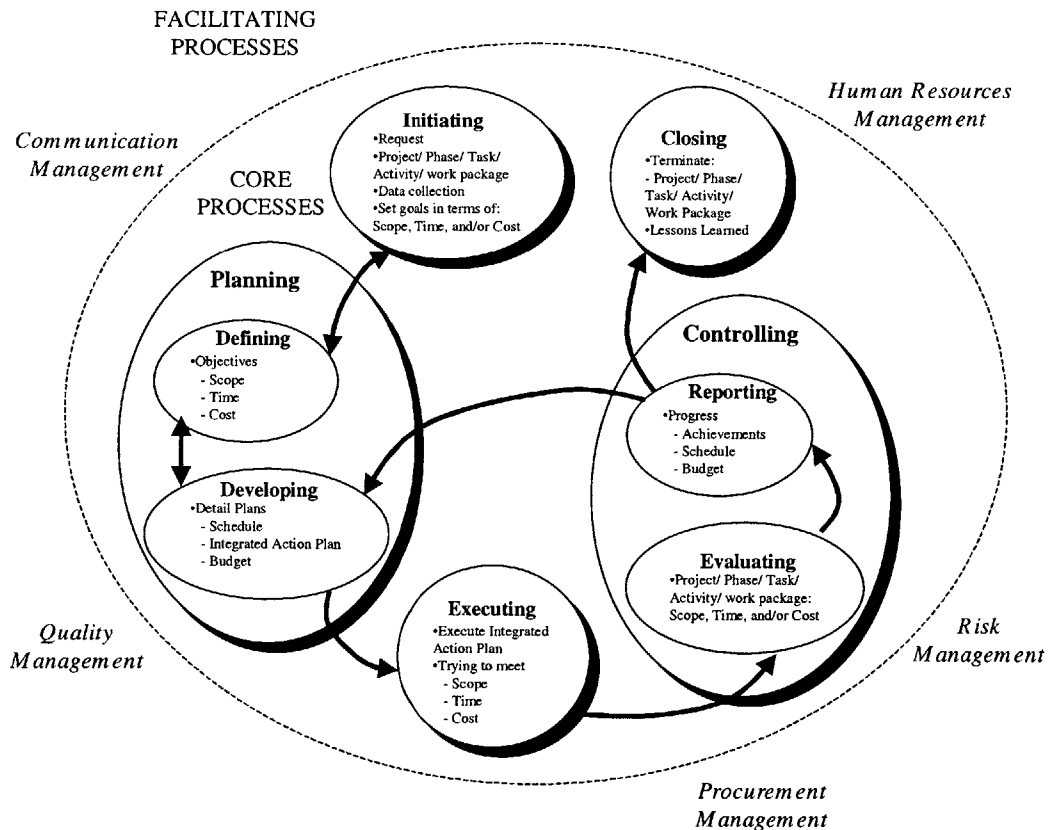


Figure I-12: Five Process Groups Project Management Model (Adams et al. 1999)

In Figure I-13, Badiru et al. (1995) propose an alternative project management process model that can also be related to the process groups defined by the Project Management Institute Body of Knowledge as follows:

- Problem Definition and Mission Statement for the Initiating phase;
- Planning, Organizing, Resource Allocation and Scheduling for the Planning Phase;
- Tracking, Reporting and Control for the Controlling phase
- Termination for the Closing phase

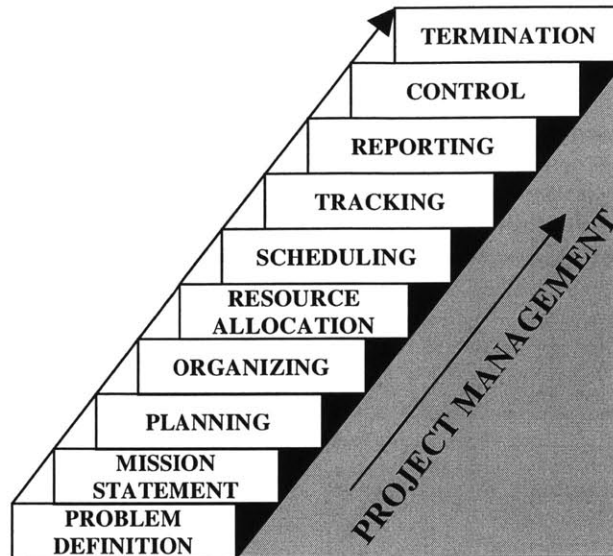


Figure I-13: Project Management Steps (Badiru et al. 1995)

This ladder represents the project management of a project from the beginning until the end and helps the people involved to understand the sequence and importance of all of the elements. Many companies do not include the final element, the termination and the lessons learned. In the long term, such firms will incur losses as they will repeat the same mistakes and will not improve their processes and the efforts to reduce their costs. In the following session we will present an effort of many companies to reduce the cost for their projects and increase the revenues by reducing the life cycle of a project and deliver it faster to the market.

5.2 Efforts to reduce the life cycle

Because nowadays the market, the technology and the communication processes change rapidly, both the customers and the companies try to reduce this life cycle of the project. The customers because they invest their money on the project and they want to operate it as soon as possible so that they start having income from this investment. The companies also want to finish the project earlier for many reasons. Some of the reasons come from strategic goals and some other from operational. Strategic goals include the mission of the company to finish the projects so that they can collect their fee and move to the new ones and to build a good reputation in the market. Operational reasons include the desire to have a solid team through the whole process of the project so they eliminate the number of the personnel that is changing and replaced due to retirements and personal reasons. This leads to lower need for training the new staff on the project and consistency in the policies and the quality of the work. Other operational reasons is the avoidance of the frequent changes that are asked from the customer or the market as needs that the project is designed to cover change dynamically and the avoidance of the risk and the contingencies that come from the project environment.

The actions that should be taken to reduce the life cycle vary in different case. The mostly used are:

- **Minimize the rework:** It is very well known that the work that does not meet the specifications and the quality requirements has to be done again. This is called rework and many times it reaches very high levels. It not only

increases the budget for the company and the delivery time but many times prevents the following tasks to start or to be completed. Rework also affects the morale of the project team as well as the customer and as a result we have further reduced productivity and further mistakes from the project team side and complaints and disputes from the customer side. The solution for the elimination of the rework is the very well planning from the beginning, the right evaluation of the risk factors and the contingencies, the correct team selection, and the close monitoring and controlling of the project.

- Adapt concurrent processes: Concurrent process means the overlapping of the project phases. For example before the planning is completed in detail, the order of the raw material and the manufacturing process can start. This overlap requires strong and experienced project management techniques as well as a good feedback channel.
- Add value at each of the milestones: In every project there are tasks that may be supporting or even hidden, although they are essential. Many times the customer that does not understand the utility of these tasks and so does not consider progress. An example can be the ordering of the raw material of a building that for the customer does not offer a progress compared to the completion of the skeleton of the building. Every step in the work sequence should add value to the customer or we should try to eliminate it.
- Improve quality and delivery time of raw material: material with no good quality or long delivery times are many times the cause of long project cycle times as they create rework and delays. The improvement in the raw material standards require credible suppliers and a accurate quality control. It can also be effective by introducing the latest technology and connecting online the suppliers with the main office of the project with the use of the extranet. With this technique blueprints, specifications, orders and receipts can travel fast and also can be filed and handled efficiently.
- Minimize the changes: Changes and change orders can be made by the customer. The term customer is a general term and means the entity that will deliver the project. Customer may be a physical person or organization, a group of people in the market that the project attend or internal departments in the company. Market trends and customer needs may change from time to time due to customer maturity or competitor's improvements or change of customer status. Changes may create small troubles for the project or even its cancellation. The reason is that they change the sequence and the regular flow of the project and they create delays and additional costs. It is very common in the construction industry the phenomenon of exchanging decades of papers for a change to be made and reimbursed. The project team should minimize the existence of the changes by designing every detail of the project and by giving last notices of phases completion after which changes will not be aloud.
- Eliminate the bottlenecks: these are the parts of the project that have a difficult flow. An example is the approval by the authorities or a quality test by an institute. There have to be found ways and mechanisms that may reduce this lag time or activities that could be running parallel to these tasks for the life cycle elimination.

- Improve the communication and the feedback channels: communication channels exist among all the involved parties. The most important are the decision channels, the suppliers channels, the communication among the cooperating departments and the project manager – customer channel.
- Reduce as high as possible the project impacts to the natural and the socio-political environment. We know that in general there is a big amount of inertia and unacceptability when we try to alterate permanently or even temporarily the features of the socio-political or the natural environment. For example the construction of a building might cause the noise levels increase or the traffic deviation in the surrounding area that will have negative impact in the peoples' attitude. In order to decrease the project life cycle and the probable disputes that will delay the project, proper actions and precautions should be taken well in advance.

5.3 The OPMCL Method in Managing Projects

After presenting several general descriptions of project management processes, the next session introduces the OPMCL method as a way to manage projects from a project manager's perspective. OPMCL stands for Organizing, Planning, Monitoring, Controlling and Learning. Figure I-14 presents the overall OPMCL method and presents different components associated with it. We believe that this categorization of the main process of project implementation, will help the project manager and the team members to see the differences between the identical project stages processes and work under this frame more efficient. OPMCL framework is a hands on approach that focuses on the project itself and the decisions that are taken in the tactical and the operational management levels.

This method deals clearly with the operation design and implementation of the project. It comes after the scope and the mission of the project is defined and stops with the completion and delivery of it. Also it introduces a new element that examines it more in depth, the project organization. This is how the organization should be structured for the most effective results.

Strategic design involves factors as feasibility analysis, market analysis, setting targets for the project, analysis of the competitors, set the company's competitive advantages related to the project, invest and finance the project. This is the beginning of the definition of the Project Scope.

Operations and lifecycle support are all the activities that are needed for the project to be operated and maintained. These include training of the users, technical support, maintenance of the system and repairs or replacement.

The two above parts of the lifecycle of the project will not be discussed in the material of this thesis. Our focus will be in the system design, the detailed design and the development/ fabrication. System design is the software and hardware architecture that will support the project implementation. Detailed design includes the specifications, the budgeting, the scheduling, the reporting process, the organizational and the work breakdown structures. Development and fabrication is the execution of the project until the final delivery to the customer.

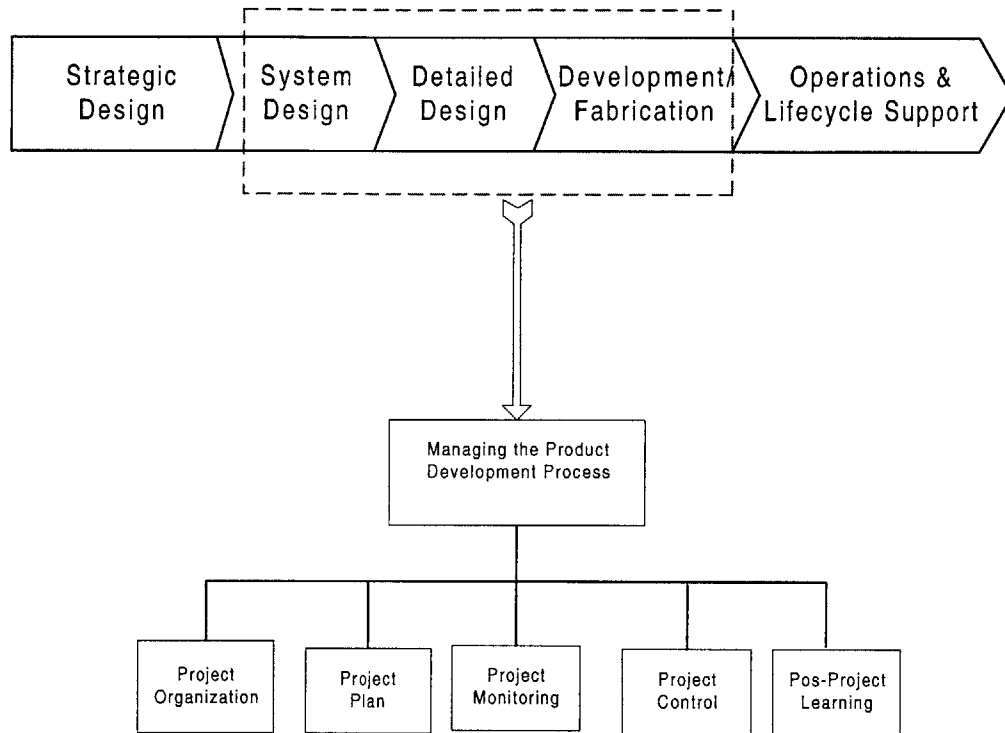


Figure I-14: Project Management Components (Peña-Mora et al. 1999)

For these three phases in the life cycle of a project we have developed the OPMCL framework. The OPMCL method covers the process groups of initiating, planning, controlling, executing and closing of the Project Management model of Adams 1999.. The rationale behind this is that the OPMCL method takes the perspective of project managers. Project managers usually do not necessarily participate in the strategic decision of undertaking the project because they are appointed at the end of the “Initiating” phase. Similarly, the actual accomplishment of the work is incumbent upon the contractor and subcontractors but does not require the direct involvement of the project manager.

The five categories of the OPMCL method serve as a basis to breakdown the structure of this thesis. Only the two of the OPMCL method components will be presented in Part II and Part III of this thesis. The Project Organization and the Lessons Learned respectively.

At the end of each part, case studies are presented from different industries related to and classified with the OPMCL method.

PART II

PROJECT

ORGANIZATION

INTRODUCTION – DEFINITIONS

The Definition of an Organization

Nowadays with the use of information technology, the need for better quality in less time and the existence of a strongly competitive environment, the projects require more specialized people to get involved. The profit margins have become narrower for the companies. The stockholders are reluctant to invest in industries or organizations that have a probability of cost and/or time overruns as of the existence of a lot of contingencies in their projects.

Information technology gives everybody access to information in a rapid way and allows the “buyers” to be continuously informed about the changes and the tendencies of the market. Also the “sellers” have to be continuously updated because of the competition as well as flexibility/ responsiveness to changes that in some markets occur very frequently.

Mergers and teamwork is the phenomenon of our time in almost every industry especially those that depend on information systems. Nowadays requirements have made almost impossible for individuals or for fortune hunters to enter into this environment. These are the demand for better quality, the competitive cost and time constrains, and the need for continuous changes or updates. All these affect the whole supply chain that participates in the implementation of the project and as a conclusion good organization is needed for the successful delivery of projects.

We will call an *organization* the system of individuals who need to work together in order to execute a project or a series of projects. This system will convert the raw materials into products or services, as we will see below.

In general an organization can be a company or a merger, a partnership, a joint venture or even a working team.

Organizational Structure

For the organization to have a good performance, it needs a structure. Structure is the set of formal relationships established in a team to execute a set of functions for a project. The structure and more specifically the organizational breakdown structure, that is a chart with levels of hierarchy and sectors of common characteristics, shows who is responsible for which task and to whom the customer or the organizational employee should go for problem resolution. The organizational breakdown structure (OBS) shows the tasks and the responsibilities so that there is not overlap of work or conflicts, and also makes each person responsible for the task that he/she executes.

Organization Design

Organization Design is related to constructing and changing of the organization’s structure to achieve the organization’s goals.

Each organization, before undertaking a project, has an internal structure. The project manager has to decide whether they will use that specific structure or they will

create a different one to comply better with the project needs. The process that starts from the project initiation and continues until the planning phase of the project, and has as its objective the justification of the proper OBS, is called organization design. This design takes a lot of factors into consideration such as:

- The kind of project, the complexity, the risks, the required quality, budget and the geographic location.
- The environment that surrounds the project and the organization, that includes suppliers and raw materials, taxation system, legislation, human resources, financial resources, market, technology, economics, international and industry matters, socio – political factors and the natural environment that is impacted.
- The culture of the organization.

The creation of a new organizational structure or the redesign of an existing one, will not only take time but it also needs effort as each organization needs to work with its own culture.

Objective of Part II

As it is mentioned in the organizational structure session, every organization has its own structure. For example, a software company has the development division (software engineers), the marketing division (sales persons), the accounting division and the human resources division. All these divisions have one manager and they are vertically integrated under the manager of the company. The company that has this organizational structure can undertake a project that would have some specific requirements to meet, and try to execute it. There is a case of success but also there is a possibility of better performance for the company in the specific project if another organizational structure was used.

In this part, we will examine the different types of organizations, their advantages and disadvantages, and the criteria with which we choose the organizational structure for a project or make the project fit to an existing one. The environment, the culture of the organizations, the requirements for the organizations, ways of defining the best structure, conflicts and negotiations will also be presented in this second part of the thesis. Then, we will introduce the use of information technology and software tools to provide us with a better understanding of the selection of the organizational structure. Finally we will present these concepts within the context of a set of short cases.

The purpose of this second part of the thesis is to help project managers decide if the current organization on a company can fit the specific project and which are the criteria for organization selection or organization redesign that will result in an improved performance.

Two levels of implementation will be examined, the strategic level and the operational level. By strategic level, we mean the decisions and the functions that are taken in the upper levels of the organization. By operational level, we mean the supporting processes that are implemented to execute the project.

In Part II, we will examine the organizational structure of the organizations (companies) that undertake the projects. The project organizational structure is usually a subsystem of the organizational structure and follows the same rules and design concepts. In many cases it is similar to the structure of the organization when the organization is established only to execute a specific project.

ORGANIZATIONAL CHARACTERISTICS

CHAPTER 2

2.1 BETTER DEFINITION OF ORGANIZATION

In the life of the project process, there are five different stages and three elements involved. The stages are the OPMCL, Organization, Planning, Monitoring, Controlling and Lessons Learned. The three elements involved in the project process cycle, (Figure II-1) are: the customer/user that needs a product or a service (project), the organization that undertakes all of the phases of this project from the beginning until the completion and the project itself that has should meet specific standards and requirements within its socio-political context and in harmony with the natural environment.

Figure II-1 shows the parts of the process for a project:

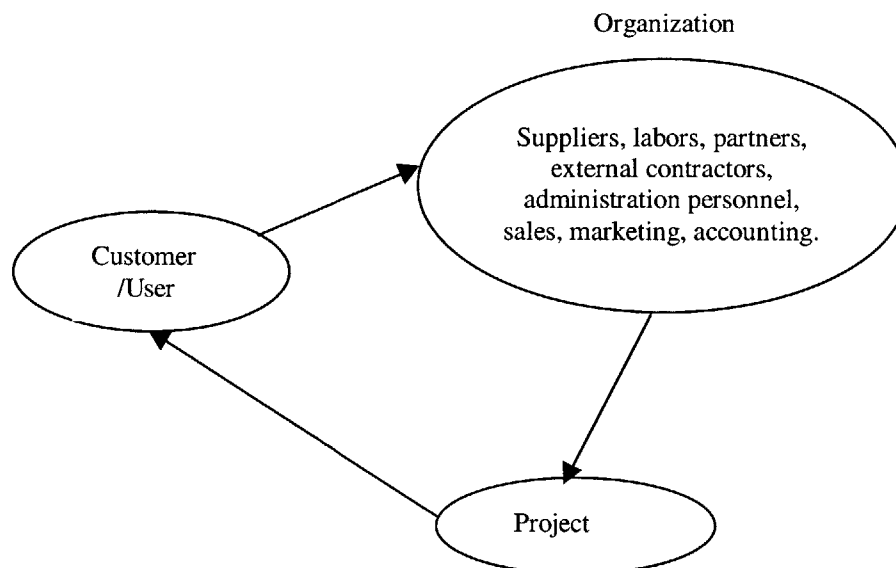


Figure II-1: The elements of the project cycle process.

The Customer/User usually sets the requirements or the goals for the project and the organization executes the whole process. The process that the organization follows may include: the designing or redesigning of the structure of the company's organization, the project planning, monitoring, control and the close out phase with lessons learned. Of course Figure II-1 represents the key components of a project process. Detailed analysis includes the probability of cooperation (integration) of the customer/user with the organization, the suppliers, and the external partners.

The organization operates in a specific environment and its role is to execute the project or simply convert the inputs to outputs. In Figure II-2, the organization is represented by a process transformation system which converts the inputs that are usually the raw materials to outputs that is the product or the service.

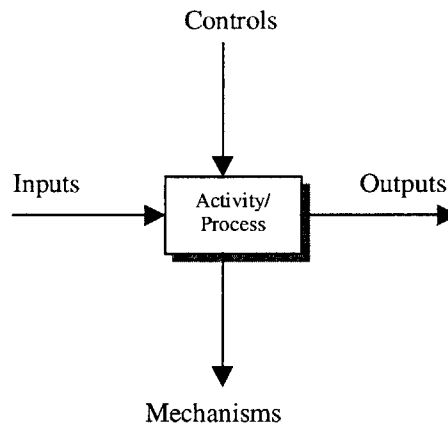


Figure II-2: Organization as a transformation system

To understand better the role of the organizations their functions and their importance in the execution of the project, we will present below in this part of the thesis, some important parameters and classification of organizations. These are the managerial levels, the organizational dimensions, the challenges of the organizations, the organization environment, the organizational culture, different types of organizational structure, the criteria for a project manager to choose a structure, and the problems and conflicts that organizations face.

2.2 MANAGERIAL LEVELS OF ORGANIZATIONS.

Organizations have two levels of management. The strategic level and the operational level. Strategic level consists of top management and middle management and is the upper level of the hierarchy that sets the goals and give directions. Operational level consists of the lower management and the team members or the workers on the project. Figure II-3 shows the levels within the organization.

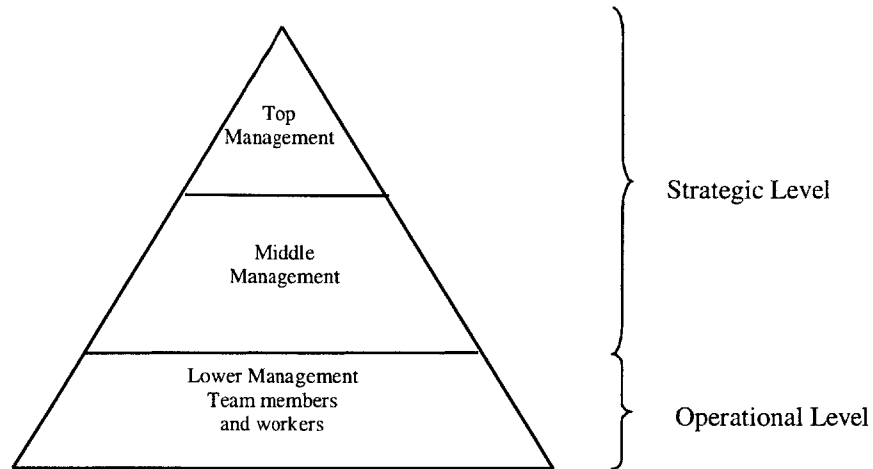


Figure II-3: The Managerial Levels within an Organization

The top management is the senior management and the middle management is usually the project or the functional manager. In figure II-3 there is connection between the strategic and the operational level. Project managers need to have also technical skills as they are coordinating technical individuals or teams. They need to coordinate the operational level in the firm. Nowadays the requirements for project managers are also business skills. Project managers need to have a good understanding of the strategic plans and the missions of the company and the projects that it undertakes.

2.3 DIMENSIONS OF ORGANIZATIONS.

A good way to understand how organizations function and their role in projects is to analyze their components from different points of view. The first analysis is the dimension at aspects of organizations. Organizational dimensions are classified into two types: the **Structural** dimensions and the **Contextual** dimensions.

Structural dimensions describe the internal characteristics of an organization and define the basis for measuring and comparing the performance of different organizations. These are:

- ◆ Complexity
- ◆ Formalization
- ◆ Specialization
- ◆ Standardization
- ◆ Hierarchy of Authority
- ◆ Centralization
- ◆ Professionalism
- ◆ Personnel Ratios

The contextual dimensions give a more general picture of the context of the whole organization and they refer to the:

- size
- technological position
- levels of the technology
- environment and goals.

2.3.1 Structural Dimensions

Formalization: this measures the amount of written documentation that is used for the internal and external communications of the organization. Documentation includes job processes, job descriptions, specifications, schedule and cost charts and in general every paperwork that is used for communication between the members. It is logical that bigger and more complex organizations require more documentation than simpler ones as, in the latter, commands and directions can also be given orally. Also, the nature of the projects and their requirements specify the level of formalization that an organization should have. Projects that need the cooperation of many teams and team members and where the margins for mistakes are very narrow, or projects that involve research and development, require a high level of formalization. The same happens with public or large organizations with powerful stakeholders to whom the manager should report. An obvious disadvantage related to the formalization is the lack of flexibility in cases where a quick decision is needed.

Specialization: This measures the degree to which the tasks are divided within the organization. Low specialization characterizes an organization in which the employees have a wide range of responsibilities and perform a wide range of tasks. With high specialization, employees have a narrow range of tasks to execute. Usually, in large-scale organizations, the specialization is high as every division deals with several matters, which are often complex. Specialization helps the employees to have a better knowledge of a specific matter, but deprives them of a general perspective of the function of the organization. Many mistakes and high levels of rework may occur when employees do not have a general overview of the project.

Standardization: This measures the extent to which similar or repeated activities are performed in the same manner irrespective of the location or the time frame in which they are happening. As an example, the production line of a manufacturing plant may have the same specifications no matter in which country the plants are located. Another example is with a restaurant chain; the products sold under that firm's name will have the same specifications, the same price, the same service and, in most cases many times the stores will have the same decor. With standardization we have the following benefits: we have better control of the job, as it follows a specific route that is difficult to deviate from. The employees know their tasks and are focused on them. Productivity is increased because employees reach higher levels of the learning curve. The only disadvantage is that standardization is not flexible enough to engender innovation.

Hierarchy of Authority: This describes the levels of the reporting system and the command and control structure. In the organizational structure that we will present in the next chapters, we will see that there are usually vertical and horizontal lines. The horizontal lines represent the levels of hierarchy. As we go down the organizational chart, employees have less authority. Another term that classifies organization hierarchy is the wide or narrow span. Span, as we will see in the next chapter is the number of employees that are reporting to a supervisor. If the supervisor has responsibility for many people then we have a wide span.

Complexity: This measures the number of sub-activities that exist within an organization. It can be measured along three dimensions, the horizontal, the vertical and the spatial.

Horizontal complexity is the number of functions that exist in the organization, the degree of differentiation between the units depending on the number of members, the nature of the tasks they perform, and their education and training. We can say that as the number of different responsibilities within an organization that require special knowledge and skill increases, the organization gets more complex. It is more complex because the diverse and large numbers of units have difficulties in coordination, communication with each other, and being cumulative. Departmentalization and specialization are terms related to the organizational complexity. Specialization characterizes grouping of the tasks that are performed by an individual. There are two types of specialization, the functional and the social specialization. In the functional, the tasks are broken down into simple and repeated ones. In the social, the individuals are specialized, not their work. Departmentalization is the way we group the different individuals that perform the same type of job. With the departments, the organizations can coordinate the activities that have been horizontally differentiated. They can be created on the basis of function, product, client, geography, technology or process.

Vertical complexity is the number of levels in the hierarchy. It refers to the depth of the structure of the hierarchy that the organization has. The more levels that exist between the top (that is the administrative departments) and the bottom (that is the operational function), the more vertically complex an organization is. The span of control that will be presented in 5.2.2, characterizes the number of subordinates that each manager has.

Spatial complexity is the number of geographical locations in which the organization has offices, plants, warehouses, sites, and personnel. In this kind of complexity it is obvious that the communication process is not only based on personal criteria. It is much harder as more use of information technology is needed, there is no personal communication, there is often a time difference especially in the global arena, there are different cultures, and coordination can easily fail.

Centralization: This shows in which hierarchical level decisions are taken. In a centralized organization, decisions like material purchasing or recruiting or simple decisions referring to the construction site are taken at the top of the hierarchy. In decentralized organizations these decisions are taken at the lower levels.

Professionalism: This measures the level of education and the formal training that the employees have. Professionalism is measured by the number of years of training that the employees have or need to have.

Personnel Ratios: These ratios represent the number of employees with the same characteristics, e.g. same level of hierarchy, same region, educational level, divided

by the total employees of the organization. Personnel ratios include administrative ratio, clerical ratio, professional staff ratio and labor ratio.

2.3.2 Contextual Dimensions

Size: This represents usually the number of people in an organization. It can also measure other parameters like the total sales or the profits or the machinery that the company has.

Organizational Technology: This measures the levels of the technology (actions and techniques) used to convert the inputs into outputs through the organization.

Environment: This includes every element related to the organization, which is outside the organization's boundaries. These are the government actions, the current legislation – taxation, the environmental impact, the industry standards, and the market conditions.

Goals and Strategy: These describe the competitive techniques used by the organization that distinguish it from the others. Goals are the targets that the organization set for a specific future period. Strategy is how the organization handles its resources and its units to achieve its goals.

All of the above dimensions are independent and characterize the kind and the features of an organization. They can give analytical measurements for the project manager to compare two or more organization forms and choose the most appropriate for his/her project. In session 1.4 we will present the challenges that project organizations face, in order to understand better how organizations operate.

2.4 CHALLENGES OF PROJECT ORGANIZATION.

Project organizations face several challenges. This session presents how complexity of the internal structure, short life of a project, different cultures, uncertainty and distance between people can represent significant barriers to the design of project organization structures.

Complexity of internal structure. The number of persons involved in a project and their interdependencies make difficult the coordination of the work especially when the tasks are difficult, in new areas and require a lot of rework and coordination. The special needs of the projects such as flexibility, customer orientation, and marketing focused nature lead to more complex processes that need to be well coordinated in order to succeed a win-win situation.

Cultural differences. The people as units and the different sub organizations that are cooperating through the process of the implementation of a project, have different ideas, goals and most of the times different way of getting things done. This is called different culture and the organization has to take into account the different cultures within its structure, the culture that the project needs and the culture of the customer/user. All of these parameters have to be coordinated and controlled for the successful satisfaction of the requirements of the project. In Chapter 1 of this part we will present the culture of the organizations and the different types of culture.

Uncertainty /Risk: Projects especially the ones that involve research and development and those that are long lasting and complex, have a great factor of uncertainty. By the term uncertainty we mean the changes of prices through out the years, the political situations, the interest for the specific projects, the levels and the amounts of rework for the R&D projects which leads to overruns in budget and in time.

Geographic distance among people: Globalization, technological specialization and labor and material cost reduction have led to people working on the same project from different locations. This creates the need for better team coordination and more quality controls.

Temporary life of projects: Every project has a temporary nature: it has a beginning and an end. This doesn't mean that the projects have short duration, indeed some of them last for decades. The challenge here is whether the redesign of an organizational structure is worth it for a small scale or short term project.

In Chapter 2 we will present a very important issue for the organization: the organizational culture which specifies the performance and the reactions of an organization. Studying and understanding the culture of an organization will help us in the selection of the organizational structure or the types of projects that a company can successfully undertake. It will also give us an understanding of how flexible the changes to an organization can be and how the remote subdivisions of the company could perform better.

ORGANIZATIONAL CULTURE

CHAPTER 3

3.1 INTRODUCTION

“Culture can be analyzed as a phenomenon that surrounds us at all times, being constantly enacted and created by our interactions with others.” {Schein }

[The culture of a group has been defined by Schein as]: *“a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems”. {Schein }*

Every nation has its own culture and its own way of getting things done and reacting to situations. There are significant differences between Europeans, Americans, Asian and African people in their way of life, the food they eat, the habits they have, their preferences, their holidays and macroscopically in their life values life goal.

Exactly the same but not with that great variance can be the difference between two companies that belong to different industries. Comparing them together, we will notice that there is a difference in the way things work. The goals and the values of one company in the first industry may not mean much to the company in the second industry simply because each industry has its own needs, objectives and strategies. Of course, learning across industries is feasible when the proper analogies and context are sought and understood.

Even if we examine two companies that belong in the same industry, we will notice that they may have differences in scope and objectives. Especially nowadays that companies are going global, we can even observe different cultures in subdivisions of the same company. These differences should be managed by the leader of the organization in order to align the objectives of all the members and smoothen these differences for the sake of the organization that he/she leads. Here, we will present the different cultures and the way they can be created and maintained in an organization or project team, in order to help the managers to handle difficult situations.

3.2 WHAT IS ORGANIZATION CULTURE

The culture of an organization is the sum total of the learning embodied as a set of implicit assumptions that come to be taken for granted.

The culture can be the way the people communicate with each other, the trends that occur within the organization, the policies, the behaviors, and in general the way things are done.

Some examples of organizational culture:

Let us assume that we have an organization that is involved with internal quality tests and always presents the real results to the customer even when they are not in its favor. This is the culture of the organization. The customer knows that there is no possibility for that organization to present fake results and automatically the customer gets into the work process as a team member trusting and cooperating more than before. Both parties then have a common goal, that is the right implementation of the project.

In the business environment, there are organizations that are led by a single person and others that are led by a committee. There are organizations that are inflexible to changes, especially those that are led by a committee, because a new innovation has to first be approved by the majority of the members. This usually takes some time compared to an other organization where a single open-minded person is in charge of the management and takes decisions faster.

Within an organization the type of relationship between the employees that are in the same or different levels of the organizational hierarchy, is reflective of the culture of the company. The culture specifies whether there are formal or informal reports and the type of the work process and whether it follows the specifications strictly or is open to new ideas and innovations.

Another example from the automotive industry comes from the case of Toyota and Ford. These two big companies have different approaches to the way research, production and other responsibilities are undertaken by the project managers. In Ford the staff are directly involved in the process and have the ability to put their ideas on the table. In Toyota, there is a hierarchy among the engineers that comes from the period of time they have worked for the company. There are also checklists and a strong reporting process that does not allow any deviation from the original schedules.

The prospective client has the ability to recognize the culture of each organization and choose which of them better fits her/his project. Culture is very important for both sides especially in cases of difficult or long lasting projects, as the cooperation is more intense and conflicts are more likely to arise because of cultural problems. And here we mean the way that people get things done. Of course, in the technical world there are the norms that both the organizations and the client follow and these help to avoid conflicts. There are also many other matters that cannot be described in specifications and norms that are important for a good relationship.

For the project manager, culture is the first parameter that has to be investigated in parallel to understanding of the structure the company. Knowledge of the culture of the company will prevent many conflicts and will help the project manager specify from the beginning of the project the type of relationships required between the members. The project manager will also know what he/she will face in the process and how the decisions and the changes he/she will make will be implemented. In 2.3, we will present the types of culture that the organizations have.

3.3 TYPES OF CULTURE

There are several types of culture that organizations follow based on the nature of the projects, the leading authority and the trust between the members of the teams. The main categories that these cultures are divided into are:

Centralized culture: this type of culture is based on the command and the leadership of one person or one central committee in the case of global organizations that take decisions and set the pace, the quality and the requirements of the work. In this type of culture mistrust and competition prevail. The advantage is a better organization and leading procedure as well as remaining in focus and keeping a certain style of culture in the areas of the projects. The main disadvantage is that there is no freedom and employees are usually not allowed to innovate unless the leading persons agree to it. Low levels of interest and a trend of low productivity may prevail in the personnel.

Decentralized culture: this type of culture is usually met in global companies or in companies that have major subsidiaries. The main company may have a specific culture but it also allows the divisions and the subsidiaries to keep another type of culture. This is a more flexible and market-based technique. For example a chocolate manufacturer that is in the European and the US market, may vary the culture of the local subsidiaries and many times also the product in order to follow the market needs. In Europe people need first quality and pure traditional made chocolate even if it is made by a small firm, but in the US people prefer to buy from the biggest brand name. In this organizational type, decisions are taken locally and each subdivision is open to innovations. Trust and good communications prevail within the organization.

Competitive culture: this is the type of the culture that is characterized by competition within the same function. For example, when the employees report to two different bosses simultaneously and usually the goals of each boss are not the same but contradictory of each other. Each of these bosses try to get his/her work done without having in mind the general frame and the scope of the organization. This type of culture needs a lot of coordination, communication and specific care as it can be disastrous for the whole organization.

Corporate culture: this type of culture is supported by values that all the employees respect. These values are acting of behalf of the common interest and include ethical guidelines for dealing with the customers. This type of culture is based on cooperation, teamwork, trust and effective communication. Corporate cultures take time to be build, but they can be destroyed in a very short time. Nowadays corporate cultures are essentials for the organizations to be more competitive and to survive in the long term.

In Chapter 3, we will present the environment and its sectors within which the organization exists and operates. The environment sets the boundaries of the organization and defines the way that it should comply with the environmental rules.

ORGANIZATIONAL ENVIRONMENT

CHAPTER 4

4.1 INTRODUCTION

As we saw in Chapter 1, the organizations are executing their transformation process from the inputs (raw material, resources) to the outputs (product, services) within a certain environment. For better understanding of how the organizations work and what will be the criteria for choosing a specific organizational structure, we will analyze in this chapter the environmental issues.

4.2 THE ENVIRONMENT DOMAIN.

The environment that includes the organization and justifies its features and performance is called its domain and can be categorized into sectors. These sectors are subdivisions of the external environment, which have the same characteristics. This classification into sectors will help the project manager in further analysis and measurement of the external parameters as well as assigning the risks that come from each of these sectors. The following figure II-4, shows an organization's environment and its sectors. This environmental domain is transmitted also to the project that the organization undertakes.

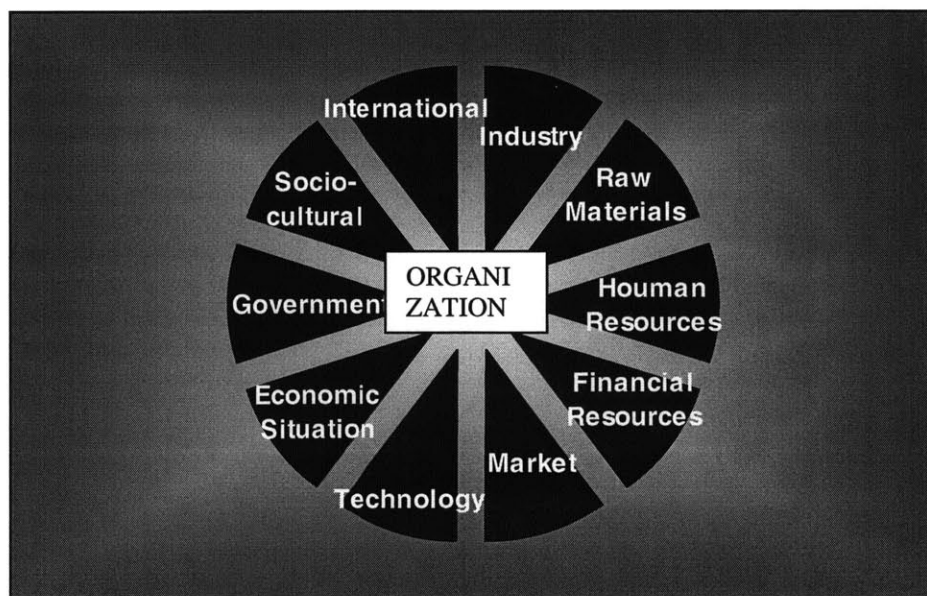


Figure II-4: The environment domain and the 10 sectors.

Now we will analyze each sector independently:

Industry: Includes the competitors, the special industry characteristics, the market share of the specific industry in total of revenues, the size of the industry, the trends, the culture of the industry, the fragmentation, the allowance for innovation, the barriers to entry, the commodity or not and the influence of the industry on the size of the organizations. All these factors are very important to analyze the characteristics of the industry that the company belongs to or is going to enter. This analysis will be very valuable for the project manager to choose the organizational structure of the company or redesign the existing one. Let us analyze each of the parameters of the industry. Tracking of competitors is called benchmarking in business parlance. Benchmarking includes the tracking of the competitors' performance, the number of plants they have, their culture, their market share, the strategies they follow, the innovations they introduce, the level of training of their employees and their relationships with customers. All this information creates the areas of concern for an organization and offers an area of questioning for the persons responsible for the organizational design. The industry fraction of the environment also includes the new industrial trends and the competition from the other industries that may offer substitution products.

Raw Materials: Organizations use raw materials as inputs in the process to create the final product or services. These raw materials can be from paper to components ready for assembly. The study and analysis of the raw materials includes the kind and the number of the suppliers, their pricing policy, their vulnerability to changes in the price of their raw materials, their stocks, services, delivery times and faith in the company. Raw material is a very important sector as it may affect the budget and the performance of the project as well as the delivery time. It may also lead to conflicts that will create loss for the organization. Especially when we have research and development companies that need immediate contact with suppliers and flexibility to changes, the need for vertical integration is more obvious. Vertical integration on the suppliers' side, means that the company includes the suppliers into its business processes.

Human Resources: another very important element of the organization is the human resources. This analysis includes the training, the qualifications, the size of the labor pool, the expectations of the employees, the unions, the wages, the level of faith and the culture of the employees. Human resources is an important issue in any organization and the project manager should pay a lot of attention to this and motivate the employees. Also there are periods in the organization such as closure of projects and beginning of new ones when there is no need in many employees. These employees have to be assigned to other projects or tasks, or get laid off. The last one creates not only a social problem but also losses for the organization as experienced people may have to be laid off in the period when only a few staff are needed and then "rookies" have to be hired and trained again when a new project is being undertaken. This cycle costs a lot of time and financial resources for the company and also discourages the other employees from doing productive and quality work, as they know that after the completion of the project they will be laid off. The human resources fraction of the environment also includes the attitude of the employees towards the project.

Financial resources: they include the availability of money for the execution of the project. Bonds, insurance companies and banks are included in this sector. The interest rates affect the growth of the organization; Low interest rates help the fast growth of an organization. Many times, there is also the problem of liquidity when the company has invested all of its assets; This can make the company vulnerable to a sudden crises. Also, there is the fear of control being transferred to lending agents because of the high level of loans.

Market: In this sector there are many issues that the company should investigate prior to deciding the design of the organizational structure. The market reflects the customers and their preferences in relation to the products or the services of the organization. The parameters that should be considered are:

- The size of the market in terms of units of product or profits.
- The kind of the market in terms of mature or educated customers.
- The degree of innovation involvement versus the traditional way of the process in the project or product.
- The analysis of competitors and the potential market share of the company. The definition if the company is a big player in the market or not.
- Investigate if the project will be repeated or not.

Technology: The technology sector deals with the use of knowledge, techniques and IT tools to execute a project or to improve internal communication within the company. Both are very important for the organizational selection. Related to the use of technology in the process of the project, a high technology company differentiates from a low technology one in terms of lower cost, faster response time and flexibility to changes. For example, a construction company may have all the branches and the construction sites connected with the headquarters using an intranet. This allows the easy and rapid flow of information within the company and between the company and the suppliers. Remotely located sites have online communication with the offices and requests for machinery or raw materials are processed faster. Drawings, schedule tables, blueprints and even pictures are carried in minutes. Branches are connected to the headquarters and reports are exchanged easily. This company is more technologically advanced than a company which communicates in the traditional way, by telephones and the post. So this company is more flexible to changes and has reduced expenses. Using technology for the internal communication and needs of the company, such as email communication, web boards and file transfer in digital form, the communications channels are simplified, less paperwork is needed, and the response time is decreased.

Economic Conditions: This reflects the general condition of the economy and the economic health of the country or the region in which the company operates. This includes unemployment rates, purchasing power of the customers, interest rates, inflation levels, taxation system, excess of production capacity, demand and supply, and long term or short term market investments. An interesting example was in 1998 with the crises in Malaysia. Most of the projects slowed down, especially the construction ones, because of the nation's economic crises.

Government: This sector includes all the regulatory, legal and political issues that are valid in the environment that the organization operates. Important issues that specify the type and the strength of the organization are: the discouragement or encouragement of lawsuits from customers against companies, the levels of the consumer protection, the required quality tests, the safety regulations, the requirements for public information, the import – export restrictions, the pricing constraints, the taxation system, the health system, the bounty availability and the stability into policies.

Socio-cultural: This sector includes characteristics of the market of the area that the organization operates and also the characteristics of its employees. Demographic characteristics, age of population, income distribution, composition of work force, and population dispersion have to be analyzed. From the employees' side, the phenomenon of dual career family and the hiring and firing consequences have to be taken into account as a major social problem. The impact of the project on the society and the attitude of the society towards the project, belong to this environmental fraction.

International: This sector refers to the companies that are doing business internationally. It includes parameters such as currency exchange risk, foreign language and culture, stage of regional economic development, regulations, political risk, raw material prices, and labor wages. All of the above can affect the operation of an international company that is headquartered elsewhere.

The analysis of the environment within the company is operating, will help the project manager in the design of its organizational structure, as he/she will design an organization that will be flexible to changes and at the same time meet all the needs and be protected from the uncertainties of the environment in which it operates.

In Chapter 4, we will introduce some of the organizational requirements before we start analyzing the different organizational structures. The reason for this is to show to the reader how these requirements can be served through the different structures.

ORGANIZATIONAL REQUIREMENTS

CHAPTER

5

Organizations are nowadays forced by the competition and the increased needs to support some extra features for the better execution of the projects. These are: the including the customers as part of the organization, support for a flexible process, support for quick feedback, the involvement of the community that is the source of knowledge, and the integration of technology as part of the strategy. These added features bring added value to the organization, the project and the customers. In this chapter we will analyze each of these requirements and show their value to all the involved parties.

5.1 INCLUDE CUSTOMERS AS PART OF THE ORGANIZATION

The term customer is very wide and may include each individual, group of individuals, another company that buys the product or services, public agency and stakeholders. In general the customer is everyone that uses the project. There is also another classification of the customers: the internal, the intermediate and the external customers.

Internal is the people within the organization that use the product or the service. They may be another department in the same company. For example the customer of the planning department is the manufacturing that uses the drawings and the specifications to implement its tasks.

Intermediate customers are usually companies that stand between the final user and the manufacturer. They are distributing the product either by keeping an inventory or selling directly.

External customers are the final users of the project or service.

The mission of any organization that wants to increase its revenues is to keep the customers satisfied by meeting their needs. This is a very difficult task for the organization as the customers usually “speak another language than this the experts of the company”, and we mean that the customers are not expertise in the area of the project. A company that wants a software program for the accounting department may have never dealt with programming languages and so it doesn’t know the capabilities of a software.

Also the duration of a project can vary from few days to several years. In the meantime, during the project duration whether it is at the design, execution or closure phase, the needs of the customer that the project will serve may change in scope or may increase or decrease. That means that the specific project may not meet the needs of the customer any more unless the customers are involved in the process. It is therefore of paramount importance that a structured approach is adopted for eliciting and stoning client requirements.

The main concern at the time that both the parties realize the change in scope, is how to handle this new parameter and whether they should keep on working on this project or make the necessary changes or even abandon it. Everything now is a matter of priorities and also a matter of the organizational structure.

A very simple and very common example comes from the construction industry. It is very common that the owner most of the times has not specified clearly his/her needs or the needs are dynamically changing with time. As a result, the owner changes his/her mind in the middle of the construction process. From one point of view, the change should take place, as the customer needs are now not met and there is no reason to keep on a project that it will prove to be useless for the final user. The matter that comes out is whether the contractor and the subcontractors are capable of making these changes, whether the project should stop completely until new drawings are issued, what is the extent of demolition or rework, what are the time delays, and finally what is the total cost for these changes.

The customer may have in mind a simple change, for example, to move an interior wall to another position, but the construction manager already knows that this is a change order that will cost not only time but also money. Probably some rework will be required as the changes come after other stages of completion, which also may need rework. In addition the cost will increase as the overhead and the profit margin of the subcontractors for this custom work will be more than the bid price. Now the construction manager has the problem of satisfying the clients, resolving a probable conflict without creating a trouble for the general contractor and the subs, and also trying to keep his/her project on schedule.

In a customer-driven organization the project would have to facilitate the changes in comparison to a project-driven organization that would have to oppose the changes in order to keep to the schedule and the budget. Usually, in the construction industry a middle path is followed.

Now let us analyze the importance of being flexible to changes and being customer-driven and find out what is the best strategy that the project manager in charge should follow in these cases. First, it is commonly accepted that keeping the customer satisfied is the most important issue for the organization. The specific customer not only will give the company future projects, but also will give references to other potential clients (by word of mouth).

On the other hand, the concern is about who is going to cover the additional expenses and the cost of any delays. Should the organization cover these expenses in order to keep the client satisfied or should they be passed on to the latter and if so to what extent?

These problems are commonplace in every single project from simple ones to the most complicated. The implementation of project management in an organization helps in avoiding such problems early on by involving both the project manager and the client in the project as a working team. This means that there is cooperation and an attempt from the organization's side to understand the real needs of the client or even try to help him/her specify his/her needs. This depends on whether the organization is dealing with educated or uneducated clients. Educated clients have their needs specified and are very clear in their goals. Most of the time they can specify the output of the project, the quality and the standards, the delivery time and also to some extent, the specifications. The organization should at the very beginning identify the customer requirements.

Compared to the previous category of clients, the novice ones, most of the time have a general idea in their mind and some related or not related information about similar projects in their area of interest. The pitfall in the case of novice clients is that many of them have no knowledge on the costs, the time required or the standards. The project manager has three choices. The first possibility is to make a project, which complies with the organization's default standards or secondly to interview/ educate the client, or use a combination of the above methods. The best solution, especially in large-scale projects, is to involve the client as a part of the organization.

Involving the client as a part of the organization automatically engenders partnership with shared goals. This integration helps both sides as the objectives are clearer and will speed up not only the design phase but also the monitoring and controlling phase as well. The customer gives the organization feedback about the product and the organization makes the necessary adjustments for a successful result.

Another mistake that many organizations do, is that they send to the customer the marketing people that they may not have a complete picture of the capabilities of the manufacturing and the designing departments. The result is that many times they undertake projects that are not feasible for the organization only because they do not want to loose the customer. The right approach in this matter would be to listen to the customer needs and then get a meeting with representatives from all the departments of the organization (product development, manufacturing, operations and service) together with the customer to present the customer needs. By this way the whole company will participate and give feedback whether they can technically meet the customers needs and whether all the departments have the available resources to undertake such a project. This is called concurrent project management.

In this way, conflicts are prevented and if they do surface they can be resolved in the early stages when the damage is not great.

5.2 SUPPORT A FLEXIBLE PROCESS.

Like everything in life, predicting and being flexible is very important for the organizations and for their projects. Recently, the changes are rapid. Companies' objectives focus on satisfying the customers needs because the competition is very stiff. The use of information technology has created a very fast data transmission and as a result of this, in many industries the old way of keeping the resources away from the customer has been already past. Now the customers have access to a variety of databases through their personal computer and can evaluate the offers with a one step procedure. Also, referring to business to business projects, the needs of the business that needs the project may change during the design or even the implementation phase of a project.

A simple example comes from the software industry. Company "A" needs a specific software program for its production line and calls company "B" to execute this project with defined standards and specifications. It is very common for the specifications and the needs to change at the implementation stage because company "A" has changed scope trying to stay ahead in a very competitive environment. The change may result in company "B" not being capable any more of meeting the new needs of the project and company "B" may seek for company "C" to execute the revised project. This is a tremendous expense for all the parties involved.

Being flexible means that the whole project or some of its components can be easily changed. First of all both companies “A” and “B” should be prepared for the change from the beginning of their cooperation. They should evaluate all of the possible scenarios that may happen and all of the risks that the project has. They will then be prepared and also develop solutions for most of the predicted changes. In addition company “A” should design its organizational structure in such a way as to be flexible to changes without extreme cost. They should be able to reallocate people and have a rapid feedback mechanism.

5.3 SUPPORT QUICK FEEDBACK

As we will explain in the system dynamics Chapter 13, the use of feedback is very useful for every organization, and it helps to improve its performance. Feedback is the channel of information coming from an advanced stage of project implementation to a previous stage that contains useful information about its operation, performance, quality and whether the project meets the initial goals or not. It is a very useful tool as it involves the customer and the quality control members of the team. It is a verification and calibration of the project, which leads to optimization and success.

The companies should support quick feedback. Quick here means that the whole cycle that contains testing, evaluating the results, decision making, redesigning, remanufacturing and again testing should be done as quickly as possible. The quick feedback reduces the whole project time, the cost and keeps the morale of the team members high. The organization should have an organizational structure that supports this. Nowadays, with the use of information technology and its applications, organizations have the ability to monitor even the most geographically isolated projects with the exchange of electronic information and data and also by conducting virtual meetings between the team members.

5.4 INVOLVE THE COMMUNITY THAT IS A SOURCE OF KNOWLEDGE.

The success of the project relies not only on the previous experience of the members but also in the quality of their knowledge. The projects that are one of a kind require new ideas and most of the time, innovative and capable people that will handle all of the peculiarities. Even if two projects are similar in concept, they can never be exactly the similar because they are in a different time or place segment. The involvement of the community that is a source of knowledge, such as the scientific community, will add value to the whole system. This will be done by bringing new techniques and experiment every kind of innovation and improvement in the whole process from the stage of the organizational structure building until the last stage of evaluation and lessons learned. Successful organizations support the interaction of the scientific community and are open to innovation and new techniques.

5.5 TECHNOLOGY IS PART OF THE STRATEGY

As mentioned before technology and specifically information technology has become an integral part of almost all of our activities. Now consumers have ready access to databases that before needed a lot of time and contacts to acquire. Also, companies are

using services such as web-boards, email and virtual meetings. Globalization and international activities are now commonplace for the companies. Projects can be executed as a whole or partially in every part of the world and could be coordinated from the headquarters without the need for frequent travel by the main staff.

As an example, an electrical tools manufacturer has many different teams dispersed all around the world for economic and development purposes. The manufacturing teams are in countries with cheap labor hours or cheap raw materials or strategic distribution locations. The research and development teams are in countries that are technologically advanced in a specific component of the tool. All these teams have to cooperate to deliver the final product. The team that develops the motor has to be in cooperation with the team that designs the handle, the team that designs the skeleton and the team that designs the transformer. All of these teams have to be connected to the marketing department to examine the preferences of the customers and also get feedback about the cost margins that are allowed and are usually defined from the sale price of the unit. Each of the teams needs the feedback of the others and a quick communication and information exchange channel. Technology allows this information transaction and communication even without the team members travelling to meet each other. In session 7.4 we will discuss virtual teams, their effectiveness and how they operate.

In Chapter 5, we will analyze the different types of organizational structures that have been established in project management. We will see the advantages and disadvantages of each one and when each of them is used. This will make the project manager aware of the different structures and help him/her decide which one better suits to the project.

ORGANIZATIONAL SELECTION

CHAPTER 6

6.1 INTRODUCTION

Project Management deals with the execution of a project within a specific budget and time, meeting a specific set of standards and quality. To achieve that, a project organization should be formed or selected. The selection should depend on criteria such as the type of project, the available time, the proposed budget, the difficulty of the work, the degree of scientific work needed, the available human resources, the culture of the company and the environment in which the company operates. All these factors should be taken into consideration before or during the design phase of the project as they help the organization to determine its needs and which of the organizational structures best meets that needs.

The project organizational structure should fit the nature of the project, the nature of the participating organizations, and the environment in which the project will be performed. It should allow proper communication among the participating members and provide quick channels of information where it is needed.

In this chapter we will present the different types of organizational structure that can be formed and their advantages and disadvantages.

6.2 TYPES OF ORGANIZATION

The types of structure of the organizations are classified/ categorized based on their nature (formal – informal), their span (wide – narrow) and their performance (functional, project oriented, matrix). There are also other types of formal organizations such as the bubble organization, the market organization, the chronological organization, the sequential organization, the military organization, the political organization, the autocratic organization, the virtual organization and the ad-hoc organization.

6.2.1 Formal- Informal Organizations

The first basic categorization of the organization is the formal and the informal organization. With formal, we mean every form of organization that gives specific roles to each unit of the organization. It is the formal channel of communication, reporting and providing responsibility transfer within the organization. It may have a form of hierarchy or a form of separated tasks, but either way it is the formal structure of the organization and everybody should comply and work with it.

Unlike the formal organization, the informal organization consists of relationships that have been created between the members of the organization and the

informal sharing of responsibilities and tasks. This is used for very small organizations where the tasks are simple and the work to be done requires only a simple organization. It can be also met in complex organizations in case of emergency situations. It offers more power and quicker decision making in such situations.

6.2.2 Wide – Narrow Span

The classification based on span divides organizations into wide and narrow span. Figures II-5 and II-6, show the difference between these two categories. It can be seen from the figures that in narrow organizations, the number of subordinates reporting to a manager is fewer than the wide-span organization.

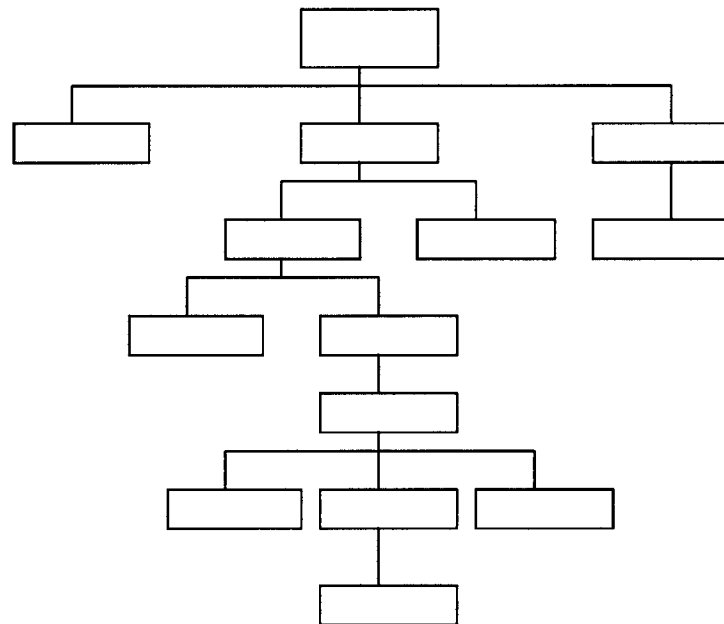


Figure II-5: Example of narrow span

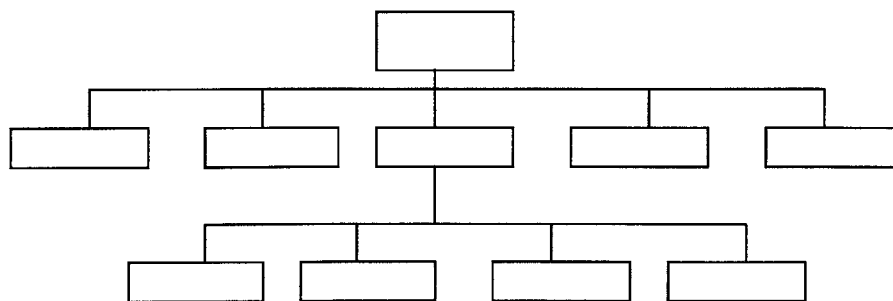


Figure II-6: Example of wide span

6.3 FORMAL ORGANIZATION TYPES

The formal organization, in terms of functionality and breakdown structure, can be divided into three main categories: *The functional, the product or divisional and the matrix.* In the following sessions, we will analyze each category and present the advantages and disadvantages of each one. We will also evaluate them and suggest their use depending on the main goal of the project to be executed.

Figure II-7 shows the different levels of commitment to a project. Beginning from the left to the right, we can see that the area on the left represents a functional structure in which few people are devoted to a single project. They are shared between different projects. At the other end we have projects that have personnel devoted to them. The staff in that case work full time on the specific project.

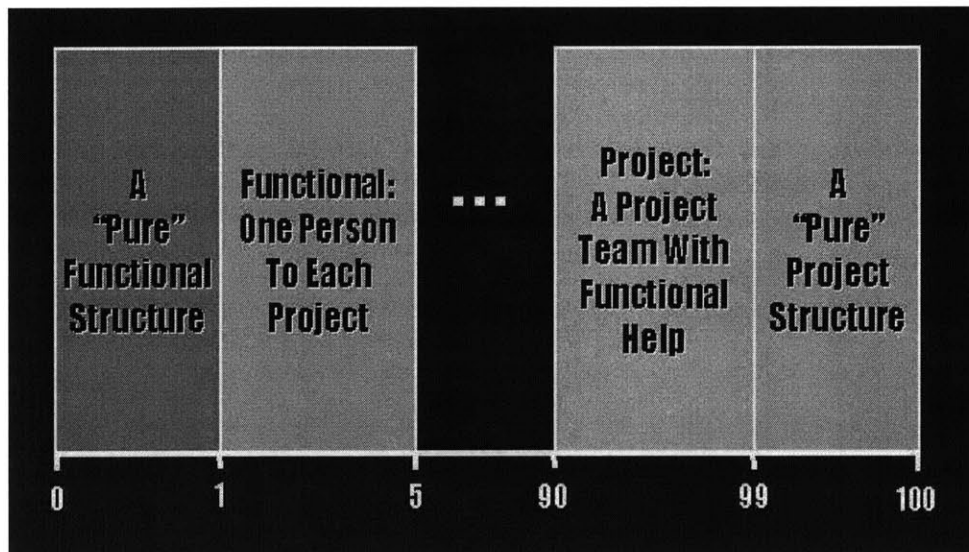


Figure II-7: Range of Matrix Organizations. Percent of personnel fully committed to a single project.

6.3.1 The Functional Organization

This is the traditional organization form that most companies normally have. These organizations are subdivided according to their functional operations. For example, functional operations are sales and marketing, design, manufacturing, accounting-logistics, human resources. These functions have staff that can be used in the different activities/ projects of the company and there is the possibility of one person being used in more than one project at the same time. The entire staff report to the functional manager. Each of the divisions has its own human and financial resources. An example of a functional organization is represented in Figure II-8. It comes from the construction industry. For a construction project to be designed, architects and engineers

are used as well as construction and project engineers. The firm in Figure II-8 has divisions divided by the function that every one executes in the delivery process.

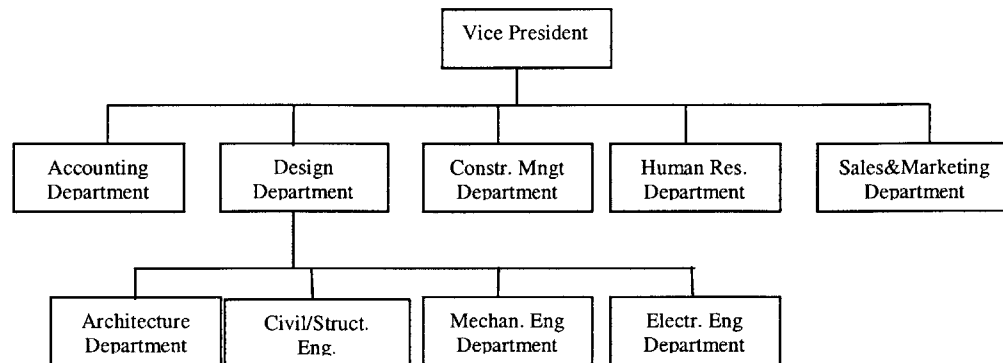


Figure II-8: Functional Organization (Design Firm)

The design department may include architects, civil engineers, mechanical engineers and electrical engineers. The architects deal with the spatial layout design; the civil engineers with the structural analysis and design; the electrical engineers with the electrical supplies and the high voltage; the mechanical engineers with the heating, ventilation and air-conditioning and the construction managers with the whole construction procedure. All of these engineers have a leader in their function that is the manager of the function. The manager assigns the engineers of the organization to the different projects and usually an engineer can have the responsibility for more than one project. The engineers report directly to the functional manager and the latter reports to the vice president of the organization. The other departments of the company, the construction management, the human resources, the sales and marketing and the accounting, operate in the same way.

As mentioned previously, this organizational structure used to be the traditional one for many years and is still prevalent today. It keeps the company under the control of a pyramid and devolves responsibilities as it goes down the structure. It helps in the solidity of the company by dividing it in departments with their own manager and specifically sharing responsibilities in each department. Each department contributes to the organization and the “product” with its expertise, and human resources can be easily assigned to specific projects.

The advantages that come from this type of organization are:

- **Availability of broad personnel base:** The division manager can assign due to the needs of the company the division personnel to specific projects in line with the needs of the organization and can easily move/ rotate them around until the best combination is found. Since they all belong to the same division and may be in the same building, everybody is aware of the projects and the problems that the organization faces.
- **Identifiable technical line control:** Since the operations are specific for each division, a person knows specifically where to attend for a matter.

- Grouping of specialists to share technical knowledge: Since the personnel work under a specific department that contains other personnel with similar skills, help, advice and solutions are usually available from the rest of the staff in the same division.
- Flexibility in the use of manpower: the personnel can be assigned in different projects depending on the current needs.
- Control over personnel: each employee has only one “boss” to report to, making control relatively easy.
- Clear hierarchy of supervision: Each of the organization members knows exactly the duties that are assigned to and to whom should report to. The higher someone goes up the hierarchy the more the responsibilities.
- Collective line of responsibility: The whole division has responsibility over the activities of the organization related to its particular function.
- Assignment of personnel to different projects: The personnel can be assigned to different projects depending upon the overall work load, the nature of the work, availability, the delivery time, qualifications. This assignment can be dynamic, changing with time and the needs of the organization.
- Continuity and consistency of functional disciplines: Since the organization has a specific culture as a whole or as a specific division, specific disciplines are followed in every organizational activity.
- Possibility of departmental policies, procedures and missions: The departments can set their own unique goals and objectives. They can measure their productivity and efficiency and use the lessons learned to improve their performance. Also, they can use checklists and capture experience that can be transferred to newcomers.

The disadvantages that come from this type of organization are:

- Reduced time to market: since the decisions are more difficult to be taken as there is not a leader committed to the project, the time that the project finishes is slow.
- No one individual is directly responsible for the total project: as many personnel from different divisions are involved in a project, officially, the responsibility is shared and coordination may be difficult. This is often due to the fact that, since each person relies on the knowledge or the qualifications of others or the other divisions, he/she does not have an oversight of the whole project.
- Project oriented planning may be impeded: This type of organization is not flexible enough to respond promptly to the needs of the project or the client. It has its unique culture that probably goes back many years and tries to undertake new projects in the same old ways. Lack of flexibility and innovation characterizes the whole organization.
- Lack of clear line reporting may happen in the lower levels of the structure: since many staff are involved in the same field, confusion may occur in the decision making and reporting procedures.

- Coordination is complex: there may not be fair distribution of tasks for each person and coordination is always confusing as there is considerable interaction of activities.
- There is the possibility that the strongest functional group will claim authority over the organization or the execution of the projects.
- More decision time is needed as the organization handles two or more project simultaneously that may conflict with each other.

6.3.1.1 Subcategories for functional organizations

Functional organizations can further be divided into two subcategories: *the project wholly within a functional structure and the project across functional structures.* (Richard Hauser East Carolina University)

In the *project wholly within functional structure*, the project manager and the staff come from a single functional group. This form of structure aids the uniformity of the team, which already has established experience and probably formed informal relationships by working together. The disadvantage is that the room for innovation is limited as all members of the team are already familiar with a certain way of getting things done.

In the *project across functional structures*, the project is divided into segments and each segment is handled by appropriate functional groups. Coordination is responsibility of both the functional group managers and the senior manager. The most obvious disadvantage that comes out of this subcategory of functional organizations is the difficulty in coordination because of probable differences in functional culture. Another disadvantage is the required time to establish relations of trust between the team members that may cooperate for the first time. The advantage is that new ideas and techniques can be introduced by the interaction of members from different departments and there is scope for research and innovation.

6.3.2 The product or divisional organization or project oriented organization

This organization structure is usually found in organizations that have been established to execute a specific project or ones that give emphasis to the project, the quality or the marketing and sales. The main characteristic of this structure is that project teams are assigned on full time basis.

An organization that is project-oriented, has different groups of projects and on each one has assigned full time engineers, marketing and sales analysts, manufacturers, and other groups as needed. The task of each group is the specific project and the reporting process is to the project manager of the project. These projects can be within the headquarters or the branches of the company or even to remote temporary locations. The characteristic of this project-oriented organization is that it is has a temporary structure and decomposes after the completion of the specific project. Employees have to leave the company or are assigned to other projects.

A typical schematic diagram for a project-oriented organization is presented in figure II-9, where the company in the example has four different projects. These projects can be independent of each other like four different construction sites in a construction company or related to each other like the design or manufacturing of four different components of the same unit, or the different modules of a software project.

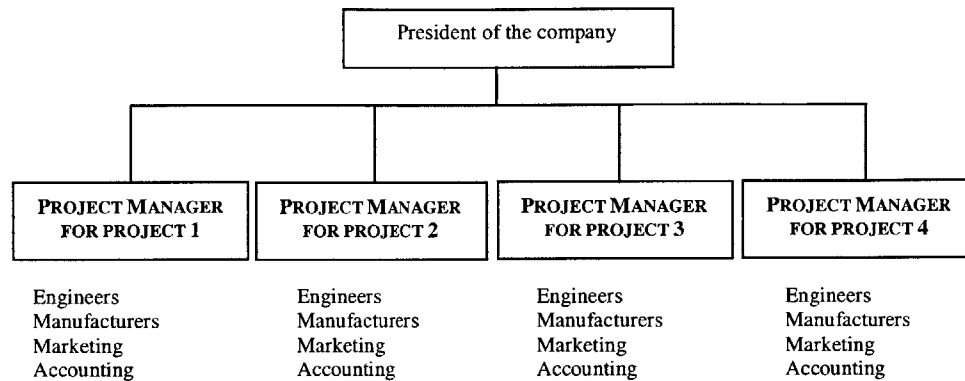


Figure II-9: Project-Oriented Organization

The advantages that come from this type of organization are:

- Control of the project from one single authority that handles all of the decisions: This authority is the project manager that is in charge of the project and is given the responsibility to make all the decisions related to that.
- The reaction time is very quick: since there is not much involvement of higher levels of authority, and as the project manager makes the decisions related to the project, the bureaucracy is limited.
- The personnel work only on one specific project full time: there is no sharing of time between two or three projects for the same person. Each member is fully devoted to the project and so there is more control and responsibility to one authority.
- Responsiveness to customer or marketing changes: When the organization is project-oriented, the main concern is to satisfy the customer or the market. Since it is also flexible it can easily adapt to changes and new trends.
- Good performance in schedule, quality and budget as the emphasis is on the project and not the organization's needs: The project manager since he/she has the resources available, can handle them in the most efficient way for productive, schedule and cost optimization results.
- Simplicity of structure and reporting channel: The structure is simple and easily familiar to every member of the project team as they cooperate and, in most cases, are co-located. The reporting channel is easier to follow when there is close cooperation and a common goal.

- Common purpose for all of the project members: All of the members have a common goal - the successful completion of the specific project they are working on. Of course, many of them may have set as a goal their personal success, but the main advantage is that the departmental goals do not exist. For example, in functional organizations, the marketing manager would have as a goal to satisfy the customers in contrast with the manufacturing manager who would have as a goal to create a functional, easy to maintain and operate facility or product.
- Fast communication lines: people working on the same project are fully accessible all the time and the established relationships and the common goals facilitate faster and more effective communication.
- Full authority of the project manager: the project manager that is in charge of the project is able to handle the given resources, employ or deploy personnel, choose the suppliers and talk with the customer.
- Better motivation, commitment and concentration: As all team members are fully devoted to one project, they are able to feel the satisfaction of creation or completion and share the rewards that may come from a good performance.
- Reporting to only one person: This prevents the confusion that may arise from reporting to more than one person.

The disadvantages that come from this type of organization are:

- Inefficient use of resources: For better utilization of the resources, the main organization assigns them carefully and most of the time at lower levels than needed.
- No concentration on research and development for the future but only on what the project requires: The field of research for better operation and performance of both the organization and the project team, is limited here because of the high level of focus on the project implementation.
- The exchange of experience and technical knowledge between the projects and the other members of the whole company is limited: As the goal is the implementation of the specific project, actions such as keeping analytical records or research into operational issues that could help the whole organization when undertaking similar projects in the future are limited in the project-oriented structure.
- Duplication of efforts for similar tasks between different projects: In the pure project-oriented structure, there is no cross-project communication, as there are no established channels of communication between the different project teams. As a result, projects that may have the same or similar tasks (such as the market analysis for a component) duplicate effort, which costs money and time for the main organization.
- Reduced skill diversification: Members that are used to working in teams, and most of the times together, have reduced skills not only because they have no contact with other new members but also because the high focus and devotion climate leads them into considering themselves as experts. The result of this is to be closed to new ideas because of lack of time or enthusiasm.

- The opportunities for the career development of the personnel assigned to this kind of structure is very limited: the personnel hardly acquire new experience and every time after the completion of the project are reassigned to other projects that may be in different geographical locations.
- Poor utilization of man-hours: As the demand for specific personnel is not constant through the life cycle of the project, many times there are members that are not fully productive.
- Difficulty in retaining, transferring and relocating the project personnel after the completion of the project: The organization has to be ready for the next project after the completion of the current one and should have plans for reallocating the personnel. This is often difficult and personnel adjustment and training under the new conditions take time.
- Difficulties in the workloads and the hiring-layoff phases as the project phases in and out. From research it is proven that the start up and close out phases are the most difficult for personnel hiring or layoff, as the demand for human resources is not constant.
- Delays in training the new personnel and losses in firing experienced personnel as the project phases out: The cost of firing experienced personnel because of limited utilization and then hiring rookies when the demand is increased, costs a lot of money to the organization and creates lags, conflicts and disorganization.
- More overhead as economies of scale is not used: As the project manager is often free to choose the suppliers for the project and the time that it needs the materials, the organization may not be able to take advantage of the economies possible with bulk orders.
- Can not handle high levels of technical risk effectively, as the representatives of each functional department are usually isolated from their peers. In cases of high technical risk, functional and matrix organizational structures are preferred.

6.3.3 Matrix Organizational Structure

This structure is popular with management professionals. It combines in a way both of the previous structures and implements multiple accountability and responsibility for a project or function. It combines the advantages from both the functional and the project-oriented structures. Usually, there are two lines of command and responsibility: the vertical and the horizontal. The vertical line represents the functional commands and the horizontal the project commands and responsibility. In this kind of structure we have the advantage of full resource utilization in addition to flexibility and rapid decision time.

A typical schematic diagram for a matrix organization is the following:

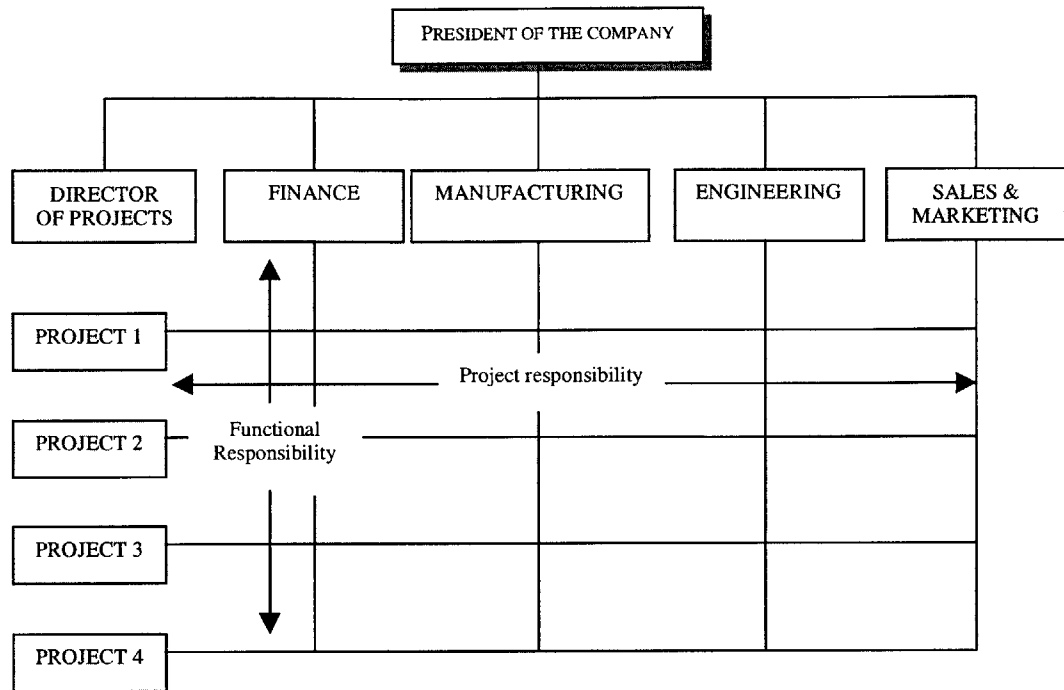


Figure II-10: Matrix Organization

The advantages that come from this type of organization are:

- Better utilization of resources: The functional manager assigns resources to each project in the most efficient way from the perspective of the whole organization. The limited life of the project and short term changes in resource requirements can be better managed as resources could be reallocated dynamically.
- Reduction of cost due to the efficient sharing and utilization of the resources: Teams and functions can easily communicate and share the resources in the most efficient way.
- Adaptation to changing environment: The matrix organization can adapt to changing conditions such as new competitors in the market, termination of existing projects, realignment of suppliers and subcontractors as the organization “works “ in both directions.
- Multilateral flow of information: Information and technological messages can be passed through the projects at the same time that the organization’s scope and needs are made widely known to the project members.
- Opportunity to work on a variety of projects: the team members have the opportunity to be transferred to other projects that fit better with their interests and their abilities. They can also remain loyal to a specific project without the fear of being laid off after its completion.

The disadvantages that come from this type of organization are:

- Two bosses reporting process: because of the matrix organization the project team members have to report to the line or project manager and the functional manager at the same time. This multi-reporting process often creates conflicts and misunderstandings, as the limits are not always clearly defined.
- Technical knowledge: The project manager is not likely to be an expert in all technical aspects of the project, therefore he must rely on the expertise of the functional managers the time that he has the whole responsibility for the outcome of the project.
- Problems of authority: As the functional managers negotiate resource allocation to the various projects in the long term and the project manager negotiates the performance, delivery time and budget of the project on a day-to-day basis, problems can be created because of the different interests.
- Goal setting for the project: The project manager has short term goals and is focused on the project performance while the functional manager has long term goals and is focused on the performance of the whole organization. These different perspectives often conflict and create problems within the organization.
- Conflicts among project managers: when more emphasis is given from the functional managers to a specific project rather than the rest, there might be disenchantment from the other project managers, as their main goal is the success of their own project and not the cumulative performance of the organization.
- High overhead cost due to additional lines of command: the system has to be organized in such a way as to support the two different reporting lines: the horizontal and the vertical. Additional communication, paperwork, man-hours and conflict resolution is required.
- Complexity of the structure: It might be quite difficult for a team member to get adjusted to the two lines of command, putting pressure on the internal balance of his/her job. Misunderstandings and bad quality of work (sometimes on purpose), may occur.

6.3.3.1 Subcategories for matrix organizations

The matrix structure of an organization is divided into three subcategories depending on the level of dominance of functional over project-oriented structures. These are the functional matrix, the balanced matrix and the project matrix. Figure II-11 shows the different levels starting from left with the functional matrix and finishing on the right with the project-oriented matrix.

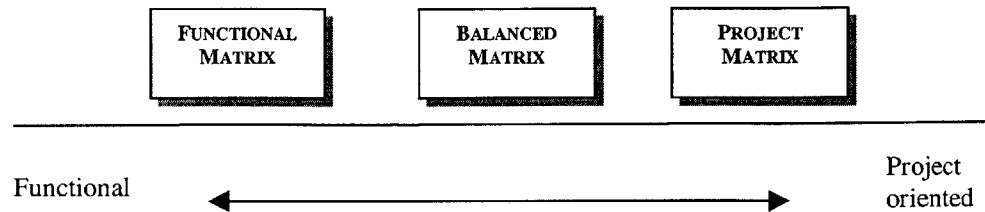


Figure II-11: Subcategories of Matrix Structure

In the *functional matrix* structure the project has a team leader in each functional department and the tasks are passed from one team to the next. Although there is a matrix structure, the priority is given to the functional departments of the organization. The project is implemented within the departments taking full advantage of the positive functional characteristics. There is a project leader, but he has no authority. He only oversees the plans made by others. The problem with this structure is that the companies think that they are using an advanced organizational structure, in reality they add another layer in their bureaucracy.

In the *balanced matrix* structure functions and projects have the same priority. As we saw before there is a great potential for conflict between the two authorities, the functional and the project manager. A good solution to avoid these conflicts is to make the project manager responsible over how each of the team members will spend his/her time, and the functional manager responsible for the individual's professional growth.

In the *project matrix* structure we have a project-based structure, in which the functional structures are duplicated in each project. This occurs usually in large-scale projects where the functional organization is created based on the project needs. The project manager, also called heavyweight team leader, controls all the project related issues, including design trade-offs, but the functional manager retains title to the people.

6.3.4 Other Organizational Structures

There are also other organizational structures beyond the traditional and the most commonly ones that we presented above. These are the *bubble organization*, the *market organization*, the *chronological organization*, the *sequential organization*, the *military organization*, the *political organization*, and the *autocratic organization*.

These types of organizations are customized to meet specific project or organization needs.

6.3.4.1 The Bubble Organization

This organization type is used for simple projects especially for political or social movements. The characteristic of this organizational structure is that there are functional teams around a common project goal. This structure is mostly temporary and disintegrates whenever the project goal is accomplished or is no longer of interest. Figure II-12 shows a bubble organization:

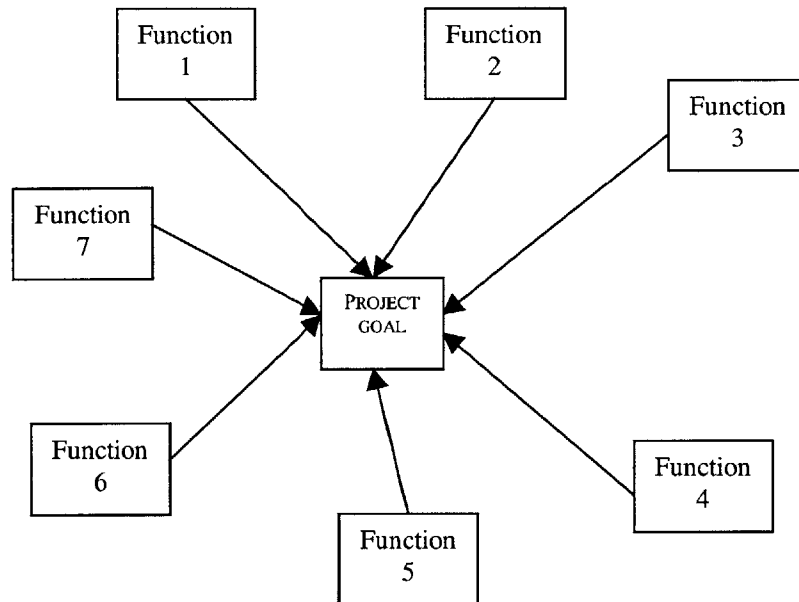


Figure II-12: The bubble Organization

6.3.4.2 The Market Organization

This type of organization is mostly used when we want to have flexibility and to get market feedback. With this kind of organization market knowledge can be transferred between different products. Figure II-13 shows a market organization structure:

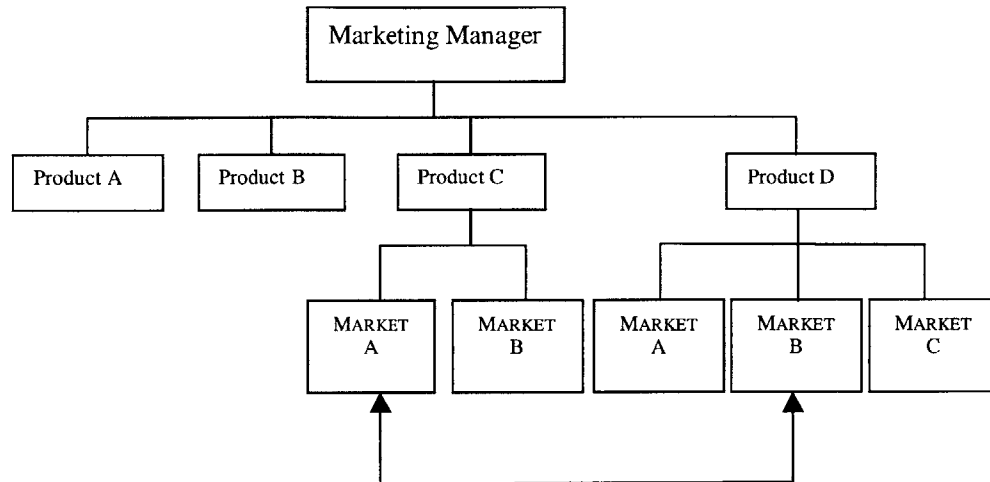


Figure II-13: The Market Organization

6.3.4.3 The Chronological Organization

The chronological organization is used when time sequence of the various tasks is critical for the implementation and the organization of the project. Figure II-14 shows an example of a chronological organization:

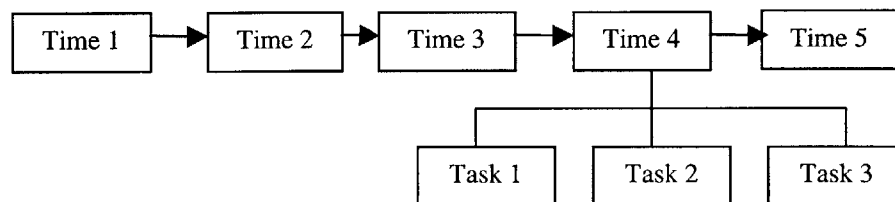


Figure II-14: The Chronological Organization.

6.3.4.4 The Sequential Organization

In this type of organization importance and quality of the project are the basis for the structure and its performance. The quality of each task should be completed before we proceed to the next time. This differs from the Chronological Organization in terms that the tasks in the time section should be done in the planned sequence. Figure II-15 shows a sequential organization structure.

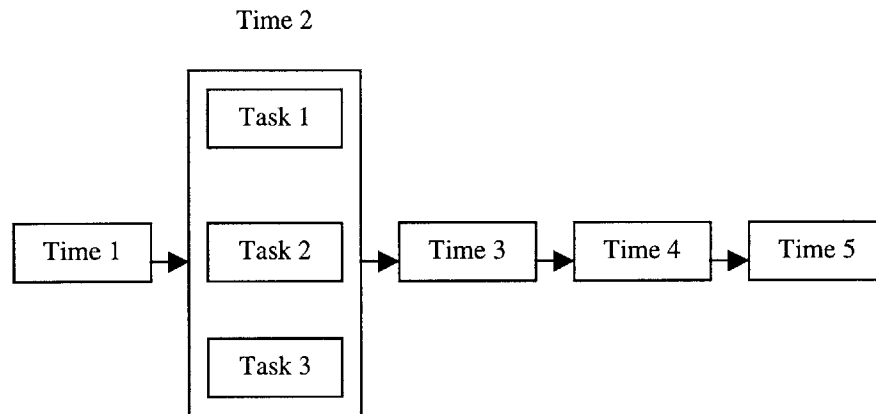


Figure II-15: The Sequential Organization

6.3.4.5 The Military Organization

This type of organization has the characteristic of a very strong hierarchical structure. It does not allow informal channels of communication or responsibility. The top is more powerful than the bottom parts of this structure. Figure II-16 shows a typical example of a military organizational structure:

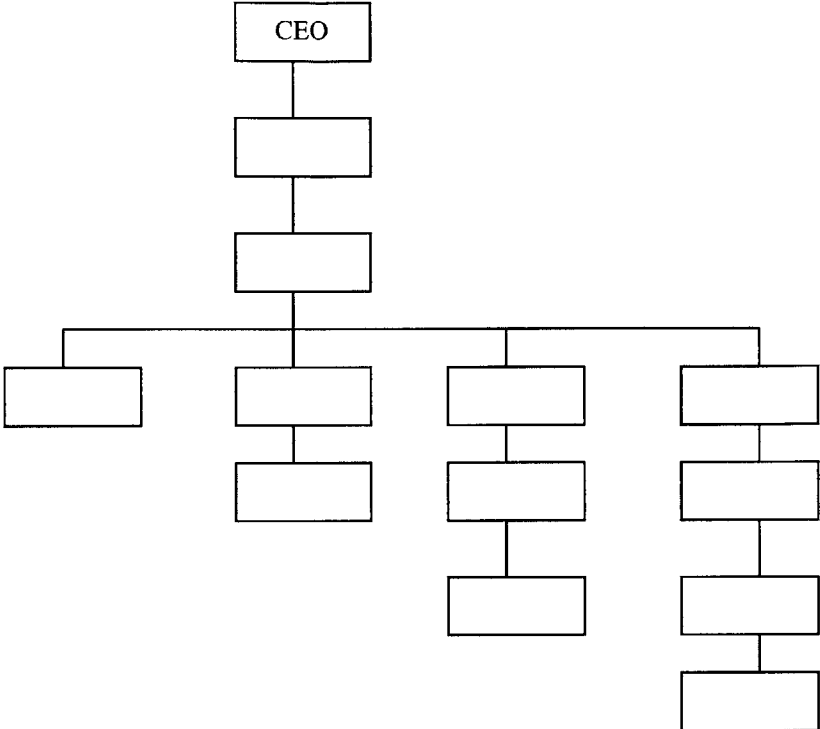


Figure II-16: The Military Organization.

6.3.4.6 The Political Organization

A large base and a reverse command structure characterize the political organization. The base is more powerful than the head especially in democratic organization structures. Figure II-17 shows a political structure:

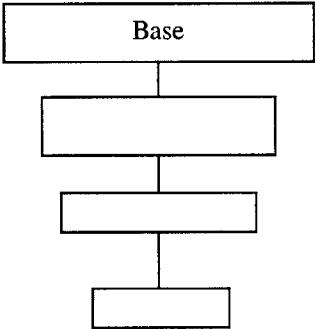


Figure II-17: The Political Organization

6.3.4.7 The Autocratic Organization

This is a reverse of the political organization structure. Usually there is a single authority at the top and everybody reports to him/ her. The main difference between this and the military organization structure is that in the latter the head can be replaced.

Figure II-18 shows an example of the autocratic organizational structure:

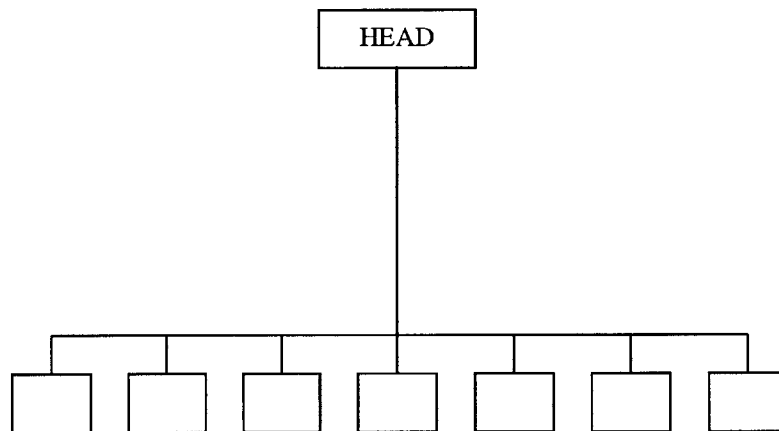


Figure II-18: The Autocratic Organization

6.3.4.8 The Virtual Organization

The virtual organization consists of teams or functions that are remotely located from each other. This is the most recent type of organization especially now that many companies extend their activities to the international field and go “global”. The communication between these teams or functions can be implemented with frequent travel or, nowadays, by means of modern information and communications technology. Different time zones and even non-working days occur in this type of organization that have to be seriously taken into consideration.

An example of a virtual organization could be an appliance manufacturer, where the different stages of the product development take place in different geographic locations. In this case there is the need of a close coordination and feedback among the different teams. With this kind of organization we can have better R&D results as experts all around the world can be used full time or part-time without the need to move. Figure II-19 shows a typical virtual organization.

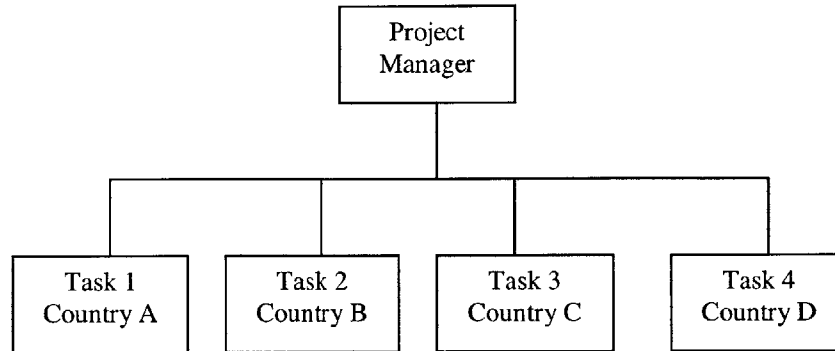


Figure II-19: The Virtual Organization.

6.3.4.9 The Ad-Hoc Organization

The Ad-Hoc organization is characterized by no hierarchy at all. A group of people simply get together to do a project. They are all experts in their field and the goal is to complete the project. There are no levels of hierarchy at all. Everything is resolved and decided at the same level. Coordination is achieved through many meetings. This type of organization is not stable and is temporary. Figure II-20 shows an Ad-Hoc organization.

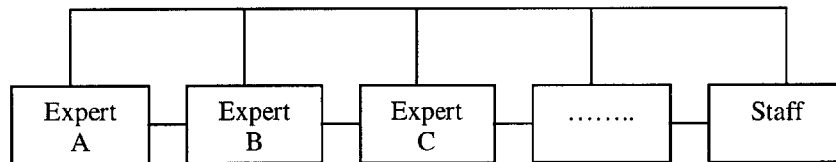


Figure II-20: The Ad-Hoc Organization.

6.4 FACTORS JUSTIFYING ORGANIZATION SELECTION.

As we have mentioned before and after the introduction of the different types of organizational structure, each project needs a specific organizational structure in order to be successfully implemented. This means that the companies choose the type of project that they will execute, or modify their structure to meet the needs of a specific project or, in large-scale projects, new organizational structures may be necessary. We will examine here the criteria for organizational structure selection by matching a project type with an organizational structure.

Before we decide which of the above structures we are going to use, we have to take into consideration the following factors that are related to the company's and the project's characteristics:

The number of projects and their relevant importance: In a case where we are dealing with an organization that undertakes projects which have little common areas or are not so frequently undertaken by the company, the most suitable organizational structure is the functional organization. As the company is developed within the general departments, it can apply the knowledge and resources to the various ongoing projects. As the number of the projects increases and their relevant importance by the means of quality, time and budget constraints, the firm should move to the matrix structure.

Level of uncertainty in projects: Where all the projects have different levels of uncertainty (risks), this uncertainty affects the cost, time and quality of the project. Even the same pattern of project that will be executed at a different time has different risks. These risks could come from the human resources (whether there are experienced employees or not), the price of the raw materials, the political factors and the taxation system. To handle the uncertainty, a feedback control system is created to define the differences from the original plans and detect the trends that might lead to future deviations. For this feedback system to work more efficiently, the project manager should control all the resources for the project and take decisions on his own after being involved with the rest of the project team, which should be fully committed. So we conclude that a project-oriented organization is more suitable when the level of uncertainty of a project is high.

Type of technology used: When a project is based on a number of different technologies and the application of these technologies to the project is not continuous through its life cycle, then the matrix organizational structure is preferred. If the project is concentrated on a technology that is coming from one functional area then the functional organization is preferred. When the project is based on several different technologies and the effort required is continuous and the work in each area is enough to employ at least one person, then the project-oriented structure is preferred. R&D projects where the need for new technologies and processes is needed and the level of uncertainty is very high, are best developed through project-oriented structures.

Project complexity: If the level of complexity in the project is very high, then better coordination and scheduling is required among the team members and the project-oriented structure is preferred. Low complexity projects can be implemented with a functional organization or with a functional matrix structure.

Duration of the project: Short-term projects do not justify a special organization form and could be efficiently handled within a matrix organization. Long term projects are better performed in a project-oriented structure.

Resources used by projects: When more than one project uses the same resources and especially if the cost of the resources is significant, then a functional matrix organization is preferred. In the case of low cost shared resources or little common resources, the project-oriented structure is preferable.

Overhead cost: If projects share facilities and services then the overhead cost is divided and as a result it is reduced for each project. A matrix organization should be preferred in that case.

Data requirements: When databases or acquired knowledge has to be shared among different projects, then the functional organization is preferred.

Level of client involvement: When the client is highly involved in the process of the project, then the project-oriented structure is preferred as it includes the client into the working team. Nowadays, client involvement is the trend for successful flexible and more efficient projects with a reduced response time. Low client involvement can be handled with matrix or functional organizations.

Response to market/ flexibility: As the market changes rapidly due to the maturity of the consumers, the competition and the introduction of information technology, flexibility in changes should be supported by the organizational structure of the project. In this case, a project-oriented structure should be followed. In the case of a line project that does not get impacted as much by external changes, either matrix or functional structures would be best.

Communication channels: This includes the definition of the needs of the projects or the company in terms of communication. We specify which departments or teams should communicate with each other, what the levels of communication should be, and the speed of the communication or the feedback required. After this definition we can create the linkages between these organizational units, as we will analyze in the Chapter 6.

Finance and accounting: This is also a very important factor. It includes the accounting information that travel through the company, the purchasing power of the company and the levels of leverage. For example research has shown that a project at the set-up stage does not need as much money and resources as at the close out stage where there are many details and contingencies. It depends on the company's financial power, the speed and the volume of the projects that can be undertaken. Also when the company borrows money under high interest rates, the development is slower. Slower development requires a functional organization where the utilization of the resources and the economies of scale reduce the cost significantly.

Coordination: This factor should also be considered to determine whether high or low levels of coordination are required. It should be specified the structure that can offer the best coordination in collaboration with the communication channels, the amount of overload that the teams or individuals have and the special skills that may be required for the specific project. Functional organizational structure offers better coordination in the organizational level and better utilization of the expertise of the individuals, while the pure project organizational structure offers better coordination within the project frame.

6.5 TIPS FOR CHOOSING AN ORGANIZATIONAL STRUCTURE THAT WILL CARRY THE PROJECT.

Think of all of the above factors: write down the factors and analyze each of them for the specific situation. The best analysis is the one that will approach best the uncertainty parameters and the needs of both the organization and the project and will give the project manager the most resources for solving potential problems.

Define the project with a statement of objectives: specify the desired outcome in terms of quality/performance, cost, delivery time.

Determine the key tasks associated with each objective: then define which function of the company serves these key tasks.

Arrange the tasks in sequence: A detailed and careful design of the task sequence will prevent the project manager and the organization from many problems and conflicts.

Determine which organizational units are required to carry out the work and the relevant importance of other units: Task assignment is very important. Analysis of the existing work load in the departments and consideration of overlapping tasks and authorities are very important in that phase.

List any special characteristics of the project or the organization: special requirements and characteristics should be noted and served from the organizational structure.

Write the advantages and the disadvantages of each structure for a specific project: Then choose the most suitable for the company and the project organizational structure, taking into account the priorities.

In Table II-1, we can see a comparison matrix with the main advantages and disadvantages from each of the analyzed organizational structures.

Type of Organizational Structure	Flexibility to Market Changes	Quick Reaction Time	Customer Satisfaction	Resource Utilization	Conflict Vulnerability	Simplicity of Reporting Channel	Fast Communication Channel	Use of Economies of Scale	Research ability	Employees Advantages
Functional				X		X		X	X	X
Product	X	X	X			X	X			
Matrix					X		X	X	X	X
Bubble	X	X	X			X	X			
Market	X		X		X					
Chronological				X	X					
Sequential				X	X					
Military				X		X		X		X
Political					X					X
Autocratic				X		X		X		
Virtual	X		X						X	X
Ad-Hoc									X	

Table II-1. Matrix with main Advantages – Disadvantages of different types of Organizational Structures

ORGANIZATIONAL DESIGN

CHAPTER

7

The design of the organization that is reflected in an organization chart, as we saw before, should meet the following three goals:

- Evaluate the needs that the project or the company has, prioritize them and try to serve them.
- Create the vertical structure of the organization: specify the hierarchy, the line responsibility and the reporting channels.
- Create the horizontal structure: specify the communication channels and the correlation between the departments and the functions of the organization.

In this chapter we will analyze the design procedure with emphasis on the horizontal and vertical design as a way of developing the most effective and operational organizational design.

7.1 EVALUATE THE NEEDS OF THE PROJECT – COMPANY

If we were a consultant whose task is to create an organizational structure for a company or to redesign the existing one, what we would do? First of all, we would interview the upper management and collect information related to:

1. The mission of the company (whether they are focused on increasing their market share or they need immediate profits).
2. The scope of the project/s that it undertakes (whether they are customer, market oriented or if they follow the process that the firm has established through the years),
3. The levels of authority (how many administrative staff and how are they graded compared to the lower levels of the company), and their relationships, the type of span (wide, narrow), etc.
4. The culture of the company and the environment in which it operates.
5. Past related problems and the way they overcame these problems.

Then we would examine the socio-political factors and the various risks that may apply to the project/s. We would also examine the constraints and set the priorities between the three factors: cost, schedule and quality.

Finally, we would interview some of the employees to have the whole picture from the bottom up.

After the collection of this information, we would do a checklist and try to design the organizational structure that would fulfill all the requirements of this checklist taking into account the advantages and the disadvantages of the various organizational forms we studied. Then we would focus on designing the vertical structure.

7.2 DESIGNING THE VERTICAL STRUCTURE

The vertical hierarchy of the company is represented with an organizational chart. It shows the employees, their place in the organization, whom should they report to, and for what they are responsible. It also shows how many levels of management are above and below their entity and how the company operates through them. They can see the span of management and how decisions travel from the top until the very bottom and vice versa. Here we will analyze the vertical information linkages.

7.2.1 Vertical Information Linkages

Vertical linkages are used to coordinate activities between the top and the bottom of an organization. It is the transfer of the command from the top to the lower levels and the feedback channel from the lower levels to the top. We can understand how important this channel of communication is. The success of the organization depends partially on how easily and quickly the information travels through that channel. Organizations may use a variety of structural devices to achieve vertical linkage. These devices include hierarchical referral, rules and procedures, plans and schedules, positions or levels added to the hierarchy and formal management information systems.

Hierarchical Referral: The first vertical device is the hierarchy or the chain of command. For example, if in one level of hierarchy a problem arises that the employees do not know or are not able to solve then this problem passes to the next hierarchical level to find a solution. In most cases passing up and down information in the hierarchy is not so effective method for vertical coordination so other methods are used by the organizations.

Rules and procedures: Another device for vertical communication is planning and scheduling. This means that upper management can provide the employees with carefully designed plans, specifications about the quality of the job and schedules about the completion time. This technique, especially when the plans and schedules are carefully designed, can be used for controlling the employees and keeping track of the department or project progress.

Levels or Positions added to Hierarchy: When too many problems or responsibilities comes to the top where the management is, then we have the case of overloaded managers that need help in their tasks. This happens usually in newly established organizations or ones that are making innovations and contain a high level of uncertainty in their tasks. In this case, we can have positions added to the hierarchy to assist to the overloaded ones. Such additions reduce the span of control and provide for more accurate or effective control and communication.

Vertical Information Systems: This is another very important device used to increase the vertical communication channel. It includes written information, periodic reports and database information that is passed from the top to the bottom and vice versa.

The importance of this device lies in the fact that it reduces paperwork and face to face meetings and makes the communication more interactive and easy. An example is the Web boards of a company and the use of an Intranet. The members can post in their specific place on the Web site of the company problems, announcements and comments that can be read simultaneously by other members of the same level or from higher levels of the hierarchy. This is a rapid way of communication without having persons printing, carrying and filing documents and can be accessed from anywhere even from a geographically remote location.

The following matrix shows the ladder of mechanisms for vertical linkage and control.

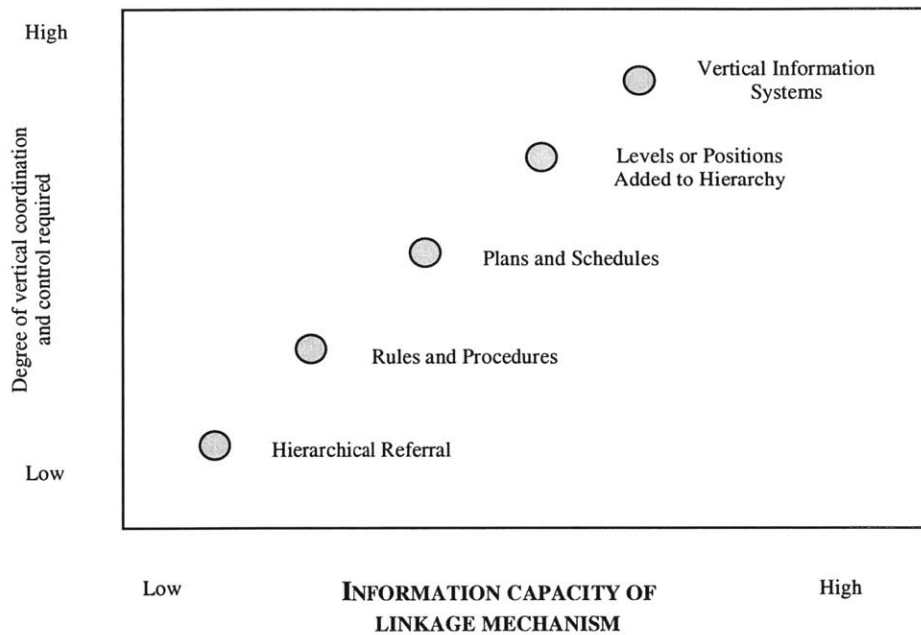


Figure II-21: Ladder of Mechanisms for Vertical Linkage and Control.

7.3 DESIGNING THE HORIZONTAL STRUCTURE.

7.3.1 Horizontal Information Linkages

The vertical linkage is the traditional concern of organization designers but the horizontal linkage is also very important. Horizontal linkage refers to the amount of communication and coordination there is horizontally across the organizational departments. It overcomes the barriers between the departments and provides a higher level of control between employees to achieve unity of effort and the organizational objectives. The need for horizontal communication increases as the amount of uncertainty increases. Horizontal linkages are not drawn in the organizational structure chart but they are part of it. The following devices provide the horizontal coordination and control.

Paper work, Memos and Reports: This includes paperwork that is sent between the departments about a problem or decision. Other departments may be added to the mailing list or sent a copy of correspondence, just for information purposes. This type of communication provides low levels of coordination and does not permit a large volume of information to be processed.

Direct Contact: This includes all the face to face meetings or the conference calls among the management to solve specific problems or create strategy. This is a higher level of communication but has the following disadvantages: It is not so flexible in the arrangement of the time and the place of the meeting; many problems that can be solved at the lower management level are not of interest in the upper levels; people that have a different opinion may be overshadowed by others that have the power of taking control of the meeting. Also they take time and sometimes people have to be moved to the location of the meeting from different locations.

Liaison Roles: This is the next level of communication. Liaison roles often exist between engineering and manufacturing departments, where coordination and feedback between them is needed. This role can be served by a person whose responsibility would be to maintain the communication channel between these different departments.

Task Forces: The previous linkages, the direct contact and the liaison roles usually link two departments. When communication is between more than two departments, a more complex device is required: the task forces. A task force is a temporary committee composed of representatives from each department affected by a problem. Each of these persons represents a department in the meetings, and carries information back and forth to the department. Task forces are a very effective device and solve problems at the horizontal levels and reduce the transfer of the problems up the vertical structure. Their role is temporary and they decompose when the task is complete.

Full time integrator: This is the strongest horizontal linkage. A whole department is created for coordination purposes. A full time integrator most of the time is a product manager, a project manager, a program manager or a brand manager. The difference between this and the task forces is that the full time integrator does not report to a functional department. It is a sole department outside the other departments and has the responsibility of coordinating several departments. The integrator can also be responsible for the whole project. The role requires special skills. The integrator should transmit trust, should persuade, and should be able to coordinate and maintain communication between people.

After having analyzed the design of organizations and the communication channels, in the next chapter, we will present the role of the project manager and the teams.

PROJECT MANAGER, TEAMS

CHAPTER 8

8.1 INTRODUCTION

The project manager is the person responsible for a project and is different from the functional or line manager. The difference exists in terms of the leadership arena. The functional manager leads a specific function or department of the company. We cannot compare the power of the functional manager to the project manager because each one has different fields of leadership. Their authority derives from the organizational structure of the company and the emphasis depends on what the company is trying to implement (project or functional). The line manager has less authority in a project than the project manager and is the person who has direct contact with the employees and the teams. Conflicts arise between all of the three types of managers because each of them might serve different goals of the company. In this chapter we will analyze the authority, the required skills and the responsibility that the project manager should have. After, we will see the team formalization and the leading committees.

8.2 THE PROJECT MANAGER

The project manager is responsible for the whole project in matters of meeting the specified quality/performance, budget and schedule within the socio-political factors and the natural environment. He has to lead the team or the teams involved in the project to motivate them and also handle the cost or budget overruns and try to manage and control them in the best way.

8.2.1 The Roles of the Project Manager.

The job of the project manager includes a set of ten roles (by Mintzberg), that the project manager has to follow. These ten roles fall into three categories, the interpersonal, the informational and the decisional roles.

Interpersonal Roles: This category includes the *figure-head*, *the leader* and *the liaison* roles. Some of the tasks that the figure head role is compiled from are the performance of the manager in the employees' events such as weddings and meeting/dinning with clients and local authorities. The leader role is the project manager performance as the leading person responsible for the motivation and the application of the right directions within the project organization. This role is very important but also very difficult to be implemented successfully because the project manager has a lot of responsibilities but not enough authority. The project manager is a middle management position that can not usually offer promotion or other incentives to the employees with out taking approval from the upper levels of the organization. He/she needs to use his/her influence to encourage and motivate the people to get the things done. In the liaison role the project manager makes contacts outside his/her vertical chain of command. The contacts with the external people most of the times are critical for the success of the project.

Informational roles: This group of project manager roles includes all the getting and transferring of information by the project manager. The project manager act as *monitor*, and scans the environment for information. The environment can be either internally in the project or externally in the other divisions of the organization or in the open market (customer, competitors, new technology). Most of the information can be oral and referred to gossips among the team members about the performance of their colleagues, their dissatisfaction and the problems that reduce their productivity or the quality of the product. Then the project manager has to evaluate this information critically and very carefully and if found to be very important distribute it within the project team as feedback. Many times the information is needed to be transferred outside the project team, usually to the higher ranking of management, or the customer, or the stakeholders. This role is called *the spokesperson*. The effective project manager should be a good and mature carrier of this information.

Decisional roles: Since the information comes to the project manager, he/she has to evaluate it and if needed take the right actions. The four decisional roles identified by Mintzberg are: the entrepreneur, the disturbance handler, the resource allocator, and the negotiator roles. In the entrepreneur role the project manager is constantly looking for new ideas that would suggest to the senior management and after approval will initiate. This is very commonly met to the very technical oriented project managers that they often come out with ideas such as new products, improvement of existing ones, new processes or innovation in the organization. The second decisional role, the disturbance handler is handling with the pressure that the project manager faces when he/she tries to make a change such as change in scope, change of personnel or conflicts among involved parts. The third and very sensitive role is the resource allocator one. The project manager, in cooperation with the functional manager, might choose from the beginning, who from the organization's personnel is going to work on his/her project, which period of time and for how long. People that are not offering the appropriate services to the project should be replaced or relocated to other tasks. Finally the negotiator role of the project manager and probable the most important one, is the key role as it keeps all of the balance among the team members, the customer and the organization and the project team and the senior management. A good project manager should resolve the conflicts early on by taking the proper actions and not letting them to become bigger and above his/her authority and solving capability.

In the next session we will see what the duties of the Project Manager are.

Duties of Project Manager.

The project manager usually manage and direct the resources to achieve the objective of the project, act as a counselor on technical, business or even personal issues, delegates and then supervise the project tasks and at last he/she resolves the conflicts that come up. The following tables shows some of the most common activities and duties of the project manager.

- Define the project plann
- Prepare the project plan
- Present and sell the project and the project plan
- Convey the purpose of the project
- Implement organization policy and procedures

- Apply effective project management methods and tools
- Interact with general management
- Interact with line managers
- Obtain project resources
- Coordinate the use of project resources
- Interact with customers and suppliers
- Interface with other projects
- Prepare and review budgets
- Review milestones
- Develop schedules
- Revise schedules
- Revise budgets
- Manage the project team
- Delegate responsibilities
- Define issues, problems and opportunities
- Participate in specific project tasks
- Analyze issues
- Prepare management presentations
- Make management presentations
- Determine project status
- Perform “what if” and projection analysis for the project
- Deal with conflict with management
- Deal with conflict within the project team
- Restructure project plan
- Understand the tools and methods used in the project
- Learn from previous projects
- Deal with the impacts of project change
- Coordinate the removal of project team members
- Coordinate the arrival of new team members

Table II-2. Duties of Project Manager (Project Management for the 21st century, Bennet P. Lientz)

After describing the duties of the project manager, we will analyze the skills that the project manager should have for excellence staffing.

8.2.2 Skills for the Project Manager

In earlier years the project manager needed to have leadership, technical and problem-solving skills as the nature of most of the projects was technical. Now, most of the positions for project managers also require some business skills. Companies want to suppress the phenomenon of functions within the same company without any communication channels because people are very specialized in their subject and do not have a critical thought about the needs of the other departments. For example, the design engineers of a car company should think of alternative solutions if their initial one does not meet the requirements of the marketing or financing department. The project manager needs to have an overall knowledge of how the organization operates and what its goals and needs are. The skills the project manager must have are:

- **Leadership:** The project manager has to lead the team of people or the teams and the individuals that will execute the project. These teams or individuals can come from within the organization or from outside. In the last case they can be suppliers, external partners, consultants or other project managers.
- **Interpersonal Skills:** The project manager should be able to motivate, organize, control and bring to the correct path the employees and the tasks under his/her supervision.
- **Communication Skills:** The project manager should have the ability to work with people, to communicate and to transfer information horizontally, vertically and spatially in and out of the organization.
- **Decision Making Skills:** The project manager should have critical thought, be able to take quick and right decisions and present a solution to problems as they occur.
- **Strategic planning skills:** The project manager should have the ability and the knowledge to plan strategically during the lifecycle of the project when it is needed. That refers to selecting the key people for staffing the project, the available resource allocation over the tasks, putting feasible milestones, calculating and also taking the risk as well as applying the feedback that he/she gets to alter the project scope when needed.
- **Innovation Skills:** The project manager should have an open mind especially to the new trends and technology, should be adaptive to new methods and follow the new enterprises that are rapidly changing.
- **Ability to work under pressure:** this is an important skill as most of the projects because of unpredictable factors often run above schedule and budget and corrective actions should be taken.
- **Negotiation and Conflict Resolution:** Conflicts are very usually met when different personal or organizational goals come into collision, or customer and organizational disagreements occur in the process of the project.
- **Influence to get the job done:** when they have little authority or rewards power, then the project managers need other ways to get the job done. They need to use motivation, put tangible goals for the project team and gain the respect of the team by presenting a straight and value driven character.

- **Business Skills:** As we explained before, the project manager should know the basis of the business terminology and how they operate, because the projects are related to business, as they are attending to customers and stakeholders are involved.

8.2.3 Early Stage Involvement

In the earlier years, companies used to hire the project manager after the completion of the planning stage. Nowadays, they have understood that this has several negative impacts.

First, with the introduction of concurrent engineering, which involves the overlap of the project process stages. During the design stage manufacturing personnel would get involved in the process providing valuable knowledge on issues such as manufacturability feedback. The first prototype can be manufactured and the quality engineers can test it. This would save a remarkable amount of time for the project. In this complex case of concurrent engineering, which needs more coordination and organizing than the traditional process, a project manager should be involved from early on.

Secondly, the designers usually do not have technical implementation skills or do not know how to implement value engineering. Value engineering are the alternative ways used to produce a material or part with same characteristics as the planned one, but with cheaper price or easiness in manufacturing. These ways may include different materials or different techniques used for his product. This can save money and time for the project. The project manager should get involved early on as the expense on his/her wage will save a lot of money for the company and resolve conflicts.

Companies that have achieved excellence in project management, among others, they bring the project management early in the life of the project to assist in outlining it, setting its objectives, and also helping the marketing people on marketing and sales issues. Executives assign project managers for the whole life of the project. The project manager should not change over the lifecycle of the project although the rest of the staff might change or changes of scope that are inevitable might happen. They should be changed only in cases that instead of solving the problems, they try to bury them.

Project Manager v.s. Line Manager.

We have seen the difference between the functional and the project manager in chapter 5.3.3, but still we haven't made clear the difference between the line and the project manager. The difference is in the responsibilities that each of these managers have. As a general rule, the project manager is responsible for the whole process of the project as a macro management approach and the line managers are closer to the implementation practices. Table II-3 Shows the responsibilities of both the project and the line manager.

Responsibilities Project Manager vs. Line Manager	
Project Manager	Line Manager
<ul style="list-style-type: none"> • Define scope of the project • Identify line areas that contribute to project success • Get approvals • Monitor and report on progress • Manage identification and resolution of problems • Negotiate scope deliverables • Control changes to avoid creeping scope • Plan and schedule user training • Ensure the development of user's manuals and training materials • Plan and carry out testing and data verification • Plan final implementation • Plan for post implementation user support • Provide input to the line manager on the performance of team members • Declare the project done 	<ul style="list-style-type: none"> • Estimate costs • Commit to deliverables • Manage ongoing line responsibilities • Report status on a regular basis • Report variances immediately • Identify cross-functional requirements and provide functional and technical expertise • Identify and resolve problems • Assist in development of test, training, implementation, and support plans.

Table II-3 Project Manager's responsibilities versus line manager's responsibilities. (In search of excellence in Project Management, Harold Kerzner)

8.3 THE TEAM

A team is a small number of people with complementary skills who are committed to a common purpose, performance goals and approach for which they hold themselves mutually accountable. {Teams at the top, the McKinsey Quarterly 1994}

As we saw before, teams can exist in functional departments working for a project but reporting to the department, or in project-oriented organizational structures being completely devoted to a specific project, or in coordination roles. Small teams usually consist of 4 to 6 persons and most of the time they have an internal leader. This is the person that coordinates the team, divides the tasks and creates the incentives. The leader is also responsible for the external communication between the team and other teams or the organization. Teams can execute a specific task or can move to different tasks every time as integrators. Their role is usually temporary and decomposes after the task is completed. Many changes in the team composition may happen until the optimal combination between the members is found. The team is the next level of unit in the organization in terms of complexity after the individuals.

The advantages of the small teams versus the large teams are:

- Easier coordination because of the fewer people.
- Less time spent on informing the members and updating the project status.
- More flexibility because the members have to do more tasks themselves.
- The project manager can also get involved in getting tasks done.

In the next session we will see a particular form of team which is widely formed in organizations, that is the virtual team. It is certain for the project managers that they will have to work with such teams and this is the reason we will make an extensive presentation for this category of teams.

8.4 VIRTUAL TEAMS.

8.4.1 Definition

Virtual is the team whose members are geographically dispersed and have a common objective and a defined deliverable.

Technology has made global team work an everyday reality for thousand of people. People in geographically distributed locations can now work on the same project without leaving their desk or country. The often face to face meetings have been replaced by videoconferences and electronic mail. The information channel is nowadays rapid and secure. Architecture, mechanical drawings, images, contracts and specifications can be transferred throughout the world in seconds. Internal (within the team) and external (with other teams or other organizations) communication can be achieved effectively. Information technology has created a lot of advantages for companies and their employees. It gives the opportunity for specialists in every location to meet, exchange ideas and work under a common goal without having to leave their location. These people have the possibility to work better in their environment with their own tools, be close to their family, and undertake many jobs since they are not required to travel extensively. In this paragraph we will compare the virtual to the co-located team and examine the additional requirements for the effectiveness of virtual teams.

8.4.2 Differences among virtual and co-located teams

First we will discuss the place that these teams meet and discuss or plan their tasks.

The co-located teams usually have a specific place to work, meet, exchange ideas, schedule the next steps, assign tasks, and control the productivity and effectiveness of the members. Members present their problems with visual effects, on boards and put post notes and progress reports at this place.

The virtual teams do not have this real place instead they communicate by emails or telephone conferences or videoconferences. There are virtual web boards

where every body could asynchronously post reminders, problems that come up, and progress of the tasks.

Disadvantages of the virtual teams compared to co-located teams.

Trust is the most important issue for team effectiveness. The image from the camera is not complete, people cannot see the emotions of their colleagues; most of the time people do not even see each other or talk to each other as the work exchange is in digital format. Even the videoconferences do not join the members as each of them is placed elsewhere surrounded by other environments, the image transmission is poor and the camera shows only the face of the persons and leaves questions about the rest of their environment.

The first meetings, dinners, events that break the ice and forge links for teams do not exist, not even interpersonal relationships or the discovery of common characteristics. It is difficult for a virtual team to work under the same goal with full devotion and trust to the members and the final goal of the task.

Another problem that is faced in dispersed teams in different time zones is the difference in hours. Virtual meetings that are scheduled in the afternoon for the headquarters may find some of the members in the very late hours of the day tired from the daily work. Problems that arise in one location and need immediate response may require the team members in other locations to be on call for 24 hours and this has an adverse effect on their private life.

Another important issue that the virtual teams face as a disadvantage is the cultural differences that exist because of the different origins of the team members. These differences can act negatively to the consistency of the team as different members set different priorities for themselves, have different holidays, and understand differently the messages from the team leader or other team members.

Finally, conflicts arise more easily, as there is no firm work coordination and frequent ideas exchange. Some of the members may not be consistent in the delivery times of their task, as of other heavy load, and may delay the whole team process.

8.4.3 Virtual team effectiveness

There are four basic principles that have to be followed whether or not the team is co-located. The team must have complementary skills for the job to be done, must establish goals to follow for collective accountability, must agree to a common approach to getting the work done and at last have a common purpose that will bind them together and with the task.

Credibility, trust building and quick channel of conflict resolution should be added as essential for virtual teams to work effectively. These values can be achieved by many different ways. Some of them are:

- Arrange an initial face to face meeting and maintain contact with time to time meetings

- Learn about each other's culture.
- Set consistent and complimentary goals – objectives
- Agree on a protocol for communication
- Learn about communications technology
- Maintain the system
- Set achievable but tight and often milestones for the better control

Below we will present the maturity model for virtual teams. The reader will see the different steps of maturity that these teams have to achieve for optimal performance.

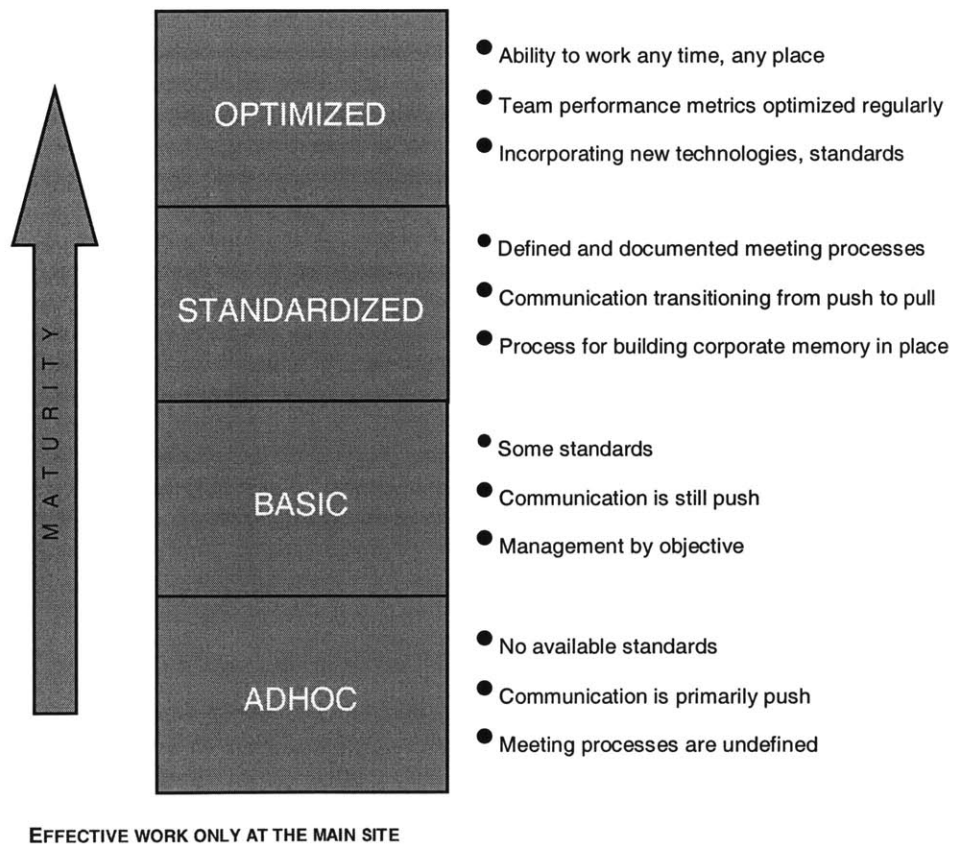


Figure II-22: Maturity model for virtual teams

From Figure II-22, it is obvious that when the virtual teams have clear goals, technological standards, and performance metrics then they make steps towards higher levels of maturity and optimization.

8.4.4 The Project Manager's Check list

Below we will present some important questions that the project manager should have in mind before each virtual meeting to achieve the optimal performance of a virtual team:

- Are all team members clear about the overall objective of the project?
- Can every team member state the vision, mission and objectives for the meeting?
- Does every member understand his/her accountability for the output and time frame?
- Has the team established a set of operating agreements for the meetings?
- Are team members checking on each other formally or informally?
- Do all team members know how to use the technologies and processes for conducting meetings?
- Are progress, changes and problems related to the project communicated to the top management locally and globally?
- Are meeting decisions and minutes documented and distributed?

In the Chapter 8, we will present the linear responsibility chart that will show us a method for assigning responsibility and tasks to the teams or the organizational elements in general.

8.5 LINEAR RESPONSIBILITY CHART.

After the definition of the organizational structures, the project manager, and the formation of the teams, responsibilities and authority relationships should be specified. The linear responsibility chart is a very important tool for this purpose. It is also known as a matrix responsibility chart. It summarizes the relationships between the project participants and their responsibilities in each element of the project. Elements can be a task, a decision, a contract or a report. The columns represent the managers of the organizational departments while the rows represent the project elements. The cells make the connection between the organizational departments and the project elements and show the amount of responsibility that exists.

8.5.1 Example

Table II-4, shows an example of a linear responsibility chart:

Engineering	Mfg	Contracts	Project Manager	Marketing	Quality Assurance	Activity
I	I	O, A	P	B	A	Respond to RFP
I,N	I,N	I,R	P		A	Negotiating Contract
P	A	R	O,B		A	Preliminary Design
P	A	R	O		A	Detailed Design
R	P		O,B		R	Execution
I	I		O,B		P	Testing
N	N	P	A	N	A	Delivery

Table II-4: Example of linear responsibility chart

Explanation of the notation of the chart:

(A) *Approval*: Approves the work package

(P) *Primary Responsibility*: Indicates who is responsible for accomplishing the work package

(R) *Review*: Reviews output of the work package

(N) *Notification*: Notified of the output of the work package. As a result of this notification, the person makes a judgement as to whether or not any action should be taken.

(O) *Output*: Receives the output of the work package and integrates it into the work being accomplished.

(I) *Input*: Provides input to the work package.

(B) *Initiation*: Initiates the work package.

In the next chapter we will present some forms of problems that the projects have and arise from not clear defined roles, misunderstandings in the responsibilities and pure project or organizational coordination.

CONFLICTS - NEGOTIATIONS

CHAPTER

9

9.1 INTRODUCTION

In projects, especially the very complex ones, or those involving many people with different cultures, levels of knowledge, or different environmental origin, conflicts are commonplace. Other causes of conflict can be the inadequate plans and specifications, the changes in the tasks or the order of the job or personality clashes. Conflicts affect very negatively the outcome and the process of the project and should be prevented or resolved very early on. If conflicts are not resolved in time then the disputes escalate and may result in litigation. Litigation allows people that are, most of the time, completely unfamiliar with the nature of the project to make a judgement. At that time the matter is out of the control of both parties to the conflict and the expenses that burden the project are usually tremendous. In this chapter we will present the types of conflicts, the conflict intensity over the project life cycle, and the alternative dispute resolution methods available.

9.2 TYPES OF CONFLICTS.

There are many types of conflicts that may arise in a project. These are categorized by the sources that they come from and include:

- **Scheduling:** Includes disagreements that come from timing, sequence of tasks, duration of tasks and project, and feasibility of activities.
- **Managerial and Administrative Procedures:** These come from disagreements on how the project should be managed. Issues include authority, power, responsibilities, project scope, design of the work, agreements with other groups, and general administrative support.
- **Communication:** disagreements also result from poor communication flow between the staff, or between management and staff, and include misunderstanding of the project goals, the strategic mission of the company and information flow between the members of the project team.
- **Goal or Priority:** Disagreements here arise from the lack of goals or poorly defined project goals. These include different views about the project mission and the importance of the different tasks.
- **Resource Allocation:** This is a common problem when we have a matrix organization. It includes the allocation of human resources, raw materials, equipment and facilities. The disagreements are between the different teams, different projects or the different departments within the organization

- **Reward Structure/Performance Appraisal or Measurement:** These disagreements are related to payments and are made from the inconsistency of the team performance and the project goals. For example, project managers may promise rewards to the team members without having asked their boss or the organization whether this is feasible.
- **Personality and Interpersonal Relations:** This includes interpersonal conflicts that are based on egoistic behaviors rather than technical disagreements.
- **Costs:** These conflicts arise from the lack of cost control and or the allocation of funds.
- **Technical Opinion:** These disagreements arise from different opinions on technical issues, specifications and performance.
- **Politics:** These come from the politics of the company and include the hidden missions or agendas of members of the organization.
- **Poor Input or Direction from Leaders:** These arise from the poor clarification of the upper management concerning the project goals or the organization mission.
- **Ambiguous Roles/Structure:** These are found especially in the matrix structure where two or more persons have overlapping assignments or goals.
- **Unresolved Prior Conflict:** These reflect disagreements that arise from prior unresolved conflict within the organization or project team.

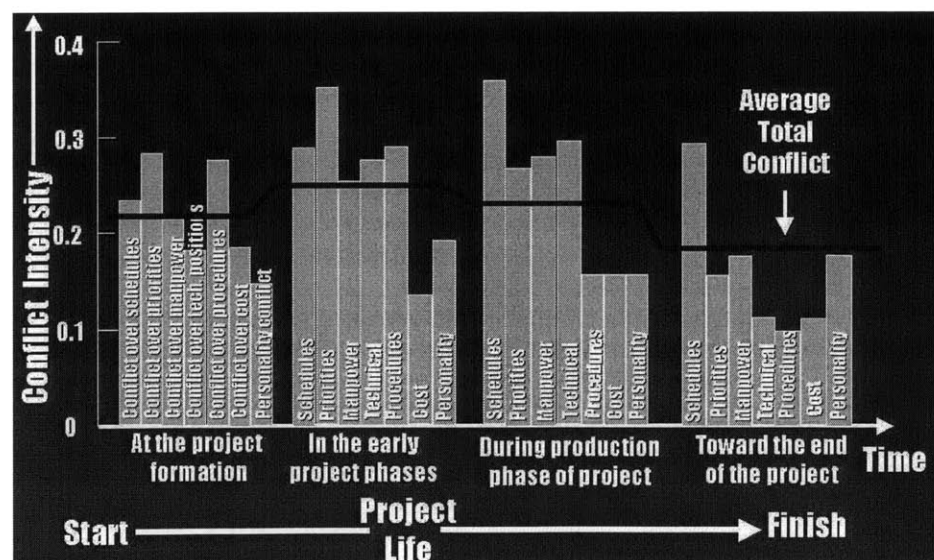


Figure II-23: Conflict Intensity over the Project life Cycle {Shtub }

As mentioned at the beginning of Chapter 9, conflicts can involve any of the stakeholders involved in projects. This includes customers, teams, team members, individuals, project managers, functional managers, line managers, other administrative personnel, suppliers, external contractors and subcontractors, public employees and organizations, and political entities. Conflicts are in the daily calendar of the project manager but most of them are trivial and can be quickly resolved. The internal conflicts, when they are at the lower level of hierarchy, can be solved with the intervention of the project manager as a more knowledgeable or authoritative person. Conflicts that occur at the higher levels can be resolved by the senior management or can lead progressively to litigation. Figure II-23 shows conflict distribution and frequency during the life cycle of a project.

In session 9.3 we present Alternative dispute resolution, a method that analyses the stage of the conflicts and tries to prevent and resolve the conflicts before they get to the next stage.

9.3 ALTERNATIVE DISPUTE RESOLUTION.

9.3.1 Background

Alternative Dispute Resolution (ADR) refers to any procedure, agreed to by the parties to a dispute, in which they call upon the services of a neutral party to assist them in reaching agreement and thus avoiding litigation: assisted negotiation, as opposed to unassisted negotiation or adjudication. Types of ADR include prevention, negotiation, standing neutral, non-binding arbitration, binding arbitration and litigation. With one exception (binding arbitration), the goal of ADR is to provide a forum for the parties themselves to work towards a voluntary, consensual agreement, as opposed to having a judge or other authority decide the case.

In addition to serving as a potential means of avoiding the expense, delay, and uncertainty associated with traditional litigation, ADR also is intended as a vehicle for improving communication between the parties. ADR provides a forum for creative solutions to disputes that better meet the needs of the parties.

9.3.2 The ADR Act of 1990

In November 1990, the U.S. Congress passed legislation that authorizes and encourages Federal agencies to use alternative dispute resolution techniques to reduce the growth of litigation. In enacting the Administrative Dispute Resolution Act, the Congress expressed concern that traditional forms of proceedings used to resolve disputes between agencies and members of the public have become too formal, costly, and lengthy, and asserted that ADR may be, in at least some instances, faster, less contentious, and more economical. The ADR Act requires Federal agencies to appoint a dispute resolution specialist to work with the Administrative Conference of the United States (ACUS) and the Federal Mediation and Conciliation Service (FMCS) in considering whether, and under what circumstances, ADR techniques may benefit the public and help the agency to fulfill its statutory duties more effectively. Specifically, each agency must develop an ADR policy following an examination of possible uses of ADR in formal and informal adjudication, rulemaking, enforcement actions, the issuance and revocation of licenses or permits, contract administration, litigation brought by or against the agency, and other

agency actions. Similar legislation exists in other parts of the world, including Europe, where the benefits of the ADR have been recognized.

9.3.3 Dispute Avoidance and Resolution Techniques.

Table II-5 shows 46 techniques categorized into 6 steps depending upon the characteristics of the methods. The major differences are third party involvement, binding or non-binding methods, and on-site or off-site processes. It is referred to construction projects that are usually more complicated in terms of disputes, because of the complexity, the changes and the different socio-cultural type of people working in them.

Step	Category	Technique	
PREVENTION	Equitable Risk Sharing	Economic Price Adjustment	
		Geotechnical Baseline Report (GBR)	
		Third Party Beneficiary Clause	
	Escrow Bid Documents		Negotiated Compressed Process
		Project Award and Delivery Mechanism	A+B Bidding
	PEPC Delivery System		
	"Bridging" the Design-Build Gap		
	Incentive Programs	Cost/Schedule Incentive Matrix	
		Subjective Determination of Fee	
		Superior Time-Management Allowance	
	Competent Engineering and Documentation		Constructability Analysis
		Cost and Schedule Control	Cost Statement Submittal
	Certified Payroll Submittal		
	Negotiated Equipment and Labor Pricing		
	Joint Project Scheduling		
	Schedule Audits		
	As-Build Schedule Submittal		
	Forward-Price Change Orders		
	Right of Refusal on Change-Order Cost Quotations		
	Sub-Contractor Payment Requirements		
Dispute Resolution Clauses			
Training and Development			
Partnering			
NEGOTIATION	Structured Negotiations		
	Step Negotiations		
	Facilitated Negotiations/Meetings		
STANDING NEUTRAL	Neutral Advisor		
	Owner/Agency Review Boards		
	Dispute Review Board		
	On-Call Contractor		
NON-BINDING ARBITRATION	Mediation and Conciliation	Mediation	
		Conciliation	
	Advisory Arbitration (Non-Binding Arbitration)		
	Fact-Based Mediation		
	Mini-trial or Executive Trial		
	Summary Jury Trial		
	Voluntary Settlement Conference (Rent-a-Judge)		
BINDING ARBITRATION	Mediation/Arbitration (Med./Arb.)		
	Adjudicator/Expert Determination		
	Arbitration	Single Arbitrator	
		Baseball Arbitration	
	Shadow Mediation		
LITIGATION	Court Appointed Experts		
	Judge Pro-Tem		
	Trial by Reference (Referee)		

TABLE II-5: 46 Dispute Avoidance and Resolution Techniques (Adapted from Sosa 1999)

Figure II-24 shows graphically the steps in dispute resolution and the authorities that are involved in each step.

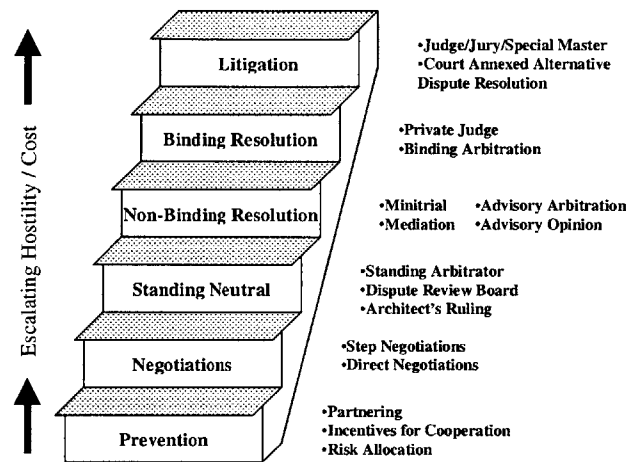


Figure II-24: Construction Dispute Resolution Steps (from CPR 1991, cited by Vorster 1993) Dispute Resolution Steps

At the prevention stage, as shown in Table II-5, vast arrays of techniques are possible. This flexibility comes from the fact that the contract has not yet been awarded, and the project has not yet started at this time. Hence, the role of the owner is significant because he/she is responsible for the design and choice of an ADR that best fits the characteristics of the project. The mechanisms of those techniques can be categorized or grouped based upon the underlying principles, such as risk sharing, contract award, incentive programs, and cost/schedule controls. The basic idea of this first stage is the early identification of possible areas of conflict for a specific project and the effort towards avoiding conflicts. Prevention is proven to be more effective and less expensive than having to deal with already established conflicts.

The second stage is negotiation, the use of which lies at the very core of the current ADR movement (Boskey 1993). After the prevention stage, which assumes that disputes will arise, negotiation represents the first stage where an attempt is made to resolve a dispute. A successful negotiation should result in a solution acceptable to all parties that will not harm their relationships. It is also an important benefit of negotiations that parties have control over the process and the outcome. There are three important techniques designed to improve the negotiation process: structured negotiations; step negotiations; and facilitated negotiations. The first two focus on the importance of organizing and structuring the negotiation process, while the third focuses on the importance of facilitating the communication process among parties (Sosa 1999).

The standing neutral stage incorporates a third party into the project who is mutually accepted by project participants. The neutral and knowledgeable party provides a prompt, rational, impartial, and on-site review of disputes. In large-scale infrastructure projects where issues become more complex and technical, determination of the Architect/Engineer is questioned and the role of the neutral party becomes more essential. It is important to notice that project participants still have control over the dispute resolution process and outcome at this stage.

The non-binding arbitration is the last stage where the parties still have control over the outcome of the dispute by participating in the development of an agreeable settlement in conjunction with a neutral third-party. Non-binding procedures are characterized by higher levels of formality, compared to the previous stages. However, they are still flexible so that parties can enter the proceedings voluntarily and select the third party by mutual consent. The six types of techniques listed in Table II-5, can be organized in a continuum. From mediation to rent-a-judge, we may have increased levels of formality and expenses, and decreased levels of flexibility, which allows us to choose the best option for the project.

In the final two stages, binding arbitration and litigation, all decisions reached by the third party are mandatory and imply strict procedures and rules for their implementation. Arbitration is the most widely recognized and used binding ADR procedure, with some variations as listed in Table II-5. Arbitration represents a definite move away from the “win-win” approach with increased formality, cost and tension between parties. However, arbitration has its main advantage over litigation in that its reliance on knowledgeable third party neutrals makes the procedure more effective, especially with regard to technical issues.

Though it is not an ADR, litigation is the final stage of the dispute resolution steps. Litigation can be effective, when arbitration clauses are not incorporated into the contract, or when legal issues are a major focus of disputes. In most cases, however, it is a costly, time-consuming, and less flexible procedure. Some options are listed in Table II-5 that try to save time and money, and promote communication between the parties during the process.

The six dispute resolution steps described above have their distinctive purposes and roles in resolving disputes. Control over the process and the outcome is one of the important factors used to discern the characteristics of the steps. In addition, it is found that several variations of techniques at a stage each offer different levels of flexibility, formality, or cost, to form a continuum. Considering these, we may have numerous options for the dispute resolution process. A systematic approach needs to be developed to properly design and implement the process.

SOFTWARE SOLUTIONS

CHAPTER
10

This Chapter presents two IT (software) solutions for project organizational design: The Organizational Consultant (ORGCON) and VitéProject. How these two software programs operate will be explained including the advantages and disadvantages of each and the situations in which each of them is used. In session 10.1 we will analyze the concept on which these methods rely: the prioritization of objectives.

10.1 PRIORITIZATION OF OBJECTIVES

Two prioritization matrices are constructed to weigh the relative importance of the various objectives of project management. The first prioritization matrix maps the impediments inherent in the management of projects with the objectives of the area of project management under consideration. Figure II-25 presents the generic matrix for prioritizing objectives.

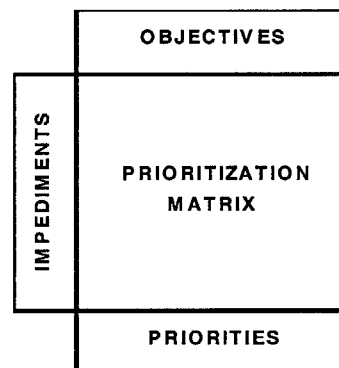


Figure II-25: Prioritization matrix based on impediments

The goal of the matrix in Figure II-25 is to assess which objectives are the most difficult to attain given the complex environmental characteristic of projects. When evaluating the features provided by IT solutions, the weights assigned will highlight which features address the most critical objectives.

The second prioritization matrix is used to evaluate to what extent traditional techniques of project management address the objectives of the project management area under consideration. The feasibility of project management techniques with traditional tools serves to prioritize the techniques: 1 means that the technique is hardly achievable with traditional tools, 2 stands for a technique that is achievable but requires a lot of work and 3 is a traditional – non-IT based - managerial technique. The rationale is that if a technique is achievable with traditional tools, then the objective addressed by the technique should not be a major area of focus for project management IT solutions.

Figure II-26 shows a generic matrix for prioritizing objectives of project management according to the availability of techniques and their feasibility with traditional tools.

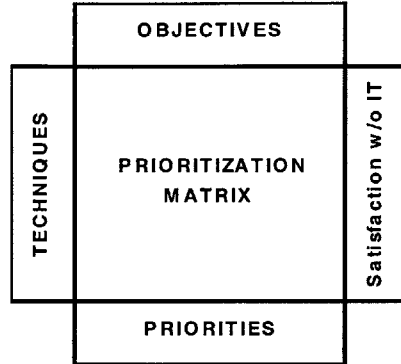


Figure II-26: Prioritization matrix based on techniques' availability and feasibility

Priorities resulting from impediments and technological feasibility are then combined and normalized to come up with the overall priorities for the objectives. Priorities from impediments are ranked on a scale of 1/3/9, and priorities based on available techniques on a scale of 1/2/3. The priority relative to technological feasibility is divided by the priority resulting from the impediments to give the overall priority of the objective.

Considering two different scales from 1 to 3 and 1 to 9 gives more weight to the impediments than to the availability of feasible techniques. The rationale behind this is that an objective that does not face many impediments, and that is not achievable with traditional techniques, should have a lower priority than an objective that faces many difficulties and that can be done with traditional techniques. Figure II-27 shows the results of the combination of priorities resulting from technological feasibility and impediments that define the overall priority of the objective.

		TECHNIQUES			
		Feasibility			
		High Many		Poor Few	
		Quantity	3	2	1
IMPEDIMENTS	Many ↑ Few	9	3 many impediments but traditional techniques available	4.5	9 many impediments and few techniques achievable
		3	1	1.5	3
		1	0.3 few impediments and traditional techniques available	0.5	1.0 few impediments but few techniques achievable

Figure II-27: Construction matrix for prioritizing objectives

10.2 EVALUATION OF PRODUCT FEATURES

The evaluation matrix summarizes how an IT solution's features meet the objectives identified from the theory of project management. More weight is given to features that address objectives that were attributed greater priority from the prioritization matrices. The objectives of project management become the entries of the evaluation matrix. The features of the IT solution that are to be evaluated are listed on top of the evaluation matrix.

Figure II-28 shows how the evaluation matrix is built from the prioritization matrix to the evaluation of IT solutions.

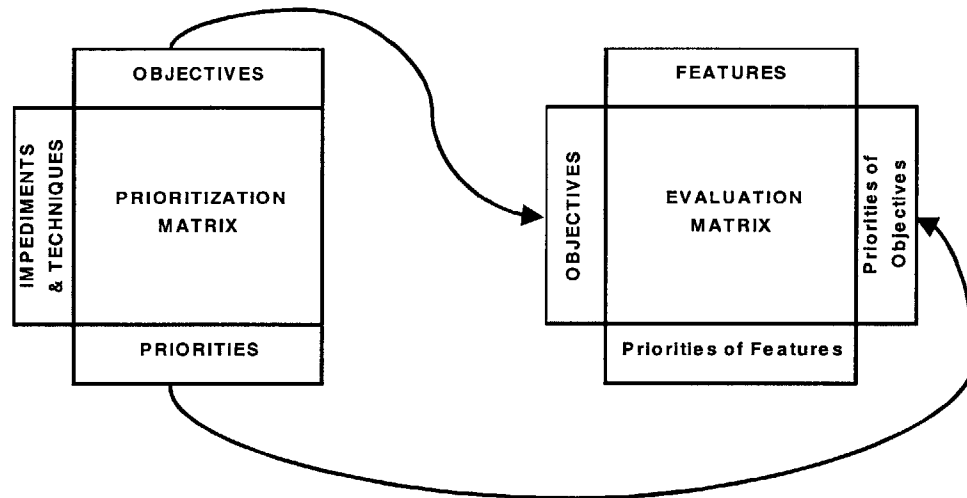


Figure II-28: From the prioritization to the evaluation matrix

The weights computed for each feature highlight how critical that feature is to improve the project management process: the more challenging the objectives addressed, the more important is the feature. Looking at the matrix horizontally provides a global vision of the objectives addressed and of those unaffected by IT solutions. This analysis serves as a basis for providing recommendations for future development of IT solutions.

10.3 ORGCON 7

ORGCON (The Organizational Consultant) is an expert/knowledge-based system for organizational design distributed by EcoMerc (www.ecomerc.com).

ORGCON synthesizes a large body of literature on organization theory as well as practitioners' experience into more than 350 "if-then" rules. Version 7.0 of ORGCON runs on personal computers in a window-based environment.

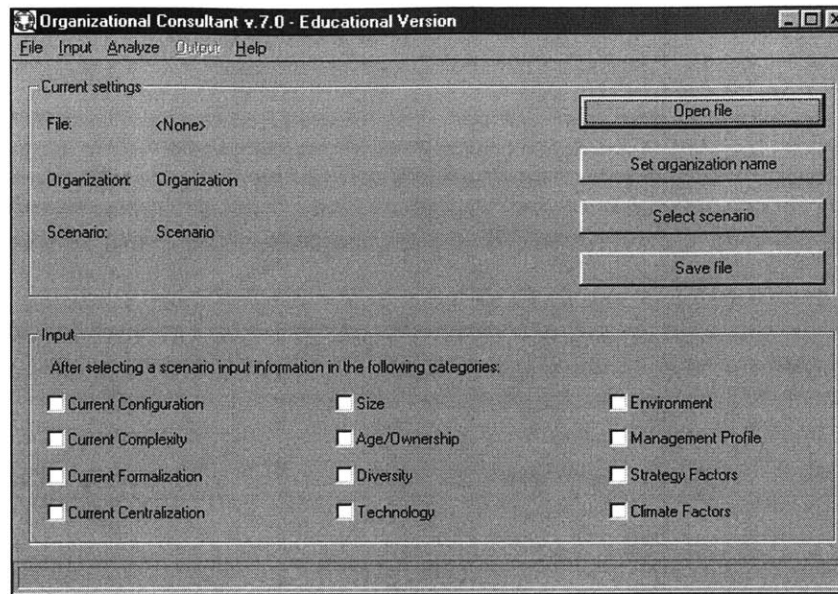


Figure II-29: ORGCON main window

Product features

The analysis of the functional principles of ORGCON can be subdivided into inputs, computation engine and outputs.

Inputs

ORGCON requires two different kinds of inputs: (1) a description of the current organization and (2) information regarding the contextual factors (Management style, Climate, Size/Ownership, Environment, Technology and Strategy).

Describing the current organization requires answers to a series of direct and indirect questions. For instance:

Configuration: what is the organization's current structure (functional, simple, matrix, etc.)?

Formalization: Are written job descriptions available for (all employees, top or middle management)? How much latitude are employees allowed from the standards? What percentage of all the rules and procedures that exist in the organization are in writing?

Centralization: To what degree does top management participate in the interpretation of information input? To what degree does top management directly control execution of decisions? How much discretion does the typical middle manager have in hiring and firing personnel?

The remaining questions are aimed at determining the contextual factors. For example:

Age/Ownership: How old is the organization (young, mature, old)? What kind of ownership does the organization have (private, incorporated, public, subsidiary)?

Technology: What is the major activity of the organization (production, service, wholesale, retail)? Does the organization have a routine technology? Is the technology divisible?

Management profile: What kind of decisions does top management prefer to make (policy, general or operating decisions)? Does top management prefer to make long-term or short-term decisions?

Diversity: Does the organization have many different products? Does the organization operate in many different markets? Does the organization have many different products in the foreign market?

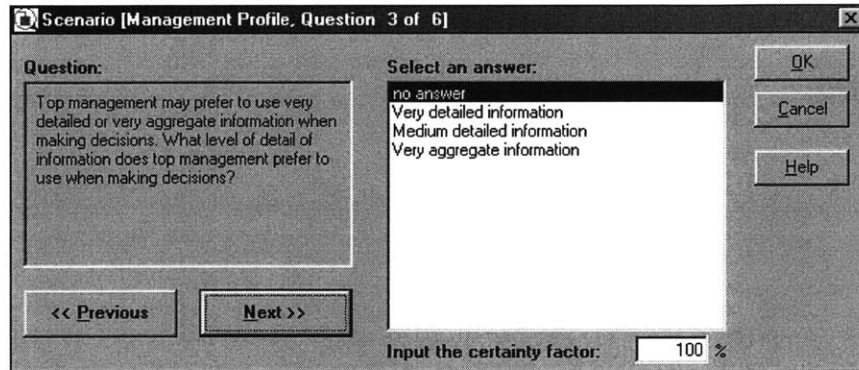


Figure II-30: Input-window of ORGCON

Computation Engine

The computing engine of ORGCON follows the “*if-then*” format of production rules in expert systems. This format fits well to organization theory since most knowledge is expressed as “*if-then*” rules. For example, it is commonly accepted in the literature that the size of the organization affects its structure. To illustrate this point, one rule in the knowledge base is:

If size is large

Then formalization should be high

Similarly, technology is a determinant to choose an appropriate organizational structure:

If technology is routine

Then organizational complexity should be low

ORGCON is composed of more than 350 “*if-then*” rules. To put together all these pieces into a coherent and consistent set of rule statements that provide some reference to the applicability of a rule, the certainty factor principle is used. Each “*if-then*” statement is associated with a certainty factor between -0 and 100 . The stronger the certainty factor in absolute value, the stronger the recommendation. Table II-6 associates the values of certainty factor with the confidence in the recommendation.

Table II-6: Certainty factors and strength of recommendations

Certainty factor	Confidence in the recommendation
100 or -100	Absolute recommendation
Between 80 and 100 or -100 and -80	Recommendation is almost certain
Between 60 and 80 or -80 and -60	Very strong recommendation
Between 30 and 60 or -60 and -30	Strong recommendation but not mandatory and not sufficient by itself to be strong recommendation
Between 0 and 30 or -30 and 0	Weak recommendation
0	No recommendation

Certainty factors can also be associated with inputs to mitigate the impact of the least reliable information on the results. Certainty factors resulting from each “*if-then*” rules are then combined to give the overall value of the recommendation.

Outputs

The outputs of ORGCON consists of 5 parts: (1) an input data summary and its interpretation to obtain a listing of the contingency factors for the organization, (2) the characteristics of the current organization, (3) a situation misfits report, (4) the recommended organizational structure, and (5) an organizational misfits report.

The **Input Data Summary** combines and interprets answers to the questions about the organization and its situation. It restates the answers to the questions concerning the organization's current configuration, complexity, formalization, and centralization. Responses to the various questions on the contingencies of age, size, technology, environment, management style, cultural climate and strategy factors are also interpreted.

The **Current Organization Characteristics** based on the answers calculates the organization's complexity, formalization, and centralization.

The report of **Situation Misfits** lists any unbalanced situation among the contingency factors of management style, size, environment, technology, climate, and strategy.

The **Organizational Consultant Recommendations** are provided based on the answers about the organization, its situation, and the conclusions with the greatest certainty factor. Organizational Consultant derives recommendations for the organization's configuration, complexity, formalization, and centralization. There are also recommendations for coordination and control, the appropriate media richness for communications, and incentives.

The report of **Organizational Misfits** compares the recommended organization with the current organization.

House of quality for ORGCON 7

ORGCON provides ordinal recommendations on configuration, complexity, compliance, centralization and coordination and control. These recommendations point out the discrepancies between the current organization and the contextual factors and suggest ways of changing the organizational for a better contingency fit.

Table II-7 shows the recommendations for a typical construction project. The general characteristics for the project were:

- A large number of job titles
- Few advanced degrees
- Many levels of hierarchy
- A great amount of geographical dispersion
- High concern for quality

The recommended degree of organizational complexity is high (cf 100).

Large organizations should have high organizational complexity. When PROJECT has a process production technology the organizational complexity should be high.

The recommended degree of formalization is high (cf 55).

PROJECT has a high capital requirement, which leads to high formalization. Large organizations should have high formalization.

The recommended degree of centralization is medium (cf 36).

There is evidence against it should be: low (cf -3).

There should be tight control over current activities. PROJECT is a large private organization. Large private organizations should have medium to high centralization.

PROJECT should use media with high media richness (cf 70).

The information media that PROJECT uses should provide a large amount of information (cf 70).

When the environment of PROJECT has high equivocality, high uncertainty, and high complexity, coordination and control should be obtained through integrators and group meetings. The richness of the media should be high with a large amount of information. Technology efficiencies can be obtained by sharing technology, information and new developments across divisions. Liaison managers and technology committees are possible coordination mechanisms. Conferences among technical professionals can be very effective.

The recommended structure for PROJECT is a divisional structure.

Table II-7: Output of ORGCON for a generic project

The recommendations of ORGCON 7 are mapped with the objectives of organizational design in Figure II-31.

		FEATURES					Impediments priority	Technological priority	Normal weight
		Complexity	Formalization	Centralization	Media richness	Configuration			
OBJECTIVES	Select individuals						1	1	12%
	Decompose work	1					1	1	12%
	Attribute subtasks	1					1	2	6%
	Coordinate subtasks		3	3	9	3	9	3	35%
	Control completion		1	3	3	3	9	3	35%
		0	1	2	4	2			

Figure II-31: Evaluation matrix for ORGCON 7

Looking at the matrix vertically, one can notice that the most important feature of ORGCON consist of advising for the degree of media richness. ORGCON also provides interesting insights about centralization and configuration. In contrast, complexity and formalization are not significant.

Turning to the horizontal axis, ORGCON only helps in defining to which extent an organization should coordinate subtasks and control completion. For instance, ORGCON advocates for review meeting in large-scale construction projects. However, this is not rocket science; the project review meeting is a proven practice in construction.

In conclusion, ORGCON must be seen as a *Decision Support System*. It does not help directly in designing project organizational structure, but it helps to get people to work together. ORGCON requires users to contribute information and interpret the outputs. Hence, this tool acts as a facilitator in the decision making process of re-thinking organizational structure and tend to decrease “hands-off” (Keith 1998). ORGCON should not be considered as a black box where data are “magically” transformed into the best possible organizational structure. Yet, the macro angle from which ORGCNO looks at organization tends to overlook the specificity of project organizational design and does not provide quantitative recommendations.

10.4 VITÉ PROJECT

Vité was founded in 1996 by Stanford University and three professors, Dr. Ray Levitt, Dr. John Kunz, and Dr. Yan Jin. VitéProject is the result of a 10-year research

effort on the Virtual Design Team to find ways to improve organizational performance in executing projects; if had the goal of “designing projects and enterprises as completely and systematically as engineers currently design bridges”.

Product features

VitéProject 2.2 was released in 1998. It runs on MS Windows 95/98 or NT4.0 Pentium-based personal computers.

The first step in using VitéProject is to provide the tool with a micro-description of the organizational structure. A graphical model-editor (Figure II-32) allows users to specifically input the actor, activity and project models (see Session 3-2.c.ii). These items of information about the project, which are usually gathered through interviews of the project team, include:

- All project activities and their duration, required skills, level of complexity, level of uncertainty, etc.
- Project’s organization, including participants, organizational hierarchy, roles, expertise and skill levels, project policies, etc.
- Interdependencies between project activities
- Relationships between the organization and the activities.

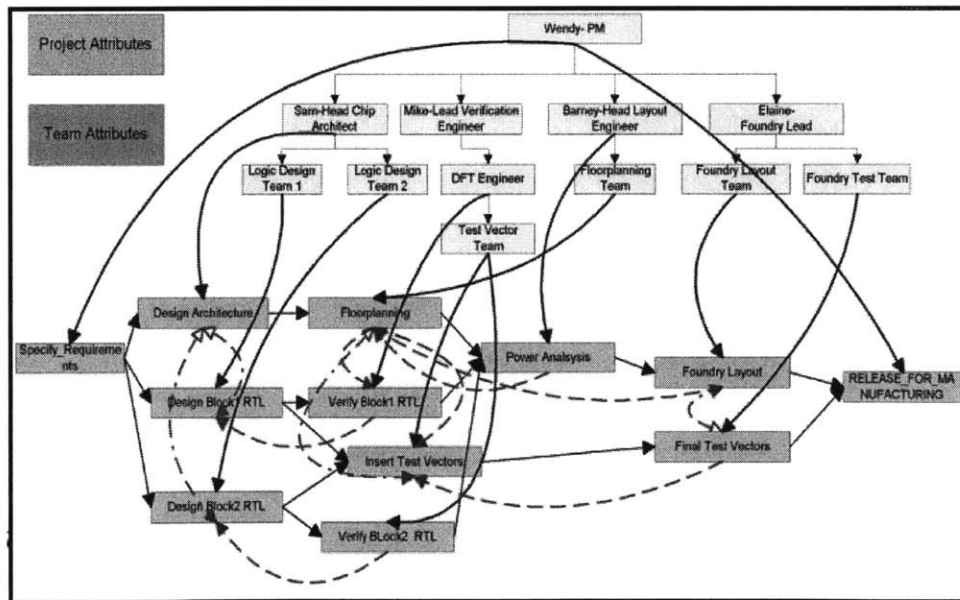


Figure II-32: Vité’s models

The VitéProject model represents project participants - actors - and supervisory relationships that define the organizational structure for the project (top organization chart in Figure II-32). Each actor is assigned project activities. The precedence relationships between activities are modeled using a traditional CPM/PERT network (bottom chart in Figure II-32). The chart also includes information flows (dashed arcs

with empty arrow heads) required to coordinate tasks and failure dependencies (dashed arcs) between parallel activities. Each activity in the process plan is assigned a person responsible from the organization chart.

This model provides the basis to perform discrete event simulations using inheritance and behavior methods based on pattern matching from standard Artificial Intelligence techniques. In each time increment, the behavior of each participant (actor) of the team is modeled, generating a database of events. Multiple simulation runs are executed to provide accurate statistical validation of the project's behavior. The data computed by the simulation engine produce charts showing project schedule, cost, process quality risk, participants' backlog and work breakdown between direct work and rework, waiting, and errors (Figure II-33).

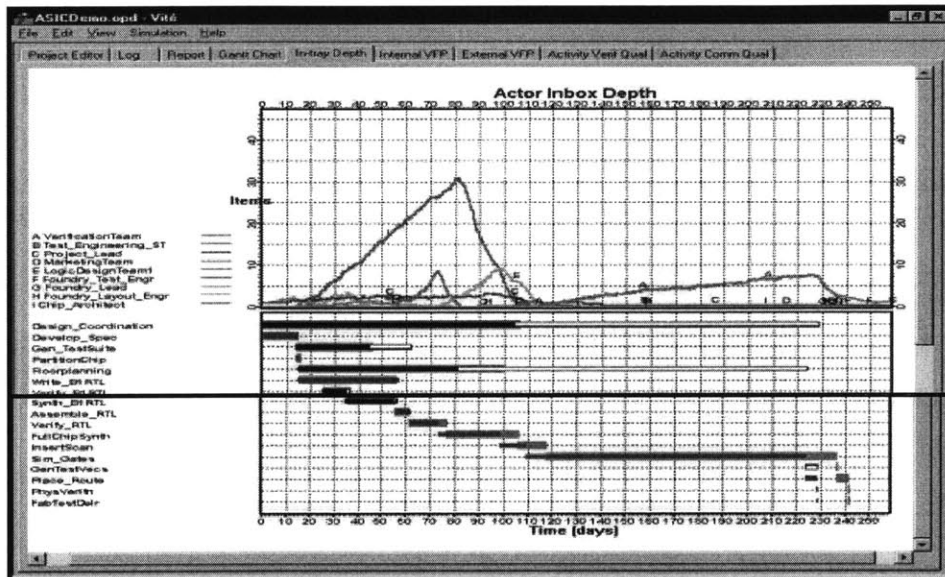


Figure II-33: Vité's output window

House of quality for VitéProject

VitéProject explicitly models workload, either directly or indirectly, of each actor. Then, sources of information bottlenecks, which create delays or low quality in projects, can be identified and tackled efficiently. By running “What if?” analysis with VitéProject, one can determine where to add resources and what kind of resources. Figure II-34 presents the House of Quality for VitéProject.

		FEATURES								
		Actors	Project activities	Work assignment	Task dependencies	Information flow	Authority relationships	Impediments priority		Technological priority
OBJECTIVES	Select individuals	9						1	1	12%
	Decompose work		9					1	1	12%
	Attribute subtasks			9				1	2	6%
	Coordinate subtasks				9	9		9	3	35%
	Control completion						9	9	3	35%
		1.1	1.1	0.5	3.2	3.2	3.2			

Figure II-34: Evaluation matrix for VitéProject

VitéProject has been specifically developed for project organizations. As a result, its evaluation matrix exhibits a perfect fit between the product’s functionality and the objectives of project organizational design.

A drawback of VitéProject, compared to ORGCON, is that it functions as a black box. Users do not have the opportunity to learn any concepts of organization theory. Another problem is that modeling project organizational structures is rather complex. Finally, for real life projects, computations can become delicate. As an illustration, a single run of VitéProject for a small project characterized by 50 activities, 20 actors, one year duration and one day typical subtask size generates about a million simulation events and takes about 15 seconds on a medium-class Pentium II system.

VitéProject was primarily designed to handle small and technologically complex projects such as product development, technology implementation and rollout, Total Quality Management or Business Process Reengineering. For construction projects, the process of modeling the organizational structure may appear quite complicated.

10.5 CONCLUSION

The chapter presented two IT solutions for project organizational design based on the information processing view of organizations and contingency theory.

ORGCON is an expert system that summarizes the theory of organizations in 350 “if-then” rules. The macro view of organizations makes ORGCON not specific

enough for construction project organizations. However, ORGCON is interesting for fostering communication between project players to develop the organizational structure.

VitéProject allows one to model individual actors in the project organization to compute workload resulting from direct work and coordination work. VitéProject meets all the issues of organizational design raised by the theory. However, the modeling process can appear too complex for small organizations while the computation engine seems limited to deal with large organizations.

After defining the organization to be used on a project, project managers have to deal with the planning process. The next chapter presents the first phase of the planning process: project time and cost estimating.

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PART III LESSONS LEARNED

PROJECT AUDIT

CHAPTER 11

INTRODUCTION

After having seen the different stages of the life cycle of the concerning the organization, the planning, the monitoring and the controlling of a project, in part III we will present a very important issue, the lessons learned. A lot of project managers undervalue this part. Many of them think that it would be a useless expense for the project, others think that they do not have enough time and they move to the next project and others believe that there is nothing to learn from previous projects as the future projects are not similar.

In this part, we will see that the lessons learned not only improve the performance of a project during its implementation, but also help the organization perform better in future projects. We will analyze a modeling approach using the system dynamics method. We will present the project audits and evaluations and at last we will see how to manage the termination of a project.

In Chapter 11, we will present the project audit, a process that is applied during the development of the projects and at the end of them. In Chapter 12, we will see the project termination and in Chapter 13, we will present the learning on projects and the system dynamics method as a tool for feedback.

PROJECT AUDIT

As projects are managed by people and they involve many contingencies, pressures and risks, many times they are poorly managed or they could have been managed better. There are various tools that help the project managers overcome these difficulties. Some of them are the detailed planning, the monitoring and the controlling techniques. Another useful tool that has a lot of power is the project audit.

11.1 DEFINITION OF THE PROJECT AUDIT

The project audits are small tasks that are taking place periodically during the implementation of the project, or at the end of it. They have the purpose of evaluating it, presenting its strengths, its weaknesses and what has been done good or bad so far. They examine the project on the spot. This means that the project audits make a time section and examine what has been done so far. The conclusions that come out from the final report of an audit are very useful for the next steps of the project and also for other projects. The project audit can forecast the next parts of a project and can offer solutions for correction or prevention of future mistakes.

The main steps of the audit are:

- Studying the initial plans
- Examining the performance which may or may not conform to the plans
- Evaluation of the results
- Remedy actions to correct variances.

The audits take place during the process of the main project and at the end of it. Audits are usually described in the contract with the client. When the client is a public organization then the audits are required and they follow a specific standard format described in the contract. The interested parties for the performance of the audits are:

- The project manager that seek unbiased information from groups or individuals within the project organization
- The external stakeholders or sponsors of the project; customers, owners, financial institutions, government agencies and many times social groups who seek realistic information on the project.
- Social groups including consumer groups, environmentalists and religious organizations who seek accurate information from every source.

In this Chapter, we will present the purposes of the project audits, the objectives of an audit, the time frame of the audit, the constituency of the audit team, the life cycle of an audit and the implementation of an audit.

The project audit is an examination performance of the project management till the time of the audit. It examines the methodologies, the procedures, the records, the budgets, the expenditures, the performance and the degree of the project completion.

There are three different types of audits: the general, the detailed and the technical. The time that the audits take place can be predetermined in the contract or can be unexpected. Usually there are audits after the beginning of the project, during its development and at the end of the project. The audit should contain the following information: the current status of the project, the future status, the status of crucial tasks, a risk assessment and the limitations of the audit. As in the project, audits also have a life cycle that consists of the following stages: the initiation, the project baseline definition, the establishing of the audit database, the preliminary analysis of the project, the audit preparation and the project audit termination.

The essential parameters for a successful audit are: the definition and the constituency of the audit team, the access to project records and the access to project personnel. The project audit measures the performance of the project at a specific time shot. The measurement criteria and methods that the audit should rely on are more complicated than they seem to be at the first sight. Some of the parameters are obvious and are measurable because they can be checklists or quantities, but some others are very complicated and most of the times have conflicting results to other units in the project and so they can not be measured and evaluated accurately. By the term conflicting results here, we mean that the completion level and the quality achieved in most of the tasks affect the successor tasks because they are correlated. For example, in R&D projects where there is a lot of uncertainty, many times it happens that the quality or the completion level of a task affects the implementation of the next task. If the quality is bad, the next task can not be executed and the project manager needs to revise the task that caused the problem otherwise the mistake will be enhanced. This may be a labyrinth when the project auditor will try to find the real causes of the bad performance and may need to extend his/her research to many areas.

In the following sessions, we will give detailed definitions for each of the elements and the methods for auditing.

11.2 PURPOSES OF AUDIT/EVALUATION

Project audits serve as an evaluation of projects at the specific time when the audit is taking place and give recommendations for future steps on the project. The purposes for the audit are:

Report the current status of the project: The project audit reports the real status of the project concerning the quality achieved, the time and the expenditures already spent till that time. These three factors will be compared to the planned ones in the project-designing phase. The project audit evaluates the contractor's contractual obligations and the management expectations as well as the performance of the working team. The project audit also examines the status of the natural environment and the socio-political environment and the changes that might have occurred since the project started or since the previous audit.

Forecast the status of the project: This includes forecasting the status of the quality, schedule, cost, natural and socio-political environment of the project in various future times as compared to the contractual obligations and the management expectations that are presented in the initial designing plans or later updates.

Clarify Performance, Cost, and Time Relationships: The evaluation of the relation between the quality/performance and the degree of completion as well as the budget and the time for completion, give the project managers valuable information. First of all they identify the current stage of the project related to the completion. Secondly they understand how each of these parameters affects the rest of them. By this understanding, they can be able to identify which of these parameters are the most critical for the specific project. All these three factors are evaluated taking into consideration the status of the natural and the socio-political environment.

Identify Problems Earlier: The audit is an overall examination of the parameters of the project and offers an evaluation of the resources spend and the degree of the project completion. This overall examination of the current status of the project helps identify the potential problems earlier and so the project manager will have the time to prevent them. Research related to the natural or the socio-political environment should not be underestimated. Problems that are source from these types of the project environment might be harmful for the project.

Improve Project Performance: After the identification of the critical parameters, the project manager will pay more attention to them. Also the recommendations that will be presented on the audit will help the project manager improve the project performance as a matter of quality, time and budget, the effect on the natural environment and the socio-political environment in which the project is developed.

Locate Opportunities for Future Technological Advances: The involvement of outside people that are not related to the specific project will give the project certain advantages such as recommendations for the introduction of technological solutions or the improvement of the existing ones.

Evaluate the Quality of Project Management: Audits are studying carefully the actions of the managerial personnel, the causes and the pressure that created favorable or unfavorable conditions and offer a realistic evaluation of the quality of project management.

Reduce Costs: the contribution of audits in cost reduction is great since future unfavorable conditions can be prevented and rework can be eliminated as well as future favorable conditions could be repeated.

Reduce potential conflicts in the natural and the socio-political environment: As the audit will recognize the role and the influence of the project in the above environments, prevention or remedy that will be planned from the management will reduce the risk of potential conflicts.

Speeds the Achievement of Results: Since the relationships between the main factors of a project is clearly identified, and the mistakes and rework is eliminated, the results or the outputs will be achieved in less time.

Identify Mistakes, Remedy them, and avoid them in the Future: There are mistakes that are very common for projects and are repeated more than once through the project life cycle. The reason is that they are not identified, or are taken as granted situations. Mistakes can be in the hiring and the firing process, the handling of the material resources, the scheduling conflicts and slippage, and the low levels of quality. Project audits identify these problems, analyze the causes and propose realistic solution for the future prevention and also for the remedy of the current status.

Provide Information to the Client: The project audits is one of the way that the clients will be informed about the true status of their projects. They need to be assured that their resources are being used as planned, that the results meet their objectives and that the reports of the project are complete, accurate and objective.

Reconfirm the Organization's Interest in and Commitment to the Project: Identify whether the interest from the organization side is still vivid or the organizational objectives have changed and further actions are needed. Many times, during the project, the scope may change especially when this is not clearly defined in the beginning. Change of scope means that first of all we can not be in the position to know when the project is finished, as we do not know what we should deliver. Scope change usually needs reengineering and a lot amount of rework and in some of the cases it leads to project termination. The project audit identifies whether the project is still in the organization interests or not by evaluating the organizational needs versus the project objectives.

Provide valuable lessons learned for future or parallel executed projects: all the outcomes from the audit concerning the evaluation of the methodology used, the personnel performance, the quality of the suppliers and the resource utilization can be used for other similar projects that the organization undertakes.

The secondary goals that the project audits have are:

Improve understanding of the project value to the organization: Project audits analyze the relationships and the problems with the projects and also offer a macroscopically overall view of them. They help the organization understand whether a project can be valuable or not and also specify the kind of value that this project adds.

Improve Organizational and Managerial Processes: Since the managerial problems are identified and the relationships are clearer and more objective after the project audit, the process of organizing and managing the projects is getting improved in the following phases of the project.

Provide an Environment for Creative Work: Creative work and pure competency are getting again as priorities as the procedures now are clear and there is no existence of hidden agendas. Under the fear of regular control the team members work more efficiently and the production rate is being increased.

Identify Strengths and Weaknesses in Project Personnel, Management, and Decision-Making: This identification of the strengths and weaknesses in project personnel and especially in the decision making process, will help the project and as a consequence the whole organization to understand the bottlenecks in the decision process and the causes for that. Only then, they can understand who has really authority and can control things and also where the delays in the decision process are.

Identify Risk Factors: Risks can change during the process of the project or new risk factors can be added. The project audit identifies these risk factors that are currently existing, their affection to the project and suggests possible ways for mitigation or controlling.

Improve Contributions of Projects to Personnel Growth: Since the strengths and weaknesses of each of the project members are identified and the scope of the project is clearly set, the efficiency of each project member is passing to more advanced levels. The team members learn from their mistakes, and develop themselves and the rest of their environment.

Identify Potential Managers and Leaders: The project audit that examines the effectiveness of each team and most of the times each of the team members, identifies the capable persons that can enter higher levels in the organization.

Identify the areas where the best returns on investment are to be obtained: Especially with the information technology projects, that the objective is the maximization of the return on investment, the project audit analyzes all the factors that contribute to the project success, categorizes them and put a weight factor that shows the important of each of them.

11.3 FINANCIAL VERSUS PROJECT AUDIT.

In the business terminology, we meet the term financial audit. Both the financial and the project audit have similar processes and investigation procedures. Each of them focus on different type of subjects. The project audit focus on the performance, the expenditures and the time spent at the time of the audit compared with the pre planned values of these factors. The financial audit focus on the use and preservation of the organization assets. The scope of the project audit is more broad compared to the limited scope of the financial audit. Table III-1 shows the differences among the two different types of audits.

Table III-1. Financial vs. project audit

	Financial Audit	Project Audit
Status	Compares the current status of the business to the accepted standard (ex. Industry, competitors)	Compares the actual status of the project to the planned one.
Predictions	The company's state related to economical growth	The future status of the project including deviations from schedule, cost, quality, natural and socio-political environment.
Measurement criteria	Finance-accounting methods/terms	Financial terms, schedule progress, resource utilization, quality –goals established by the contract.
Record keeping system	Standard finance-accounting format established by legal criteria and professional standards.	No standard system, uses the established by the contract or general applied practices.
Recommendations	Few or none depending on the management system	Usually cover management issues and risk mitigation.
Qualifications	Professionally qualified auditors	Lack of technical expertise auditors, lack of funds and time for audit.

The project audit examines financial, managerial, and technical aspects of the project. It is applied to a specific project in a specific organization.

11.4 THE AUDIT LIFE CYCLE

11.4.1 Phase 1: Project Audit Baseline Definition – expert team formation

Like in every project, the first and very important phase is the scope definition. The project audit has an additional reason to have a clear and solid scope and objectives. The auditor will need to come many times in contrast to the various teams negative attitude which is outsource from their beliefs that the purpose of the project audit is for controlling their actions. The project auditor before the initiation of the audit on site should have already hold a check list of what he/she has to examine and till what depth. Also he/she needs to specify the length and the formality of the audit report that has to deliver at the end. The actual audit requester and whether he/she is under pressure or not should be identified in this phase for a realistic project audit. This phase consists of the following four steps:

The project Audit Initiation: The initiation takes place with the request of the audit requester that can be described in the contractual agreements or can be exceptional ordered.

The Project Audit Preparation: After the request for audit is approved by the project authority, if different from the audit requester, the project team has to be informed about the audit. Specific data or records should be asked to be collected or become available to the auditor before he/she will arrive to the site.

The Project Auditor Preparation before the on Site Audit: Before the auditor arrives to the site to collect information, he/she should get prepared for the project audit by reviewing the project audit methodology, the scope of the audit, the project to be audited, the time available for the audit and the requirements for the audit report.

Establishing the Purpose and the Scope of the Audit: The project auditor should meet with the audit requester to determine what is to be accomplished by the audit and what the constraints are. The constraints include the available time and budget for the audit, restrictions as to contacting project personnel, availability of project staff and records.

Expert team formation: After the definition of the scope, the depth and the areas of interest in the audit and before the initiation, the formation of the project audit team is taking place. The members that consist this team should be experts in the different areas of interest and they choose a team leader, the project auditor.

11.4.2 Phase 2: Project Baseline Definition

This phase follows the Project Audit Baseline Definition phase and starts when the auditor has established the scope of the project audit and has collected enough knowledge from the audit requester. This phase is performed on site of the project and many times require travelling among different locations. The purpose of this phase is for the project auditor to establish the baseline of the project as a comparison unit for the project audit. This phase include the following steps:

Contract baseline definition and analysis: In this step the project auditor identifies and analyses the contractual documents and the set of the drawings and specifications. All this information helps him/her specify the baseline of the project including the required quality, the expenditures that should be spent by that time and the different time milestones that have been set. Using this information as a baseline for comparison, the project auditor will compare the actual status of the project with the planned status in the following phases.

Specify additional customer expectations: The project auditor in this step investigates if there are any additional commitments to the client that come out from additional contracts or agreements.

Specify additional management expectations: The management might have additional expectations of the project, many times different than the planned. The auditor should investigate and report these expectations because they define the project status. These expectations reflect the management's resource allocation, the policies and the expected performance of the project.

Develop project performance baseline: This step is the analysis of the data gathered in the previous steps, a putting them together and the tracking of the possible conflicts among the contractual arrangements. Finally in this step the auditor builds the complete project performance baseline. The complete project performance baseline identifies all the matters to be resolved by the auditor and specifies the priorities for the next phase, the detailed audit program.

Develop detailed audit program: This is the final step of this second phase and constitutes the principal objective of it. The auditor reviews the detailed project audit program and fits it to the current case. This step includes the questionnaires, the checklists and the data gathering forms to be used to the specific project audit. At this stage, the project auditor's workbook forms a detailed audit program which will be executed in the next phase, the detailed audit program execution.

11.4.3 Phase 3: Detailed Audit Program Execution

This phase includes the execution of the audit program, which is produced in Phase 2. The questionnaires, the checklists and the other forms are completed in this phase. The project auditor investigates all the areas of interest concerning the project. The issue that is important in this phase and needs a lot of attention is which areas should the project auditor investigate in greater depth. This decision should be taken taking into account the importance of those areas and the affection they have in the time limit of the project audit. The time spent for these areas should be subtracted from the whole time of the audit. Another important issue is the background of the project auditor, which may lead him/her to investigate related areas that feels comfortable leaving outside other important ones. This phase consists of the following steps:

Preliminary assessment of the project organization, management, methods and controls: This step concentrates in the examination of the project's organization, administration, record keeping, planning, monitoring, controlling, record keeping, the techniques and working methods used. This examination will help build the statements for the current and future project status.

Compose a statement of both current and former status: This step has the objective of completing the project auditor's statement of current and past project status as far as possible within the project history. The project auditor will concentrate in areas of progress and schedule performance, cost, contract compatibility and comparison with customer and management's expectations.

Preliminary quality assessment: In this step, the quality achieved by the time of the project audit is measured. The project auditor also identifies the areas of uncertainty and concerning the project quality and the amount of rework needed.

Compose preliminary statement of forecast project status: In this step, the project auditor develops his/her forecasts of the future project status.

Complete project organization, management and methods audits: In this step, the project auditor after having defined the depth and the scope in the previous steps of this phase, he/she examines additional issues. These include the project planning, the project organization and staffing, the project administration and record keeping, the working methods and techniques, the controls, the communications, the project facilities and environment, the support to the project,

the contract administration and controls and the controls over suppliers and subcontractors.

Technical quality audit: The depth of this step depends on the requirements of the project audit requester and the quality uncertainties. The technical quality audit is a thorough inspection of the work done and the amounts or rework from a technical point of view.

Revise statement of project status: This step is a revision of the uncertainties and the findings of the previous steps of this phase. In this step, the previous statements are updated and the remaining uncertainties are noted.

Completion of detailed program and review: The objective of this step is to complete the examinations of the remaining topics. These include the relationships between project and user and the performance of suppliers and subcontractors. The completion of his/her step defines the completion of the auditor's data collection.

11.4.4 Phase 4: Preliminary Analysis and Presentation of Results

This phase includes the analysis of the information gathered in the previous steps and the composition of a draft version of the project audit report. The phase includes the following steps:

Analysis: The project auditor analyses all the collected material and results of the previous phases and prepares a draft version of the project audit report.

Review of findings with audit requester: The project auditor in this step, presents verbally the results to the requester and undertakes the commitment of delivering the project audit report in a specific time period. The purpose of this step is to compare the auditor's findings with the knowledge of the requester, to collect additional information that will help the project auditor to write his/her report, to make the project auditor more capable to the best presentation of the results to identify probable areas of misunderstanding and at last to exclude the information that is not valuable to the project audit requester.

11.4.5 Phase 5: Audit Report Preparation and Transmittal

This phase includes the preparation of the project audit written report and the letter of transmittal. The phase is complete only when the project audit report is delivered to the requester. The following steps are needed for this phase:

Prepare auditor's report: This step is described in session 1.10 and refers to the preparation of the written project audit report. The report includes: the current project status, the future project status, the status of crucial tasks, the risk assessment and analysis, the information pertinent to other projects, the limitations and assumptions of the audit.

Prepare action plan and letter of transmittal: This step includes the preparation of the necessary recommendations and remedy plan that the project auditor delivers.

11.4.6 Phase 6: Project Audit Termination

This phase is the completion of the project audit and consists of the following steps:

Project auditor's evaluation: In this step the project auditor sends a copy of the project audit report to the audit service management and prepares and submits the post audit report that is used for feedback and evaluation. The audit service management is the division of the organization that is responsible for the audit administrative functions. In some instances, it may be a separate division, but in most of the cases it is consisted of personnel from the already existing departments as a part time occupation.

Administrative termination of audit: In this step, the costs for the project audit are calculated and reimbursed and the project audit report is evaluated whether it will be used to relevant projects or not. Also the decision for further training of the auditor and/or the management of the project is taking place.

These six phases consist the life cycle of the project audit from the initiation and the scope definition until its termination and conclusions. In the next session, we will present the essentials for the project audit.

11.5 ESSENTIALS FOR A PROJECT AUDIT.

For the project audit to be valid and acceptable by the management and credible, there are some essential steps that should be followed. The most important of them are the choice of the audit team, the access to the project records and the access to project personnel and other people. In this session, we will analyze each of them separately as well as the methodology used for each one.

The audit team: The choice of the project audit team is critical and guarantees the success of the entire process. Unfortunately the selection criteria for the audit team, many times do not rely on the skills and the contribution of the members but on their availability at the time of the audit. For a successful audit that will offer important lessons to the next phases of the project or to future projects, the team members should be selected due to their relevance to the project, their qualifications on areas that are important for the project and due to their previous experience in audits. Also the size of the team should be analogous to the size and complexity of the project. In a small project, often one person can go through the whole audit process, but in large and complex projects, representatives from various categories are required. The probable team members can be selected from the following categories depending of the type of the project:

- The project itself
- The accounting department
- The marketing department
- Purchasing management
- Human resources department
- Legal /Contract department
- Technical specialty areas

The customer
Senior management

The team members have a leader, the project auditor that gives directions and has the general coordination of the project audit. The team members that are experts in their field of interest should determine with the project auditor the areas and the depth of the examination.

Access to project records: In order the project audit team to be effective and conduct a credible project audit, the free and continuous access to the project records is required. In many of the government or R&D projects, records are characterized by a classification of security. In these cases, the project audit team should be formed from persons with the right clearance level. The responsibility for keeping the records is coming from the project personnel and the responsibility for data gathering belongs to the audit team. Collecting the data is a very time consuming process. This is due to the variety, the complexity, and the big quantity of the data, the probability of the missing information, the data involvement in an ongoing project and the probable negative attitude of the project personnel that has to be interviewed by the project audit team. After their collection, the data should be organized and filed in a systematic way. At last, the most important is for the data to be stored in a safe place against theft, fire and humidity.

Access to project personnel and others: This includes the contacts between the team members and the project members as well as other people like subcontractors, suppliers, and consultants. Contacts with the project audit team and the customer are not allowed unless they have the approval of the senior management and serve a specific goal. Several rules should be followed when contacting the project personnel for the avoidance of misunderstandings and conflicts. First of all, the project personnel should be aware of the ongoing project audit. Some of the information can be given confidentially. The project audit should examine the validation of this information before using them, and keep the confidentiality of the interviewees. Tensions and personal contradictions should be avoided. The contacts with the personnel should take place in the form of interviews to collect the additional data.

11.6 TYPES – LEVELS OF PROJECT AUDIT.

There are several constraints that may limit the depth of the project audit such as the available time, the available budget, the available information, their quality and their storage and the request from the project auditor requester. Other limitations include the amount of distraction that the project audit will cause to the personnel working on the ongoing project and the concern about the project morale if the audit will not follow a constructive and advisory route. The factors that define the depth of the project audit are the time, the cost and the impact on the performance. These factors affect the depth as follows:

Time: This includes the available time for the project audit. This assigned time for the project audit is defined from the importance of the audit (routinely process or to solve problems), the goals, the available personnel for the audit and the available budget. Project audits are specified in the contracts as regular activities in the process of the project, but they can also be requested when a problem is on the foreground. When we refer to small projects, we need not devote a lot of time since the data and all of the information is limited. When we refer to a large-scale project or a complex one, then more time is needed. Also when the audit is taking place in

the beginning of the project, then it is understandable that it will need less time than an audit at the end of the project. The time available specifies the depth of the project audit and also the issues in which the concentration should be.

Cost: This includes the budget available for the audit. In large-scale projects or projects with greater importance, the available budget will be much more than a regular audit outsourcing from the contractual agreements and follows the normal procedure. The available cost affects the number of the personnel used in the project audit, the process whether will be quick or detailed and the handling of the data including the collection, the storage and their maintenance.

Impact on Performance: when we audit, we should not forget that the project may be still ongoing. This means that the project personnel should work continuously on the project without reducing its performance as a matter of productivity or time. Many times the project audits especially when their investigation takes long and goes deep, create anxiety to the project personnel and reduce their morale. As a result there is an impact on their performance.

These three factors justify primarily the depth of the audit. The project audits classification according to their depth is as follows:

The General audit or Overview: This type of the audit is usually constrained by time and cost resources and offers an overview examination of the project. It is usually used after the completion of milestones specified by predefined contractual agreements. It covers all the six issues that noted in session 1.10 of the project audit report.

The Detailed or administrative audit: This type of audit is a more advanced level than the general audit and usually it follows the later. The detailed audit examines in depth the issues that are chosen because of a more risky attitude or because of a existing problem. Although the detailed audits go in depth, they can not examine technical or complicated quality issues.

Technical or technical quality audit: This type of project audit that is carried out by qualified technicians under the supervision and guidance of the project auditor, examines the project in specific technical issues that have a problematic or not satisfactory performance.

The selection of the type of the audit, is arranged by the project audit requester and the needs of the project or the contractual agreements between the organization and the customer.

11.7 TIMING OF AUDITS

The timing of the audit depends on the special needs of the particular project. We will assume here that we have a usual, typical project that does not have any special needs. Usually the first audit takes place after the initiation of the project and when the work is about the 5% of the whole project. The reason for that is that the sooner the problems are discovered, the better they will be addressed. The second audit takes place when the project is at the 20% of its completion. Then other audits may take place, the number and the time of which may be defined in the contractual agreements or defined by the project audit requester. As the project develops, the need for technical audit is eliminated. Instead, audits that are

concentrated in managerial issues like the close out of the project and the reassignment of the resources are needed. The last project audits are the post project audits that take place after the completion of the project and usually are necessary as they are described by the customer in the contract. These audits provide the customer with information on the deliverables and the management with useful feedback.

11.8 WHAT WE AUDIT IN THE PROJECTS.

When we audit a project, we need to have a checklist of the essential issues and a clear plan of what we have to examine and analyze. It is logical that the project auditors most of the times are not welcome by the project members for the two following reasons. The most important reason is the stress they are feeling because they will be under control and inspection by an authority. The second reason is that in order for the audit to be conducted, they need to allocate a portion of their time, in disadvantage of the project, to inform the project auditor. And of course they never can know the skills, the experience and the objectivity of the project auditor who may come to a wrong and unfair for them conclusion. In this session, we present what the project audit usually examines in a project. These factors are:

The detailed plans and specifications: A comparison of the plans and the specifications with the actual quality and quantity achieved is taking place. In projects that quality and project progress can be measurable, then the evaluation is easy. In projects that do not have a very clearly defined scope or involve a lot of research, the delivery status is not predefined and the amount of rework needed as well as the time for completion can not be easily estimated. In these cases, it is very important that the project auditor has relevant experience on similar projects.

The managing, the methodology, the monitoring and controlling procedures: The methods and the tools in the operational and the strategic level that are being used and their efficiency are evaluated in the project audit. The management effectiveness and the methodology that the project managers use to monitor and control the projects are examined. The introduction of more efficient tools, or the improvement of the existing ones can be suggested in the audit report.

The risks and contingency allowances: As we referred in the previous session, the risks are constant through the execution time of the project, but they are rather dynamically changing. New risks may come out from the project itself, from changes in the political or environmental situation, changes in resources, changes in the market or even changes from the customer side. These new risk status should be examined in the project audit. These risks and contingencies will be evaluated how important they are and how much and under what way they affect the project performance.

The staffing arrangements: The initial arrangement should be evaluated in every project audit with efficiency and best utilization criteria. Many times there are project members that are skilled in other areas of work than they are assigned to. In other cases there is more personnel in one department than needed and a lack of personnel in other departments.

Internal communication: The internal communication channels have to be examined and evaluated by measuring their effectiveness, the speed of information flow and their flexibility.

Reporting channels: The examination of these channels will conclude to a lack of supervision or oppositely to tight supervision and bureaucracy that unreasonably slows down the decision making process. Another thing that has to be examined, is the responsibility issues and how they are assigned. Multi responsibility for the same issue as we know leads to the fact that nobody is responsible.

Customer relations: These relations are very important, as the client is the primer sponsor for the project. The client should give directions and objectives for the project. Frequent interaction is needed and the prevention of conflicts and disputes should be pursued. The project audit should examine the current status of the relationship with the customer and make reasonable predictions about the future relationship.

Subcontractor and suppliers relations: The subcontractors and the suppliers are another very important element of the project environment. These are the teams or the individuals that will provide the raw material and execute the tasks. A good project performance depends on their performance and levels of cooperation.

Relations with third parties: Third parties involve outside partners like consultants, attorneys, shipping companies and public organizations. The level of the relationship among the organization and them should be evaluated and weaknesses should be identified.

Accounting and finance performance, budgets and expenditures: Also financial matters should be evaluated, like how quickly the blueprints pass to the headquarters, what is the money flow to the project and what will be the budgeting predictions for the future. The expenditures are being evaluated if they were reasonable and at the right time.

Records: The essential records and statistics that are kept from the beginning of the project are examined by the project auditors for the better understanding of the previous parameters. An access to all of the records should be permitted for the auditing team.

Environmental and socio-political issues: The physical, the socio-political environment and the impacts the project has or might have in the future are examined. For example the project might affect the eco system of an area or change the morphology of the ground that might have as a result floods in the nearby towns.

Degree of Completion: The last and the most important is the degree of completion. This is difficult to be justified as in a lot of projects the amount of rework can not be justified and in others the scope is not clear and the project managers do not know when the actual project finishes.

11.9 MEASUREMENT CRITERIA.

The measurement criteria of the audit factors are most of the times a critical factor for the process and the success of the project audit. There are projects that the project auditor can easily specify the amount of the work done, the quality and the resources and time spend. These are projects with clear scope, and defined beginning and end. However, there are other projects that the end and the deliverables are not yet defined clearly or the quality of them by the time of the audit

is unknown. This happens in R&D projects which most of the times do not allow the project managers to specify the time of the completion and the amount of the rework due to low quality that is added to the planned rework

In the simple projects, concerning the measurement criteria, the time the expenditures and the work (tasks) completed are tracked. In the more complex problems, the need of experts in the various fields and a technical project audit are required. The project auditor should start from the determination on the tangible deliverables. Tangible are the deliverables that are usually described in the contract and can be measured, analyzed and evaluated. They can be the final or intermediate deliverables. When the deliverables include a lot amount of units, then the project auditor should split them into different sub-units for the better analyses and evaluation.

11.10 PROJECT AUDIT REPORT

The project audit report is the outcome of the project audit. It is a written document that presents all of the examination of the current status of the project the time of the project audit. It compares the current status with the planned status and comes up with conclusions about the quality of the management of the project. Then, it makes a prediction of the future project status and presents remediation when asked. The language used should be simple and avoid probable misunderstandings. The project contractual agreements should be analyzed and presented clearly. The comparison between the planned and the actual status should be objectively presented and directly charges to team members should be avoided. The project audit report includes the following parts:

Introduction: This session is a description of the project and provides the framework for the better understanding of the reader. The project scope and objectives should be presented in this part.

Current Project Status: The status of the time that the project audit is taking place should be reported and referred to the following factors:

- 1 **The cost:** this will be a comparison of the actual cost (expenditures) with the budgeted cost. Special care and reference should be given to the changes of the management expectations during the project that may have caused differences in the time distribution of the expenditures. Also changes in the customer expectations and the scope of the project that cause different amounts of expenditures should be reported in the comparison.
- 2 **The Schedule:** This is a comparison of the time the tasks or the milestones should have been completed as scheduled in the initial plans, with the actual time they finish. Also here different management and customers expectations should be reported if occur for the more objective comparison and understanding of the probable differences.
- 3 **The Progress:** This session compares the resources spent with the work produced. Special consideration should be taken in Research and Development projects that the scope and the method used is not clear and a lot amount of rework is needed. The critical tasks that have problems are reported in this session and projections can be made

regarding the time and the amount of the remaining planned expenditures. The report in this specific segment should be done accordingly to the OPMCL life cycle and also include the progress that the three project management levels, the strategic, the tactical and the operational have made.

- 4 **Quality:** This session depends on the type of project being audited. The quality measures the degree to which the output of the project matches with the pre-specified designing and contractual agreements. Many times quality is difficult to be measured in that cases the technical quality audit is required.
- 5 **The Scope:** This session refers to the examination of the objectives that the project should achieve at the time of the audit and the usefulness of it. It is noticeable that most of the times the project get a differentiated objectives through the implementation. This is called scope creep. The final report at this level has to describe the scope that the project has at the specific time of the audit.
- 6 **Natural and socio-political environment:** This session includes the description of the current status of the natural and the socio-political environment that might have changed from their initiated status or have differences from the predicted status. These changes might have been caused by the project itself or other external factors. The importance of this last set of factors even though many project managers underestimate it, it can be crucial for the continuation and the well performance of the execution of the project.

Future Project Status: This part of the project audit report contains the conclusions of the auditor regarding the future progress of the project that can be predicted from the history and the current status of it. Predictions refer to cost, schedule, and quality for the remaining tasks in the various future milestones. No assumptions should be made about technical matters that are still under investigation at the time of the project audit. Recommendations can be made about changes in technical approach, budget and schedule for the remaining tasks. Also the future project status segment has to be based on the format

Status of Crucial Tasks: In this part all the issues that the auditor has characterized that need close monitoring from the management, are presented. It is also presented the critical issues relationship with the objectives of the project. The interaction of the project time, cost and performance as they are in the OPMCL life cycle framework and coming from these crucial issues will provide the management with useful information for decisions about the future of the project.

Risk Assessment and Analysis: This part includes the presentation of the main risks issues and their projected impact on the project time, cost and performance. Also they can be presented possible future risks that may occur in the project process.

Limitations and Assumptions of the Audit: The last part includes all the limitations and the constraints that the project auditor faces and works like an index for the project audit report. These limitations should be mentioned for the more objective presentation of the project audit. Time, depth, lost records, negative attitudes, focus in specific directions, assumptions and poor inputs should be mentioned as well as how these limitations affect the data and the outputs. Only by this way will the project auditor have presented a complete and objective report.

The audit belongs to the learning process rather than the monitoring because its purpose is to inform the customer and the organization about the actual state of the project and the management about the effectiveness of the methods they followed. It provides the essential feedback for all of the involved in the project parties and has the purpose of further future improvement for the specific or for future projects. This feedback may come from all the parameters of the project eco-system if conducted successfully. It will show to the management, which is usually looking only the one side of the facts, that in order to lead a project into success they need to have in their mind all of the interrelationships between the parameters of the multi dimensional eco-system.

The following tables present a selected sample of the project audit questionnaire. Table III-2 shows the open question list, where the project auditor notes down the important questions that come out before the initiation or during the audit process.

The columns are referred to the question description, the probable source of the answer, who requested the question and to which section of the audit report this question is related to. Table III-3 shows the classification of the collected documents for the project audit. These tables help the project auditor categorize the issues and handle them more effectively.

PROJECT TERMINATION

CHAPTER

12

12.1 INTRODUCTION

Projects are a temporary endeavor. Even in case of projects that may take a lot of time to complete, there is always an end. They have a limited time of execution and a life cycle as we saw in Part II. Thus in this thesis's framework, the last step of the project execution is the project termination. With the term project termination, we include all of the necessary actions that take place for a project to finish. The projects finish for various reasons. These include project completion, lack of money, slippage in schedule and budget, change of interests and political or national economical reasons.

This phase is also a very important phase as well as the factors that created the termination. The project has to close out, the personnel have to be reassigned to other projects, if available, the material and resources should be decomposed or transferred to other projects and the natural environment should be turned to the original or the preplanned status. Reports should be filled out and all the bills should be paid. One very important issue that the project manager should take into consideration how to manage the project termination in order to increase personnel morale. People that will see that are laid off will not be in the mood to work productively, the same happens with the people that will not be comfortable with their reassignment. These people will lose the interest of working or they will try to prolong the completion time as much as they can.

In this chapter, we will analyze the project termination categories, the decision when to terminate a project, the termination process and the final report.

12.2 PROJECT TERMINATION CATEGORIES

We say that a project is being terminated if the work is ceased or slowed to the point that further progress on the project is no longer possible. This may happen by cutting the budget of the project, by moving resources and personnel to other projects or by letting the management getting less and less involved in it.

There are four types of project termination: The termination by extinction, by addition, by integration and by starvation. Below, we will analyze each of these categories and their characteristics.

12.2.1 Termination by extinction

This type of termination has three subcategories that are characterized by the reasons that cause the termination. The first reason can be the successful completion of the project. By that we mean that the project reached its goals and objectives, the product or service is delivered to the customer and is running. The second reason can be the unsuccessful completion of the project. The project did not reach its goals especially in R&D projects that half of the times during the development phase come to conclusions that the objectives that were set in the beginning are not feasible. Then, the project has to stop instead of going to the next stage because there is no reason to continue it. The last reason is the termination by murder. This is the sudden termination of the project because of political or change management reasons.

In this type of termination by extinction, there is still a great amount of work to be done for the total completion of the project. The personnel should be reassigned to other projects, the materials and the machinery should be transferred to the locations of the new or other existing projects and the final report should be completed. Accounting and administrative job has also to be done. The project history will be completed by the project manager or by a person assigned for this reason. This project report will be the project history and will offer the lessons learned for other projects.

12.2.2 Termination by addition

The characteristic of this type of termination is that the project stops existing as an entity and becomes part of the parent organization. Projects as we have seen have their own organizational structure. In cases that the project is successful and has to be continued as a routine project, then it becomes a department or a part of a department within the existing organization. The project ends up by this type of termination.

The issues that the project manager should pay attention are the smooth transition from project to department, and the morale of the personnel as well as the changes in hierarchy and the reporting channel. The transition should be made smoothly because every change can affect the main factors of the project and lead it to failure or bad performance. The personnel most of the times has a problem of freedom. The initiatives and the roles they could have by managing the project themselves, can now be diminished by the obligation to obey to the rules that the parent organization has. This can cause the project performance to be lowered or even make capable team members to quit because they can not comply with the new rules.

In this termination, resources should be transferred to the parent organization and paper work should be filled. New standards and rules should be added and probable the personnel should have to move to a new location in the parent organization building.

12.2.3 Termination by integration

In this category of project termination, the project is finished as an entity and it is being integrated in the parent organization between the various departments. All of the resources, the personnel, the material, the equipment and the services or the products are distributed between the departments of the parent organization or the client. The output of this termination is that the project now comes a part of the parent organization or the client. The difference from the previous form of termination, the termination by addition, is that the later creates a new function or department in the parent organization or enhances an existing one.

The problems that could be created from this type of termination are referred to personnel, manufacturing, accounting/finance, engineering, information systems, marketing, purchasing, contracting and distribution channels.

The personnel have to be distributed within the existing departments. The concerns that come out from this distribution is whether the teams will keep to exist, whether the personnel that will be assigned to new projects will be available for the old one, and how the team members will fit into the new structure.

Concerning the manufacturing, the concern is whether the training and the production line are completed to work in the parent organization.

The terminated project should be audited and the accounts should have been closed and not transferred in the new structure. The property should be distributed according to the valid agreements.

Concerning the engineering, the drawings should be complete and on the file, the manuals should be completed and understood and the training programs for the new employers should be established. Maintenance should also be taken care of.

As of the information systems, they should include the whole test of the new system, the compliance with the parent organization and the training of the users.

In the marketing issues it is included the integration of the existing marketing department of the parent organization with the marketing strategy of the project and how these two probable different strategies can comply.

In the end, the purchasing, the distribution channels and the contracting services should be aware of the change and the integration of the project so that they could be able to handle more effectively the situation.

12.2.4 Termination by starvation

This kind of project termination takes place when the project has many reasons to be terminated but not officially. The project does not have progress however it exists in the papers as pending. The reasons for the existence could be political or strategically in the organization. Some times there are projects that add credit to governments and organizations. These projects are preferred to be terminated by starvation rather than cancellation or extinction. In project starvation, the budget and the resources are gradually or suddenly taken away from the project and only some few part time personnel is remaining to report no progress.

Equipment and material in these cases could be either maintained in their places or moved to other projects. The project is never reported to be officially canceled, however it is stalled. It is very seldom that for the project to start having progress again unless there is a political change or a project transformation.

12.3 FACTORS FOR TERMINATING PROJECTS.

During the execution of the project, the organization makes project audits to track the performance of the project and acquire a real and accurate picture of the project status, as we saw in this Part in Chapter 11. The project audits investigate and evaluate the project as this is executed. In the first phase, the project proposal, before the project begins there are for sure strongly convincing elements for the project to start. During the project execution, these elements may change or new obstacles may show up. There is a possibility that the project lose its attractiveness from the market, or the stockholder's or the technology side. There is a possibility also that the organization that executes the project in the competitive environment lags behind the competitors. This is a presentation of two fundamental reasons that the project should be terminated. Other reasons may include the changes in the sociopolitical and the natural environment that the project or other sources have caused and the project will then not be feasible or will be unable to operate within these new parameters. But what are the criteria to decide whether a project should be terminated or not and what are the measurements for this decision?

In this session, we will refer mostly to R&D projects that half of them are terminated or cancelled before completion. Then we will make an overview of the criteria and their universality along the different geographic allocations.

Balachandra in 1996 presented a study in comparing the factors of R&D project termination in four industrial nations. The research was conducted in US, United Kingdom, Germany and Japan. It compares the termination factors and their coefficients for these for countries. In this study in order for the factors to be evaluated, except the need for translation there was also the need for some of the factors to be restructured as of their meaning aspect. The questionnaire that was given to the companies in different countries had to be universal for the results to be more accurate. Table III-4 contains the discriminating factors for project termination.

The study concludes that these factors are common for the four studied countries. The initial hypothesis was that these four countries have similarities but they also have differences in various aspects related with the projects. The similarities are that all of them are technologically advanced, highly industrialized, and they have similar market economies. The differences apply on cultural aspects. The Japanese and the European organizations are more hierarchical than the US organizations that are rather flat. The German managers appear to put more weight on timing, while the US. managers emphasize cost (R.Balachandra, Klaus Brockhoff, 1995, business and management practices, Industrial research institute.). In this study that was conducted between the US and Germany, they found that in both countries the approaches to R&D and new product management, and to management practices in general are similar and the factors that determine the termination of the projects are similar as well.

Discriminating factors for project termination in the US, United Kingdom, Germany and Japan	
Probability of success via tech route	Change in probability of commercial success
Deviations in time schedules	Change in number of endures
Deviations in cost schedules	Change in support of project management
Time of anticipated completion	Change in support of R&D management
Chance event	Change in commitment of project leader
Smoothness of technological route	Change in availability of experts
Pressure on project leader	Stage of lifecycle
Project champion	Adaptability of project leader.

Table III-4. Discriminating factors for project termination in the four countries. (R. Balachandra, IEE transactions on engineering management, vol 43 No1, Febr. 1996)

In addition to the above mentioned universal for the four studied countries factors, other factors that determine the continuation or termination of projects are:

1. The scope of the project has to be within the financial strength of the organization
2. The project needs to have the support of all the departments (finance, manufacturing, marketing, human resources)
3. The level of innovation of the project team.
4. Whether the organization has the required skills to exploit fully the project.
5. Whether the project team is still enthusiastic about the success.
6. The degree that the results can be subcontracted or developed in house.

Table III-5 presents the rank order of the important factors in terminating R&D projects. This study was conducted among 36 companies.

Rank Order of Important Factors in Terminating R&D Projects (36 companies) Factors and number of companies reporting these factors as important.	
<u>Factors</u>	No of companies
<u>Technical</u>	
Low probability of achieving technical objectives or commercializing results	34
Technical or manufacturing problems can not be solved with available R&D skills	11
Higher priority of other projects requiring R&D labor or fund	10
<u>Economic</u>	
Low profitability or return on investment	23
Too costly to develop as individual product	18
<u>Market</u>	
Low market potential	16
Change in competitive factors or market needs	10
<u>Others</u>	
Long time required to achieve commercial results	6
Negative effects on other projects or products	3
Patent problems	1

Table III-5. Rank Order of Important Factors Considered in Terminating R&D projects (36 Companies) (Dean, 1968, B.V. Evaluating , selecting and controlling R&D projects. NY American Management association)

The termination process is decided by the senior management or the project manager and has to be passed to the lower levels of the project. In the next session, we will analyze the steps that the termination process follows and the persons responsible for each of these steps.

12.4 THE TERMINATION PROCESS

The termination process may consist of two parts. First the evaluation whether to terminate the project or not takes place. Then if the decision is to terminate the project, the termination implementation follows. When a project terminates or sets planned termination time, the only part to be connected with is the terminations implementation. In this session, we will analyze firstly the decision process and who carries it, and secondly the implementation process, the steps and who carries them.

12.4.1 The Decision Process

In Session 12.3 in this part we saw the factors that are examined for the termination decision of a project in four technologically developed countries. There are models that help into the termination decision. These models fall into two generic categories. The first category of the termination decision models, base the decision on the degree to which the project qualifies against the set of factors that have been generally set and are associated with successful projects. The second category bases the decision on the degree to which the specific project meets the objectives and the goals that have been set in the project proposal.

The termination factors may change in the different life cycle stages of the projects. This is understandable because there is a lot of uncertainty about the amount of rework and many times about the objectives of a project in the beginning of it. As the project gets to the end, we can more easily evaluate whether it is successful or not. In advanced stages, we can evaluate whether the project is technically achievable and also the time and the cost required for the completion as well as the impact of the project to the natural and socio-political environment and vice versa. An example can be the research and development of a new generation biotechnology product that will replace a human organ. The development of this product will have social impact, as many people will benefit from the transplantation of the new synthetic organ. From the other side the cost of the research and the development as well as the time needed for the product to pass all the lab tests might be tremendous out of the scope that the specific project should be terminated and the research led to another alternative direction. Another example can be from the pharmaceutical industry that many companies produce generic drugs that do not leave large profit margins. However they are not willing to terminate this mas production projects as they operate as platform projects and give the companies the economies of scale that are needed for the production of a new drug with higher profit margins but low market share. This information, about how well the project is doing, will help the termination model to output the decision.

The models that are used are spreadsheets in the most common formats like excel and lotus. These include the termination criteria that have been set as important with the weight factors due to the importance of each of these criteria. Usually these are checklists or boxes that need to be evaluated by a grading scale, for example 1 to 10. In the next step, the values are multiplied by the weight factors and added together. The result can be compared to a predefined by the contract success value, or by same method extracted values of similar successfully proven projects.

12.4.2 The Implementation Process

After the termination decision is taken for the project, there is a series of tasks that have to be implemented in order for the project termination process to be finished. The project termination is the last task in the project life cycle that we study in this thesis. As a part of the project execution, it has to be planned, scheduled, budgeted, monitored and controlled.

First of all a leader has to be assigned to this task. This leader can be either the project manager or a person that specializes in project termination, the project terminator or a person from the project team who will be promoted to project terminator. Usually the project manager moves to another project before the previous is terminated and the use of another person is necessary. After the definition of the project terminator, a set of tasks follows that will lead the project to termination.

The tasks that have to be executed for the project termination are:

- The transition management. The completed project has to be transferred to the client that can be a physical person, another organization or the same company that develops the project but another part of it. Whoever the customer is, there must be a transition stage management and operations that all of the project issues will be passed to the user.
- The reassignment of the project personnel to other projects or the laying off: The project personnel has to be reassigned to the new projects so that there is not any lag time between the completed and the new project. At the same time some of the project personnel has to be part time available to give information or additional work for the completed project for a period of time. This task is very important for the right personnel utilization, the reputation of the company that cares about its employees and the successful project completion. Because of its importance, we will analyze this issue further in session 2.4.3.
- The transferring to other projects, selling or disposing of the remaining material, machinery, equipment and buildings that were used for the project: The project has used raw material, equipment, buildings and has produced waste material. When the project is over, the remaining of the previous list have to be collected, reassigned, sold or disposed properly.
- The collection of the manuals and the training of the end user as applicable: The final instructions for the user, the troubleshooting, numbers for immediate response and service have to be issued and delivered. Also training courses for the user should be established if needed.
- The collection and reposition of spare parts and foundation of maintenance program as applicable: Spare parts or a depository of material or software should be kept as needed or a maintenance program should be established and contracted.
- The decision what records and files to be kept and for how long: Not all of the shop drawings, the specifications and the paperwork are essential when the project has been terminated. The termination manager has to decide which of the records to keep, collect and store them in a safe place according to company, owner or governmental policies. The retention list should be formed with the cooperation of the termination manager and the technical and operational staff.
- The close out of the billing, the payments to the subcontractors and the closing of the project books: All the bills have to be arranged as well as the payments. After the project completion, the pending charges or the payments have to be put separately because after a period of time the key persons of the project will not be available to recall any past records. For the same reason, the project books have to be closed and matters that are still pending should be easily identified.
- The closing of the legal matters, the warranties and the project documentation: the contract should be checked whether the deliverable meets the standards, disputes should be arranged and the project documentation should be collected and handed to the proper person. The organization legal department has to be informed by the project personnel about possible pending issues.

- The definition of the project deliverables and the protocol of project delivery: The delivered project or service should be defined, described and accepted or rejected partially from the customer.
- The restoration of the physical or the socio-political environment in the initial stage before the project started, or the preplanned by the specifications, the contract or the current regulation. Many times, when either or both of the physical and the socio political environment status is not specified, then this status has to be defined by the project manager or the termination committee.
- The final report or project history document: This report is not an evaluation one, but the history of the project. It includes the way the project was managed, the ways the problems were solved, the mistakes and conflicts that occurred and who served this project. Many organizations that have been established as learning organizations are keeping a detailed database of project histories for the employees to review. Employees may change very frequently and the gained experience can be lost if not stored in the data bases. A very interesting example is that with the big consulting companies that have customers from all the industries and the practices. Consulting companies keep detailed project and industry records not only to use in similar future cases but also transmit the best practices among the different industries. Because of its importance, we will present the final report separately in session 2.6

In Figure III-1. (Meredith) shows the design for the project termination and the parts that should be included.

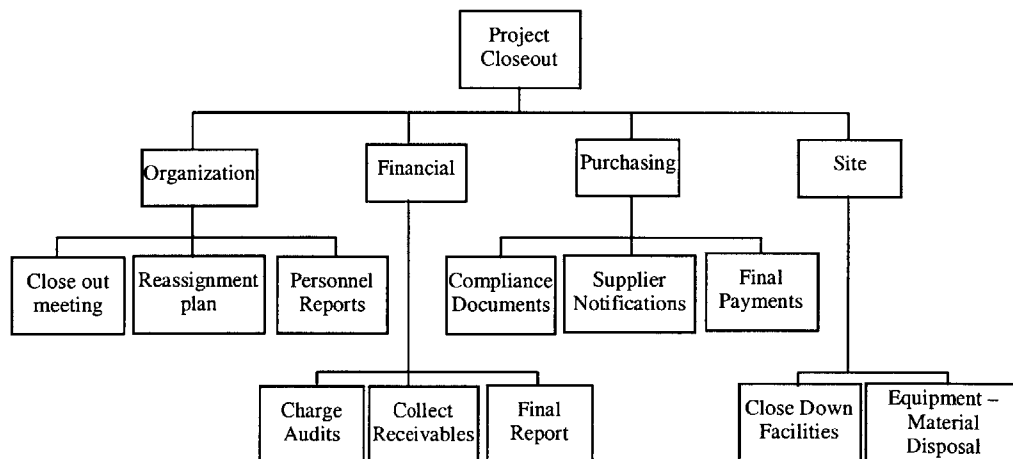


Figure III-1. The design for the project termination and the parts that should be included.(Meredith)

12.4.3 Reassignment of Project Personnel

The human resources are a very important factor for the project. Starting from the team personnel and ending with the subcontractors and the suppliers, these people have first to finish the ending project with the same productivity factor and then they have to be reassigned to new projects due to the needs of the organization. The time the reassignments will be announced is very critical for the past project completion. There

will be people that will learn they are laid off and others that will have been moved to projects or locations below their expectations. As a result of these, their productivity will decrease or they will try to suspend the job as much as they can and the management may face serious problems in the completion of the project.

Also the technique of keeping the reassignment report until the last moment will create a bad reputation for the organization or the project manager about the caring of its members. The best solution in this case is a documented reassignment report and support from the management. Also the monitoring and controlling techniques that were used in the previous stages should be active in the stage of project termination. In this last phase of the project, the project manager can understand his/her influence on the project personnel as a leader as well as the commitment of the personnel to the project.

Transition plan needs to be developed in consultation with the employees. Prediction for next projects should be taken into account. There is the phenomenon in large corporations of hiring personnel for a project, spending time, money and performance of the experienced personnel to train them and after the project completion firing experienced personnel. The organizations should be very careful because the trained personnel are an asset for them. Boeing has studied this phenomenon and has ended up in a system dynamics model for the better understanding of which kind of personnel should be fired and in what percentage of each category. (Term project for the class: Application of system dynamics, spring 2001, professor Jim Hynes). Other companies when a project is over and until the beginning of a new one, use their employees in house production, dealing with internal issues or being assigned as part time to other projects that may need a speed up or additional resources. Transition management is a very important issue and must be very well planned well before the end of the project. The phase out plan should be conducted to avoid draining all the good employees from the old project. Skills and needs have to be evaluated and people should be assigned to other projects or training until the new project be initiated.

As conclusion in the important matter of the human resources, prediction and scheduling in advance is essential for both the organization and the personnel itself. The organization has a better utilization of the human resources and does not need to lay off experienced personnel. From the other side, social problems that could be created from the massive laying off, are avoided and the organization keeps its reputation as employee caring particularly in tight labor markets. In the next session, we will see an example of a close out checklist for a project.

12.5 INSTRUCTIONS FOR CLOSE-OUT CHECK LIST

Table III-6. Close out checklist example, adopted from Meredith, Mantel "Project Management 4th edition" 2000).

The following figure shows a close-out check list example.

Project title _____ Completion Date _____

Contract No. _____ Cost type _____

Customer _____ Project manager _____

Instructions for table completion

Column I – item No: each task listed is identified by a specific number and grouped into categories. Categories are based on functions, not on organizations or equipment.

Column II – Task description: Task descriptions are brief tasks that could apply to more than one category but are listed only in the most appropriate category

Column III – Required, yes, or no: Check whether the item listed applies to the project

Column IV – Date required: Insert the required date for accomplishment of the task.

Column V – Assigned responsibility: Insert the name of the person responsible to see that the task is accomplished on schedule. This may be a member of the project office or an individual within a functional department.

Column VI – Priority (PR): a priority system established by the project manager may be used here, e.g., priority #1 may be all tasks that must be accomplished before the contractual completion date, priority #2 within two weeks after the completion date. Etc.

Column VII – Notes, reference: refer in this column to any applicable procedures, a government specification that may apply to that task, etc.

Item No	Task Description	Required		Required Date	Assigned Responsibility	Priority	Notes Reference
		Yes	No				
A.	Project Office (PO) and project team (PT) organization						
1	Conduct project close-out meeting						
2	Establish PO and PT release and reassignment plan						
3	Carry out necessary personnel actions						
4	Prepare personal performance evaluation on each PO and PT member.						
B	Instructions and procedures						
	Issue instructions for:						
1	Termination of PO and PT						
2	Close-out of all work orders and contracts						
3	Termination of reporting procedures						
4	Preparation of final report(s)						

Table III-6. Close out checklist example (Continued)

Item No	Task Description	Required		Required Date	Assigned Responsibility	Priority	Notes Reference
		Yes	No				
5	Completion and disposition of project file						
C	Financial						
1	Close out financial documents and records						
2	Audit final charges and costs						
3	Prepare final project financial report(s)						
4	Collect receivables						
D	Project definition						
1	Document final approved project scope						
2	Prepare final project breakdown structure and enter into project file						
E	Plans, budgets and schedules						
1	Document actual delivery dates of all contractual deliverable end items.						
2	Document actual completion dates of all other contractual obligations						
3	Prepare final project and task status reports						
F	Natural & socio-political Environment						
1	Restore the initial or the preplanned conditions.						
2	Give notice to the agencies and the authorities that the project is completed						
3	Inform the various social groups that the project is completed						
4	Inform about the usage of the project, the benefits and impacts and probable next steps.						
G	Work authorization and control						
1	Close out all work orders and contracts						
H	Project evaluation and control						
1	Assure completion of all action assignments						
2	Prepare final evaluation report(s)						
3	Conduct final review meeting						

Table III-6. Close out checklist example (Continued)

Item No	Task Description	Required		Required Date	Assigned Responsibility	Priority	Notes Reference
		Yes	No				
4	Terminate financial, manpower, and progress reporting procedures.						
I	Management and customer reporting						
1	Submit final report to customer						
2	Submit final report to management						
J	Marketing and contract administration						
1	Compile all final contract documents with revision, waivers, and related correspondence						
2	Verify and document compliance with all contractual terms.						
3	Compile required proof of shipment and customer acceptance documents.						
4	Officially notify customer of contract completion						
5	Initiate and pursue any claims against customer.						
6	Prepare and conduct defense against claims by customer.						
7	Initiate public relations announcements						
8	Prepare final contract status report						
K	Extension-new business						
1	Document possibilities for project or contract extensions, or other related new business						
2	Obtain commitment for extension						
L	Project records control						
1	Complete project file and transmit to designated manager.						
2	Dispose of other project records as required by established procedures.						
M	Purchasing and subcontracting						
	For each purchase order and subcontract.						
1	Document compliance and completion						
2	Verify final payment and proper accounting to project						

Table III-6. Close out checklist example (Continued)

Item No	Task Description	Required		Required Date	Assigned Responsibility	Priority	Notes Reference
		Yes	No				
3	Notify vendor/contractor of final completion						
N	Engineering documentation						
1	Compile and store all engineering documentation						
2	Prepare final technical report						
O	Site operations						
1	Close down site operations						
2	Dispose equipment and material						

12.6 FINAL REPORT

The termination process includes the final report or project history as it is called. This report is the last document that describes the management and personnel performance, the problems and their solutions during the project and in generally the whole chronicle of the project.

The elements that the final report contains are described in this session. These are the project performance, the administrative performance, the organizational structure, the project and administrative teams, effects on the natural and the socio-political environment and the techniques of project management. We will analyze each of them separately.

Project performance: this contains a comparison of what the project achieved with the objectives from the project proposal. As the final report is not a project audit or any kind of project evaluation, the project terminator can express his/her opinion on what has been done right or wrong and suggest effective ways or resolution and performance in similar cases or in similar projects.

Administrative performance: This includes a presentation of the administrative forces during the project. Although the administration cannot get involved into technical matters that will give solutions to the project problems, it can help the project in different ways. The administrative performance especially the poor or the excellent one should be mentioned properly and the project terminator should suggest alternatives ways of administrative performance in same projects and in similar organizational structures.

Organizational structure: As we saw in Part II, each of the project organizational structures has advantages and disadvantages. In the final report the project terminator presents the project conformance and efficiency into the organizational structure that was used. He/she also suggests alternative organizational structures to be used in similar projects.

Project and administrative teams: There are people that work better as individuals than in teams and there are people that perform better while in teams. Also there are specific combinations of persons that when they are in a team they can collaborate effectively. These persons and teams should be mentioned and reported in the final report. The reason for this is that project managers would be able to assign properly their team members to work with the most efficient way.

Effects on the natural and the socio-political environment: As we have discussed earlier, projects affect the natural and the socio-political environment and vice versa. In this session of the final report it will be presented the cause and effect relationship from the project implementation to the above vital factors. A construction project most of the times alterate the environmental status and the production of a new commodity material commonly changes the social environment by introducing new living standards that might have further positive or negative affections to other social factors. In this session the project terminator can make suggestions about the way that the negative consequences could be avoided in respect of the natural and the socio-political environment. For example when a company executes projects internationally, then it runs the risk that the project can be terminated because of changes in the political environment that supported these projects.

Techniques of project management: This includes a description of the techniques of project management used in the project during its implementation and their effectiveness. Also new techniques that worked well should be highlighted. Recommendations and suggestions should follow.

As we saw in all of the components of the project report, recommendations should be done where applicable. The purpose of the final project report is to present the history of the project, to highlight good or poor performances and suggest alternatives for future projects. In the next Chapter we will see the system dynamics method, a feedback process that helps the organizations utilize its past experience, be updated by getting continuous feedback and recognize the whole set of forces that drive the project ecosystem.

12.7 SUMMARY

In this chapter, we saw the termination categories for the projects: the termination by extinction, by addition, by integration and by starvation. We also analyzed the factors responsible for project termination and statistics for geographical differences and similarities coming from companies in the most technologically developed countries. We also presented the termination process, and the steps for the final report preparation. We have to highlight again the importance of the termination phase for the project. Many project managers and organizations consider the project to be finished after the product is completed and passes its final tests and inspections. The reality is not like that. In the project process, the project team has to pass a transitional stage in the beginning and also after the completion of the product or service. The termination process makes the final delivery of the project and prepares the organization for the next one. Most importantly as we will see in Chapter 13, the conclusions and the take aways are stored in files or data bases and can be used very effectively by the organization for future projects. These consist the lessons learned that we will present in Chapter 13 of this part.

LEARNING ON PROJECTS

CHAPTER 13

13.1 INTRODUCTION

Consider how many times you have experienced or heard about projects that are characterized by schedule and budget overruns, have been seemingly stuck at “90%” of completion level, or experience late realization of additional time or resource needs. How many times have you seen new products with flaws discovered after their release to the market, or have experienced difficulty comparing the performance of different, “unique” projects. These are very common for many development projects that fail to meet their time and cost targets, with the overrun typically between 40 and 200 percent.

In addition the last decade the projects and the organizations that execute them have changed in terms of more environmental demanding needs. These needs include faster adoption to the frequent and rapid changes of the environment, faster delivery, better quality of projects and less budget spent. The big traditional organizations that used to produce standard types of projects that the customer should comply with, no longer exist because of the competition and the more demanding and well rounded customers. Competition has created such an environment that the companies are fighting to survive rather than to make the profits that were used to some time ago.

The solution to the above facts is the learning in the projects and the establishment of the learning organizations. By this way the mistakes of the past will not be repeated in the projects and higher levels of quality, delivery time and reduced budget will occur. By establishing a learning technique within the organization the feedback of the actions of the organization will be flowing across all the departments. This will lead to faster and more accurate decisions.

13.2 WHY LEARNING IS NOT HAPPENING

The environment of the projects is very complex. The project performance problems are fundamentally dynamic problems; they change not only through the time but also through the different set of scenarios/decisions. Below we will present the reasons that the organizations are poor at lessons learning from prior projects.

First of all the measurement of the project performance is a not well specified factor as many of the project variables such as quality can be revealed many times after the release of the product into the market. For example, in many software projects bugs are discovered after the release of the program in the market. This fact leads to the conclusion that the rework needed for the correction of the mistakes and the achievement of the desired quality can not be accurately calculated as a matter of the time. Projects that are seemed to be at the completion stage and in schedule often get delayed. This means that it is difficult for the project managers to locate the real status of the projects

and as a result to take the necessary decisions. When the problem is not identifiable, then learning can not be implemented.

Then the correlation between the project variables, most of the times can not be clearly defined and further analysis is needed. The mental models can not easily capture this analysis when it is very detailed. The result is that the project managers usually take a partial view of the project problems and the probable solutions and many times are led to wrong decisions in the wrong timing.

Another mistake that is commonly met in the management levels is that they view the project statically; they think that while changing a parameter by taking a decision, the reaction of the project outputs is well defined. This “expected” output is not always the actual result as the project parameters are not only changing dynamically but also they have multiple correlation among them and sensitivity varies.

Another reason that learning is not happening is that the project managers view each project as “unique”. They consider each of the problems and the obstacles they face as one of a kind and they believe that there is not any benefit if they look in previous projects. In the reality the experience of previous projects, or different companies experience, or even different industries practices can many times be applied to a specific project. Consulting companies acquire cross industry experience and build knowledge databases for future applications.

Finally, the lack of the organizations that support learning and the lack of money in the companies for learning purposes is another factor for poor learning structure system within the companies. As a matter of personnel, the limited span of the project manager career path and the high attrition rates lead to poor lessons learned implementation.

In the next session we will see why learning is critical for the organizations and the projects that they execute.

13.3 WHY LEARNING IS CRITICAL

Today corporations face critical issues such as reorganization, restructuring, employee skills shortages, high levels of employee attrition, knowledge doubling every two years, global competition from well established world companies, new technology and demand for flexibility.

New methods of cost reduction, quality improvement and faster delivery should be found so that companies make profit and remain in the competitive environment. The need for better coordination and manage of the supply chain that led most of the companies to reengineering came very early on stage. Projects started to be viewed not only by the successful completion of their scope but under a critical examination of how they could be better performed. Questions like which management mistakes could have been avoided, whether the resources were well and fully utilized started creating the new learning process. Managers realized that there was a way to learn how to execute their projects better. This concept led to the creation of the learning organizations.

Learning organization is every organization that learns from the past experience or from others experience and improves its project cycle. We have to clarify that organizations that are getting feedback are not necessarily learning organizations. This

feedback has to be analyzed, categorized, filed and be easily accessed by the employees to be used for future projects.

The techniques used for better performance can be the benchmarking (internally or externally), the policy design and the management training.

13.3.1 Benchmarking.

Benchmarking is classified into two categories: the internal and the external. Internal is the comparison between two different projects or departments of one company. The analysts watch the performance of the project or the department and make useful conclusions about which techniques are successful and which are not. Successful techniques can be used in other departments or projects and lead to improvement of performance. External benchmarking includes the analysis of other companies, or other companies' projects or even other industries best practices. It has the same concept with the internal benchmarking. The difference stands in the environment that the benchmarking takes place.

We will see an example of external benchmarking in two industries having different marketing rules and functionality. Benchmarking in this case can be applied in the concept of the issues. Special consultants that do the benchmarking find the similarities in the way the industries work, analyze them and then apply them in different industries. Benchmarking is a better word for watching the ideas and the techniques of the competitors and then taking or adopting them in their own organization. This can be, the origin of the competitors resources, the reaction of the competitors to the changes of the market or the best practices the competitors use. Benchmarking is a whole profession. Special companies undertake to make the benchmarking projects for customer organizations. The results from the benchmarking give valuable information to the organization and the managers decide whether it would be in the organization's advantage or not to adopt these competitors' techniques.

Benchmarking provide guidelines for establishing initial budgets, schedule, and work plans, indicate areas for improvement (when internal projects are compared to external projects) and identify sources of variation among projects as a guide to potential risks.

13.3.2 Policy Design.

Policy design means translating the results of model analyses into management practice. (Without simulating each project, for every decision). Policies are general rules that govern a stream of individual decisions. Polices are categorized into the Heuristics and the "rules of thumb".

An example of heuristics for resource scheduling includes:

- As soon as possible
- As late as possible
- Shortest task first
- Most resources first

- Minimum slack first
- Most critical followers
- Most successors

We will see now the difference between the policies and the decisions.

A policy is a statement of how information is converted into action (e.g., dividends per share depend on earnings per share and availability of cash; when to start work on a downstream phase based on upstream progress)

A decision is the result of applying that policy at a point in time to the information at hand (e.g., to pay \$2.50 in dividends per share in 1994; to start production in June 1998)

Below we elaborate see some examples of policies:

- Do not hire in ways that reduce avg. experience below 5 years
- Assume undiscovered rework equal to 3 times known rework (varies with fraction complete)
- Do not apply substantial labor to a phase until 75% of the prerequisite work is perceived to be complete (depending on typical rework)
- Freeze the design 6 months before scheduled start of prototype production
- Increase testing when rework is above normal
- On high-risk projects allow a schedule reserve of ..., and use it when ...

13.3.2.1 From ad-hoc decision-making to policy-based management

When we start understanding how the projects react in the changes of their environment and how the variables are correlated, we pass from the ad-hoc decision making to the policy-based management. First we define the policies (make hypotheses). Then we test, evaluate and systematically improve them.

The policies that work can be implemented throughout a project organization; they can be:

- Taught to new managers
- Explained and defended to customers
- Adapted to new situations

As a result from the implementation and the improvement of the policies, effective project management becomes: More systematic and less artful, institutionalized and the source of competitive advantage

13.3.3 Management Training

Management training is another method of learning in the organizations. Managers, senior or new ones, attend special seminars on new practices or areas of weakness by external specialists. These seminars may include the information on new automatization or information technology tools that can be useful in their management processes. This source of learning can be external if the specialists come from the outside of the organization or internal if they come from different departments or different projects. In both cases we have a knowledge transmission that accelerates and improves the performance of the management and the organization.

Management training is classified into the three following categories:

Bringing external experts or consultants into the organization that transmit their experience or new theories to the management. The external experts can be from the academic area, the same industry practitioners, or from different industries. They teach the management of the company new methods or they explain them innovative ideas that can make the managerial process more efficient.

Rotating the people around the departments so that they acquire spherical knowledge and understanding of the whole function of the company. This is extremely useful if we consider the very often disputes between the marketing and the manufacturing managers. Sales people most likely demand from the engineers qualifications for the projects that are not feasible. By rotating the personnel into the different areas of function between the company, these people are better coordinating the projects.

Exchange of personnel between the different located offices of the company or periodically meetings and conferences. By this way the employees have the chance to know ideas, policies and successful practices of their colleagues that are dispersed in different geographical locations. The conclusions from this form of training when it is well organized and effective are very important for the organization and for the individuals.

13.4 LEVELS OF LEARNING

There are three different types of learning within the organizations: the individual, the group/team learning and the organization learning. The learning organizations have developed and encourage all the three types of learning.

Individual learning. The organizations are consisted of individuals; in order to characterize an organization as learning organization, individual learning should occur. Although this is necessary, individual learning doesn't guarantee a learning organization because the organization learning as a matter of equation is greater than the sum of the individual learning. The individual learning may have many sources of learning such as self-managed learning, learning from peers, computer aided learning, learning from experiences of past projects. In the organization everyone should be enthusiastically willing to learn and encourage the others to learn. Usually the new hires or the less experienced employees have a mentor from that is one of the more senior peers who leads them through the learning process.

Group/Team learning. Teams are very important parts of the organizations. Teams are constituted from individuals that are working for a specific project or inside a

specific department. We have to distinguish that here by the term team learning we do not mean the team training process. The team learning is the process of sharing the experiences (positive or negative) between the team members, or between the different teams and ensure the growth of the organization. Team learning occurs every time that a group of people are brought together.

Organization learning. This is the third type of learning within an organization. The difference between the two previous types, the individual and the team learning consists of two aspects. First the organization learning occurs through the learning of both the individuals and the team learning of the organization. Second, the organization learning includes all the past knowledge and experience that the organization has developed in forms of organizational memory and is retaining with mechanisms such as policies, strategies and knowledge databases. The importance of the organization learning is very high as it keeps the learning process in high levels. Individuals may by the time lose their enthusiasm in learning, or may lose the contact with each other, or may leave the organization taking with them the knowledge that they have acquired. There are four types of organization learning (by Michael J. Marquardt): the adaptive, the anticipatory, the deuterio and the active learning.

13.4.1 Types of learning in organizations

Adaptive learning

The adaptive learning is when the individual or the organization learns from the experience that the feedback of an action gives. For example an organization makes an action that can be a decision. For example when a project is behind schedule, the project manager tells the personnel to work overtime. This action leads to more work execution and results for the project to gain the lost time. The feedback from this action is that when the personnel works overtime, then we have a speed up in the project implementation.

Adaptive learning is categorized into the single-loop and the double-loop learning. In the single-loop learning the members of the organization respond by evaluating and responding to the changes that their actions have caused and correct further their actions. The feedback of their actions is very useful for the optimal adjustment of their decisions. Single-loop learning is obtaining direct solutions to immediate problems and is the most commonly met learning loop within the organization. It represents the mental models that the managers work with.

The double-loop learning is a more deep learning process and examines additionally why errors or successes occurred in the first phase of learning. The difference between the single and the double loop learning is that while the single loop learning finds the policies for the strategies that should be followed and considers them constant, the double loop learning includes a dynamic analysis of these policies. The double loop learning is more complex but more close to the reality.

Anticipatory learning

This type of learning is based on the organization effort to learn from the future expectations. The organization seeks to avoid the negative results and experiences by identifying the future opportunities, by finding ways to achieve them and avoid the probable mistakes. The organization gets equipped with the knowledge of how to

respond to a future scenario. An example can be the preparation and the decisions of the organization to respond to a project that might be delayed.

Deutero learning

Deutero learning is a more advanced perception of learning. In this type of learning the organization learns how to learn. The learning methods that were taken for granted and constant in the previous types of learning are getting evaluated and new strategies for learning may be invented. In this type of learning the staff is more creative and proactive in learning.

Action learning

Action learning involves working on real time problems focusing on the learning that is acquired by implementing the solutions. It is the best method of learning as it provides a tested learning process that enables the personnel to learn more efficient and quick. The individuals or the groups of the organization use this type of learning to examine a difficult task and bring the learning results back in the organization after having tested them. The benefits from action learning are the development of the skills and the knowledge that is acquired through real time problems. The learning is increased when we test it in real problems. The organization learns critically as the personnel is able to set and test the assumptions, they receive accurate feedback and they are more challenged as they work with unfamiliar problems in unfamiliar settings. Also the organization has the opportunity to examine the organizational system as a whole and this creates a more effective learning.

3.4.4 Interorganization learning. This learning includes the organization learning from other organizations like suppliers, competitors, customers, partners. The interorganizational learning is the transfer of knowledge among different organizations.

13.5 THE ORGANIZATIONAL LEARNING CYCLE.

In an organization there is not enough for the members or the teams to have the willingness to learn. There should also be the structure within the organization that will support the learning process and the utilization of it. The organizational learning consists of four steps that compose the organizational learning cycle. The four steps are: the knowledge generation, the integration of the new knowledge into the organization, the interpretation and finally the action taken based on the knowledge interpretation.

The knowledge generation comes as a result from the action that can be a decision against a problem or to improve some characteristics of the project. In the next step this knowledge has to be introduced to the organization by the managers become available to all the departments and the employees with the form of a report or keyword searchable database. In the next step of the learning cycle this acquired knowledge should be interpreted into policies and strategies for the projects. Finally new corrective actions based on the previous interpretation should be taken for the project.

13.6 LEARNING SKILLS AND DISCIPLINES

Model for learning The Solution: Five Disciplines

As Peter M. Senge refers in learning organizations there are five disciplines (learning techniques) for learning: systems thinking, personal mastery, mental models, shared vision, and team learning

Learning organizations learn to innovate constantly by paying attention to these five "component technologies." They are never mastered, but the best organizations practice them continuously. (Peter M. Senge)

1. Systems thinking. People are taught to be analytical when they have a problem. They are practiced to analyze it into smaller components and find the causes for each of them. This is a very useful technique because it goes until the source of the problem but has an important disadvantage. We lose the consequences of our actions and decisions and we lose the whole picture of the problem because of the loss of connection. Systems thinking helps us see the same time the analytical issues and their effects to the whole problem. In contradiction to the mental models that are limited and can not be easily handled in the mind of the user/manager, the systems thinking offer patterns and ways of introducing the change and the risk factors without losing the scope of the problem. Systems thinking is a framework for seeing patterns and interrelationships. It's especially important to see the world as a whole as it grows more and more complex. Systems thinking makes these realities more manageable; it's the antidote for feelings of helplessness.

2. Personal mastery. The discipline of personal mastery includes a series of practices and principles. Three important elements are personal vision and creative tension.

Personal vision. By this term we mean the objectives most of the people have for their organizations. For example they would like a specific performance and a specific amount of revenues and profits for the next year. This is an objective for the person but it may be not the real vision.

Creative tension. There are unavoidable gaps between one's vision and current reality. A company for example may want to speed up a project to gain the lost time, but the lack of additional capital is an obstacle. The gap that is created between the real and the personal vision creates a creative tension. The two solutions that can be offered in this case are that either the real or the personal vision pulls the reality towards their part. That releases the tension. But these are the dynamics of compromise and mediocrity. Truly creative people use the gap between what they want and what is to generate energy for change. They remain true to their vision.

3. Mental models. These are the models that we use and we keep in our minds. Some people have the ability to handle more information than others do. A very fundamental model is the one with the supply and demand. We all know that when the supply increases the demand decreases because of excess and when the demand decreases then the supply increases. This is how the world works. Simple or more complicated models can be handled in one's mind. But when more parameters or changes are taking effect, then the human mind can not process all the parameters. Many managers and consultants apply their mental models in their businesses that come from their expertise

and their practice. This involves the disadvantage, especially nowadays that innovation is rapid, for them not to track right every detail and their model and consultation to fail to give the right solutions. Also mental models can not be easily tested under all circumstances for the reason that they are not clear.

4. Shared vision. No organization becomes great without goals, values, and missions that become shared throughout the organization. A "vision statement" or the leader's charisma is not enough. A genuine vision breeds excellence and learning because people in the organization want to pursue these goals. Shared visions create a commonality that gives a sense of purpose and coherence to all the activities the organization carries out. Few forces in life and the business world are as powerful as shared vision. Shared vision is very important for organizations that want to adapt learning methods. People learn best when they strive to accomplish things that matter to them.

5. Team learning. This includes the learning that exists within a team of people by cooperation. People have the opportunity to work and communicate, to see the mistakes but also the methods that each of them follows. Then they adapt or reject these methods as useful to them or not. Team learning is an important asset for the organization. People can also learn how to cooperate with the other members of the team and can increase the productivity and the performance as a team and not only as individuals.

These five characteristics describe the essential for an organization that is lessons learned concerned. In this thesis we will analyze the systems thinking and an application that is called system dynamics.

13.6.1 Systems thinking

Introduction {<http://learning.mit.edu/res/kr/systhink.html> }

System Dynamics is the method used effectively for complex systems. Here, we will see the use of system dynamics in the project organization as a method of getting feedback from some specific elements of the system and then recalculating all the consequences to the other elements and to the final goals of the project.

A simple example of feedback is when the project is behind schedule. Then the project manager assigns more human resources to the project or suggests the personnel to work overtime. Then the production is getting increased, the tasks are finishing quicker and the project gets again into schedule. The feedback here comes from the measurement that the project is behind schedule and the project manager acts until new measurement shows him/her that the normal condition is turned back.

The systems thinking and the dynamic modeling provide the means of understanding the structure of the projects, designing robust projects and learning across projects.

Projects are composed from many parameters that are correlated together and influence each other. Project managers using their experience can make decisions about actions that can take (inputs) such as working week, number of personnel, schedule pressure, etc. and expect the outputs such as changes in the delivery time, changes in the quality level and changes in the cost of the project. Project managers use mental models that come out from their experience or from others experience as policies. They know that if they face a delay in a phase of a project, then they have to put additional resources or increase the overtime of the employees in the next phases to catch up. Mental models

are effective as long as they are limited in complexity and can be handled by the human brain. In cases that are becoming more complex and dynamic, there are some tools that can track this complex dynamic behavior. One tool that we present in this thesis is the system dynamics. System dynamics is the tool that can capture the dynamic behavior of the project by first defining the factors that influence the project, then tracking their behavior, making correlation among them and at the end applying a sensitivity analysis so that the user can understand the dynamics of this environment. An example that shows the advantage of system dynamics compared to the mental models is the following. Managers in the previous case usually add resources in the project. In some types of projects this doesn't mean necessarily that the project will speed up. New hires need training to be productive and this means that the mature employees should devote some of their productive time to train them. As result the project may even slow down in the beginning. System dynamics can capture this behavior of the project as well as other kinds of behavior in parallel and produce outputs that are closer into the reality.

System dynamics is an analysis for the project manager to understand the dynamics of the project and its sensitivity in the potential changes. Using this tool the projects are more effectively designed and implemented. Also this analysis offers the cross project learning not only for similar but also for different kind of projects. The system dynamics is a way of thinking focused no understanding the behavior of the variables and the project over time using the feedback of the actions.

The Concept

As a project manager, when you hire more employees to speed up the project have you ever experienced the project to move with the same development rate or even slower for some time and then it comes to the expected higher rate? Is this against the policy that the more resources the project manager has, the faster the project finishes? This mental model that most of the project managers work with can only explain what will happen in the long term after an action when the turnover that this action cause will stabilize. But what is happening in between and for how long needs further analysis that a more detailed method such as the system dynamics can capture. The new staff needs to get training to become experienced, until the new staff becomes experienced the quality of the work follows as well as the productivity of the existing stuff because they commit an amount of their time to train the new hires and to correct their mistakes. As a result the work completion rate remains the same or even drops for some time after the new personnel is hired.

Figure III-2 explains better the above situation.

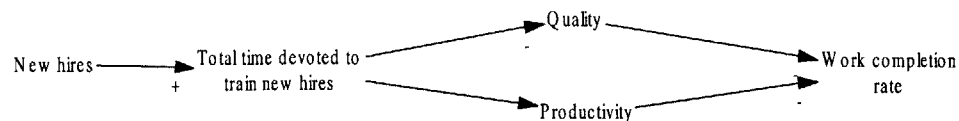


Figure III-2. The policy resistance

As the number of the new hire increase, the total time that the already experienced personnel devote to train the new hires increases. As a result of this the quality and the productivity falls that concludes the work completion rate to fall.

This primary analysis offers more accurate results to the project manager and makes him/her aware of how the dynamics of the project work. After that the project manager will compose new policies that will have a dynamic behavior and offer results closer to the reality.

In the next session we will see the feedback function in the system dynamics models.

13.6.2 Feedback

The entire environment that surrounds us works with feedback. Every project consists of tasks or otherwise “work to do”. Let us assume now that our company has a pool of trained employees suitable to execute these tasks and that the tasks do not have any time constraints. The more someone work for the tasks, the faster these tasks will finish. Let us introduce now the terms “estimated completion”, “behind schedule”, “add resources”. The “estimated completion” is measured in days and represents the number of days that the project needs to be finished, or the remaining days for the completion of the project. The “behind schedule” represents how many days the project is behind schedule compared to the original planned delivery time. This works as a measurement criterion for the project manager to act. The “add resources”, for this example corresponds to the skilled employees that the project manager can add in order to bring the project back in schedule or reduce the “estimated completion”. The following Figure III-3 shows graphically the correlation between these three variables.

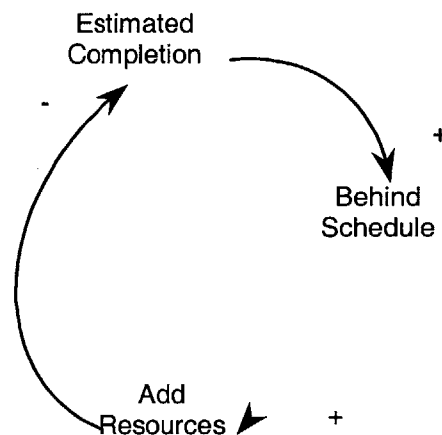


Figure III-3 Corrective actions for a project behind schedule.

When the project manager phases the problem that the project is behind schedule, then he/she adds more resources from the skilled employee pool. In this stage we assume that the company has a number of skilled employees available. This action results for the estimated completion variable to decrease and as a result the variable “behind schedule” will decrease. This is a feedback loop because we see that the action of the project manager to add resources results to the initial variable that was the measurement criterion for the project manager decision. When then the project gets back in schedule, the project manager cuts down the additional resources. This feedback loop adjusts the project to achieve a goal that is to eliminate the “behind schedule” variable.

This is a simple loop that can also be captured by a mental model and is based on the initial assumptions that we made. We have to note down the minuses and the pluses that the arrows carry. We use the plus when the change of the cause results to an analogous change on the result. For example the more we are behind schedule, we add more resources, or the less we are behind schedule, the less resources we add. We use the minus for the opposite reason; when the change causes the opposite change in the result, for example if the more resources we add, the less estimated completion we have. We have two different types of loops. The reinforcing and the balancing. Reinforcing loop is when by changing one variable and then passing the change through all the loop, the returning feedback to the same variable has an analogous change. Balancing is exactly the opposite. The change creates an opposite change after the feedback. In our previous example, the **more** estimated completion we have, the more behind schedule we are, the more additional resources we need, the **less** estimated completion we have. This is a balancing feedback loop.

Let us now be more realistic and correct the initial assumption that the additional employees are coming from the skilled pool that the company maintains. Let us assume that they are new hires not trained to the job or not compatible with the company's culture. In this case the project will have problems of dilution in quality aspects. That means that more work that produced will not meet the standards of the quality and as a result should be repeated. So instead of the new hires finishing the work, they will degrade the quality and add to the "remaining work" variable. Sequentially the "remaining work" variable will increase the "estimated completion" and the first loop will require more "add(itional) resources". Figure III-4 shows the two above described loops:

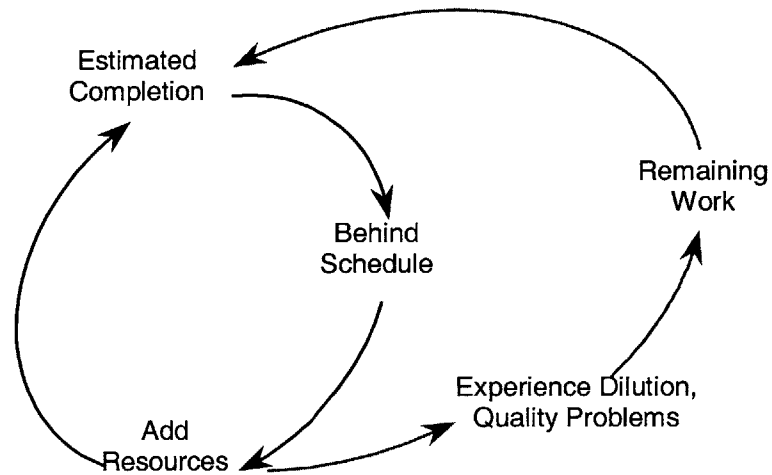


Figure III-4. The effect of the new hires on the project scheduling.

13.6.3 Definitions of the System Dynamics symbols.

In this session we will analyze and explain the functionality of the symbols used in the system dynamics method.

The arrows, straight or curved, represent the cause and result relationship of the variables. They have polarity. Plus is used when an increase/decrease in the cause results to an increase/decrease in the result variable respectively. Minus is used when an increase/decrease in the cause results to a decrease/increase in the result variable respectively.

Below we give some examples of the symbols that are used in the models. Let us take an example in the construction industry that deals with the project delivery time and the number of mistakes that have to be reworked and corrected. The more time pressure for the project delivery, the more mistakes are happening because of pressure and because people are trying to cut corners. Mistakes have to be corrected and this leads to added work and even more time pressure for the project delivery. (Figure III-5)

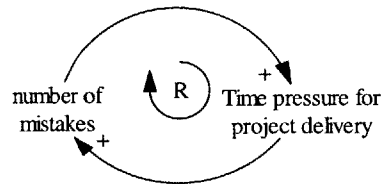


Figure III-5. The time pressure loop

The arrows here show the cause and the effect of the variables. Notice that they have polarity. Also notice that we started from **more** “time pressure for project delivery” and we end up to **more** “number of mistakes” after running a loop. This kind of loop is named *reinforcing* loop and is symbolized with capital “R”. Reinforcing loops tend to increase or decrease the parameters exponentially. (Figure III-6 tracks the behavior of the reinforcing loops)

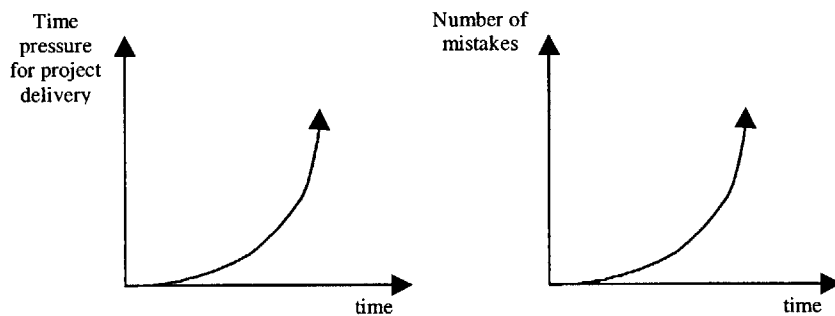


Figure III-6. The behavior of reinforcing loops.

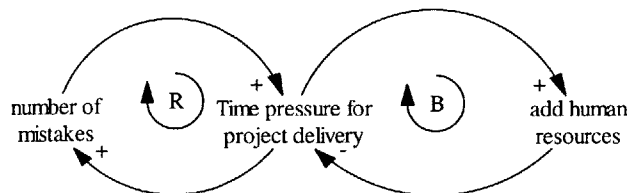


Figure III-7. Adding human resources.

Now let us add to this environment additional human resources that will help on the execution of the tasks. The **more** people we add the less time pressure we will have as they will release the existing force from the heavy load and of course the less time pressure will lead to **less** people to add. (Figure III-7 shows the new status of the environment).

Notice that we started with **more** and ended up with **less**. This kind of loop is named *balancing or controlling* and is symbolized with capital "B". Balancing loops tend to increase or decrease the parameters towards a goal. (Figure III-8 tracks the behavior of a balancing loop)

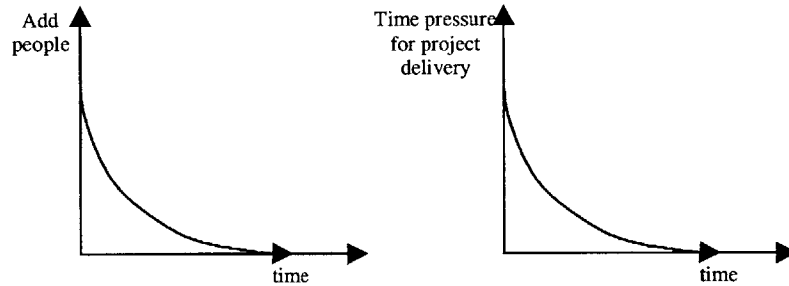


Figure III-8. The behavior of balancing loops over time.

13.7 THE PROJECT MANAGEMENT MODEL

Now let us work on a more complicated setting in the construction industry. Before we proceed with the model we need to introduce the stocks and the flows. The "stocks" or "levels" -- define the state of the system. They are the accumulation of a variable through the time. The "tasks to do" is a level. It has an initial value that starts to decrease with the progress of the work. "Tasks done correctly" is another stock. Imagine each of the stocks as a pool of tasks that have exactly the same characteristics as of the nature of the work, the effort required, the completion time and the delivery method. The personnel that are assigned to execute these tasks move these tasks from the tasks to do pool to the tasks done correctly. The rate with which the tasks are moving is a flow and it is named "completion rate". The "completion rate" shows the quantity of work subtracted from the "work to do" over time. Flows or "rates" -- define the rate of change in the system state. Figure III-9 Shows the two levels and the flow.

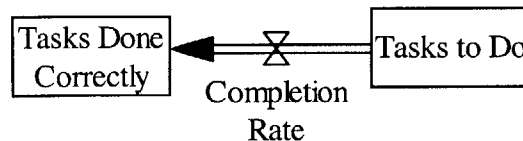


Figure III-9. Levels and flow.

The stocks have an initial value. In this model when the project starts, the “tasks to do” initial value is equal to the number of the tasks that apart the project. However the initial value of the “tasks done correctly” stock is zero.

Assuming that the tasks that are executed have good quality and they do not need any rework, we can easily find the time to empty the level “tasks to do” and complete the project. The “expected time required” is the new auxiliary that defines the time required for the project to finish and is equal to “tasks to do”/“completion rate” at a specific time. In order for the result of the “expected time required” to be useful for the project manager, it has to be compared to the “time available” at the same time. The “time available” is a subtraction of the “calendar time” from the “deadline” of the project.

Comparing the “time available” to the “Expected time required” we can see how much ahead or behind in schedule we are. If we are ahead of schedule, then we do not need to act. However, if we are behind schedule then we need to put “schedule pressure”. This means that the “completion rate” should be increased and the task execution should be faster. Figure III-10 shows the calculation of the “expected time required”.

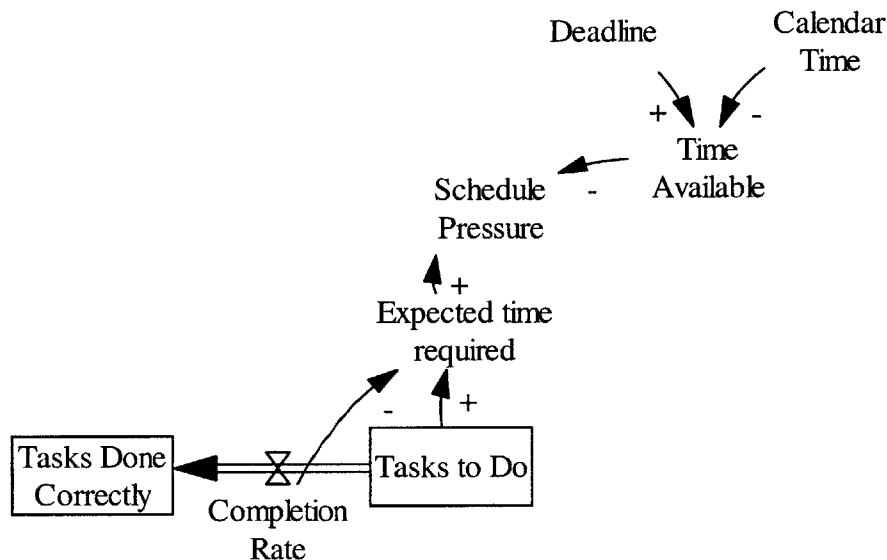


Figure III-10.Schedule pressure

The “schedule pressure” can be applied in various ways. The most common is for the project manager to put the employees work overtime. This is translated to the increase of the “workweek” that is measured as hours /week. The increase of the “workweek” will result to an increase of the “effort” that is measured in person*hours/week and as a result an increase in the completion rate. This is represented by the balancing loop that we named “extra effort loop” and is shown in figureVI-11.

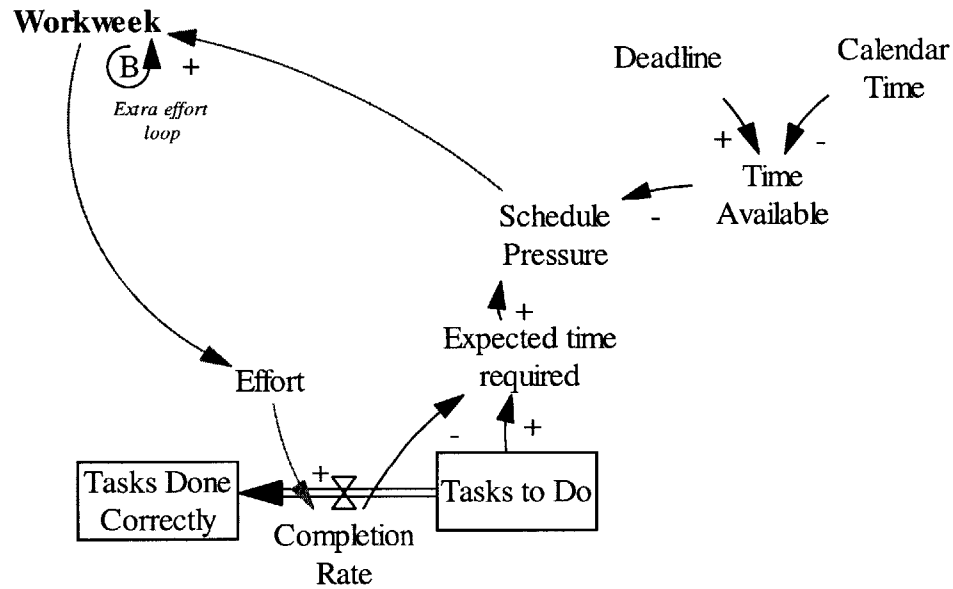


Figure III-11. The extra effort balancing loop.

The “extra effort loop” helps correcting the “schedule pressure” and works towards the declination of the “expected time required”. However, if the increase in the “workweek” will keep for a long time, then it comes into effect the Brook’s law. When you add resources in a project that is late, then the project goes even more late. Many project managers experience this phenomenon that is due to the “fatigue” of the employees that comes after an extensive time of overtime working. “Fatigue” leads to reduced “productivity” of the employees and reduced “quality” of the completed tasks. This created a reinforcing loop that extends the initial problem of the project to be late. We have named this loop “midnight oil loop”.

Now we have to define the “quality” of the work. Work that is not executed correctly is returning back to the “tasks to do” stock in order to be reworked. Operationally this is achieved by including the auxiliary “quality”. “Quality” is an auxiliary variable and defines the percentage of the flow that is passing from the work to do stock to the tasks completed correctly stock. The completion rate flow now is multiplied by the quality factor. The higher the quality the more the completion rate flow. The same happens with the “productivity” of the employees. The “completion rate” is straight forward affected by the “productivity” that is measured in tasks/week.

Figure III-12 Shows the “midnight oil loop” where the more “workweek” increases the “fatigue” of the employees and this affects negatively the “productivity” and the “quality” that consequentially reduce the “completion rate”.

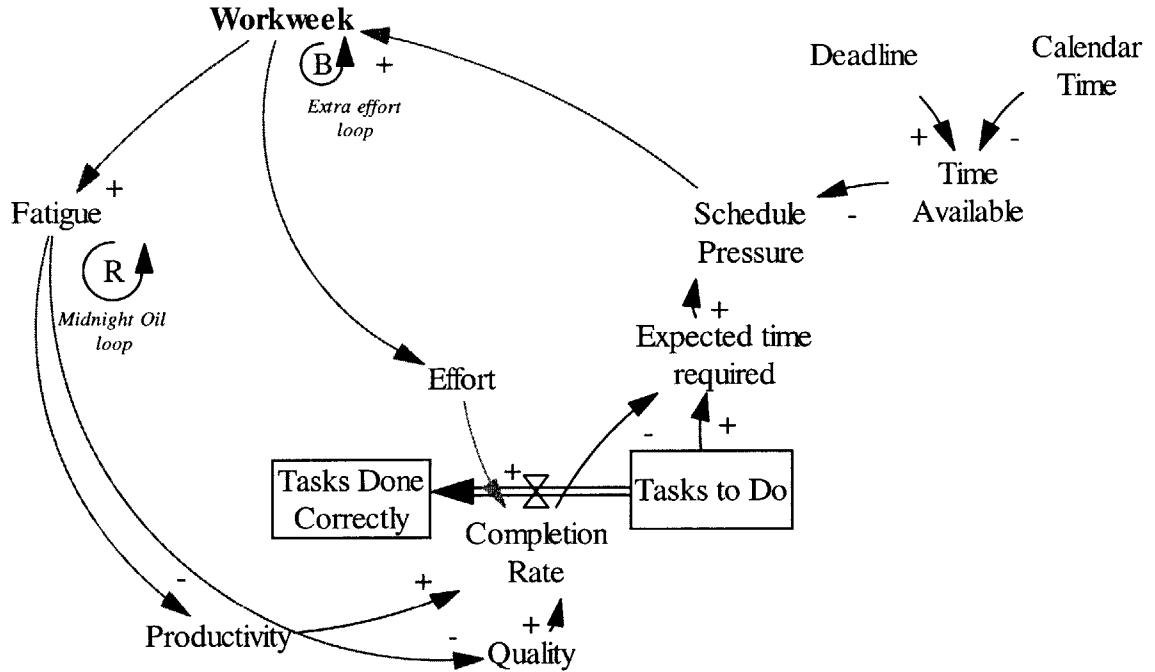


Figure III-12. The midnight Oil reinforcing loop.

Even further when the “workweek” will keep for a longer time, then employees will start quitting their jobs. We will call this in our model “attrition”. Since it is noticed that the people that leave the company influence the others in their working “effort”, we have an additional reinforcing loop that we name “attrition loop”. Figure III-13 shows the “attrition loop” in our model.

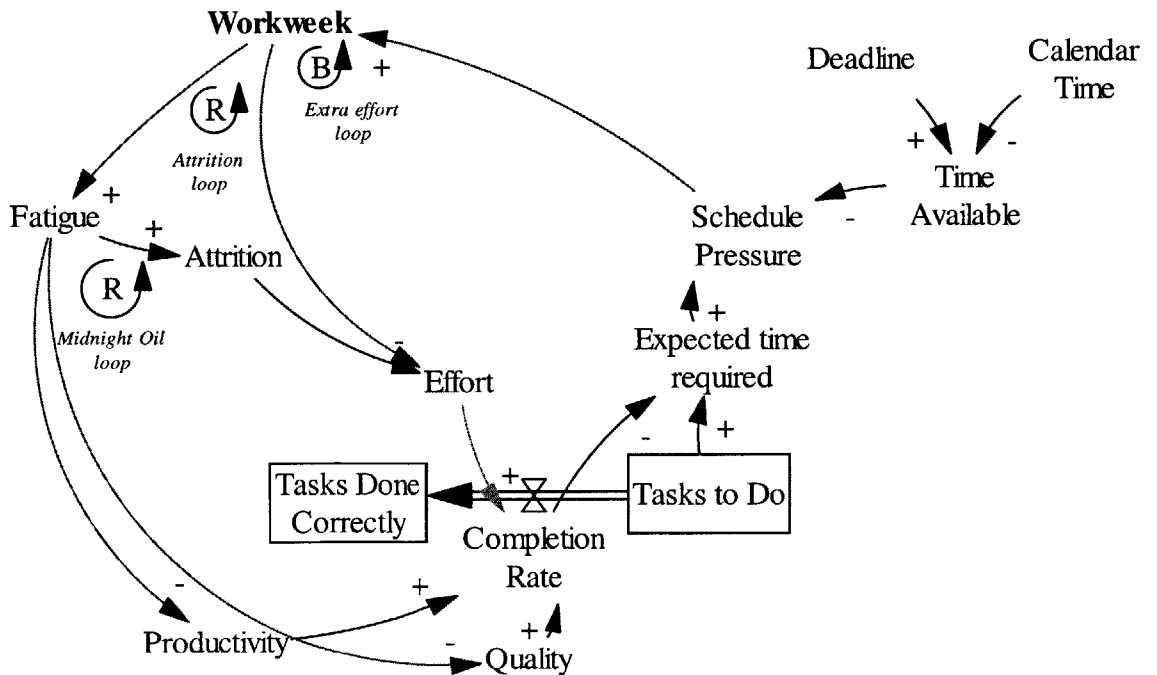


Figure III-13. The attrition reinforcing loop

Another way to bring back the project into schedule and reduce the “schedule pressure” is to start “hiring” employees. This is a more long term policy, has a higher cost because of the recruiting and the training expenses and the results are not obvious from the beginning. When the project manager starts “hiring” employees, the number of “inexperienced” employees is increased. With a lag, because it has to intermediate the training period, the number of the “experienced” employees is increasing as the “inexperienced” ones are getting trained. This leads to increase of the “effort” since the “experienced” employees produce more tasks/ week. The above loop we call “new hires loop” and is shown on Figure III-14.

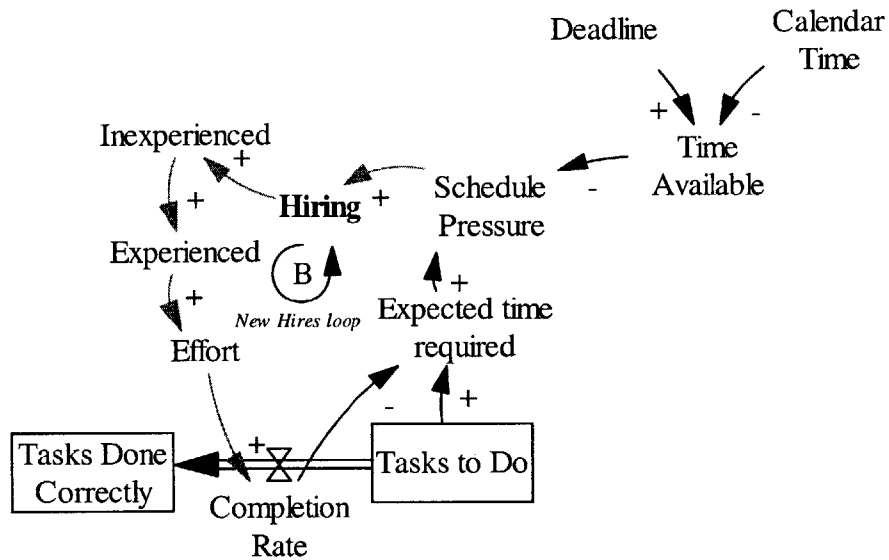


Figure III-14. The new hires balancing loop.

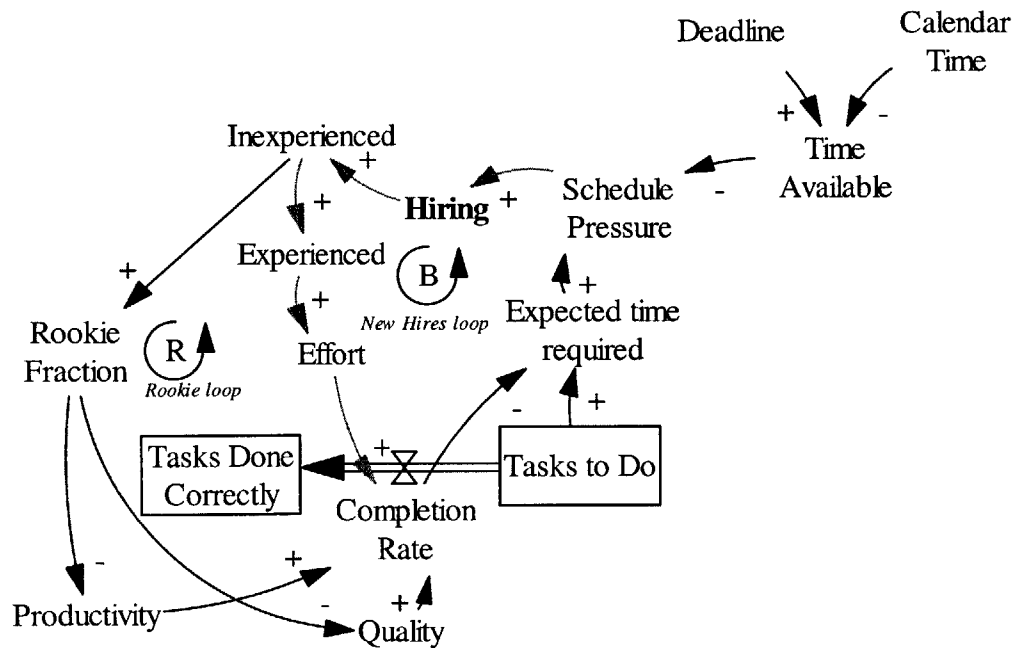


Figure III-15. The rookies reinforcing loop.

However, we have to take into account that when the number of “inexperienced” employees increases, the “rookie fraction” in the company increases proportionally. That results to lower “productivity” and “quality” work because the “experienced” employees have to devote some of their time to train the “inexperienced” ones and correct their mistakes instead of being fully devoted to their tasks. This creates a reinforcing loop that we have called “rookie loop” and is shown on Figure III-15.

Another way of lighten the “schedule pressure” is to improve the process of doing the tasks. This can be done by the increase of the learning curve, by discovering new working methods, reengineering of the company and the value chain, or integrating the suppliers to the project. We call this “process improvement” and it has positively results on the “productivity” and the “quality”. This balancing loop we call “process improvement loop” and it is shown on figure The characteristic of this loop is that it has a lot of delays until it will get into effect. Process improvements take time to show results.

Another way of reducing the “schedule pressure” may be by applying “scope erosion”. This means that we can omit tasks or reduce their completion time for the shake of saving time. Since the level “tasks remaining” is getting unloaded, the “expected time requested” is getting reduced. The scope erosion may lead the company to loose its market share and /or its reputation. We have named this balancing loop “scope erosion loop” and it is shown in Figure III-16.

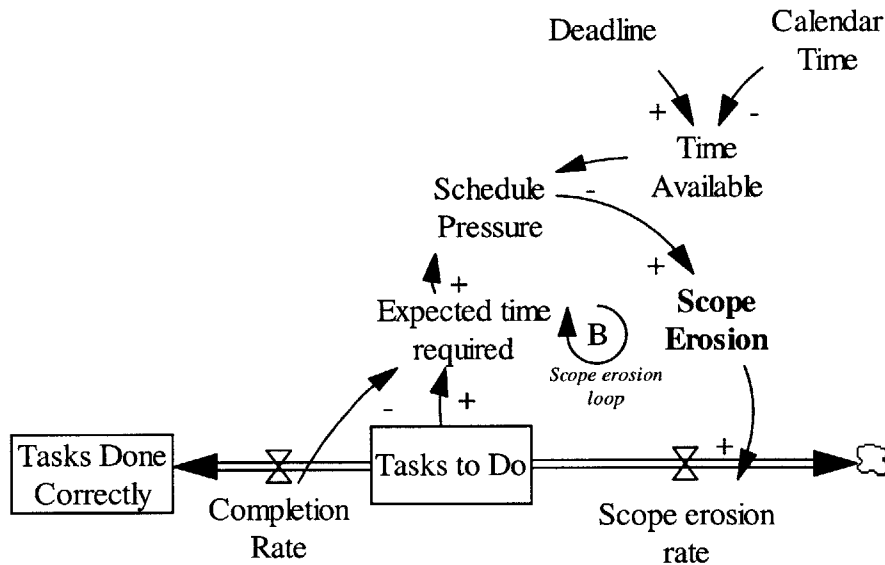


Figure III-16. The balancing scope erosion loop.

with an additional two over eight, (0.25) speed and the project manager will happily recalculate the time needed for completion with the new completion rate and predict that the project will be delivered on time. However, some projects are getting back again into delays even though the labors are working two extra hours every day and the project manager doesn't know how to react. The effect of "fatigue" is "turned on" and the productivity has dropped down. The "fatigue" came into the system with some delay. Delays should be very well identified and tracked in terms of behavior because they can affect the state of the system unexpectedly. In this case the delay started an additional reinforcing loop.

Moving further, the project manager will adapt other solutions if the schedule pressure is big or the labors can not work more overtime. In this case hiring new labor will try to stabilize the system. This is a more long term decision and involves a delay until the new hires start being productive and their existence increase the completion rate. In fact it has been noticed from the reality that in the beginning the project slows down for two reasons. The new hires make mistakes that after they need to be corrected and they spend valuable time of the expertise labor in order to be trained. In this case the delay may create other type of undesirable results. The project manager after seeing that the project does not speed up to the desirable rate, may keep hiring more labor. That may lead to over capacity of human resources after the time that the training will be completed and experienced people will start going to full production.

Even further, in the long term the schedule pressure can be released by improving the process. That may be achieved by applying new technical or process methods, or installing new equipment in the project value chain or in the task execution process. This method involves more delay than the previous and the results are in the long term.

The last described remedy on the schedule delay is the scope erosion loop. Scope erosion can be achieved by omitting tasks, by using alternative material that may serve the project needs not completely, or by "cutting corners" (lowering the quality). This kind of solution is more related to the customer relationships and the reputation of the contracting company.

From the above analysis the project manager can establish a policy related confront to the schedule delay of the project. If the delay is not serious, then the project manager can bring the project back to schedule by applying labor overtime. If the delay needs extensive overtime to be eliminated, then the project manager may think about hiring new personnel and additionally put the labor force to work overtime. In the case that delay phenomenon is repeated or monitored to other projects, then the process improvement will be more effective and beneficial even though it takes more time to show results.

13.9 CONCLUSION

Having started from the need of learning in the projects in order to improve the performance, the cost, the time to the market and the impact on the natural and the social political factors, we presented the different methods that may contribute to this learning. After we saw the levels of learning as well as the types of learning in the organizations. In the learning skills and disciplines we focused on the systems thinking and we presented one of the methods, the system dynamics that we believe it works very good in analyzing the environment and defining the various cause effects relationships. At the

end we saw how after this project environmental analysis we concluded to policy creating.

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