



GLOBAL PROJECT MANAGEMENT
- DEVELOPING SYSTEM SOLUTIONS IN A MULTI-ORGANIZATIONAL
ENVIRONMENT

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September 2002

Submitted in partial fulfillment of the requirements for the
degree of Licentiate of Engineering

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Ex.R. 02-06
TRITA-ICS-0204
ISSN 1104-3504
ISRN KTH/ICS/R—02/04--SE

Stockholm 2002, Universitetservice US AB

Abstract

The traditional view of project management is being challenged by the globalization of markets, mergers of international companies, and the integration of managerial and business processes in global corporations. The development of Information Technology and the rapid growth of the Internet has created an opportunity to utilize global resources, resulting in new and unique problems within project management research that need to be addressed.

This thesis focuses on problems in project management experienced by global system suppliers trying to adapt their businesses to the rapid changes of customers needs. It especially focuses on geographically dispersed organizations consisting of several organizations in different countries, with disparate history and corporate culture, developing and delivering complex systems under the company's name.

In order to identify potential problems faced by global multi-organizational companies, especially system suppliers with large research and development (R&D) budgets, a framework is suggested. This framework divides the problems into three categories: geographical, organizational and cultural. The problems identified in the case studies are then classified to these categories. Finally, a description of how the identified problems can be managed is provided when the most important success factors identified in the studies are presented.

Key words: Project management, Globally distributed teams, Industrial projects, Global development projects

Acknowledgements

Before presenting the thesis, I would like to thank the people who have made it possible and gave me inspiration on this journey called research.

First of all I would like to thank Professor Torsten Cegrell, my supervisor, for enabling this research. Torsten has done a superb job in creating an inspiring research and education tradition at the Industrial Information and Control System in KTH. Furthermore, Mrs. Judy Westerlund, the department's most indispensable asset, who inexhaustibly manages everything from plumbing to proofreading, and all the things in between that keep this department running.

I am indebted to all present and former colleagues at the department for creating an atmosphere that is fun and rewarding. In particular, I would like to thank Mikael Eriksson, for inspiring cooperation; regardless if it is research, teaching or just hanging out, I have great fun working with you. Mrs. Narcisa Jonsson for stimulating research cooperation. I would also like to forward special thanks to Dr. Jonas Andersson for valuable discussions complete this thesis and for all of your advice along the way, and Dr. Pontus Jonsson for valuable comments.

Dearest thanks to my friends and my family that make my life, for your support and encouragement. Last but not least I would like to express my gratitude to my beloved Magdalena for tremendous work in proofreading this thesis, and her support and patience for all those evenings that turned into nights.

Stockholm, September 2002

Joakim Lilliesköld

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Chapter 1

Introduction

1.1 RESEARCH BACKGROUND

The environments in which projects are executed are constantly changing, implying that businesses today have to abandon many of the principles that have guided generations of managers. Instead, new sets of rules and objectives have to be developed to enable the successful management of change, and guide companies to transform into 21st century corporations. In this transformation, the prerequisite for industrial project management is changing, and some of the key drivers of this change are: trends in procurement strategies, development of technology and products, and trends in organizational structure.

Looking at the *traditional industrial company*, it was more or less geographically concentrated, with tangible assets. Companies, such as ASEA, LM Ericsson, Astra, were in most cases hierarchical organizations organized into functional units with stable interfaces to its customers, partners, suppliers, and competitors. In these organizations, most interactions occurred within business units, amongst people who had similar perspectives and goals. The main goal of the traditional company was to produce products of high quality and low cost through mass-production, based on the ideas from pioneers such as F. W. Taylor and H. Ford in the early 1900s. Since then, mass production has been the dominant paradigm in industry.

However, increased competition is forcing management to rethink how business should be conducted. Manufacturing managers agree that achieving low cost, coupled with high quality, is no longer enough to guarantee success, but merely reflect “qualifying criteria” rather than “winning criteria” [Selen 2000]. Besides focusing on capacity and size, companies are rationalizing product portfolios. In this specialization process, companies are focusing corporate investments to fewer activities, and improving the knowledge vital to their core business while outsourcing others.

Procurement strategies of industrial clients¹. The increased focus on core-business has led to a situation where many traditional clients in basic industry, such as pulp and paper, do not have the in-house capacity to integrate components from different suppliers to create an effective system. Their core business is rather to understand their customers' needs and to produce products of a certain quality. Since investments in improved quality or new production capacity normally are capital intense, clients are re-thinking how to best utilize their organizational resources. In order to reduce capital cost, clients put pressure on the system suppliers to increase efficiency and accomplish projects within decreasing time frames, meaning that the time from planning and placing an order to system delivery and installation is decreasing. Hence, there is a trend towards procuring more comprehensive system solutions, including engineering services.

Another driver for the increased interest of procuring system solutions is the new type of client organizations that has appeared during the last decades. These clients are made up of nationally or globally distributed organizations, formed to adapt to the end-customers' changing needs. In many cases, they are not interested in technical details; rather, they are interested in functions, such as the production cost of power and how much a specific market is willing to pay. These companies require extensive commitment and responsibility from the chosen system supplier. Thus, the focus of the transaction between the traditional actors is shifting from *components* to *systems* and *services*, which implies major changes for all the involved actors, especially the suppliers.

Technology and products. Traditional component or system suppliers are also showing an increased interest in taking on larger system responsibilities in the development and delivery of complex system solutions. In the past, industrial suppliers sold their products with a good profit, and the additional software as well as the installation projects was included with the products "for free". But, many of these suppliers are facing lower margins caused by a higher degree of COTS²-products in their product portfolio. In most cases, the production of these products is outsourced, resulting in that company profit is more or less directly related to additional services such as supplementary software and well managed installation projects.

The recent development of information technology has enabled system suppliers to offer complete system solutions, which consequently increases systems' complexities. Information technology is by many traditional suppliers seen as the glue connecting the different products into a system. Further, it has also provided the possibility to integrate different computer based systems that have been used in different areas within the company; for instance, control systems can be integrated with administrative business systems [Cegrell 1997].

¹ I.e. companies depending on complex systems from suppliers for their business

² COTS – Commercial Off The Shelf

Furthermore, the development of information technology has also provided the opportunity to utilize resources all around the world. The recent development of the Internet has especially had a profound impact, creating possibilities to global business operations.

Organizational Structure of industrial system suppliers. Companies that develop complex products and systems need to make them flexible enough to be sold on a global market. In order to create these globally applicable systems and products, the use of global teams is appropriate as a means to provide knowledge about the different requirements on the different markets [Wheatley & Wilemon 1999]. Consequently, there is a trend in many industrial areas to globalize research and development (R&D) as well as competence portfolios.

Globalization is also motivated by the high cost associated with the development of new industrial products, creating a need for a large global market for the product in order to cover costs [Levene & Purkayastha 1999]. There is a strong belief that large-scale operations at distributed locations create an advantage and that as complexity increases a larger piece of the market is needed in order to cover the costs of administration, development, production, logistics, service organization, and sales.

There has been a widespread surge in *mergers and acquisitions* in all industries in an effort to take part of the global market; especially suppliers with large R&D budgets such as: energy, telecommunications, semiconductors, steel, pulp and paper, drugs, and biotechnology firms, [Serapio & Dalton 1999]. ABB's purchase of Elsag Bailey and the merging of Valmet-Rauma to Metso, Ericsson-Hewlett Packard Telecommunications (EHPT), and ABB-Ahlstrom are some examples. The trend of mergers and acquisitions seems to be a part of a global strategy for companies [Hopkins 1999] trying to become strong global market players. But, as the pace of *outsourcing* and of *mergers and acquisitions* increases, the map of suppliers, partners, customers and competitors is changing rapidly. These changes, as well as the demands and the needs of the end-customers, are shifting so quickly that some people stress that we are heading for a new paradigm of flexible/agile production. An agile company is one that has the ability to rapidly alter any aspect of the manufacturing enterprise in response to changing market demands.

The *global industrial company* differs from the traditional company in several ways. Global companies have mobile employees and mostly intangible assets compared to those of the traditional company. Looking at the process of restructuring a traditional, sometimes also multinational company into a global and agile organization, many companies end up in a situation where they need to reorganize frequently in order to adapt to a changing market and break down organizational boundaries. Consequently, these global companies, especially those involved in the development of complex systems, perform in a constantly changing business environment of global customers, partners and competitors [Bergman 2001].

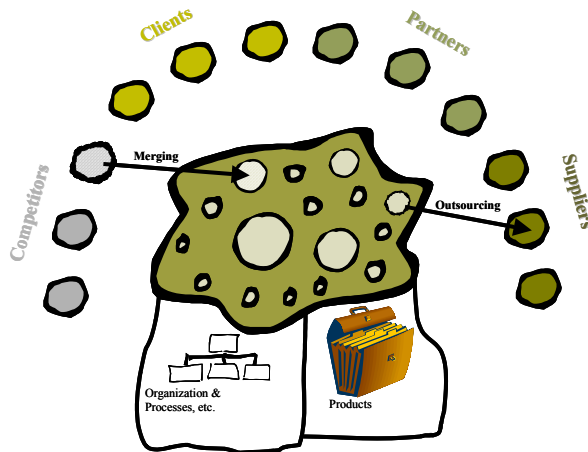


Figure 1 - The changing environment of a system supplier

Thus, the company ends up in a situation where one part of the company can be outsourced to a supplier virtually overnight; and one who is a competitor one day, can the following day be a part of the company. Once merged, the company will consist of several organizations, each with a history of its own, often originating from different countries with well-established internal management processes, and having a business culture of their own. However, knowing that it takes years to implement effective changes [Hartman 2001], the newly merged company will consist of several more or less independent organizations within the new organization which need to perform at their best under the company's name in order to stay competitive.

From a project management perspective, this multi-organizational environment brings with it additional issues that need to be managed. Since a majority of these companies' business opportunities are organized as projects, the role of project management is evolving and increasing in importance. Typically, many companies have increased their share of projects versus other activities from 1/3 to 3/1 during the last decade. Furthermore, the rapid pace of change in the organizational structure outside the project brings about uncertainty amongst the project members that needs to be addressed as well.

Further, information technology has had a profound impact on communication, creating new opportunities to manage projects globally, as well as store and share information. Developing complex system solutions in these multi-organizational environments, prerequisite new approaches in project management since projects need to be integrated not only across different geographical regions, but also unified amongst different business processes, management styles, operational support systems, and organization cultures, adding extra dimensions to traditional project management.

1.2 RESEARCH RATIONALE

There are two reasons for this licentiate thesis to be written: to create a basis for further evaluation and analysis of potential problems in global projects, and to increase the knowledge of how geographically dispersed projects can be managed. While there exist some knowledge about how project teams work at a single location, theoretical knowledge about how geographically dispersed project teams function and are managed are currently at an early stage and remain fragmented in a number of academic and professional disciplines [Evaristo & Scudder 2000]. Further, much has been written about factors for success in projects, but there is limited literature available on factors for global project success [Levene & Purkayastha 1999].

1.3 RESEARCH QUESTION

The purpose of this thesis is to summarize the experiences from several studied procurement and development projects in global environment and elaborate on the impact they cause on project management. In order to reach the goal of this research, a number of research questions have been formulated accordingly:

- What is the present state-of-the-practice regarding global project management in multi-organizational system development projects?
- What key problem areas can be identified in industrial system development projects due to globalization?
- How can the identified problems be managed?

1.4 DELIMITATION AND MAIN ASSUMPTION

The thesis has a project perspective, meaning that technical problems and challenges outside project management are left out of this work.

The primary unit of analysis in this thesis is complex system development project. Typically, the type of project referred to, is consisting of several projects (often called programs, see Chapter 4.2) with the goal to develop a system solution or a new product platform. These projects contains several engineering disciplines such as software, hardware, power engineering etc. Further, the budget of these projects is more than 100 million SEK, and the development is spread all over the world in different organizations of the company.

As mentioned above, the type of system addressed in this thesis is a complex technical system such as the control and automation system of the electricity grid. A description of what is meant by the term *complex* can be found in Chapter 4.1.

The types of companies or corporations studied in this thesis are developing complex system solutions to customers worldwide. Typically, these companies are present on the

global market, such as ABB and Ericsson, with technical research and development organizations (R&D) all over the world. Their R&D organizations consist mainly of highly skilled engineers who are experts in their field. Further, many of these R&D organizations have a different history and have been part of the company between one day and 100 years.

1.5 MAIN RESEARCH CONTRIBUTION

The outcome of this research effort has been a framework that can be used when identifying problems, and some recognized success factors in the management of global projects. The results have been obtained through case studies, further described in Chapter 3. This thesis contributes to the general project management body of knowledge mainly in three ways:

State-of-the-practice description of global project management in multi-organizational system development projects. In Chapter 4, a description of the characteristics of global industrial projects is provided. Further, in Chapter 4.6, a framework is suggested to describe the state of practice. In Paper II, the described case study shows an example of how a global development project is organized and managed.

A description of key problem areas that occur in global industrial development projects. This study shows some of the problems that require extra attention when managing a global project. To identify these problems, a framework is suggested. Specific problems and challenges can be found in Chapter 5: Identified problems occurring in global development projects; Chapter 7, Summary of result, Paper II; and Paper III.

Managing the identified problems. Success factors in the management of globally distributed projects are presented in the Chapter 7: Summary of result; as well as in Paper II and Paper III.

1.6 RELATED WORK

Since the scope of this thesis is rather wide, the related work may be found in several adjacent domains such as *Project Management*, *Information Systems*, *Organizational theory*, *Systems Engineering*, and *Software Engineering*.

As pointed out in Chapter 1.1, this licentiate thesis deals with global projects with the goal to develop complex system solutions to customers worldwide. Thus, the primary reference discipline for this licentiate thesis is **project management**, which is presented in Chapter 3. Project management research is an area, which is still at an early stage. Nevertheless, research differs depending on which perspective the analysis is made from; it can be from the organizational perspective, team perspective or individual perspective. Further, the research can focus on single project or multi project. Thus, project management research is naturally diversified depending on which angle the research is conducted from.

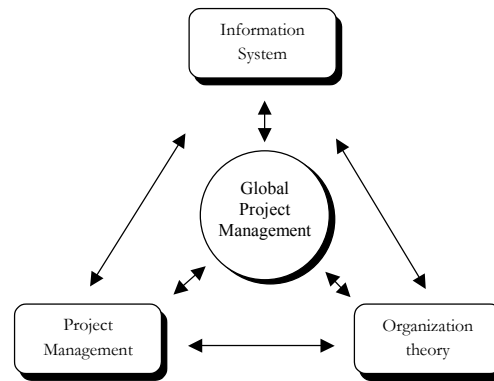


Figure 2 – Related work

Information system as a discipline descends from the study of (primarily administrative) computing as an instrument to solve organizational problems. Over time, it has evolved into a broad research field attempting to put IT in its context, thus, it addresses a wide array of non-technical factors such as management, organization, economy, legal aspects and human factors [Andersson 2002].

Related works regarding this topic are: Olson [2000], whose primary focus is on project management methods and tools suitable for information systems; Walsham [1993], who directs his research towards issues surrounding computer systems, particularly interpretations concerning the development, use, and value of information systems in organizations; and Galliers [1992], who argues for the shifting of focus in information system research from technological issues to the integration of value adding processes of the business, and getting value for money from information technology.

Organization theory is a multi-dimensional research area with a number of schools and directions that attempt to explain, predict, and influence the behavior of organizations and the people working in them [Holt 1999]. *The classical school* of organization theory is based on Taylor’s “Scientific Management” from 1913, with the focus on efficient production based on the assumption that there is one “best” way, and that human resources, by economical motivation can be programmed and utilized the same way as physical resources. Over the years, many different schools have developed within the organization theory. An overview of this research discipline can be found in [Holt 1999] and [Koontz 1982]. Other important contributors to the different schools are: [Heyel 1939], [Burns & Stalker 1961], [Lawrence & Lorsch 1967], [Seiler 1967], [Basil & Cook 1974], and Mintzberg [1978]. Under the subject of complex product development and organization theory, Adler [1999] has written some interesting work as well.

Other related research areas, such as: **Systems Engineering** and **Software Engineering**, join together a number of traditional engineering disciplines in order to design, implement,

maintain, and further refine the complex (computer based) system's focus on similar problems. This is a part of the scope of this thesis, but the focus in these disciplines is handled separately. A comprehensive introduction to systems engineering in the context of project management is given in Eisner [1997]. Further, software engineering in the context of project management can be found in Pressman [1997], and Paulish [2002].

1.7 OUTLINE

This thesis is composed of two parts. The first part is an introduction and summary providing the background, underlying theory and the summary of the thesis. This part is divided into nine chapters. The second part is the enclosed published papers.

Chapter 2, *Research Methodology*, describes the work that led to the writing of this thesis. The case study methodology is introduced, and the three projects studied are described briefly. Finally the research quality is addressed.

Chapter 3, *Industrial Project Management*, describes the underlying theory addressing project management in an industrial context. The chapter starts off with the definition of the term project, then describes the project management body of knowledge and ends with the evolution of modern project management.

Chapter 4, *Industrial Projects*, describes the delimitation of the project addressed in this thesis.

Chapter 5, *Identified problems occurring in global development project*, is divided into the three areas, geographical, organizational and cultural, which is presented in Chapter 4.6 and Paper II.

Chapter 6, *Summary of Included Papers*, presents the included articles

Chapter 7, *Summary of Result* and further work.

Chapter 2

Research Methodology

Research in the field of project management is cross-disciplinary, and closely related to practice [Söderlund 2000]. The project management methodology contains several different disciplines that in most cases are research areas of their own. Therefore, diversity is an inevitably feature of project research. It is argued by Söderlund [2000] that there is a need for requisite balance and reciprocal relation between themes, theories, and techniques.

2.1 RESEARCH METHODS

Research methods can be classified in various ways. However, one of the most common distinctions is between: *qualitative* and *quantitative* methods [Myers 1997]. When research methods are discussed it is important to realize the difference between the concepts quantitative and qualitative. Quantification is: the assignment of measures to studied phenomena, e.g. assigning a body, its mass into m kilograms, or the number of days to a deadline. Qualitative reasoning is instead, focused on the multitude of characteristics of a phenomenon that cannot be measured. An example of a qualitative study is then: the effect on quality of life of mobile communication.

Quantitative research methods were originally developed in the natural sciences to study natural phenomena. In time, quantitative methods have become well accepted in the social sciences, including survey methods, laboratory experiments, formal methods (e.g. economics) and numerical methods such as mathematical modeling [Cheong 1999].

Qualitative research methods were on the other hand, developed in the social science to enable researchers to study social and cultural phenomena. These methods are for instance case study research, action research, and ethnography. Qualitative data sources include observations and participation observation, interviews and questionnaires, documents and texts, and the researchers' impressions and reactions [Cheong 1999].

The purpose of this research effort, the lack of theories in the area, and the absence of empirical arguments all impose a qualitative method for studying global projects. The second argument supporting the choice of a qualitative study was perhaps the most convincing, since well developed theoretical foundations were lacking both of the main theoretical areas, international business research, and project management literature [Lagerström 2001]. According to Lagerström [2001], the theories within the area of international business, and specifically the organization and management of multi national corporations, are developing continuously as a result of the rather extensive amount of research that is being performed. Lagerström [2001] comes to the conclusion that the theories within the area can therefore still not be characterized as mature.

This research effort is based mainly on the qualitative case study method, which is suitable since the purpose of the study is to increase the knowledge of multinational projects of complex system oriented products. Yin [1994] is even more explicit when it comes to the choice of suitable research design. He stresses that a case study is appropriate when explorative questions such as “why” and “how” are asked, and when a modern phenomenon is in focus, which is the case in this thesis.

2.1.1 CASE STUDIES

Although there are numerous definitions, Yin [1994] defines the scope of a case study as follows:

“A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”

Thus, a case study is an investigation of specific real-life phenomena, such as individuals, organizational or managerial processes, programs, and organizational change. Clearly, the case study research method is very well suited to global project management research, since the object of the discipline is concerning organizational and human issues rather than technical issues.

This research effort has been strongly influenced by suggestions from Yin [1994]. Yin advocates the use of a case study protocol to document the research process. It is important that the protocol is written at the start of the project, taken into account, and then updated continuously. During the course of data collection, multiple sources of evidence are used. This means that several sources: e.g. documentation, interviews, observations, is used to get a clear picture of the studied phenomenon. *Triangulation* is usually used to verify that the data actually is valid. Triangulation is the process of corroborating where all pieces of information point to the same fact. Data analysis can start as soon as the relevant parts of data collection are finished [Yin 1994].

The main criticism of case study methodology is that early case study research efforts have lacked rigor [Yin 1994] and that it has sometimes not gained creditability since the research procedures were not made explicit. Therefore, the readers of the study could not judge the

soundness of the effort. In response to the critique, Yin has suggested a framework for case study research [Yin 1994]. Another weakness with the case study approach is often related to the fact that the case study is often restricted to a single event or organization, and that it is difficult to acquire similar data from a statistically meaningful number of similar organizations in order to make generalizations [Haglund 2002]. To reduce the impact of these weaknesses, Yin [1994] suggests the use of multiple case studies.

The data collection in the case study research is based on interviews, surveys, and gathering of both official and unofficial project documentation. Interviews and surveys with open-ended questions are a common way of gathering data. The method is characterized by qualitative data collection where the researchers asks questions directly, or indirectly via a survey or questionnaire, to a respondent. The design of the survey or questionnaire to use is very important. The design must be done with care in order to ensure that the correct operational measures for the studied object are covered by the question [Johansson et al. 1997].

When interviews are performed as research, it is important to include questions that clarify the respondent's personal views in the matter, in order to correctly interpret the replies. Further, it is important that the respondent feel comfortable with answering questions on his/her involvement in the studied events in order to get honest and unbiased replies to the questions [Johansson et al. 1997].

The analysis should be free from subjective reasoning and bias. Further, it is possible to perform quantitative analysis of data collected through interviews and surveys. As an example of this, the number of respondents' reference to a specific event in the studied project can be counted. Irrespectively of whether a qualitative or quantitative analysis is done on the collected data, the data can then be compared to the operational measures.

2.2 RESEARCH APPROACH

One of the criticisms of case study research is, as mentioned above, that the procedures have not been explicit enough. In this section, the author attempt to address the critique by thoroughly explaining how the research was conducted.

The work with this thesis has been divided into three parts. The first part was a study of procurement trends in traditional industry in 1998. The second part was a study of the distribution of responsibility and collaborations within industrial systems projects in 1998-2001. The third part, focused on global project management when a systems supplier is facing the changes identified in the previous projects, and develops a new product portfolio. This case study was conducted in 1999-2000. All the case studies have been divided into three major phases: project initiation, data gathering, and analysis and presentation.

Field Study I: New Procurement Trends. The first study was investigating trends affecting the procurement strategy of clients having a need for investment in a complex produc-

tion or support systems. Within the field study, two case studies have been conducted in close co-operation with clients, suppliers, contractors, and consultants within the pulp and paper industry. Furthermore, the collected data has been extended with a series of interviews with executives to further explore the future roles and responsibilities of the different actors active in the industry.

The field study began with a comprehensive data gathering consisting of three components. First, we undertook a literature search of the experiences from international and Swedish procurement projects carried out during the last years. Then, two case studies were made to identify the typical problems when procuring a complex system. The two case studies were made within two different clients organizations in the same line of business, but each had chosen different procurement strategies.

In the first case study the client has tried to minimize the risks for its own organization and carry through a functional procurement. The two main suppliers had to share the responsibility, project management, and systems engineering in a consortium. The consortium also was responsible for the detailed design.

In the second case study, the client chose to keep the risk and the responsibility within its own organization. In this case, the client handled the project management, systems engineering, and the detailed design. Therefore, the client did not have any need use functional procurement since they mostly made small procurements of components and sub-system that they put together themselves.

The last step in the data gathering was a series of interviews made with key personnel of the different actors in the industry, such as consultants, entrepreneurs, clients, and suppliers. Within the client organization, interviews were mainly carried out with the chief buyers in different lines of business. The interviews focused on the typical problems within procurement projects, and how they believed that procurement project of the future should be managed.

Field study I contributed to the state of the practice description of procurement trends in the traditional industry of Sweden. Further, the study was used as a foundation for Field Study II and III.

Field Study II: Distribution of responsibility and collaborations within industrial system projects. Based on the case studies in the first field study, a second study was started to further investigate the client supplier relation in complex system procurement projects. This field study was executed in the same manner as the first one; following three steps with a comprehensive literature review, case studies and finally supplementing interviews. The field study consisted of two major case studies within the same client organization. The case studies were interesting since the client chose two totally different approaches when procuring the system. The reason for the different approaches was that the client did not have the resources to procure the way they had traditionally done, and therefore searched for new approaches when procuring. In this field study, in depth interviews

with key personnel in other client organizations were made to offer supplementary details to the case studies.

Field study II contributed to the state of the practice description of who could be responsible for project management and systems engineering in complex industrial projects. Field Study I and II contributed to increase the prerequisite state of the practice regarding industrial projects and was used as a profound to Field Study III.

Field Study III: Project Management in a Global Multi-Organizational Environment. The final field study was one case study of a system supplier, trying to adapt to the changes identified in the first two field studies. Field Study III differed from the other two, which are considered rare occurrences; since the clients usually carried out a similar project every 30-40 years. Field study III was the third development project, out of a series of three that the system supplier carried out with a similar scope. The case was interesting, since the supplier failed to meet the scope, cost, or time constraints in the first two projects, while the last project met its scope, was delivered on time, and was considered by the supplier to be a success. Finally, one of the researchers had also been actively involved in the two failed projects, and still had access to all project relevant data. The most interesting question is what in particular attributed to the success of the third project.

Field Study III contributed with a state of the practice description of problems and success factors in global industrial projects, the result was used to generalize a framework that can be used to identify problems in a global environment.

2.3 RESEARCH QUALITY

As with all activities, the quality of the work is important. This quality is often measured in form of quality of the produced results. Measuring quality of research can however not be done merely by studying the results of the research, the quality of the research process itself is of even greater importance. Research quality is often judged depending on its validity and reliability [Helander 2000]. *Validity* is defined as the absence of systematic errors in research – i.e. does the research really study what it intendeds to? *Reliability* is defined as the absence of random errors – i.e. the research should not depend on who conducts the study [Lundahl & Skärsvad 1999].

Issues of **reliability** deal with the possibility to reproduce the results. The objective of high reliability is consequently: to ensure that any other investigator, using the same set of collected data, comes to the same conclusions. Achieving high reliability is done through careful documentation of collected data and performed analysis. When performing case studies, Yin [1994] suggests the use of a *Case Study Protocol* to ensure structured and complete documentation of the case. A further method to achieve good documentation of case studies is the creation of a repository of collected data: raw data as well as analyzed and refined results of performed surveys, interviews and experiments stored in a uniform way.

To increase reliability, all the interviews and case studies followed a protocol developed for each individual project or case study. Furthermore, great effort was made to search for relevant sources of data. As mentioned in the previous section, before the case studies began, a comprehensive literature review was made resulting in the case study protocols and the later theory chapter of the written reports, as well as this thesis.

The interview protocols served as a basis for the interviews, and later as a tool when analyzing the research material. Throughout the projects, the basic questions of the protocol were the same, complemented with some specific questions depending on the role of the interviewee. The interviews were always carried out by at least two persons, one who led the interview and one that were taking notes. The interviews were then summarized and transferred to a clean copy.

Validity deals with the issue of systematic errors and avoiding bias and subjective reasoning. This is of course of the highest importance when the research has qualitative content such as for case studies. To reduce any systematic error, the following aspects were considered:

- Interviewees in the case studies were chosen to be the key actors in the project.
- Interviewees in the complementary interviews were managers of the engineering department; project managers, sponsors, or other key stakeholder of future projects.
- The summarized, clean copy of the interview discussions was sent to the interviewee for validation. Any changes were included in the final document that was used throughout the analysis and final documentation of the study.
- In the field studies, triangulation has been attained by using multiple sources of evidence in all the case studies, including, documents and focused interviews, combined with open-ended interviews.

Chapter 3

Industrial Project Management³

The goal of this chapter is to provide a general background of industrial project management for those readers who are not familiar with the Project Management Body Of Knowledge. Thus, the De Facto standard PMBOK⁴ is very influential in the text below.

The word *project* has become a buzzword used widely in various situations. The goal of this chapter is to gain a general overview of terminology used within industrial projects⁵ by comparing and analyzing some different definition and sources.

The elements defining a project as presented in this thesis are an extract and interpretation of the written material presented in generally available literature, various manuals, regulations, and guidelines used in everyday practice by project-oriented companies and organizations. The literature itself consists not only of textbooks, but also of material derived from project management journals, various technical journals dealing with management of technology, and proceedings of international conferences.

The different views of project management, expressed in project management literature and in many corporations' manuals are beginning to receive more and more criticism [Lagerström 2001]. The reason for this criticism is that in general, the project management literature of today suffers from the unrealistic expectation that a project can be viewed as a distinct, manageable system that, once designed according to the appropriate scheduling techniques, can be isolated from the environment and applied to any organization regardless of the task at hand or of its uniqueness [Blomquist and Packendorff 1998].

³ Based on Lilliesköld, J., & Jonsson, N., *Literature survey of Industrial Project Management*, ExR 0205, KTH, 2002

⁴ PMBOK is a registered trademark of the Project Management Institute, PMI

⁵ The term industrial project is used in order to describe such undertakings as the development of an automobile, mobile telephone systems, the construction of power plants, etc [Söderlund 2001].

The focus of the literature is still heavily biased towards technical aspects and tools for project management and planning. Partington [1996] for instance, reveals in a review of the recent content of the project management journals⁶, that nearly half of the articles are still unrelated to the context of their particular industries and/or project types.

3.1 AN OVERVIEW OF THE “FIELD” OF INDUSTRIAL PROJECT MANAGEMENT

The “practical field” of industrial project management today is diverse and multifaceted, and its development is witnessed in the expansion of the professional association [Söderlund 2000]. Within this field, there are two leading organizations that are actively working on improvement of the project management profession. These organizations are the *International Project Management Association* IPMA with 20,000 members mainly in Europe (December 2001), and *Project Management Institute* PMI with 86,000 members worldwide, mainly in the USA and Canada (January 2002). Both organizations arrange conferences, seminars, and regularly publish journals in order to keep their members updated. PMI has a certification program that enables an individual project manager to obtain PMP (Project Management Professional) status. IPMA has announced that they will launch a certification program of their own, but it has not been introduced yet (January 2002). There are of course other important “local” organizations: for instance, the *Association for Project Management* APM in United Kingdom and the Australian Institute of Project Management and many others working on improving the project management profession from their perspective.

In December 2001, PMI opened the *Center for Project Management Knowledge and Wisdom* where all PMI’s publications, books, conference proceedings etc. are being collected for the time being. In time, the centre is intended to be a global electronic information center, with all references about project management collected in one place. Throughout the years, PMI has actively been working to increase the professionalism of the project manager by standardizing the definitions and knowledge in the *Project Management Body Of Knowledge* PMBOK. The PMBOK is approved by ANSI as an American National Standard (ANSI/PMI 99-001-2000). Further, the PMBOK is considered to be a de facto world standard for project management, which provides a base of definitions in the field of project management. A free copy of the PMBOK is available to download from the PMI homepage at www.pmi.org.

3.2 WHAT IS A PROJECT?

There is a tendency within the business world to call all activities “a project”. The reason for this can be found by analyzing the etymologic of the word project. The word derives from the Latin word *Projicere projectum*, “something thrown forward” [Encarta 2001, SAO

⁶ International Journal of Project Management (IJPM) and Project Management Journal (PJM)

2001]. Thus, almost all activities comply with the meaning of the word. In order to describe what a project is, this research effort will investigate some different definitions in order to narrow the description for the purpose of this thesis.

One important definition is PMI's, who states, "a project is a temporary endeavor undertaken to create a unique product or service" [PMBOK 2000].

By *temporary*, PMI means that every project has a definite beginning and a definite end. The project ends when the project's objectives have been achieved, or when it is clear that the project's objectives will not or cannot be met, or the need for the project no longer exists and the project is terminated. Temporary does not mean that the project has to be short in duration; many project last for several years. In any case, the duration of a project is finite; projects are not ongoing activities. Further, temporary does not apply to the product or service created by the project. In other words, the product created can be permanent.

By *unique*, PMI means that the product and service is different in some distinguishing way from all other products or services, i.e. it is something that has never been done before. No construction or R&D projects are precisely alike. For example, many thousands of malls have been developed, but each individual facility is unique to some degree since there is - different owner, different design, different location, different foundation, different contractor, and so on. Of course some projects are more routine than others; some degree of customization is a characteristic of projects [Meredith & Mantel 1995], but the presence of repetitive elements does not change the fundamental uniqueness of the project work.

Since a project is temporary and unique, PMI suggests that the work is carried out in *progressive elaboration*. *Progressive* means: proceeding in steps, while *elaboration* implies to be worked out more thoroughly and in detail throughout each step. It is important for the project's success that the progressive elaboration of the product characteristics is carefully coordinated with the scope definition. The relationship between the project scope and the product scope is left out of this thesis.

Researchers and writers share this view with PMI, for instance Olson [2001], Frames [1987], Schwalbe [2002], Pinto [1998], Söderlund [2001], Meredith & Mantel [1995], also define projects as unique to some degree. Further, Lagerström, defines one important attribute of a project as having a defined structural base. In this case, the idea that projects are thought by some researchers to follow a life-cycle pattern represented by four main phases (the classical waterfall methodology): initiation, followed by planning, execution/implementation, and termination [Lagerström 2001, Meredith & Mantel 1995]. Every stage in the waterfall model has different degree of uncertainty, which is another attribute of projects.

Another definition of project, similar to PMBOK's, can be found in PROPS, which is the methodology developed and used by the global telecommunication supplier Ericsson. It

states, “A project is a non-recurrent, time limited and budget undertaking, for which a goal has been set. The project is performed by a temporary organization tailored to its needs”.

Using the definitions mentioned above and other definitions, it is possible to isolate some important characteristics of underlying projects. Some of the characteristics are already mentioned above, but since most writers on projects point to four common characteristics of projects instead of defining a project with words. The characteristics are that a project has a: *clearly defined objective or assignment, finite duration, specified budget, comprised set of complex and interrelated activities*.

The first characteristic is that each project is directed towards the attainment of a clearly defined objective or set of objectives which, when achieved, mark the end of the project and the dissolution of this project team [Pinto 1998, Lagerström 2001]. In some literature, this characteristic is written as “the project is goal oriented or has a specific goal” [Frames 1987], which is separated from the organization in order to fulfill the goal.

The second characteristic is part of the PMI definition mentioned above, which states that a project has a *finite duration*, with a defined beginning and end date [PMBOK 2000, Frames 1987, Lagerström 2001, Pinto 1998]. This is the most obvious difference between a project and a permanent organization.

The third characteristic is that a project has a specified budget [Pinto 1998, Enwall 1995, Lagerström 2001], which implies that the resources needed for the assignment are dedicated at the outset of the project.

The fourth characteristic is that a project comprises a set of complex and interrelated/interdependent activities [Lagerström 2001, Pinto 1998]. Projects are built on exceptionally strong lateral working relationships that require closely related activities to be undertaken and decisions to be made by many individuals in different units [Lagerström 2001]. This characteristic is probably more pronounced for transnational projects, than it is for projects in general.

Besides these four common characteristics, another very important aspect of projects is *conflict*. The team members for instance usually play multiple roles, working part or full time on the project, while still having engagements in the permanent organization. Meaning, things are often “business as usual” regardless of the existence of a project or not. So projects need to compete with functional departments for resources and personnel. More seriously, with the growing proliferation of projects, it becomes a project versus project conflict for resources within multiproject organizations. The members of the project team are in almost constant conflict for the project’s resources and for leadership roles in solving project problems [Meredith & Mantel 1995]. Thus, more than most managers, the project manager lives in a world characterized by conflict.

These main characteristics used for distinguishing the project organizational form from other organizational forms have been criticized by some researchers for being developed

with a normative purpose as much of the literature has been within this area [Packendorff 1995, Lagerström 2001 (who refers to Engwall, Lundin and Söderholm 1998, Tjäder 1998)]. Some researchers emphasize that by using these four characteristics to define a project, it is difficult to distinguish between what is a project and what isn't. But, even though almost anything can be called a project, the fundamental similarities between all sorts of projects, be they long or short, product- or service oriented, parts of all-encompassing programs or stand-alone, are far more pervasive than the differences [Meredith & Mantel 1995].

A project can be undertaken at any level of the organization. It may involve one person or many thousand ones spread all over the world. For many organizations, projects are means to respond to those requests that cannot be addressed within the organization's normal operational limits. A project's duration can be everything in the range from a couple of days to several years. Further, a project can involve a single unit of one organization or may cross organizational boundaries, as in joint ventures and partnering [PMBOK 2000]. Extensive projects are often divided into more manageable components, called subprojects. A subproject is a segment of a project with a clearly defined objective and defined time and cost limits [PROPS 1999]. Further, a subproject can be contracted to an external or to another functional unit within the organization. Thus, it can be anything from a single phase of the project to a project of its own, with a scope of its own and a management of its own.

3.2.1 PROJECT MEASUREMENTS

Traditionally, there are three competing parameters or constraints that the project manager has to balance in order to be successful. The three parameters are time, cost and scope, and they are strongly dependent on each other. In the literature, the parameters are usually called “the core three” or “the triple constraints”.

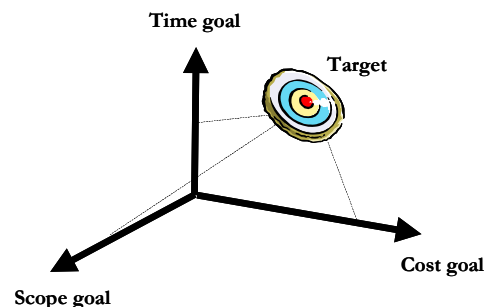


Figure 3 - The core three can be seen as an orthogonal coordinate system⁷

⁷ The idea of this picture is taken from Schwalbe [2002]

The project manager always has to consider how a change of one parameter affects the other two. For instance, if the time goal is changed either the scope or the cost of the project must be changed too. In some literature the scope parameter is called outcome, quality or function [Graham & Cohen 2001] and the form of a triangle is replacing the visual view of an orthogonal coordinate system. Quality in this case means implementation quality in terms of the project scope, where some parts of project delivery can be omitted or simplified due to the time limitation or cost overrun.

These three parameters are also used in order to measure the success of the project [Lagerström 2001, Pinto 1998]. Usually one parameter is more important than the other two, but which one is the most important differs from project to project. Also, the priority of the different parameters can vary throughout the project, for instance one parameter can be important during one phase of the project while another parameter is important during the next phase. Which of the parameter that should be prioritized in a specific project depends on the project's stakeholders. For instance, a project's client can at the beginning of the project demand quality, shift to schedule pressure, as the project gets under way, and then complain about costs as the project nears completion [Hartman 2000].

Nevertheless, numerous case studies and practical experience shows that differences between cost and time can quickly be forgotten if the outcome of the project is positive. However, this statement should not be taken as a rule of thumb. There are cases where cost is a steering parameter. For instance, in product development for open markets, it is not acceptable to have product development costs higher than the return on invested capital.

In the last few years, there has been a reassessment of the traditional model for measuring project success. The model is extended with the new parameter "customer satisfaction" [Pinto 1998, Hartman 2000]. However, this extension is not widely covered in the literature yet. Thus, that aspect will not be discussed more in this text.

3.3 WHAT IS PROJECT MANAGEMENT?

Project management is *"the application of knowledge, skills, tools, and techniques to project activities in order to meet project requirements"* [PMBOK 2000]. Further PMI states that project management is accomplished through the use of processes such as: initiating, planning, executing, controlling and closing.

Another definition can be found in PROPS, stating that: Project management is about the management of an individual project – a non-recurrent, time limited and budgeted undertaking for which a goal has been set. A project is planned, managed and performed by a temporary organization tailored to the specific needs of the project [PROPS 1999].

Organizations differ from one another, and the definition of project management in one organization is not necessarily the same as in another. Following quality management prin-

ciples, a basic tenet is that changes may be needed on occasion according to specific organizational goals and objectives and to meet specific customer requirements [Lubianiker 2000].

In smaller projects, the project management activities may be seen as the process of balancing the triple constraints (time, cost and function). But, as the scope of projects has grown to include almost all kind of activities, the project management body of knowledge has grown as well. Today, there exist several so called bodies of knowledge regarding project management, one of these is the earlier mentioned de facto standard PMBOK, which divides knowledge about project management in two major sections:

- *The project management framework*
- *The project management knowledge areas.*

3.4 THE PROJECT MANAGEMENT FRAMEWORK

The project management framework provides the basic structure for understanding project management, such as definition of terminology, describing the context of a project, and defining different project processes and how they interact. The project management framework defines different fundamental issues that the organizations need to establish before a project can be accomplished successfully. Thus, it is usually the basic parts of a company project model.

3.4.1 THE PROJECT TERMINOLOGY

To be successful in project management the fundamental consideration should be that all the involved members use the same terminology in order to communicate if problems are to be avoided [Wideman 1995]. If the project team does not have a common terminology or vocabulary, they will undoubtedly have difficulties being able to understand and communicate with each other. Familiar terms mean very different things to different people. There are plenty of examples that point out the differences in how people interpret a word. A quick survey showed that when people were given the word apple, the majority pictured a red apple with a twig, whilst some thought of green apples, others of yellow, and a minority visualized a Macintosh computer. Thus, projects need to define and communicate the meaning of the words used.

However, the diverse roots of project management have led to many different "dialects". Consequently, project communication can be foggy at best and down right dangerous at worst if people use the *same* term to express *different* meanings. In practice every project *should* have its own reference dictionary, but unfortunately this is not always the case [Wideman 1995]. But, creating a reference dictionary it is not always that simple, often definitions of words are incomplete. For instance, when looking in the dictionary what the meaning of team is, it defines a team as a group of people working or playing together. But

anyone looking at a swarm of 6-years-old playing hockey, with each child focusing on his or her own performance, knows that this definition is incomplete [Forsberg et al. 2000].

To have a common terminology is becoming more and more important as the trend towards specialists, each with their own language, coupled with the global and temporary aspects of projects, necessitate the definition of a common terminology for each project, even small ones [Forsberg et al. 2000]. Further, Forsberg et al.'s [2000] parallel to a symphony orchestra are made here to stress the importance of a common terminology (musical symbols). Imagine the challenges faced by a newly formed orchestra, composed of highly trained specialists. They come together for a short time engagement, and depend on a common terminology (the music symbols), a project plan (musical score), and leadership (the conductor) [Forsberg et al. 2000].

3.4.2 THE PROJECT LIFE CYCLE

Organization's performing project usually divides the work into several project phases, which are known as the project life cycle. All projects have a life cycle; a beginning followed by a sequence of phases in pursuit of the project opportunity. Unfortunately, the cycle is not always documented or discernible and it may not be understood [Forsberg et al. 2000]. Professional project management organizations usually have a standard or a template project cycle that includes their preferred approach. There are three aspects of the project cycle that can be envisioned as layers: the business layer, the budget level, and the technical level.

According to the PMBOK [2000], the project life cycle generally defines; what technical work should be done in each phase (e.g., is the work of the architect part of the definition phase or the execution phase); and who should be involved in each phase (e.g., implementers who need to be involved with requirements and design)? The descriptions of the project life cycle may be very general or very detailed. Highly detailed descriptions may have numerous forms, charts, and checklists to provide structure and consistency. Such detailed approaches are often called *project management methodologies*.

Although many project life cycles have similar name on the phases and similar deliverables required, few are identical. Most have four or five phases, but some have nine or more [PMBOK 2000]. A project model can consist of many different phases, in general there are some overall phases that are common in every project, these are; project initiation, project planning, projects execution, and project termination or shut down.

A company can have different project cycles depending on what kind of project that should be accomplished. For instance, one organizations software development life cycle may have a single design phase while another's has separate phases for functional and detailed design. In order to support the phases of the project, there are some process groups that overlap and vary within each phase. These phases can be seen in the picture below.

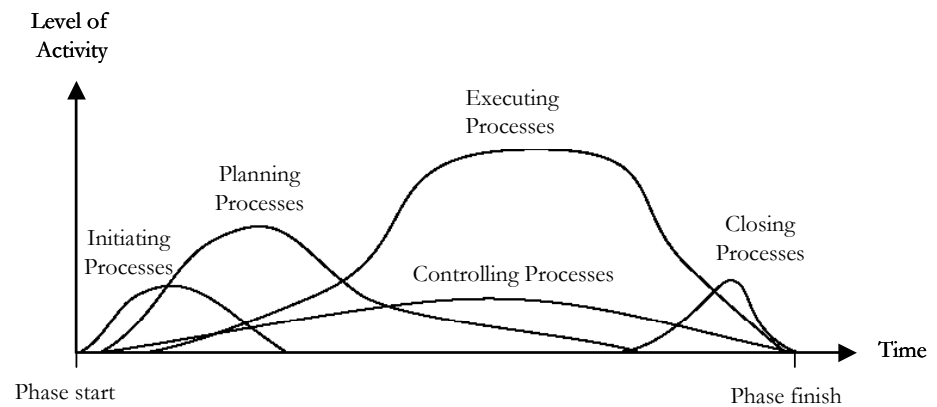


Figure 4 - Overlap of process Groups in a Phase⁸

The five processes are usually linked in many ways, but there is no general way to define this interaction. Instead, every company using project management methodology has to define this in their own project management framework.

3.4.3 PROJECT ORGANIZATION OVERVIEW

The basic purpose for initiating a project is to accomplish goals. The reasons for organizing the task as a project are: to focus the responsibility and authority for the attainment of the goals on an individual or a small group [Meredith & Mantel 1995]. Further, the project organization implies a different and simplified decision making process to obtain co-operation that is adapted to the project task or scope and be more creative compared to the traditional line organization and make possible co-operation beyond organization and department borders. Therefore, a project has three steering functions instead of the line organizations two, since the project management function is added in between, partly to replace the “normal” steering function and the “normal” executing function. Thus, project management provides a shortcut in an otherwise hierarchical organization, resulting in visible management involvement and shorter lead-times between the delivery of a proposal and the decision to accept or reject it [PROPS 1999].

The project form also allows the project manager to be responsible to the client and to the surrounding stakeholders. Gaddis expressed it, as “The project staff will be a “mix” of brainpower, varying with the project’s mission” [Gaddis 1959].

⁸ The idea of this picture is taken from the PMBOK [2000]

The project organization can generally be divided into the following three functions:

The **project steering function** includes functions such as the project sponsor who internally orders the project and is financially and commercially responsible for the project and its outcome. The newest member of the steering function of the project organization is the multi project manager who is responsible for managing the organizations project portfolio. Within the steering function, there is usually also a steering committee or steering group, who consists of managers in the organization who have the authority to take an active part in decisions concerning the steering of the project. They can provide the project with the necessary management support [PROPS 1999].

The **project management function** is responsible for managing the project toward its goal. The project manager has the main role here, and he or she receives the responsibility to plan and execute the project from the project sponsor. Formally, the project manager receives the authority to manage the project for a limited time period. PMI considers planning, organizing, leading, and controlling the four most important functions of the project manager [PMP Exam Preparation 1998].

The **project execution function** is responsible for executing the project in accordance with the plans and definitions made by the project management function. The most important role in the execution function is that of the resource owners who are the managers that provide the project with human resources, equipment etc. The receiver is the manager in the organization, who will take over after the conclusion of the project. Finally, the subproject manager is given the authority from the project manager to execute a subproject [PROPS 1999].

3.4.4 PROJECT STAKEHOLDERS

The project stakeholders include all individuals and organizations who are actively involved in the project, or whose interest may be positively or negatively affected by the project, whether or not it is completed successfully or terminated [PROPS 1999, PMBOK 2000]. Therefore, it is important that the project manager or the project management team identify all the stakeholders, and determine their needs and requirements. In some literature and project models, it is considered important that the project manager clarify the interfaces between different stakeholders and sign “contracts” with them in order to make them committed to the project. Commitment to the task and to teamwork is a very important management issue, but it is part of *the project management knowledge areas* and will be briefly discussed later. The stakeholders presented below are the most common ones and their function is important for a better understanding of this thesis.

The Sponsor is an individual or a group, within or external, to the performing organization that provides the financial resources for the project [PMBOK 2000]. In PROPS [1999], the sponsor is defined as the manager who is commercially and financially responsible for the project and its outcome. The project sponsor is the primary risk taker for the

project and makes the important decisions based on the assessment of the project's alignment with the business direction [PROPS 1999]. Thus, there is little difference in the definitions of the role of the sponsor. PROPS definition is preferable since it involves the business perspective and makes clear who is responsible for the project's contribution to the organization's overall strategy.

The Project Steering Group consists of managers in the organizations who have the authority to take an active part in the decisions concerning the steering of the project, and that can provide the project with necessary support. The purpose of the steering group is to ensure that the organization's support to the project manager in executing the project is coordinated, and that the project has access to people with the authority to provide the project with resources [PROPS 1999].

The Project Manager is the individual responsible for managing the project [PMBOK 2000]. PROPS add that the project manager is responsible for managing the project towards its goal in accordance with an agreement made with the project sponsor [PROPS 1999].

The Customer is the most important external project stakeholder [PROPS 1999]. The customer is either an individual or an organization that will use the project's product. There may be multiple layers of customers. For example, the customer for a new pharmaceutical product may include the doctors who prescribe it, the patients who take it, and the insurers who pay for it. In some application areas, customer and user are synonymous, while in others, customer refers to the entity purchasing the project's result, and users are those who will directly use the project's product [PMBOK 2000]. Customer satisfaction is a term often used in project management literature. In order to satisfy the customer, the project must understand who the customer is and what the customer wants.

The Subproject Manager is given the authority of the project manager to execute a subproject, in which he or she has the role of the project manager. The subproject can vary in size and can have a goal and a budget of its own. The subproject manager is part of the project management team in order to increase the alignment, and prevent sub optimization within the project [PROPS 1999].

The Program Manager is the single point of accountability for overall program management across multiple interdependent projects. He or she must ensure that the program is on time, within budget, and meets client requirements, which requires a high degree of cross-functional integration [Moore 2000].

The Reference Group has another important role: it is an advisory group that can be more or less linked to the different levels of the project. Often, experts who can be internal or external are included in the reference group along with people who have an interest in the project and who are able to come up with useful ideas in order to help the project management team with technical decision [PROPS 1999].

Project Team Member is the group that is performing the work of the project

Of course, in addition to the roles or stakeholders mentioned above, there are various important stakeholders affecting a project such as individuals, organizations, end user, suppliers, other projects, subcontractors, government, media etc. [PMBOK 2000].

3.4.5 ORGANIZATIONAL INFLUENCES

As follows by the definition of a project, the project is most often handled by a temporary organization. Typically, projects are part of an organization larger than the project itself, such as: corporations, professional associations, companies and others. Even when the project itself is the organization like the case is in joint ventures and partnering, the project will still be influenced by the organization or organizations that set it up. Most organizations have developed unique and describable cultures, which according to the PMBOK [2000] are reflected in their shared values, norms, beliefs, and expectations; their policies, norms and procedures; their view of authority relationships; and in numerous other factors. Organizational cultures often have a direct influence on the project.

The structure (whether it is a functional, matrix or projectized organization) and the maturity of the organization (with respect to its project management systems, culture, style, organizational structure and project management office) will affect the project differently [PMBOK 2000]. Therefore it is important that the organization define the key aspects of how the organization is likely to influence the project, and how the project interacts with the organization.

3.4.6 KEY GENERAL MANAGEMENT SKILLS

When performing a project, there are some general management skills that most likely will affect the project; these skills are not covered directly in this thesis or in the PMBOK [2000]. The skills mentioned are for instance leading, which in some literature is considered to differ from managing. Other important skills are negotiating, problem solving and the ability to “get things done”. Besides these and other general skills, the PMBOK and other literature define nine knowledge areas, which can be more unique and need special attention in the project.

3.5 THE PROJECT MANAGEMENT KNOWLEDGE AREAS

Project management knowledge areas describe project management knowledge and practices in terms of their component processes. These processes have been organized into nine knowledge areas [PMBOK 2000, PROPS 1999]. The knowledge areas describe the key competencies that project managers must develop. The descriptions in this thesis only provide an overview of each knowledge area. Nevertheless, each knowledge area can be considered to be a discipline of its own, and much research is made within each knowledge area outside the scope of project management. But, when applied to a project, all processes

should be integrated, and a holistic view of the project work should be maintained. The nine knowledge areas are:

- Four core knowledge areas lead to specific project objectives: scope, time, cost, and quality. Thus, the earlier mentioned core three completed with quality, which in some literature replaces scope as one of the core three.
- Four facilitating knowledge areas are the means through which the project objectives are achieved: human resources, communication, risk, and procurement management.
- One knowledge area: project integration management, affects and is affected by all of the other knowledge areas.

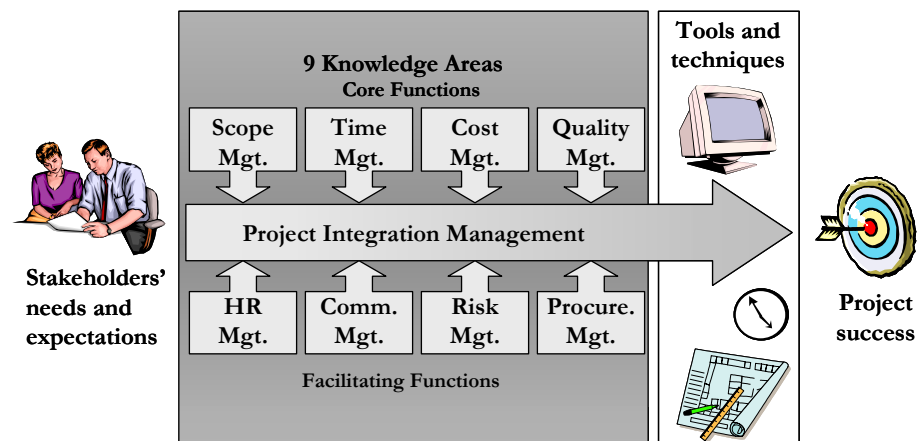


Figure 5 - The nine knowledge areas of project management⁹

The project management processes comprise of all these nine knowledge areas as parallel processes covering the entire life cycle of the project. These nine knowledge areas are defined differently in different literature. In this thesis, the presentation of the knowledge areas is based on the view of the ANSI-standard PMBOK, which is compared to an applied methodology, developed and used by Ericsson, called PROPS. There are plenty of other applied methodologies, such as ProMoTe, PPS etc. However, all of them are more or less related to PROPS, which is regarded by the author as the most established framework for managing projects in Sweden.

⁹ The idea of this picture is taken from Schwalbe [2002]

3.5.1 *PROJECT INTEGRATION MANAGEMENT*

Project Integration Management comprises of the interfaces to the projects internal and external stakeholders. Further, it includes the processes required to ensure that the various elements of the project are properly coordinated. It involves making tradeoffs among competing objectives and alternatives to meet or exceed stakeholders' needs and expectations. All the activities performed and results achieved by subprojects, subcontractors and project teams should be integrated and coordinated to alignment with the projects' strategy and goal. The Project Integration Management consists of the following major processes:

Project Plan Development is the process that integrates and coordinates all project plans to create a consistent, coherent document that can be used to guide both execution and control. This process is usually iterated several times. A famous technique that is used in this process in order to plan the project is Work Breakdown Structure (WBS). The output is the Project Plan, which is considered to be one of the most important documents in project management.

Project Plan Execution is the primary process that carries out the project plan by performing the activities included therein. In this process, the project manager and the project management team must coordinate and direct the different technical and organizational interfaces that exist in the project. Further, periodic forecast of the final cost and schedule results should be made to support the analysis.

Integration Change Control is the process that coordinates changes across the entire project. This process is concerned with a) influencing the factors that create changes to ensure that changes are agreed upon, b) determining that a change has occurred, and c) managing the actual changes when and as they occur. The original defined project scope and the integrated performance baseline must be maintained by continuously managing changes to the baseline, either by rejecting new changes, or by approving changes and incorporating them into a revised project baseline.

These processes interact with each other and with the processes in the other knowledge areas as well.

PROPS [1999] have a slightly different view of this knowledge area. They divide Project Integration Management into seven different steps starting with identifying the stakeholders and experiences from similar assignments. Further, PROPS focuses on the management of the project's interfaces in order to establish and maintain contact with all the necessary stakeholders. The step: integrated project planning is an ongoing process throughout the project up to the last step project: hand over and closure. PROPS also put a lot of effort into the preparations of project documents, such as: project plan. Finally, there is a step concerning the change control, which is part of almost every knowledge area. In this knowledge area the step is integrated change control, which is the process that handles the changes that will occur during the project in accordance with the project plan and specification.

3.5.2 PROJECT SCOPE MANAGEMENT

Project Scope Management comprises of management and control over the requirements of the project and of what should be included in the project. According to PMBOK [2000], Project Scope Management includes the processes required to ensure that the project includes all of the work required, and only the work required to complete the project successfully. It is primarily concerned with defining and controlling what is, and what is not included in the project. In order to do so, the PMBOK [2000] suggests five major project scope processes:

Initiation is according to PMBOK, the process of formally authorizing a new project, or that an existing project, should continue into its next phase. In some organizations, a project is not formally initiated until after the completion of a needs assessment, a feasibility study, a preliminary plan, or some other equivalent form of analysis that is itself separately initiated.

Scope Planning is the process of progressively elaborating and documenting the estimated work and scope of the project in order to create a written scope statement that can be used as a basis for future project decisions.

Scope Definition involves subdividing the major project deliverables into smaller, more manageable components to improve the accuracy of cost, duration, and resource estimates. Further, it should define a baseline for performance measurement and control, and facilitate clear responsibility assignments.

Scope Verification is the process of obtaining formal acceptance of the project scope by the stakeholders. Thus, it requires reviewing of the deliverables and the work results in order to ensure that all are completed correctly and satisfactorily. According to PMBOK, scope verification differs from quality control since it is primarily concerned with *acceptance* of the work result, while quality control is primarily concerned with the *correctness* of the work results. But, both processes are usually performed in parallel to ensure correctness and acceptance.

Scope Change Control is about keeping the results achieved in the project aligned with the project scope, and managing changes in the requirements and the project scope. According to PMBOK, it is concerned with a) influencing the factors that create scope changes to ensure that changes are agreed upon, b) determining that scope change has occurred, and c) managing the actual changes when they occur. Scope change control must be thoroughly integrated with the other control process like schedule control, cost control, quality control and others.

In PROPS [1999], the knowledge area: project scope management process is divided in four different steps; requirements analyzing, formulation of project goal, project scope definition, project scope control. The initiation suggested by the PMBOK is also included in the PROPS methodology, but not in any knowledge area.

3.5.3 *PROJECT QUALITY MANAGEMENT*

Project Quality Management in projects is comprised of management and control of the project performance, and of the quality of the project outcome. In general, the project should be managed according to the quality standards and procedures that are set up by the line organization. The processes suggested by the PMBOK [2000] are compatible with ISO 9000 and other important standards. They include the processes required to ensure that the project will satisfy the needs for which it was undertaken. The knowledge area in the PMBOK [2000] include the following major processes:

Quality Planning involves identifying which quality standards are relevant to the project and determining how to fulfill them.

Quality Assurance is all the planned and systematic activities implemented within the quality system to provide confidence that the project will satisfy the relevant quality standard. A Quality Assurance Department (or similarly titled organization unit) usually provides quality assurance, but it does not have to be.

Quality Control involves monitoring specific project result to determine if they comply with relevant quality standards, and identifying ways to eliminate causes of unsatisfactory results. It should be performed throughout the project and must be thoroughly integrated with the other control processes like for instance schedule control and cost control.

In PROPS [1999] this knowledge area is called Performance Quality Management in Projects. The purpose of it is to ensure that the project's outcome fulfils the specification, and that it is managed in accordance with the organizations policies, standards and directives. PROPS divide this knowledge area into four different steps instead of PMBOK's three steps. The suggested steps are: definition of the requirements and the project scope, definition of the project's quality system, implementation of the project strategy in project plans, and finally, performance quality control. Even though the names vary between the methods, the purpose and the content of the suggested steps are similar.

3.5.4 *PROJECT TIME MANAGEMENT*

Project Time Management or Project Schedule Management as this knowledge area sometimes is called, comprises the management and control of project's lead-time and time schedule. This knowledge area is also divided into several processes in developing the time schedule, and although the processes are presented as discrete elements with well-defined interfaces, in practice they may overlap and interact with each other [PMBOK 2000].

Activity definition involves identifying and documenting all of the specific activities that must be performed in order to produce the deliverables and sub deliverables that were identified in the Work Breakdown Structure (WBS) during the project plan development.

Activity Sequencing involves identifying and documenting interactively logical relationships. Activities must be sequenced accurately in order to support the development of a

realistic schedule. This is one of the processes that are supported by network diagrams such as PERT, which will be discussed briefly later.

Activity Duration Estimation is the process of taking information on project scope and resources and then developing durations for input to schedules. The input ought to originate from the person or the group on the project team who is most familiar with the nature of the specific activity.

Schedule Development implies determining the start and the finish dates of the project activities. If the dates are non-realistic, the project is unlikely to finish as scheduled. The schedule development process is usually iterated along with other processes that provide input prior to the determination of the project schedule.

Schedule Control is similar to the other general control processes suggested in the PMBOK [2000]. Thus, it is concerned with a) influencing the factors that create schedule changes to ensure that changes are agreed upon, b) determining that a schedule has changed, and c) managing the actual changes when they occur. Schedule control must be thoroughly integrated with the other control processes, as described above.

PROPS [1999] call this knowledge area Project Schedule Management, and suggest five different steps: structuring of project work, time estimating, activity sequencing, project time-schedule preparation, time-schedule control. These five steps are almost the same as the ones suggested in the PMBOK, except that the estimation and sequencing steps come in different order.

3.5.5 PROJECT COST MANAGEMENT

Project Cost Management or Project Budget Management comprises of management, and control of the project budget; including costs for the use of resources and other expenditures, as well as the project income. PMBOK [2000] suggest the following major processes:

Resource planning involves determining: which physical resources (people, equipment, materials) and the quantities of each should be used, and which project phases they need to be used during. This process should be closely coordinated with cost estimation.

Cost Estimation involves developing an estimation of the costs of the resources needed to complete project activities. If the project is performed under contract it is important to differentiate between estimation and pricing. Pricing is, according to the PMBOK, a business decision, i.e. how much will the performing organization charge for the product or service that uses cost estimate as one consideration out of many.

Cost Budgeting involves allocating the overall cost estimates to individual activities or work packages in order to establish a cost baseline for measuring project performance. In reality, estimates are done after budgetary approval is provided, but of course the estimates should be done prior to budget request wherever possible. One important aspect of budg-

eting is making sure that the project has a positive cash flow, if not, the project might have to get financing from the organization.

Cost Control is as all the other control processes, concerned with: a) influencing the factors that create changes to the cost baseline to ensure that changes are agreed upon, b) determining that the cost baseline has changed, and c) managing the actual changes when and as they occur.

Project Budget Management as this knowledge area is called in PROPS [1999], is also similar to PMBOK's definition. PROPS also suggest four steps or major processes with a similar name as in PMBOK: project resource planning, cost estimating, preparation of project budget, and project budget control.

3.5.6 HUMAN RESOURCE MANAGEMENT

Human Resource Management is comprised of leadership in projects as well as management, and control of the project organization. This knowledge area includes the processes required to make the most effective use of the people involved with the project, which includes the stakeholders. PMBOK [2000] suggest the following major processes in order to manage this knowledge area:

Organization Planning involves identifying, documenting, and assigning project roles, responsibilities, and reporting relationships. Roles, responsibilities, and reporting relationships may be assigned to individuals or to groups, which can be part of the organization performing the project, or external to it. Internal groups are according to the PMBOK, often associated with a specific function such as engineering, marketing, or accounting.

The majority of this planning is usually done at the beginning of the project, even though the result should be reviewed regularly throughout the project in order to ensure continued applicability. If the initial organization turns out to be ineffective, it needs to be revised. Organizational planning is often tightly linked with communications planning.

Staff Acquisition involves getting the needed human resources (individual or groups) assigned to and working on the project. In most environments, the "best" resources may not be available, and the project management team must ensure that the resources that are available will meet the project requirements.

Team Development includes enhancing the ability of stakeholders to contribute as individuals as well as enhancing the ability of the team to function as a team. Individual development (managerial and technical) is the foundation necessary to develop the team. Meredith and Mantel [1995] emphasize the importance of team building in the following way: "Bringing people together, even when they belong to the same organization and contribute their efforts to the same objectives, does not necessarily mean that they will behave like a team. Organizing the team's work in such a way that team members are mutually dependent and recognize it, will produce a strong impetus for the group to form a team. Project

success will be associated with teamwork, and project failure will surely result if the group does not work as a team”.

The principles and practices of good, general management also apply to the management of projects [Meredith & Mantel 1995]. There is a substantial body of literature about dealing with people in an operational, ongoing context. Most of this material is directly applicable to leading and managing people on projects, and the project manager and project management team should be familiar with it. However they must also be sensitive as to how this knowledge is applied to the projects. Subjects related to administering the human resource function, such as: delegating, motivating, coaching, mentoring, are also included in PMBOK.

The temporary nature of projects means that the personal and organizational relationships will generally be both temporary and new, which implies the importance of team building and conflict resolution. Much has been written about conflict resolution, so there is no need to summarize that literature here beyond noting that the key to conflict resolution rests on the manager's ability to transform a win-lose situation into win-win. “Conflict can be handled in several ways, but one thing seems sure: conflict avoiders do not make successful project managers. On occasion, compromise appears to be helpful, but most often, gently confronting the conflict is the method of choice” [Meredith & Mantel 1995].

PROPS [1999] divide the Human Resource Management knowledge area in four different steps: definition of project organization, establishment of project organization, coaching, and project team phase-out. The difference between PMBOK [2000] and PROPS [1999] is the project team phase-out, which is part of PROPS. The purpose of this step is that the project manager communicates with the team members' resource owners so that the competence development that has been taking place can be benefited. Further, the project manager should make sure that the experience the team members have gained including their efforts and new experiences, are acknowledged by their organization.

3.5.7 PROJECT COMMUNICATIONS MANAGEMENT

Project Communication Management or as it sometimes is called Communication Management in Projects, comprises of management and control of the information flow at all levels of the project. Project communication management includes the processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. It provides the critical link among people, ideas, and project information. Everyone involved in the project must be prepared to send and receive communication, and must understand how the communication in which they are involved as individuals affect the project as whole.

Communication management is a vast science of its own, and it is important to notice that the general management skill of communication is related to, but not the same as, project communications management. Communicating is a broader subject and involves a substan-

tial body of knowledge, which is not unique to the project context; for instance sender-receiver models and barriers to communication. According to PMI, the presence of communication barriers may lead to increased conflict. These barriers are recognized as: lack of clear communication channels, physical or temporal distance between the communicator and receiver, difficulties with technical language, distracting environmental factors (noise), and detrimental attitudes (hostility, disbelief).

As the scope of a project grows larger, it is also natural (in most cases) for the size of the project team to grow larger. In fact, it is known that the number of possible communication channels among project team members is given by the following formula: $(n^2 - n)/2$, where “n” represents the number of people on the team, which means that the number of potential communication channels grows at a greater rate than a linear rate [Hartman 2000].

Other important general communication skills that are important in projects as well are for instance: writing style, active versus passive voice, sentence structure, word choice, etc. Further, presentation technique such as body language, design of visual aid etc. are also very important in projects. Part of this knowledge area is also the choice of media, i.e. when to communicate in writing versus when to communicate orally, when to write an informal memo versus when to write formal reports, etc. Communication in a project environment can be divided into four types: formal written (project charter or management plan), informal written (engineer’s notes, mails), formal verbal (presentations), and informal verbal (conversations).

PMBOK [2000] suggest the following major processes in this knowledge area:

Communication Planning involves determining the information and communication needs of the stakeholders. This means finding out who needs what information, when they will need it, how it will be given to them, and by whom. While all projects share the need to communicate project information, the informal needs and the methods of distribution vary widely. Identifying the information needs of the stakeholders and determining a suitable means of meeting those needs is an important factor for project success. The majority of communications planning is usually done at the beginning of the project. However, the results should be reviewed regularly throughout the project in order to ensure continued applicability. Communication’s planning is, as mentioned earlier, often tightly linked with organizational planning.

Information Distribution involves making needed information available to project stakeholders in a timely manner. It includes implementing the communications management plan, as well as responding to unexpected request for information.

Performance Reporting involves collecting and disseminating performance information to provide stakeholders with information about how resources are being used to achieve project objectives. According to PMBOK this process includes *status reporting*, which describes where the project stands at a certain point, for example, by relating status to sched-

ule and budget metrics. *Progress reporting*, describes what the project team has accomplished. For example, percent complete to schedule, or what is completed versus what is in process. Finally, *forecasting* in order to predict the future project status and progress. Performance reporting should also provide general information on scope, schedule, cost and quality, and in some projects, information on risk and procurement is required as well.

Administrative Closure is performed when a project or a phase is achieving its objectives or being terminated for other reasons, and therefore requires closure. The process consists of documenting project results in order to formalize acceptance of the product of the project by the sponsor or the customer. It includes: collecting project records; ensuring that they reflect final specifications; analyzing project success, effectiveness, and lessons learned; and archiving such information for future use. It is recommended that the administrative closure activities not be delayed until project completion. Each phase of the project should be properly closed to ensure that important and useful information is not lost.

PROPS [1999] divide this knowledge area into four steps, similar to PMBOK. These are: communication analysis, establishment of communication system, implementation of communication system, and communication evaluation and improvement.

3.5.8 PROJECT RISK MANAGEMENT

Project Risk Management or Uncertainty Management in Projects as it sometimes is called, is necessary since every project involves some dimension of uncertainty or risk, which will affect project success. But, the risks and uncertainties are usually more or less predictable, and there are usually a number of critical factors that need to be handled if the project should have any chance whatsoever of being accomplished. This knowledge area suggests methods to identify the uncertainties and causes. Further, uncertainty management is comprised of management and of control of risks and opportunities in the project. PMBOK [2000] suggest the following major processes in this knowledge area:

Risk Management Planning is the process of deciding how to approach and plan the risk management activities for a project. It is important to plan the risk management processes to ensure that the level, type, and visibility of risk management are corresponding with both the risk and importance of the project organization.

Risk Identification is an iterative process that involves determining which risks might affect the project and documenting their characteristics. The first iteration according to the PMBOK may be performed by a part of the project team, or by the risk management team. The entire project team and primary stakeholders may make a second iteration. To achieve an unbiased analysis, persons who are not involved in the project may perform the final iteration. Often, simple and effective risk responses can be developed and even implemented as soon as the risk is identified. If necessary, it is recommended to include subject matter experts from other parts of the company, customers, end users, other project managers, stakeholders, and outside experts.

Qualitative Risk Analysis is the process of assessing the impact and likelihood of identified risks. This process prioritizes risks according to their potential effect on project objectives. Qualitative risk analysis is one way to determine the importance of addressing specific risks and of guiding risk responses. The time-criticality of risk related actions might magnify the importance of a risk. An evaluation of the quality of the available informations also helps modify the assessment of the risk.

The Quantitative Risk Analysis process aims to numerically analyze the probability of each risk and of its consequence on project objectives, as well as the extent of overall project risk. This process uses techniques such as Monte Carlo simulation. According to the PMBOK, both qualitative and quantitative risk analysis processes can be used separately or together.

Risk Response Planning is the process of developing options and determining actions to enhance opportunities and to reduce threats to the project's objectives. It includes assigning responsibility for each agreed risk response by individuals or parties. The effectiveness of response planning will directly determine whether risk of the project increases or decreases. It is usually necessary to select the best risk response from several options.

Risk Monitoring and Control is, according to PMBOK, an ongoing process for the life of the project. It includes keeping track of the identified risks, monitoring residual risks, and identifying new risks. Further, it includes ensuring the execution of risk plans, and evaluating their effectiveness in reducing the risk. Good monitoring and control processes provide information that can help making decisions in advance of the risk's occurring. Further, it is also important to be aware that risks change as the project matures; new risks develop, or anticipated risks disappear. Communication to all project stakeholders is needed to assess periodically, the acceptability of the level of risk on the project.

PROPS [1999] call this knowledge area uncertainty management in projects and consider it to be a cyclic process performed in three steps: identification of uncertainties, uncertainty assessment, and implementation of response actions. The purpose of this knowledge area in PROPS is the same as in PMBOK, but what to do is defined in more detail in PROPS as it is an applied project management methodology.

3.5.9 PROJECT PROCUREMENT MANAGEMENT

Resource Procurement in Projects is comprised of management and control of relations with internal and external suppliers of resources and results in the project. PMBOK [2000] views Project Procurement Management as a six-step process comprising procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout.

During the first step, **procurement planning**, the project manager is responsible for identifying and analyzing whether it is more advantageous to "make-or-buy" different products or services outside the project organization. The make-or-buy analysis should consider

both the direct as well as the indirect costs of a prospective procurement. In this context, PMBOK considers the indirect costs of buying an item from the outside, to including the costs of managing and monitoring the purchasing process [PMP Exam Preparation 1998].

Second step, **solicitation planning**, involves preparing the documents needed to support solicitation. This document is collectively called the “procurement documents” which are used to solicit proposals from prospective sellers. The next step, **solicitation**, involves obtaining bids and proposals from potential contractors to determine who is qualified to perform the work. The following step, **source solicitation**, involves receiving bid proposals and applying the established evaluation criteria to select a contractor. During the fifth step, **contract administration**, the project manager with help from the contracting specialists, monitors the vendor’s performance against the contract’s specifications, performance standards, and terms and conditions.

Finally, the **contract closeout** involves both product verification, that is verifying that the work was done, and administrative closeout, the updating of all contract records. Contract records are very important and include the contract itself and other relevant documentation such as progress reports, financial records, invoices, and payment records. These are often kept in contract file, which should be part of the complete project life [PMP Exam Preparation 1998].

PROPS [1999] calls this knowledge area: resource procurement process and divides it into the following five steps; decision on strategy for external procurement, supplier evaluation, project resource procurement, relationship management, hand-over of and phase-out of relationship. PROPS uses the step supplier evaluation instead of the two steps solicitation planning and solicitation suggested in PMBOK. Further, PROPS has a slightly different approach after the contract is signed, and focuses more on the relationship rather than the contracts that are the case in PMBOK.

3.6 THE EVOLUTION OF PROJECT MANAGEMENT

The construction of major undertakings, as for example the construction of the pyramids, or of the water system in the Roman Empire, has been recorded throughout the history. Thus, the ability to manage project is not new. However it was not until the turn of the 20th century that management became the subject of more serious study, and then only in the context of an ongoing enterprise [Wideman 1995]. In the project management literature, modern project management is considered having been born during the Manhattan Project [Schwalbe 2002] later being formalized during the 1950s large U.S. military programs/projects.

The Manhattan project, or the Manhattan Engineering District as its official codename was, was supposed to have had a turnover of more than 2 billion US dollar, and during the most intense moments it engaged more than 120 000 people [McNeil in Engwall 1995]. Looking back at the Manhattan project, it is easy to identify several important aspects that are im-

portant principles of the project management of today. For instance, the Manhattan project was goal oriented, consisted of independent cross-functional temporary organizations, and development was accomplished in parallel. Further, the work was based on the assumption that it was possible to plan and manage the future [Engwall 1995].

Before the Manhattan Project, one important corner stone was taken at the beginning of the century when Henry Gantt presented an example for planning production “to get the facts and present them in such a manner that they will be easily grasped, both by management and the workers.” [Antvik 1998] Gantt described three charts for production management: the Machine record chart, the Progress chart, and the Man record chart. Later, it turned out that the Gantt chart could also be used to plan project activities. Still today, Gantt planning techniques are presented as the basic planning methodology in almost all project management literature.

The terminology of project management was developed and established in the most advanced technical industry of its time; during the 50s and 60s. During the development of the first nuclear robot in the mid 50s, the Atlas missile (Inter Continental Ballistic Missile, ICBM), project management was a well-defined and separate discipline [Hughes 1998, Morris & Hough in Engwall 1995]. In some literature, the development of the Atlas missile program has been stated as being the beginning of the project “era”, and not the Manhattan project. The reason for this is that the success of the Atlas program led to many companies picking up the project approach. But looking back, the Atlas program had similar forms of work as the Manhattan project [Engwall 1995].

Another important program that received much attention and also is considered to be one of the most important events, was the use of project management by the US Navy in the development of the Polaris programme. The US Navy used a slightly different approach than what was used in the Atlas program when the Special Project Office was created. The Special Project Office was as an internal main supplier responsible for coordination and systems engineering [Engwall 1995]. This function was a detached project office under the chief of the Navy, and not sold out on an external system contractor as the case was in the Atlas programme.

In some literature, the Polaris project is stressed to be the first project managed with modern project management. The reason according to Engwall is that it was one of the most important and prioritized projects in the late 50s in the US. Therefore, the success of the project was often written about. Especially since the Special Project Office was known to use new, modern and efficient management methods. The Project Office had contracts with some 250 main suppliers and 9000 subcontractors to accomplish 70000 tasks. The programme had a turnover of more than 2 and a half billion US dollars, but it was the time rather than the money that was the critical issue.

In order to plan and optimize the tasks of the project, they developed the computer based control tool PERT (Program Evolution and Review Technique) in 1958. The difference

between Gantt and PERT is that the PERT chart also included the time aspect, and in the project management literature of today this method is usually described as more extensive than the Gantt charts. PERT is similar to mathematical methods for planning and analyzing networks such as the electrical system.

The focus on the Polaris programme implied that the successful use of the network planning technique PERT was widely reviewed in the press. Further, this implied that different network planning techniques rapidly started to spread, and with them the ideas of project management. Consequently, there were some different opinions on which projects were the first according to modern project management standards. Nevertheless, modern project management was developed in the large US military projects after the Second World War. The project approach was first used in the Manhattan project, but the Atlas and the Polaris programme polished and developed the approach. Many are convinced that these programs could not have been successful without the use of project management [Wideman1995].

Even though the concept of project management started to spread, the first time the term “project manager” was introduced in the literature was in 1959, when P.O. Gaddis published the article “The Project Manager” in Harvard Business Review [Lagerström 2001, Engwall 1995]. The article begins with the following statement

“In new and expanding fields like electronics, nucleonics, astronautics, avionics, and cryogenics, a new type of manager is bred. Although he goes by many titles, the one most generally used is project manager. His role in modern industry deserves more scrutiny than it has received from students of management and professional managers.” [Gaddis 1959].

The breakthrough for project management came, when PERT and similar methods like CPM (Critical Path Method) began to spread in the 1960s. The CPM method was developed by DuPont in the late 50s, and it is the most famous network planning tool besides PERT. The primary use of CPM was to plan and calculate the cost of the construction work at the company’s plants. However, the methods were equivalent, which implied that they were considered to be just another version of the other [Engwall 1995]. Another reason for the explosive use of PERT technique was that Pentagon, NASA, and other governmental functions in the US started to require the use of network planning in their contracts with subcontractors. Further, the U.S. military forced all of their subcontractors to sign the name of the project manager onto each project. The client required that the project was planned, budgeted, and followed-up in accordance to pre-specified techniques. Further, companies that used the new terminology and worked according to the new methods were preceded [Engwall 1995]. This is not the only reason the methodology spread; the belief in the method was huge. For instance, the Vice President of the US Hubert Humphrey said in a speech 1968 that:

....the techniques that are going to put a man on the Moon are going to be exactly the techniques that we are going to need to clean up our cities; the management techniques that are involved, the coordination of government and business, of scientist and engineer. [Engwall 1995]

Another driver in the rapid distribution of project management technology was the creation of organizations, especially the previously mentioned organizations PMI and IPMA. In the beginning, the network planning techniques were in the focus of these organizations. According to Engwall, it was within this area, and treatment of these methods, where the development of project management grew out into its own genre of management literature.

Looking at the development and research of project management from the introduction of PERT up until today, there are a few important milestones that can be stressed. According to Söderlund the book by Cleveland & King published in 1968 was, and still is, one of the major ones in the field. It is considered to be the classic book for “system analysis” or the “optimization” aspect of project management [Söderlund 2000]. There is still much research continuing within this area, which is focusing on planning techniques and work breakdown structures [Söderlund 2000].

In the 1970s, the military began using project management software, as did the construction industry [Schwalbe 2002]. During the 1970s, the literature also began covering the whole area of project management, not only covering different planning and control techniques [Engwall 1995]. As a matter of fact, in the beginning of the 70s, the strong belief in plans and planning techniques vanished, but the interest in project management did not vanish. Instead, the changes in the working climate during the 70s implied that the project management methodology had grown stronger. Laufer et al. [1996] support this by stating that the dominant project characteristics of the 1960s were scheduling (control), or simple, certain projects. Further, they characterized the 1970s by teamwork (integration). In the 1970s, the project management practices began the formalization and conceptualization as risk analysis, estimation techniques such as Function Points, and formal modeling of scope and objectives. Cost-benefit analysis began to emerge and, in some cases, were adopted by project managers. Further, the standardization of the system development process led to the development of structured approaches to project management. However, because of the dominance of the system development process by computer people, most project managers were technicians, and not business experts. Therefore, IT project management remained dominated by the technical aspects and not business aspects of the project.

Another important step in the 1970s was the discussion and research concerning matrix organization. This had a huge impact on project research according to Morris [in Söderlund 2001]. When the matrix organization entered the field, project research seemed to start focusing on the over-all organizational level, not only on the level of projects [Söderlund 2000].

In the 1980s, the focus in literature and research was on critical success factors. At this time, many reports were written covering project failures in previous decades [Söderlund 2000]. Publications in the different journals of project management reflected the search for generic success factors [Pinto & Slevin in Söderlund 2001]. Another characteristic of the 1980s, according to Laufer et al. [1996] was the techniques for reducing uncertainty (flexibility), both for complex and uncertain projects.

Somewhere around mid 80s, there was a change in project management according to Kerzner [1998]. He divided the evolution of project management into three different periods. Kerzner named the period up to 1985 the **Traditional project management**. During this period of time, project management was dominated by operations in airspace, defense and large construction industries. These projects were often very large and the project members worked 100% on one project. Management of costs and time were often secondary to technical issues. It was not unusual that these projects ended years behind their time schedules and far beyond their budgets. The project management level could resume with the words “wait and see”.

The following time period was called the **Renaissance of project management** by Kerzner [1998] and is said to last until 1993. This time period companies started to realize the benefits of project management. Slowly, corporations in other industries began to realize the advantages of project management, not only in order to facilitate change, but also to improve profitability. Project management began to be applied to all sizes of projects, and even the functional areas of business started to recognize the impact of project management. Multidisciplinary teams became somewhat common, and it was proposed that project management was an emerging profession.

Project factors such as cost, time and scope could be handled in a controlled manner. The way of controlling changes increased the profitability, and project teams became a more common structure. The fast development of computers and software tools also gained speed, forcing companies to adapt to the new thinking. Project management started to become an accepted profession.

The last period according to Kerzner [1998] is **Modern project management**. This period started in 1993, and during this period significant changes in both qualitative and organizational aspects of project management were gained, such as good computerized tools and proved theories. The increased development of project management objectives was a result of companies' higher interests and also confidence in project management. Tools, models and processes for project management were developed and grew highly sophisticated. Project management is now firmly recognized as a profession and career paths exist for professional project managers.

In larger, but also in smaller sized, companies that have often been attending their business for years, it is not unusual that the organization has adopted a *management by experience* attitude. It's also not unusual that the organizations are vertical bureaucracies. Project management cuts across the vertical structure, placing authority and accountability for project results in the hands of the project manager [Cook 1999]. To adapt to this new organization can be a painful adjustment that effects the positions in the old organization and hierarchical structure. By the 1990s, virtually every industry used some form of project management [Schwalbe 2002] and Laufer et al. [1996] states that the dominant project characteristics of the 1990s were simultaneity, complex, uncertain and quick, in other words the very elements that are defined as complexity in the following chapter.

Chapter 4

Industrial Projects¹⁰

When we talk about an industrial project, most often the attributes *complex* and *global* are attached. However, complex global projects are nothing unique in the industrial context. Any project can be complex or global, regardless if it is a health care project or a space project. Many projects, for instance the Manhattan project, have been fairly complex undertakings. Further, many other projects executed in the past can also be considered complex, multicultural undertakings, such as the building of the great pyramids of Egypt some thousands of years ago. Nevertheless, many authors emphasize that the modern project goes through a paradigm shift as the result of changing organizational complexities, demands, and cultures [Kruglianskas & Thamhain 2000].

4.1 PROJECT COMPLEXITY

It appears to be an accepted fact that the complexity of projects is increasing, even if complexity has often not been defined [Williams 1999, Wideman 1995]. Despite the fact that many project managers have been widely using the term “complex project”, there is still no clear definition of its meaning, beyond the generally accepted understanding that it is something more than simply a “big” project [Williams 1999]. *Complexity* is made up of several things, of which size is the most common characteristic that define a system as complex.

The complexity of today’s projects and their support environments is considered to be “yet another managerial challenge”. Technology has become a significant factor for almost every business, and it affects project activities from small to large businesses, and from private industry, to government and aerospace. When describing their operations, whether product, process, or service oriented, managers point to specific indicators of project com-

¹⁰ Based on Lilliesköld, J., & Jonsson, N., *Literature survey of Industrial Project Management*, Ex.R. 0205

plexity. Some of the indicators are: the high degree of technical complexities, technology transfers well integrated with the business processes, high levels of innovation and creativity, multidisciplinary teamwork and decision making, intricate multi-company alliances, and highly complex forms of work integration. Furthermore, a significant contribution to the project complexity is given by means of complex support systems such as enterprise resource planning (ERP), computer-aided design (CAD), computer-aided manufacturing, etc. [Kruglianskas & Thamhain 2000].

This thesis does not aim to give a definitive definition of complexity. Instead, the thoughts by Williams [1999] based on a review by Baccarini [1996] is shared. Baccarini [1996] proposes that project complexity can be defined as “consisting of many varied interrelated parts” which can be categorized in terms of differentiation and interdependency. Since the definition can be applied to any project dimension relevant to the project management process, such as organization, technology, environment etc. Baccarini stresses that it is important to state clearly which type of complexity the project is dealing with. Unfortunately, according to Baccarini, most project literature fails to do so.

According to Baccarini [1996] there are two types of complexities most commonly referred to in project management texts. These are: *organizational complexity* and *technological complexity*. Based on Baccarini [1996], Williams [1999], and Hartman [2000], the author find that two dimensions, one of which has two sub-dimensions, the other three sub-dimensions, can be used to characterized project complexity:

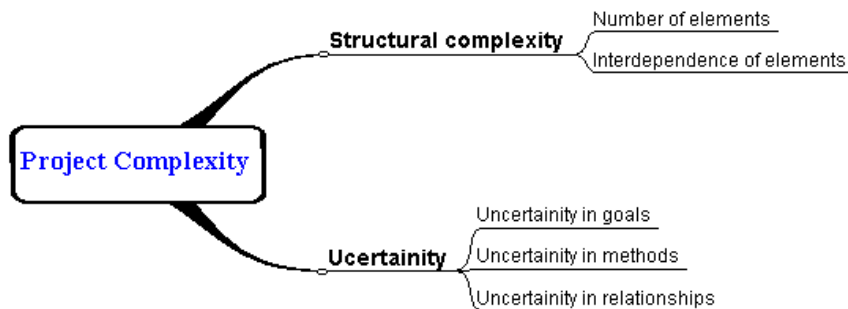


Figure 6 -The different levels of project complexity

The first type of project complexity is **structural complexity**. Normally, the literature differs between *product* (technical) and *project* (organizational) complexity. It is necessary that you view the number of elements that make the project or system (differentiating), and the connection in between the included parts (interdependence).

In terms of *organizational complexity*, differentiation would mean the number of hierarchical levels, number of formal organizational units, number of specializations, etc., and interde-

pendency would be a degree of operational interdependencies between organizational elements [Williams 1999].

In terms of *technical complexity*, differentiation means the number and diversity of inputs, outputs, tasks or specialties. Interdependency would be the interdependencies between tasks, teams, technologies or inputs [Williams 1999].

Virtually all projects are by definition multi-objective, with conflicting goals (either constraints or optimization), which add (structural) complexity. Virtually all projects have a multiplicity of stakeholders, not only the obvious: client, project manager(s) and project team, but also the owner, the public and so on. Both of these add additional dimensions of structural complexity to the project.

The other type of complexity is **uncertainty**, which can occur in different forms. In most cases, three kind of uncertainty complexity are discussed:

Uncertainty regarding goals (or specification) This means that the overall requirements and goals are not formulated well enough. This can be caused by uncertainties in specific requirements from the customer, continuous changing of the requirements, different objectives within the project from the different stakeholders, etc. Unclear requirements and continuous changing of the requirements implies that the project has to backtrack over and over again, which results in that the outcome of the project is difficult to predict and the structural complexity of the project increases. Stinchcombe and Heimer [1985] divide this uncertainty into three categories:

- a. The project itself brings better knowledge to the client regarding possible solutions.
- b. The client wants to adjust the project scope to changes in the surrounding environment, for instance market conditions, new laws or new technology.
- c. The client wants to have the possibility to adjust the project scope due to changes in the client organization.

Uncertainty regarding methods. This means that there can be uncertainty regarding which methods and tools that can be used to develop the actual system or product. Lack of experience and constraints within methods and tools are typical sources that result in this kind of complexity in projects.

Uncertainty in relationships among stakeholders usually occurs in the case of client-supplier relations. According to Stinchcombe & Heimer [1985] there are three kinds of uncertainty in the client and the supplier relation:

1. *Uncertainty of the specification* caused by the client, where by different reason cannot specify the suppliers undertaking in advance, which is part of the uncertainty regarding goals above.

2. *Uncertainty about the costs* within the client organization as well as the supplier organization can with the increasing knowledge during the project lead to a wish for changes in the compensation or the scope of the project.
3. *Uncertainty in the valuation of the performance.* The client can find it hard to judge whether or not the suppliers' performance is by the contract. It can be difficult, or even impossible to discern the different suppliers' parts of the overall system. It can also be difficult to observe if the performance is by the contract or not, unless the client continuously supervises the suppliers. The client's service in return, is usually just to pay the suppliers.

As complexity increases, there is a need to put more effort into communication and building the projects own unique culture. Further, attention to team effectiveness is important, and the time needed to build the team will increase significantly as each new level of complexity is added [Hartman 2000]. One approach to dealing with the growing increased complexity faced by companies' developing system solutions is to use program or program management.

4.2 PROGRAM

The term *program* or *programme* (as it sometimes is called) has for some time, been widely used to describe the organizing structure and process used to coordinate and direct related projects. The term *program* is derived from the military, where it was used generally to refer to an exceptionally large, long-range objective that was broken down into sets of projects. Program management of today is used to organize project-based activities. However, it is important to state clearly that a program is not a large project. Nevertheless, in project management literature, there is a widespread variation of the use of the term program.

PMI uses the following definition: "a program is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually". Many programs also include elements of ongoing operations [PMBOK 2000]. In this thesis, the author emanate from PMI's definition of program. However, in project management literature there are many other definitions that can be found. Sometimes one organization has several definitions to choose from: for instance, "The Programme Management Web Site" www.e-programme.com can't agree on one definition, but gives the following five:

1. Program management is the directing of a portfolio of projects, which benefit from a consolidated approach. In other words the program is a multiproject organization.
2. The management of a portfolio of projects towards one specific objective, which is also called a mega project.
3. The management of a series of projects within an organization and for the same client.
4. The coordinated support, planning, prioritization and monitoring of projects to meet changing business needs.

5. According to CCTA (Central Computer and Telecommunication Agency) from The Government Centre for Information Systems, UK, program management is: “The co-ordinated management of a portfolio of projects to achieve a set of business activities”

It is not only the term program that is a subject of discussion, many organizations are struggling with the difference between *project portfolio*, *multiple project* and *program management*. Program management is not the same as multi-project management. The nature and practice of program management is far more wide reaching than common *resource management*. The management of scarce resources, or the establishment of appropriate information systems, is clearly core elements of program management, but focuses attention on the technical and planning aspects rather than the generative and organizing aspects [Pellegrinelli 1997].

Program management must be built on solid project management practice, which is exemplified by Manescu [2001], who stated that: “like anything in life, we need to get the basics right first”. Program management cannot be implemented without organizational process discipline, mature project management practices, and the involvement of the executive leadership of an organization [Moore 2000].

According to Dye & Pennypacker [2000], “Currently there exists a general philosophy that all projects under way make up the project portfolio. Unfortunately, a group of independent projects does not make up a portfolio – it is simply a group of projects, consuming time and resources.” Further, the authors define clear differences between multiple projects, and project portfolio management regarding: purpose, focus, planning emphasis, and responsibility. These differences are, according to Gareis [2000], applied in *portfolio management*, *multiple project management* and *program management* in the following way:

The purpose of *portfolio management* is to simplify project selection and prioritization. The focus of portfolio management is strategic, and planning emphasis is long and medium term (long and medium term meaning annual or quarterly). Executive or senior management has responsibility for portfolio management. On the contrary, the purpose of *multiple project management* is resource allocation. Its focus is tactical, and planning emphasis is short term (short term meaning day-to-day). Project and resource managers have the responsibility for multiple project management.

The *program* differs from the *project portfolio* in the way that projects of a program are closely coupled by common, overall objectives, overall strategies, and common processes and methods. Also, besides the temporary organization, the program has a medium to long time limit in duration (long time meaning a period from 1 to 5 year), which project portfolio does not have at all. Only single projects have a time limit, not the project portfolio itself [Gareis 2000].

4.2.1 PROGRAM VS. PROJECT MANAGEMENT

In some organizations, the term *program* signifies either a complex development project consisting of several sub-projects, or a complex project organization consisting of many levels of projects, very similar to the original military usage of the term. Nevertheless, the role of the program manager does not really differ from the role of project manager, except that there is a difference in the status of the title, where hierarchy starts at the lowest level with project manager to senior project manager through to program manager.

In other organizations, the distinction is very clearly defined. A *project manager* manages a single project, while a *program manager* manages multiple projects and sets up standards by which these projects should adhere to. For example, a project manager usually defines a projects quality metrics, configuration management plan, and testing strategy for all projects within the program. Program managers manage the interfaces between projects, and look for the gaps, overlaps, and conflicts in scheduling. Sometimes, program managers play the role of resource manager, and decide how project members are shared among different projects.

However, the more prevailing opinion is that program management, in contrast to project management, provides administration for a group of interdependent projects that together achieve one or more strategic business objectives to maximize the value of their collective objectives. It blends the rigors of projects management with a strong focus on client (internal or external) interface, governance, people, and interdependencies between projects and other programs.

Program	Project
An organizing framework	A process for delivering a specific outcome
May have an indefinite time horizon	Will have a fixed duration
Evolves in the line with business needs	Has set objectives
May involve the management of multiple, related deliveries	Involves the management of a single delivery
Focused on meeting strategic or extra-project objectives	Focused on delivery of an asset or change
Program manager facilitates the interaction of numerous managers	Project manager has single point responsibility for project's success

Figure 7 - Differences between programs and project [Pellegrinelli 1997]

4.3 GEOGRAPHICALLY DISTRIBUTED PROJECT

Since an industrial project is usually large and complex, it often implies a geographical distribution due to various reasons. Most often, a geographically distributed project is also a multicultural project, but not necessarily. As the author sees it, geographical distribution of the project and multicultural project team are two different issues that each deserve separate attention.

Geographically distributed project imply the assembly of teams of experts to work together and participate in projects while remaining physically dispersed in geographically distributed locations. Such teams are in literature usually referred to as *virtual teams* [Evaristo and Scudder 2000]. Enablers for distributed projects are advanced information and communication technologies [Evaristo and van Fenema 1999]. Reasons to encompass several sites in a single project can be lack of resources, convenience, cost, monitoring, capacities, quality, etc. Usually, a project is distributed because of the high cost involved placing all required experts on one location, compared to the alternative approach; to run the project in a distributed fashion. There are also risks of loss of expertise or key competence if the most talented resources are plucked away from their natural environment. Other reasons can be political. In a merging situation, the merge can only be carried out if for instance there is an agreement that the R&D will still be situated where it has always been. Geographically distributed teams are operating in highly diverse industries such as: computer software and hardware, telecommunications, construction, electronics, biotechnologies, and in many other industries.

Distributed projects were not very common before since e-mail, groupware, shared databases, and videoconferencing were not feasible for organizations. But as information technology has developed, the use of geographically distributed teams has increased dramatically.

According to Evaristo and Scudder [2000] the term distributed can have many different meanings in the context of project management: the distance among the actual projects, the team members, or coordinators; reference to different complexity levels; need for synchronous communication among team members etc. Due to the variety of possible uses of the term “distributed”, Evaristo and Scudder [2000] suggests that *distributedness* is “not a single variable and may in fact be multidimensional”. The following are proposed to be some of the dimensions of **distributedness**:

- *The type of project* affects the way the project should be managed. Examples of types of project are: manufacturing versus design project, hardware vs. software, or mixed. For instance, ABB, a multinational group with headquarter in Switzerland, is involved both in distributed software development and the physical plant building in several locations and in many different businesses. The different divisions in charge of these objectives have very different approaches to managing their respective distributed projects. In general terms, self-sufficiency in software development is more likely than it is in engi-

neering projects that involve many subcontractors and parties to come to fruition. Naturally, it could be that different software project could generate different needs, since the software development can be very complex. Additionally, a construction project is more likely to look for partners or subcontractors in the open market, while in software development small development teams are more common. Transaction theory suggests that there will be more space for opportunistic behavior from variety of stakeholders in non-software projects due to the inherently larger number of parties involved. Therefore, the project management technique should allow not only for multiple sites but also for the large number of stakeholders.

- *Structure.* The level of structure present in the project tasks is relevant to the way the project is managed. Some projects may be complex to implement, but their high level of structure implies decreased ambiguity and therefore simplicity in management. Projects that lack structure, involve many procedures and the unstructured strategic nature of the decisions typically dictate much more communication back and forth between the project level and senior management.
- *Perceived distance.* There is continuum of possibilities between the ability to meet face to face frequently (very close) and never being able to do so. This measure applies to all project participants regardless of role. Perceived distance may also be felt between manufacturing plants, users and designer teams. Different media tools may be used to facilitate the lessening of the distance effect on a project. For instance, in the case study presented in Paper II the different subsidiaries are scattered across Europe and USA, meetings occur consistently every week over video and telephone conferencing. Perceived distance affects the communication media choice and coordination activities. Monitoring of an agent's adherence to the principal's objectives is very critical. When knowledge or trust goes up, monitoring can decrease considerably. Monitoring requires higher effort from all stakeholders involved. This higher effort also increases the transaction costs, therefore changing interaction dynamics. In other words, when a group does not trust each other, they may engage in so much monitoring that it overwhelms actual productive work to an extent that no productive work happens.
- *Synchronicity* is the extent to which people may be working on the same project concurrently. One of the conditions for total synchronicity occurs when all stakeholders are in the same time zone or are willing or need to work at the same time on a given project. Synchronization occurs both in quality and content. A related measure is how frequently people need to engage in synchronous situations. Management of synchronicity is perceived by managers as quite difficult. In most cases, monitoring of synchronous work is more difficult than sequential work. A project manager must create carefully designed monitoring methods to manage the flow of information about project status. The monitoring methods must provide information not just to the project manager and sponsors, but also between synchronized units of the project.

- *Complexity*. For detailed description of this dimension see 4.1 Project on the page 43. However, in the case of the geographically distributed project, sheer size of the project contributes to the complexity of the project management. Normally, one location project is not considered to be complex only because it is big.
- *Culture*, in itself, is a multidimensional factor. It affects the performance of distributed project in different ways. For detailed description of this dimension see 4.4 Multicultural project on the page 53
- *Information systems methodology*. It is reasonable to assume that there are differences in the needs for management of the project in each phase. The issue of systems methodology brings various levels of complexity for a project manager. Let us take two system methodologies as an example, the waterfall lifecycle and the object-oriented lifecycle. In some ways these represent opposite ends of the spectrum. Tools used in these methodologies differ significantly. A project manager in the situation where part of the project is developed using a waterfall methodology while another part is developed using an object oriented approach will have a lot of troubles with communication within the project! The two groups would barely be able to talk to each other. One of the ways of dealing with this issue may be make sure that segments of the project organization are using similar methodologies and tools. A project manager with a clear understanding of the variance in systems methodologies will have a better ability to understand and mitigate the variances in the project communications, project plans and project quality.
- *Existence of policies/standards*. It is not only the existence that is relevant, but also the extent to which the policies or standards are actually upheld in a given organization. Critical standards include scope control, estimating methodology, communication standards, scheduling methodology and programming standards. The extent to which standards are in place and upheld has a significant effect on an organization's ability to maintain project integrity. Those organizations that do not have standards are unlikely to be able to maintain project integrity.
- *Level of dispersion*. The perceived distance between the members of a given stakeholder group as well as among clusters of stakeholders, is called *level of dispersion*. For instance, all system designers in a project would qualify as a group of stakeholders sharing a role. The perceived distance among the members sharing this role is a measure of the level of dispersion of that group. Another measure would be the perceived distance among that group, and all the others groups: programmers, testers, etc. The higher the level of the dispersion, the more difficult it is to monitor the behavior of different groups as they relate to each other.
- *Stakeholders*. Their different interests add another measure of distributedness. Eventually, this dimension may evolve into a subjective evaluation of how many types of different stakeholders are involved. The larger the number, the larger the distributedness of the project.

4.3.1 *DISTRIBUTED PROJECT VERSUS CO-LOCATED PROJECT*

The opinions about distributed projects are divided. According to Hartman [2000], the misunderstandings increase with the square of the distance between sites multiplied by the number of sites involved. The opportunity for communication breakdown increases significantly as the number of people involved increases; see 3.5.7 Project Communications Management on page 33.

According to Evaristo & van Fenema [1999], a distributed project has many benefits. On the other hand, there are also many problems or costs. The principal issue is the heightened need for communication and coordination of the separate pieces of the same project being developed in different areas. This extra coordination implies a need to schedule in the different activities over several sites and concurrently try to allocate resources. In principle, the only person who has a bird's eye view of the overall situation is the project manager. There is no overlap of people across sites. Meetings across sites and different parts of the project are, most of the time, set up by project managers who are in charge of more than one site. Team members also communicate to clear up doubts or create a better relationship with other off-site project members. Interdependence across sites is considerable due to shared needs for the same resources. On the other hand, it is relatively small dilemma compared to more common cases that will be discussed next [Evaristo & van Fenema 1999].

A critical difference between distributed projects and prior programs, or traditional projects of various types is related to the focus of the coordination mechanisms. The former types of projects tend to concentrate on inter-site coordination or boundary spanning across sites, whereas the latter tend to concentrate on intra-site coordination mechanisms or boundary spanning across projects. Finally, the potential for considerable synergy between the different sites in charge of different parts of the same project is clear. The down side is the transaction costs associated with this need for coordination and communication [Evaristo & van Fenema 1999].

An interesting study made by Pawar & Sharifi [1997] compares two projects: one co-located and one distributed. The co-located project was a pilot project executed at Cookwell Ltd., a manufacturing firm that widely used distributed projects for the development of its products. The distributed projects were called the PACE project, executed by a pan-European consortium of eight partners ¹¹. The findings are interesting especially in the case of co-located project. Co-location, in the first instance, reduced the design and development lead-time and reiterations by 17%. There was a significant reduction in the number of components used in the end product (team managed to reduce the complexity of the design yet maintaining its functionality and characteristics). There was also a 35% reduction in total investment in tooling. The ownership of design problem was more widely shared. For

¹¹ Ref. to the PACE project is the grant number BE 8037-93.

instance, one team member commented “we have shortened time scales and broken down communication barriers to a certain extent by using collocation approach to designing and developing new products”. Whereas project teams set up previously did not render the desired outcomes regarding innovation in the design of products. Then, there was a tendency among members to deal with design issues on casual basis and designers did not share ideas with other actors. For instance, there seemed to be an on-going delay in the communication of market research information. This led to design freeze being postponed and dealt with it later in the development process. Subsequently, some mistakes in design were identified at pre-production trial runs, whilst other mistakes were identified during assembly operations. It may be noted here that physical collocation of design team was part of an experiment to improve time to market in design process, and was parachuted on the existing structural arrangements and thus roles and responsibilities of those involved were not redefined. Moreover, the firm’s approach to collocation was fragmented.

An other interesting remark from the same study regarding working environment in those two projects was that in PACE project partners encountered motivational problems; feeling isolated and frustrated as they were not sometimes able to share ideas or dilemmas with other partners. The pilot project at Cookwell Ltd. faced different dilemmas: whilst the team members could communicate with each other more readily, they encountered constraints accessing information and interacting with others outside the co-located team within the company [Pawar& Sharifi 1997].

A summary is the following: a geographically distributed project requires additional effort to handle coordination of the distributed units. A particular problem is communication. In reality, management has always strongly divided opinion about the distribution of the project and the decision about co-locate or distribute the project is not easy to make. However, the study of the case when a project has deliberately been co-located in order to eliminate problems caused by the project distribution has shown that some benefits have been achieved, but the biggest problems were divided opinions within the management and the communication within the project team.

4.4 MULTICULTURAL PROJECT

An increasing type of project, both in industry and in multinational agencies and organizations such as the European Union, NATO, and United Nations, is the multicultural project. This type of project is expecting to increase further mainly due to the globalization and merger and acquisition trend. Multicultural projects are sometimes also called “Cross-cultural” projects in literature. A multicultural project is mostly a distributed project, but not necessarily. A project team can be multicultural, but co-located.

In this thesis, the term *multicultural project* refers to a project that involves team members from different countries and different organizational units. However, different authors can use the term multicultural projects to refer to different types of projects. The multiple

meaning of the term multicultural can be explained by the meaning of the term culture, which refers to many different things, such as [a selection from Webster's 1996, Encarta 2001, SAO 2001]

- *The arts collectively*: art, music, literature, and related intellectual activities
- *Knowledge and sophistication*: enlightenment and sophistication acquired through education and exposure to the arts
- *Shared beliefs and values of a group*: the beliefs, customs, practices, and social behavior of a particular nation or people
- *People with shared beliefs and practices*: a group of people whose shared beliefs and practices identify the particular place, class, or time to which they belong
- *Shared attitudes*: a particular set of attitudes that characterizes a group of people
- *Improvement*: the development of a skill or expertise through training or education [a selection of definitions from Encarta 2001, SAO 2001]

In the framework presented later in this chapter, cultural difference is divided into three categories on an overall level. These are *professional or functional culture*, *the country of origin*, and *corporate culture*.

Multicultural projects require input from individuals and groups from different cultures. The differences that matter are not concerning national boundaries, the differences that matter are cultural and having to do with the environments in which projects are conducted: economical, political, legal, and socio-technical [Meredith & Mantel 1995]. A summary of what kind of projects are referred to in literature under the name "multicultural project" are the following:

- Projects conducted in another country.
- Projects conducted in a global organization, when a product and/or service is developed and delivered to the global market.
- Projects conducted within a big organization consisting of more functional units that have developed own culture, as described in Organizational Influences on page 26.

Every organization has a culture of its own; however, functional units, or departments like marketing, economy or production department, do also develop a culture of their own even though they are within the same organization. In last decade we have seen a continuously growing number of mergers and acquisitions within and across national borders, which also brings new cultures into the organization and into projects executed in such organizations. Culture; functional as well as ethnical, impacts projects in many ways.

Although research indicates that one's ethnic culture has a more significant influence on one's way of thinking and acting, than the organizational culture. No matter how well a project professional tries to adapt to an organization's culture, he or she will still be driven by his or her national culture [Sohmen & Levin 2001]. Because all people invariably seem to view the values of other cultures in terms of their own, the process of understanding and working comfortably in another culture requires great effort [Meredith & Mantel 1999].

In project reality, it can occur that the focus of the project management is strongly centralized on the project outcome and culture can become a huge problem in the critical phases of the project. Meredith and Mantel [1995] discuss Pinto's research about importance of psychological aspect of service on project teams. "In practical terms, this findings suggests that it is important for project team members to enjoy working with other team members, and to perceive the project as a valuable way to spend their time." According to Meredith and Mantel [1995], this is doubly important for multicultural projects, particularly for expatriate team members. They are away from home and depend, for the most part, on their national cohorts to meet psychosocial needs. Given this cultural isolation, the project becomes a critical source of both psychological and social payoffs, and the project manager, with a strong tendency to focus only on task outcomes, must make sure that these other needs are met.

4.5 GLOBAL PROJECT

Global projects are, as the author sees it, both geographically distributed and multicultural. Global projects are in literature sometimes referred to as transnational projects [Lagerström 2001]. These projects are organized across national boundaries within multi-national corporations, i.e. project involving members from several corporate units located in different countries [Lagerström 2001]. Because of porous international boundaries and trans-border flows of capital, global projects are becoming the norm [Sohmen & Levin 2001]. An example of a global project is described in Paper II.

4.6 MANAGING PROJECTS IN A GLOBAL ENVIRONMENT

Increasing globalization is the growing challenge of the 21st century. In order to create and sustain a competitive advantage many companies of today are trying to incorporate and implement a global perspective. Globalization has impacted project management profoundly and has only reinforced the trend toward adoption of the project mode of work organization. Businesses regularly use project management to accomplish unique outcomes with limited resources under critical time constraints [Meredith & Mantel 1995].

Global projects are spawned, sponsored, and supplied by one or more permanent and generally pyramidal organizations. In today's prevailing turbulent economic environment, the shortest practicable time and resource constraints are being imposed on global projects

by their parent organizations. This compels the networked, multi-disciplinary and dynamic project organization to streamline and accelerate internal communications to accomplish rapid transfers of salient information and useful knowledge. This is imperative to maximize efficiency in project execution towards successful and timely termination.

The globalization denotes a paradigm shift in the project management process [Wheatley & Wilemon 1999]. This new paradigm is characterized by intense market and technology transfer, multiple centers of knowledge (at several geographical locations), cross-functional learning, and reverse and interactive technology transfer, both between geographical locations, as well as between organizational units [Gerybadze & Reger 1999]. Teams are formed across physical, organizational and cultural barriers engaging in projects with a global focus [Levene & Purkayastha 1999]. It is recognized that "once settled," multicultural teams outperform mono-cultural teams.

In many aspects managing a global project is a similar process to managing a single location project. However, the globalization adds complexity that needs to be fully understood and handled by the management. Culture is an aspect difficult to handle, in contrast to communication and documentation standards that can be fairly easy uniformed within a group of companies. Global project do not only add extra aspects that is difficult to handle, some of these added aspects or challenges are not covered by the nine knowledge areas of project management.

Much of the work done in the area of global projects focuses on similar challenges, like differences in languages, time zones, organizational and personnel cultures, policies, regulations, business process, and political climates [Kruglianskas & Thamhain 2000]. Other presented challenges are cultural differences, distance problems, communication problems, leadership/followership issues, differences in "Thought Worlds", and team learning [Gupka & Wilemon 1998]. McDonough et al. [1999] stresses challenges presented by different problem solving approaches, the means used to communicate with leaders, decision-making practices, language differences, the technological capability of the members' country of origin, and extreme geographical dispersion.

However, even though many researchers have started to investigate global projects, most of them are focusing on one area at the time, such as communication. Nevertheless, there are very few frameworks in order to identify the challenges or problems faced by a global project manager. In this thesis the challenges faced by a global team are placed into three categories:

1. Geographical,
2. Cultural
3. Organizational,

This classification is comparable to categorization by Wheatley & Wilemon [1999], who divide the challenges into: 1) logistical, 2) cultural, and 3) structural. However, their classifi-

cation does not fit global multi-organizational development projects, which is the scope of this thesis.

Geographical The geographical dispersion of the project is an obvious problem. A geographical distance can affect the face-to-face communication opportunities, which according to McDonough et al. [1999] results in the transmission of a greater volume of information from one team member to the other. Therefore, information interchange tools in a geographically dispersed project are needed to handle speed, richness, and volume of the information. Because of the possible time differences from one country to the next in a multinational project organization, the opportunity for real-time interaction can be greatly reduced as a consequence of the minimal overlap of workdays across time zones and continents.

Another problem is the differences in native language. Even if the people involved speak the same language, the way they use the same language can differ, as well as putting important information in different places in the sentences and by preferring different communication styles, e.g. formal or informal, making jokes or being serious. Communication among team members thus can be prone to misunderstandings due to the different jargon and used terminology [McDonough et al. 1999].

It is also difficult to ensure the right kind and amount of information flow to the project manager, especially when the project is globally dispersed. Normally, one important aspect is the informal contacts that are more comprehensive within a single location project. In a globally dispersed project there are fewer informal contacts and less information sharing, that need to be compensated for. The global project management team has to decide what kind of information is needed and how this information should be presented. However, there often ends up to be either too little information, misdirected information, or in other ways falsified information, available to the project manager. However, the project management team risks "drowning" in information, with not enough time nor resources to handle it.

Due to the geographical dispersion in a multinational project it is even more important than in a single location project that the project goals are clear to everyone involved. Thamhain stresses that the project assignment must be clear, but that a thorough understanding of the task requirements comes usually with the intense personal involvement of the project team. Thus, obtaining clear goals in a geographically dispersed project can be very expensive if the project members have to meet face to face often.

Cultural The cultural problems in a geographically dispersed project are less visible than the geographical problems, but are often even more challenging. Being aware of cultural differences is a necessary condition for success. On the overall level cultural difference can be divided into the following three categories [Wheatley & Wilemon 1999]:

- *Professional or functional culture*, according to Wheatley & Wilemon is illustrated by the fact that one engineer from the US and one from India will generally speak the same

"engineering language". The challenge with this category is created when a cross-functional project brings, for example, engineers and sales people together.

- *The country of origin* (or region) is another cultural category. For instance the problem-solving approach used in one country can be different in another country. The French members of one global team in a study [McDonough et al. 1999] preferred to thoroughly analyze the entire problem and potential approaches for solving the problem prior to taking any action. Their US counterparts, on the other hand, preferred a trial and error approach where they quickly focused on one potential solution that looked like it might work, and then tried it out.
- *Corporate culture* can differ even between two similar businesses based in the same country [Wheatley & Wilemon 1999]. Every business organization has a culture of its own, whether it wants to or not. This culture is deeply rooted down in the internal social structure of the organization and its values and beliefs.

Organizational Differences in size, dispersion, and complexity make projects more or less difficult to manage. As discussed in the previous section, different cultures add problems to the project control process. If there are already well-established internal processes for running projects in every project location involved in the global project, it is not crucial that details in the processes are exactly the same. However, a minimum of common understanding and planning is needed in order to ensure project success.

One way to keep the need for information exchange to a minimum in a geographically dispersed project is to maximize the independence among the different subprojects. Often different parts of the total system in the project are developed at different locations. It is therefore extremely important to clearly define the interfaces between the subprojects and the sub-systems.

The successful implementation of globally distributed R&D projects with all its complexities depends largely on the support of top management. It is essential that their support is visible throughout the duration of the project [Levene & Purkayastha 1999, Kruglianskas & Thamhain 2000]. When team members act in multiple roles and report to different leaders, a role conflict can occur due to the conflicting loyalties. Team members with such multiple accountability often do not know which constituency to satisfy [Thamhain 1999]. It is an important issue for top management to resolve these potential conflicts between the line and the project organization.

Establishing a global project makes it necessary for the involved organizations to be committed to the project. Within a group of companies working together in projects, there are seldom any formal contracts regulating the project internal deliveries. It is not cost efficient to negotiate and supervise the contracts. Instead, in many cases, a project plan, similar to a contract, is used. However, the project plan does not regulate any fines if delays or other deviations occur during the project.

Chapter 5

Identified problems occurring in global development projects

Today, projects are probably the most common approach when solving time-limited tasks within companies, organizations, society etc. The use of projects facilitates an effective approach, since the task can be taken out of the day to day routine and have resources allocated for that specific task; different stakeholders with interest in the result or knowledge about the task can easily be appointed to the project and contribute with their knowledge. Further, a project manager is selected and responsible for a task, offering a shortcut in organizational hierarchies. Projects come in all shapes and sizes, which implies that the knowledge of project management is diversified.

One category of a project that has increased in numbers lately is global projects, which is the kind this thesis addresses. A global project is geographically distributed, i.e. is performed simultaneously in U.S. and Europe, and involves many different cultures. In this thesis, a global project is demonstrated as including several organizations, being all part of the same corporation, having a different history and different problem solving approaches. In many cases, these different organizations also have different project management approaches. Nevertheless, due to recent mergers or acquisitions these organizations are assumed to be able to cooperate in projects and develop complex system solutions to customers spread all over the world.

In many aspects, managing a global project is a similar process to managing a single location project. For instance, challenges such as managing scope, schedule, and the other project management functions are still important, but secondary, when performing global projects. Instead, some unique problems occur. But, in order to address some of these problems, three managerial aspects need to be considered: geographical, organizational, and cultural.

GEOGRAPHICAL

Distance between the different project locations creates a complication in communication. In all projects there is a need to establish efficient communication channels. But, in a global

project this need is even more important since the possibility to interact or meet face-to-face is limited due to the distance, making the number of communication channels fewer. Instead, the utmost need for communication has to be taken care of with help of different communication technologies. The fast evolution of information technology has provided several useful tools that have helped to overcome distances. For instance videoconference systems have reduced the need for physical meetings, however it does not fully replace them. Beside the videoconferencing system, communication channels such as databases, e-mail, telephone, fax and other means of communication are also important. In Paper II, it is found that the communication channels will not work as intended if there is no trust between the project members. Nevertheless, in global projects the opportunities to build trustful relations between the stakeholders are fewer than in a single location project.

Different *time zones* reducing the possibilities to communicate are another obstacle in global projects. For example, between Central Europe and the U.S. East Coast there is a time difference of six hours. Assuming that the average working day is from 8 am to 5 pm, it leaves an overlapping time frame of three hours. However, the project might be more global than that. Imagine there is another project site on the U.S. West Coast or in Australia as well. It then becomes obvious that there is only very limited timeframe, or no time at all for global project conference calls.

The distance and different time zones implies another problem that the global company needs to consider, this is the *cost of face-to-face meetings* versus video and telephone conferences. In many projects communication tools such as video and telephone conferences does not work as intended if there is no trust between the project members. Thus, management have to consider if the project members or the key personnel should meet and establish a personal relationship with each other in the beginning of the project. However, the cost of this approach has to be considered and evaluated. Nevertheless, the aims of such meetings are several. First, the project members need to get to know each other in order to be able to commit to each other and cooperate in an effective way. Second, the members of the project need to establish a common language. They need to understand each other so that less misunderstandings or misinterpretations occur in the project. After the initial contacts among project members, video and telephone conferences can be useful tools. Consequently, information technology is only the enabler for global information exchange, not the solution.

Thus, starting up a global project requires a communication strategy in order to handle the challenges mentioned above. Further, a successful communication strategy can create a feeling of belonging to the same team within the project and bridge cultural and geographical distance.

ORGANIZATIONAL

The fact that many different organizations are involved, some new and some old, cause another managerial problem in global projects. Developing complex systems in a global

project environment implies that it is hard to use traditional project control. It is for instance difficult to ensure *the right amount of information*. There is often too little information, misdirected information, or in other ways falsified information, not necessarily on purpose. On the other hand, the project manager can drown in information and not have enough resources to handle it.

Another related problem is how the project management team really can *see what is behind the figures* in the different progress reports. Detailed control of costs on the overall project level required extensive administration and a lot of time and energy. Instead, project management can make use of this time to solve problems and focus on the time schedule, internal deliverables and achieving the customer's requirements. Thus, the project control processes need to be established in a way that ensures that the project management team has correct information about time, costs etc without too much administration.

In the project presented in Paper II, the cost control was transferred to the involved organizations, which implied that it was almost impossible for overall project management to control them. But, letting go of the cost control creates another problem. Management can not make sure that involved organizations *work cost effective* with their project tasks, especially if there is no a formal contract, which will be discussed later.

Yet another problem that needs to be handled in global system delivery projects is that most often it is *only one organization responsible* and committed towards the client. The other involved organizations are comparable with a subcontractor to the responsible organization. However, when the objective of the project is complex high-technological industrial systems, the involved organizations usually do not have legal contract with the responsible organization. In most cases, the commitment is based on trust and flexibility instead of contracts, which normally would have been the case if a sub-contractor came from outside the enterprise group. To create such a legal contract in a case of big industrial systems would have taken too long time and probably would have had negative impact on the needed flexibility in problem solutions during the projects execution phase. Even if a legal contract had been signed it would probably have caused too long delay in the project clarifying that was responsible to solve the problem. The most probable case would be that something was omitted when the contract was created. Procurement project in offer phase most likely didn't cover all details and thus the legal contract among all involved companies can't either be complete. In the research project it was found that the general opinion within project management was that flexibility in extensive and complex R&D project contributes more to the project's result, than detailed definition of responsibilities by means of formal contracts among involved companies.

Another potential problem faced by the project management is how to make sure they can create the needed *commitment* among the involved organizations, especially if there are no formal contracts. The needed commitment can only be achieved if the management of the company support these projects, for instance by stating the company should be a comprehensive system supplier and priorities global projects. Commitment to a successful system

delivery can be established by using incentives, based on quality and functionality of the system, which in Paper III is stressed to be a better alternative comparing to an authoritarian management style based on strict contracts and fees.

On the individual level commitment is even more difficult. In global projects, the management team has little or no formal control over the members involved worldwide. The members are probably involved in a couple of other projects as well. Therefore is very important for the project management team or top management of the organization to motivate the team members. Still, there will be difficulties for the project member to decide if his or hers loyalty is towards the local company where he or she is employed or the project. When the project enters into these kinds of conflicts the project manager and the organization must find a way to handle them.

Another problem global project managers are facing is that, most likely, the involved organizations will have *different goals* with the project. Therefore, it is extremely important to filter the project goal and to focus on "the right things" such as internal deliveries between subprojects, deliveries to the customer and the time frame. By such an approach the involved organizations can use different project working processes. As long as the different organizations have the same understanding of the project goals and the project progress, different project processes will not have vital importance on the outcome of the project.

Yet another identified problem is that *the steering committee does not work* as intended. The steering committee easily gets stuck in internal political discussions regarding different solutions, and have problem to focus on the projects best. Thus, the project manager cannot use steering committees as in normal projects since organization managers want to be part of the steering committee in order to influence the project. Therefore there is a need to create a supporting instance, to help the steering committee prepare technical decisions in order to focus on critical decisions. By separating strategic decisions from technical ones, management support to the project becomes more effective.

CULTURAL

In a global project there is usually cultural differences that has to be managed. The project members are most likely to possess different expertise and origin from different countries. Thus, the members speak different mother tongue languages, express themselves differently, have different problem-solving approaches, expect different information processes and project management styles.

Different organizations do not only have project models of their own, but also unique *business cultures*, which characterizes the way information is exchanged. In some cultures information is considered to be a privilege, in other all information is available to every one involved in the project and is required for project's progress. In some environments information is reliable only if it comes from the boss. In the Paper II and Paper III it is stressed

that a complete openness among involved companies help to bridge differences in the information distribution ways.

A similar problem is *differences in management styles*. The project management team can somewhat avoid this problem if they shortcut organizational hierarchies by making the information available to everyone at all organizational levels. This can be achieved with a common project database, where all project relevant data and documents is collected. However, it can take a while before a common database becomes an effective tool if the project members are unfamiliar to use it. Thus, it is important that the global corporations decide on a world wide database and documentation standard so the project members are familiar with the interface and the project don't have any communication barriers due to new interfaces in every project.

Another problem is how to create a *common understanding of cultures*. For instance it is important to understand the greeting habits, and expressions. Misunderstandings in the project can lead to rework, significant cost overruns, and missed schedules. For instance, an expression such as: "as soon as possible", can have different meanings in different cultures. In one culture the meaning is that the task should have been done yesterday, and in another it means that the task can wait until there is time to do it. Many of these possible communication problems or language differences can and need to be anticipated in a global project.

Thus, the company performing global projects need to *create a common language*. This issue is important in every kind of project; however, in global project this is crucial. The difficulty is that even if the company language is English and all employees are more or less used to communicating in English, there is still a lot of language problem that can be identified. For instance in the project studied in Paper II some of the involved team members meant that they are "ready" with a phase when they have delivered the result, while others say they are "ready" when they are working on the task.

Another cultural difference that was found in the project presented in Paper II was that some cultures *avoid presenting problem* they had within their team until the problem became unavoidable. On the other hand, other cultures are very fond of pointing out and discussing the problems. Altogether, these differences easily lead to the mistrust and blame-games within the project. Therefore, these issues need to be captured by the project manager early in the project and handled throughout the projects lifetime.

Problems due to cultural differences can be avoided to some extent if each geographically dispersed organization develops one product or a number of products as independently as possible of each other. This implies a project strategy to *minimize the dependency* and need for communication between the involved organizations by reducing any common development. However, the final goal is still a comprehensive system solution.

In order to allow the involved organizations to *work independently* from each other dependency diagram or something similar needs to be created. The goal of such diagrams is to

offer well-defined interfaces within the project. Thus, the diagram is the base for the overall project time schedule and internal delivery among subprojects. By means of a dependency diagram, local project managers can obtain a better understanding of how the other projects are dependent on the output of their project and how the overall project time schedule would be influenced by eventual delays. The diagram should be simple to understand and updated regularly in order to become a powerful tool for anchoring project's goal in the involved organizations and subprojects.

Consequently, there is, as always in projects, a need for *clear goals* to be established and communicated early in the project and a lot of work has to be concentrated to the definition of the interfaces between the different products. Thus, the project manager has in a global project more the roll of a coordinator and system integrator than system developer.

Another cultural complication the project management team needs to consider is how to *simplify the project control*, when communicating and reporting project status. In the project presented in Paper II simple method were preferred to more advanced methods. Instead of trying to find a compromise on which common tools for project management should be used when reporting project status, it was decided to just use Power Point slides with milestones, or decision points. The key issues, milestones, and decision points were highlighted with different color in accordance with their status. The scale used was green for issues running according to schedule, yellow for issues with high risk to be late, and red for issues running behind schedule, i.e. traffic light control. These simple reports made the project status were obvious to everyone regardless of reporting culture in the different organizations. These reports were well structured, and presented a clear overview of all issues in need of immediate action and support from top management. Together with a dependency diagram, this simple presentation made it clear to everybody what action was the most urgent to discuss at the meeting.

In an environment where the involved organizations are geographically dispersed many of them have project models of their own, especially if some of the organizations are new in the company due to recent merging activities. These differ more or less from the other organizations models and are influenced by the working culture of the organization and create a unique corporate culture. For instance, a project model that is concentrated on deliveries has more routines for testing of the delivery goals, reuse from old projects etc. than another project model that is concentrated on the product development process with a goal to fulfill more different requirements at the time.

This very situation implies that the project management team needs to evaluate if they should try to introduce one unified project methodology at all locations or if they should allow everyone involved working as usual. In Paper II it is shown that the project manager could focus on a few, but important aspects like input and output from the involved organizations and several decision points. This approach allows the involved organizations to use their own project management methodology, on condition that it is not in conflict with the overall project. Thus, the project manager should not try to control the project man-

agement process in the local projects. Instead every subproject should be able to use their normal project model and working processes, as long as this model does not come into the direct conflict with the overall project model. Consequently, if this approach is used there will be two decision-making processes the subprojects have to adapt to, one from the overall project and one from the local project.

Chapter 6

Summary of included papers

In previous chapters, the recent changes of project management fundamentals were discussed. The driving forces were stressed as; increased focus on core business, globalization of markets, mergers of international companies, and the interaction of managerial and business processes in global corporations. As presented in Chapter 1.2, the scope of this thesis is to investigate global projects and particularly how has the recent merger and acquisitions activities affected global system development projects. The papers presented here are summarized according to those areas of interest. The first paper presented focuses on how downsizing affects the procurement strategy of clients when an investment in a complex production or support system is made. The second and third papers focus on problems multinational suppliers face when trying to adapt to the changes discussed in Paper I and the introduction.

PAPER I:

TOWARDS A COST-EFFECTIVE PROCUREMENT PROCESS – IN SEARCH OF NEW STRATEGIES

This paper is based on a research project exploring project procurement strategies used by the clients when investing in new or improved technology. The background to the research project is a growing interest among client organizations in procuring more comprehensive system solutions including project management, engineering, and construction services. Traditionally, clients have adopted strategies where the responsibility of the project outcome is within their own organization. In this case, the clients project manager has detailed hands-on control, which implies liability for the overall performance and technical function of the designed system.

In the paper, a new system-oriented procurement approach replacing the traditional approach characterized by detailed hands-on control is explored. The fundamental strategic ideas underpinning the approach suggested in the paper are: Firstly, a specification methodology that enables the contractors and suppliers to utilize their previous experiences, standard system solutions, COTS-products, and established network of sub-contractors with complimentary assets. This could be achieved if the client re-focus specification efforts from issues concerning the detailed design of the plant or system towards the actual output of the system – *the end-product*. Secondly, the client should strive for commissioning of a single point of contact and responsibility with a contractor in order to transfer risk and liabilities of the engineering and construction process. Thirdly, this contractor should not only be selected on the basis of price, but on its capabilities to combine and integrate innovation and best practice techniques to create a cost-effective system solution.

From a project management point of view the changes identified in this paper are mainly the increased interest in transferring the responsibility for the engineering process, the system responsibility and the project outcome from the clients' project manager to the suppliers' project manager. This implies that the supplier has to have a project portfolio that can offer different system solutions to the clients.

PAPER II:**SUCCESSFUL PROJECT MANAGEMENT OF MULTI-CULTURAL R&D PROJECTS**

The paper is based on a case study focusing on the project management issues within a global supplier trying to adapt its product portfolio to the changes identifies in for instance Paper A. The studied group of companies had through numerous acquisitions and mergers created a group with some 550 facilities in the end of 1999.

The studied project was the third attempt of a global project with a similar scope and was of great interest since the two prior projects were huge failures. The third project was though considered to be a success within the multinational corporation. When the activity was at its peak about 150-200 people were involved in the different projects that where located in one or more regions of Sweden, Switzerland, Finland, Germany, Italy and USA.

The paper identifies success factors in the management of globally distributed projects:

- 1). The project members need to get to know each other in order to be able to commit to each other and cooperate in an effective way.
- 2). The members of the project need to establish a common language. After the initial contacts among project members, video and telephone conferences were very useful tools.
- 3). The use of a common database implied that everyone involved had access to the same information. Further, the fact that the information was available to everyone turned out to be a good way of getting around different management styles in different organizations.
- 4). Project control; the overall project manager focused on a few, but important aspects like input and output from the local projects and several decision points. Thus, every subproject was able to use their normal project models and working processes, as long as these supported the milestones and decision points that were part of the overall project model.
- 5). The simple, but effective way the status reports were presented at the release meetings. Instead of trying to find a compromise on which common tools for project management should be used, it was decided to just use Power Point slides with key issues, milestones, or decision points. These points were highlighted with different color in accordance with their status, which made the status obvious to everyone regardless of reporting culture
- 6). The creation of the Configuration Change Board as a supporting instance to the Steering Committee. The Configuration Change Board could meet more frequently and had the mandate to act like the steering committee of the project in technical issues.
- 7). The creation of a dependency diagram, which allowed the involved organizations to work independently from each other. This diagram served as a base for the overall project time schedule and internal delivery among subprojects.

PAPER III:

PROJECT MANAGEMENT REQUIREMENTS IN A MULTI-CULTURAL PROJECT

The paper discusses the requirements that a global project induce on the project management. The focus is on system supplier on the global market of today is usually an organization consisting of many organizations, dispersed all over the world. Aside from the differences created by different cultures, these teams often need to accomplish more complex tasks that involve crossing not only cultural, temporal and geographic distances, but also functional and professional boundaries. These complex tasks should be accomplished in an ever-decreasing timeframe. Altogether, delivering a comprehensive system solution on the global market give rise to a number of issues the project management team needs to manage.

The requirements identified in the paper on project management in a multinational company consisting of many different organizations can be classified in four categories. These are commitment among the involved organizations as well as among the project members, culture, control, and communication.

Culture - The project members are most likely to possess different expertise and origin from different countries. Thus, the members speak different mother tongue languages, express themselves differently, have different problem-solving approaches, expect different information processes and project management styles.

Control - The project control processes need to be established in a way that ensures the project management team has correct information about time, costs etc without too much administration.

Communication - Each company has not only a project model of their own, but also a unique business culture, which characterize the way information is exchanged. However, experiences shows that information technology cannot be used effectively until the involved organizations have a common understanding of the project goals and they start to build a mutual trust and commitment. Thus, it is extremely important that the project management team is aware of the fact that information technology is the enabler for information exchange, not the solution.

Commitment - One extremely important issue to resolve in a project conducted within multi-organizational environment is the commitment among the involved companies as well as among the project members. The needed commitment can only be achieved if the top management support these projects, for instance by stating the company should be a comprehensive system supplier and priorities multi-organizational projects.

RELATED PUBLICATIONS NOT INCLUDED IN THE THESIS

BYMAN K., M. ERIKSSON, M. HAGLIND, J. HELANDER, J. LILLIESKÖLD, *Från idé till färdig anläggning– Krav på morgondagens aktörer*, External Report (In Swedish), Department of Industrial Information and Control Systems, The Royal Institute of Technology (KTH), 1998

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ERIKSSON M., J. LILLIESKÖLD, *Project Management Competence Requirements when Procuring Complex Systems*, Proceedings of IEEE International Engineering Management Conference, Cambridge, UK, 2002

Chapter 7

Summary of Results

This chapter summarizes the findings of the studies discussed in Chapter 5 and the included papers. This research effort attempts to identify some of the problems that occur in a global system development project. The focus of the discussion as well as of this chapter is on aspects more or less unique to global projects. However, almost all of the aspects that are important in a normal project are also important in a global project.

To identify potential problems occurring in a global multi-organizational project environment, the nine knowledge areas are not enough. There is plenty of research written on critical success factors in projects and global projects; however, that research usually just looks into one aspect or knowledge area, for instance communication. But in recognizing potential problems, I have not found an applicable framework in the literature. Therefore in this research, a framework is suggested; in order to recognize the unique problems of global projects that are not covered by the nine knowledge areas, this framework is divided into three areas: geographical, cultural, and organizational.

Geographical problems are the most obvious in a global project, however, these are also rather easy to identify and manage. Typical problems in this category are: distance between locations, involved time zones, travel time between locations, cost to meet face-to-face compared to videoconferences, etc.

Organizational problems typically involve questions such as: how the involved organizations are committed, when to use legal contracts or trust, and who is responsible for what. Problems also occur during cost control of the involved organizations. It is almost impossible to see what is behind the figures in the different status reports in order to make sure that the involved organizations are working cost efficiently. In many cases the steering committee does not work as intended, their work can easily get stuck on internal political issues that do not gain the project.

Cultural problems are less visible, and thus harder to identify and manage. These problems can be avoided somewhat if the project manager can create a common understanding of the involved cultures, and create a common language within the projects. However, to do so requires a great deal of time and money, which is not always included in the project budget. Further, the project manager should address the involved business cultures, and management styles, which inevitably cause difficulties. Another interesting issue is that some cultures discuss potential problem they face, while other cultures avoid doing so until the problem is unavoidable. Therefore, advanced tools to report project status may be useless, unless all the involved organizations use them the same way.

Many of the problems identified in this thesis can be dealt with if the project manager or the sponsor put in the time and effort to do so at the start up of a global project.

SUCCESS FACTORS IN THE MANAGEMENT OF GLOBAL PROJECT

Not at all surprising, this research has shown that communication is the single most important aspect in a global project [McDonough et al. 1999]. Of course there are also some other issues to consider when managing global projects. The most important issues identified in this study that the *line organization* needs to contribute with are: 1) To provide an infrastructure for information exchange, such as a common database; 2) To create a supporting instance to help the steering committee prepare technical decisions. Otherwise, the steering committee can easily get stuck in internal political discussions regarding different solutions; 3) To use simple methods such as *traffic light control* instead of more advanced methods in order to over bridge cultural difference when reporting project status; 4) Top management support. In a project without a formal contract that regulates the co-operation between the involved organizations, top management support is indispensable. In multi-organizational development projects, usually only one organization has the responsibility towards the customer. The other organizations' involvements are based on trust and not contracts.

Besides the specific organizational requirements, the *project manager* should focus on the following issues: 5) Filter project goals and make them clear and accepted by all the involved organizations; 6) Requirement engineering, with the goal to create qualitative requirement specifications before starting the execution phase of the project, reduces costs, and minimizes the risk for misunderstandings; 7) Create commitment between the involved organizations and stakeholders; 8) Create trust between the involved project members. Thereafter, communication tools can be used in a more efficient way; 9) Create a diagram showing how everyone is involved, and how some organizations potential delay will effect the end of the project; 10) Shortcut organizational hierarchies by making information available to everyone. Further, frequently repeated status reports on different management levels are also necessary to get things done. Otherwise, important information easily get stuck or filtered at the different levels of the involved organizations.

7.1 FURTHER WORK

The research process tends to create more questions than answers, and writing this thesis is no exception, rather the thesis leaves many questions that would be interesting to investigate. However, this research effort will continue with further investigations of problems in global multi-organizational development projects. The goal is to develop a more extensive framework in order to investigate how to perform projects in an ever-changing world; is there any project management “light” method that can be used on the overall level to let the involved organizations work according to the methodology they are used to use? I.e. how should the work on the program management level be organized? Is there any project management light method that can be used to easily and quickly implement a new organization into others when developing complex systems? Perhaps something like web services, that makes different computer systems cooperate over the web.

Chapter 8

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