Project business

Karlos Artto, Miia Martinsuo, and Jaakko Kujala

Artto K., Martinsuo M., Kujala J., 2011. Project business. Helsinki, Finland,
http://pbgroup.tkk.fi/en/ , (ISBN 978-952-92-8535-8)

Project business

Karlos Artto, Miia Martinsuo, and Jaakko Kujala

Project business – the project management textbook

The Project business book can be downloaded free-of-charge (pdf) from the page: http://pbgroup.tkk.fi/en/

The bibliographic data of this book is:

”Artto K., Martinsuo M., Kujala J., 2011. Project business. Helsinki, Finland, http://pbgroup.tkk.fi/en/ , (ISBN 978-952-92-8535-8) “

The Finnish language version of this book has been published since 2006 by WSOY, which is the oldest and most distinguished book publisher in Finland. The Finnish-language version of the book – “Projektiliiketoiminta” – can also be downloaded free-of-charge from the same webpage. The bibliographic data of the Finnish language version is:

”Artto K., Martinsuo M., Kujala J., 2006 (Toinen painos 2008, 2nd edition 2008). Projektiliiketoiminta, WSOY, Helsinki, http://pbgroup.tkk.fi/en/ (ISBN 978-952-92-8534-1)“

The Finnish language version is qualified to serve as a material for the IPMA certification in Finland. Both the Finnish and English versions of the book are used for higher education courses in several universities in Finland, among others in: Aalto University, Tampere University of Technology, University of Oulu, and Åbo Akademi University.

Other language versions of the book

The authors seek university partners from distinguished professors internationally who would volunteer to translate the Project business textbook into their own language, for their own interest and for the benefit of having this free-of-charge textbook available in their own language (with existent versions in other foreign languages).

The Project business glossary of terms

The authors will publish a free-of-charge Project business glossary of terms in the future. The glossary includes ca. 1,000 terms and their explanations, both in English and in Finnish. Other language versions of the glossary will be published as a result from the volunteering partner professors engaging into translating other language versions of the book and glossary. The glossary will be set available free-of-charge in the same webpage: http://pbgroup.tkk.fi/en/

Copyrights and the use of the book and the glossary

Publishers: Karlos Artto, Miia Martinsuo and Jaakko Kujala

Helsinki, 1 January, 2011
Karlos Artto, Miia Martinsuo, and Jaakko Kujala

Authors' biographies and contact data

Karlos Artto is a Professor of project business at the Aalto University, Helsinki, Finland. He is leading the Project Business research group (PB). Karlos Artto's long experience in working in industry, and his several research projects with global firms and domestic organizations provide a strong empirical basis for his academic achievements. His publications include more than 100 academic papers, book chapters and books on project business and on the management of project-based firms. He belongs to several editorial boards (including International Journal of Project Management, Project Management Journal, and International Journal of Managing Projects in Business). He has supervised more than 100 master's theses and several doctoral dissertations. His current research interests include: project business as a research area and as an area of practical application in firms; business models of global project-based firms; governance of large and networked projects; project strategy as the strategy of a single project and its relation to business strategies of firms participating to the project, and; risk management, especially new paradigms in project risk management.

Professor, Dr. Karlos Artto
Aalto University, Finland
School of Science and Technology
P.O. Box 15500, FI-00076 Aalto, Finland
Tel: + 358 50 560 4751
Fax: + 358 9 4702 3736
Email: karlos.artto@hut.fi

Miia Martinsuo is a Professor of Industrial Management at the Department of Industrial Management, Tampere University of Technology, Finland. Her field of research and teaching is service business development and project management. Besides research and teaching, professor Martinsuo has worked for almost ten years in industrial firms and consulted dozens of international firms and public organizations in strategy, business process development and management development, especially in metal and engineering industry. She has co-authored over a hundred papers, book chapters and books and is an active lecturer and coach in continuing education programs. Her current research interests include: service business innovation; decision making in product development; steering and selecting product development project portfolios; the autonomy, control and efficiency of product and service development projects; and organizational transformation towards service business.

Professor, Dr. Miia Martinsuo
Tampere University of Technology, Finland
Department of Industrial Management
P.O. Box 541, FI-33101 Tampere, Finland
Tel. +358 40 849 0895
Email: miia.martinsuo@tut.fi

Jaakko Kujala is a Professor of project and quality management at the Department of industrial Engineering and Management at the University of Oulu, Finland, and adjunct professor at the Helsinki University of Technology, where he is actively working with the Project Business research group (PB). He has over ten years' experience in industry, while working in international automation system project business before his career in the academia. He has initiated and served as a director for several large research projects with the participation of leading project-based firms, such as Nokia Siemens Networks, Kone, Wärtsilä, Metso, and Outotec. His current research interests include contextual variables in project-based firms and project networks, business models in project-based firms, and stakeholder management in the project business context. His list of publications include over 80 reviewed research papers, books or book chapters in the area of project business.

Professor, Dr. Jaakko Kujala
University of Oulu, Finland
Industrial Management
P.O. Box 4610, FI-90014 University of Oulu, Finland
Tel: + 358 40 839 1717
Email: jaakko.kujala@oulu.fi

Foreword to the 1st English language edition (2011) of "Project business"

We wrote this "Project business" textbook to include all relevant conceptual, managerial and methodological aspects necessary for a good project management textbook. In this respect, the book includes all necessary basic contents that are required from any introductory university course on project management. We sought for a pedagogically logical flow, to promote learning in project-based management. However, we did not want to fill the pages with several real-life examples, nor did we want to include fancy sidebars with examples. Instead, we only used one understandable, hypothetical but realistic example of a house construction project throughout the book when illustrating the concepts, management practices, and methodologies of project-based management.

In this book, the emphasis is on projects as part of doing business. This business-oriented view of projects permeates the book when explaining project and its management, and when explaining the management of a firm and its customer and supplier relationships. Examples of specific business-focused contents in the book are: activities regarding the customer and customer relationships, managing the suppliers and supplier networks, the chapter on 'project marketing and sales' where the focus is on pre-project business activities and the chapter on 'project-related services' with a focus on operations, business or business opportunities that follow the project execution.

Concerning project business as a field of research and empirical applications, below we elaborate the content of project business through its definition and a specific framework. Project business is a research field that adopts a business-centric view to the management of projects, firms, and networks of projects and firms. Project business has been defined as 'the part of business that relates directly or indirectly to projects, with the purpose of achieving objectives of a firm or several firms' (Artto and Wikström 2005). Project business includes activities positioned within the boundaries of projects and firms as well as aspects of collaboration within entire networks of multiple firms. We argue that any project may cross one or several firms' boundaries and business activities, and vice versa, any firm may cross one or several projects' boundaries and business activities.

The four areas of project business (Figure I) vary depending upon whether management is concerned with a project, a project-based firm, a project network, or a business network (Artto and Kujala 2008, Artto et al. 2011):

- Management of a project – addresses a single project.
- Management of a project-based firm – addresses activities of a firm involved in managing multiple simultaneous or sequential projects for the firm's business purposes.
- Management of a project network area – addresses the management of the temporary project organization across multiple participating firms and other actors each of which have their own objectives, interests, and expectations from the project.
- Management of a business network area – includes activities in the business marketplace including several firms and their business interests, often involving multiple projects that serve as temporary business vehicles to achieve each firm's permanent businesses.

The project business framework in Figure I represents a business-centric view to project research and its empirical applications. The framework highlights that projects and firms are both independent entities and interdependent networked organizations. It recognizes the variety of firms that organize their activities in projects. Some firms also run their businesses through other strategic business activities that are only indirectly project related. For example, Nokia Siemens Networks (NSN) offers major telecom network implementation projects for its customers, but also a wide range of services (that may be more related to customers' businesses rather than projects) such as business consulting and outsourcing. (Artto et al. 2011)

	One firm	**Many firms**
One project	1. Management of a project	3. Management of a project network
Many projects	2. Management of a project-based firm	4. Management of a business network

Figure I. Framework of project business: four distinctive management areas (Artto and Kujala 2008).

In Figure I, we refer to many firms when there are multiple private organizations involved in projects such as project contractors, subcontractors, designers, architects, and financiers. In addition to many firms, project networks and business networks may include public sector organizations such as government ministries, universities, and NGOs. All these firms and other organizations are relevant stakeholders interacting with projects and project-based firms in the marketplace.

Helsinki, 1 January, 2011

Karlos Artto, Miia Martinsuo, and Jaakko Kujala

References

Artto, K., Davies, A., Kujala, J. & Prencipe, A. (2011) The project business: analytical framework and research opportunities. Chapter 5 in P. W. G. Morris, J. Pinto and J. Söderlund (Eds.) Oxford Handbook of Project Management, pp. 133-153, Oxford University Press, Oxford, UK.

Artto, K. & Kujala J. (2008) Project business as a research field. International Journal of Managing Projects in Business 1 (4) 469-497.

Artto, K. & Wikström, K. (2005) What is Project Business? International Journal of Project Management 23 (5) 343-353.

Project business

Karlos Artto, Miia Martinsuo, and Jaakko Kujala

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background and objective of the book

The planning and implementation of projects have become common activities in companies, public organizations, and associations as a way of performing work efforts focused on a specific, determined goal. A significant part of the production and delivery activities of companies acting alone (and often in networks with other companies and organizations) to serve external customers can be implemented effectively as projects. In addition, many of the company's internal activities, such as research, product development, and the development of the organization and its processes, are almost always conducted as projects. According to Artto and Wikström (2005), "Project business is the part of business that relates directly or indirectly to projects, with the purpose of achieving the objectives of a firm or several firms." Engaging in project business and planning and implementing specific projects has become increasingly necessary to firms worldwide, as they strive to achieve corporate goals. Yet evidence suggests that project management methods are implemented with highly variable success.

The traditional literature on project management covers project planning and implementation. For project business to succeed, however, it is necessary to go beyond a focus on single projects being planned well and implemented successfully; it is vital to ensure that the right choices are made prior to the start of any single project. Furthermore, in managing the entire lifecycle of a project, it is necessary to adopt a long-term perspective focused on customer relationship management and on the strategic management of the broader aspects of project business. In addition to requiring basic knowledge of project management, managing a professional project business requires that a broad view be taken on the benefits that a project brings to both the consumer and the business entity or entities involved.

Consistent with a broad view, we emphasize the value of widening the focus to include business-oriented management of single projects over an extended lifecycle, including pre-project and post-project phases. In addition, management practices that transcend single projects are needed at the corporate business level. These corporate-level management practices should focus on the management of multiple projects (i.e. a portfolio of projects) simultaneously as one entity; this takes our view of project business beyond managing or making decisions separately about individual projects.

Our purpose in writing this book is to add a commercial perspective to teaching and learning the basics of project business and project management. Taking a business perspective involves an emphasis on the business aspects within single projects, as well as characterizing projects as part of their broader, often networked, business context. Furthermore, our purpose is to explain the main concepts and knowledge areas related to project management to a broad business audience. Many people working for companies engaged in project business – including project managers, project team members, steering committee members, sales and marketing managers, top managers, and other support staff – require knowledge about project business because, at some point in their careers, it is highly likely that they will be assigned to lead a project, to participate in a project, or to develop or purchase a solution in the form of a project.

Observing projects in a broader business context suggests that new perspectives on project management are required. Suitable study material does not appear to be available on bookstore shelves, however. Our book is intended to help fill this gap. We note that the project management competence baseline[1] has recently been updated internationally, and our book represents a timely addition to the development of new learning materials related to this competency baseline – materials that will be useful for purposes of educating and certifying project professionals. Our objective is to provide a general study text that covers the basics of project business and project management, one that is suitable for both teaching and certification purposes. Our book stays true to the dominant project management bodies of knowledge[2], although we apply this knowledge selectively and with a focus on project business.

This book emphasizes the basic terminology of project business, the theoretical and methodological basics of project control, and project management. Our objective is that, upon studying the book, readers will be familiar with the basic concepts of project business, will know their meaning and purpose, and will understand the way project business is implemented successfully, especially in the case of a single project. In addition, we aim to awaken and reinforce readers' interest in understanding and handling the strategic management of project business, and in developing a perspective on the effects of and possibilities for project business that is broader than the management of a single project.

The book does not contain reports on research studies dealing with project business or project management; nor does it delve into project management methods or tools, other than to describe them. Because we believe that the success factors of project business and project management are context- and situation-specific, we do not offer all-encompassing solutions to a wide range of project management issues. However, the book presents systematic management practices, tools, and methods that generally lead to success in managing project business. We urge readers to draw upon their own skills and interpretations in deciding the types of management practices and methods that should be employed in their particular project environment.

1.2 The structure of the book

The book consists of seven chapters, each of which begins with a presentation of the relevant central concepts, and proceeds through the basics of project control to the management of project business. The overall structure of the book is presented in Figure 1.

[1] The IPMA (International Project Management Association) "IPMA competence baseline", IPMA (1999 and 2006).

[2] Project Management Institute (1996, 2000, 2004, 2008) PMI Guide to the Project Management Body of Knowledge; IPMA (1999 and 2006) IPMA competence baseline; Association for Project Management (1996, 2000, and 2006) APM Body of Knowledge; ISO 10006 (1997) Guidelines to Quality in Project Management; PRojects IN a Controlled Environment "PRINCE", Prince2 Guidance (2002); and Project Management Institute (2003) Organizational Project Management Maturity Model "OPM3."

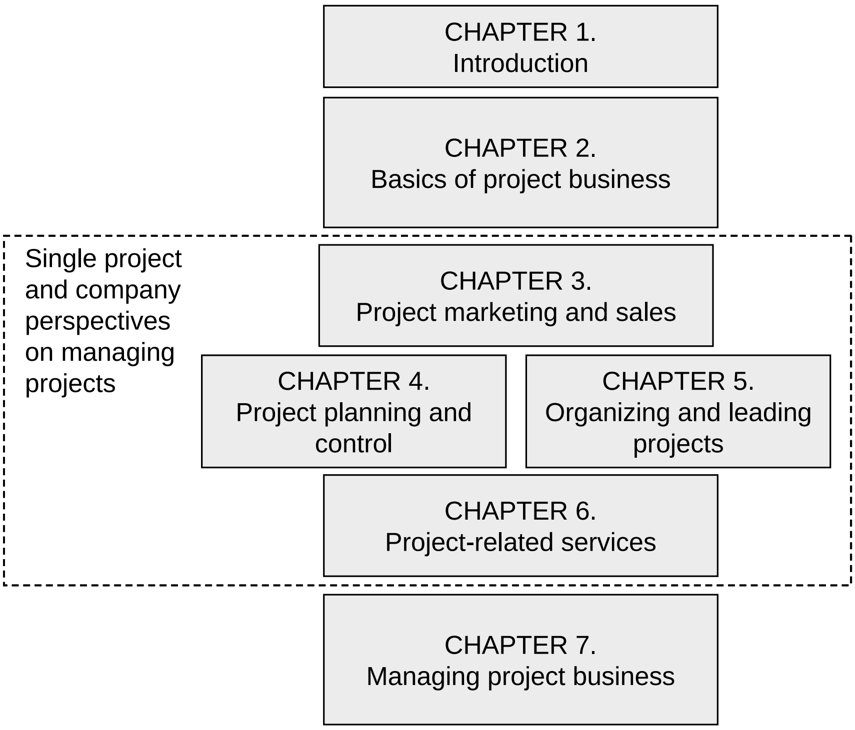


Figure 1. The structure of the book

Chapter 2 presents the two central concepts of project management: project business and project management. The history of project business is described and a foundation of knowledge on project business and project management is presented. In addition, we raise such themes as project goal, project stakeholders, and project lifecycles – themes that are repeated and discussed in greater depth in later chapters.

In Chapter 3 the reader is introduced to the world of project marketing and sales. The various phases of project marketing and sales are described, including the creation of customer relationships, and the topics organization of the sales function, salesperson responsibility issues, and the performance review aspect of sales are also discussed. Although Chapter 3 deals with the phases of project management that precede project execution, we emphasize that the tasks of marketing and building customer relationships require constant attention and effort throughout all stages of an individual project. In addition, we emphasize more broadly the need for overall company-level marketing and customer relations business activities that are not directly related to any single project; such corporate-level efforts focus on generating future projects from the relationships with customers and on creating opportunities to market post-project services.

In Chapter 4 we concentrate on project planning and control, presenting the basic areas of project management. The various areas of project management knowledge are described, ranging from integration and scope management to the management of schedules, resources, costs, procurement, risks, quality, communications, and information. We also describe methods and procedures for project planning and control. In short, this chapter covers the preparation, planning, and implementation phases of the project lifecycle.

Chapter 5 can be viewed as a parallel to Chapter 4 because, like Chapter 4, it deals with the preparation, planning, implementation, and closing phases of the project. Chapter 5, however, concentrates on project organization and leadership. It emphasizes the competences and behaviors of the people carrying out the project and discusses the roles of the project manager, the project team's way of working, and the nature of project organization and steering committee work.

Chapter 6 deals with services provided at the final stages of the project lifecycle, primarily from the perspective of the organization implementing the project. A supplier has many opportunities to provide customer support services during the operational or usage phase of the product or facility that resulted from the implementation of the project, thereby creating new business revenues and enhanced customer loyalty. Typical customer support services include developing and maintaining services, establishing the guarantee period, providing product control and support, organizing and managing services, and disposing of the product.

In Chapter 7 we broaden the perspective from the management of a single project to managing project business in a networked business context, in which projects are managed within and between companies. We place particular emphasis on the interfaces at which the project affects the company's business and, conversely, on the interfaces at which the company's choices strongly affect projects. Success factors for project management are identified in four areas: management systems, anticipative financial management, project portfolio management, and the management of customer and supplier networks. Finally, the development of project business and directions for future research in this field are discussed.

1.3 Terminology and case example

To emphasize the basic terminology of project business, the important concepts are presented in *italics*, and…

… the definitions and explanations of the most central concepts are presented in a frame.

An internationally recognizable case is presented throughout the book as a vehicle for describing the project business of a fictional company called Livinghouse Ltd., a firm that supplies two brands of single-family detached home models, constructed on site, to a fully or nearly turnkey stage of completion. The case includes the Smith family and their role in planning and implementing a project to construct their dream home, a single-family house on a plot of suburban land they own. Livinghouse draws on the services of many subcontractors, including ProKitchen Ltd., whose role as a provider of ready-made and custom-built kitchens we highlight.

Project management situations and methods are described in the case as the house construction project develops from one phase to the next over the project lifecycle. All aspects of the project are not described, but the parts that illustrate our chosen project management themes from Chapters 2, 3, 4 and 6 are related. By use of this example, we provide three different perspectives on project business: the views of the seller (Livinghouse), the buyer (the Smiths), and a central subcontractor involved in the project (ProKitchen). As for these three actors, the competitors and other subcontractors mentioned in the examples have been invented for the purpose of this book.

Although the parties involved in the case are fictional, the authors have used both their extensive empirical research data and their personal and practical international experience in project business and project management in industry to make the case highly realistic. We believe that this case travels well internationally; it was chosen because it details a common human and business endeavor that readers in countries around the world would be able to relate to in some way. The example is complex enough to illustrate the challenges facing project stakeholders, as well as the variability and uniqueness of projects. But, at the same time, it is simple enough to be understood when presented in short vignettes. Although we recognize that there are large and complex development and research projects currently underway in such areas as nuclear power, commercial center construction, and wireless IT, for scale reasons we have chosen the simpler one-family house construction project and the related project business setting. Furthermore, a house construction and delivery project is a unique product for a house supplier and involves all aspects of implementing project business, the basics of which must be known thoroughly if this project activity is to develop into a broad and profitable business for the supplier.

Although we have had to choose a specific country for the geographic setting of the case, the project actors have counterparts in most countries. Again, we emphasize that the project management and project business concepts and methods that we use as we present and analyze this house construction case would apply regardless of geography, industry, or application area.

Our case has many universally applicable components and national and international readers alike should readily digest its technical terminology. Although the nature of construction materials, the sequence of implementing the components in house construction, and the labels or names used for specific parts or tasks in the construction process may vary somewhat from country to country, readers will have no difficulty in translating any of these few and small variations into their local context.

Example: Introduction to the case example – Livinghouse Ltd., ProKitchen Ltd., and the Smith family

Livinghouse Ltd. is a house building company. It has its main office, construction yard and factory, and central warehouse located in London, Ontario, Canada. London is a modern city of 450,000 inhabitants located about 160 kilometers southwest of Toronto, the provincial capital of Ontario, Canada’s most populous province. London is about 80 kilometers north of the Canada-USA border. As is the case for many house construction companies, Livinghouse concentrates on a defined geographic area. It serves the urban and suburban areas of the city of London, and it extends its market to include other major towns and cities within a radius of 100 kilometers in the heavily populated region of southwestern Ontario, such as Windsor, which is adjacent to the US border, and Kitchener-Waterloo, which is between London and Toronto. Livinghouse’s core business is constructing and supplying the typical wood frame style of North American houses and the more European style of concrete/brick frame houses. Indeed, Livinghouse is differentiated from it competitors because it is familiar with the more European methods and materials for homebuilding, featuring walls formed from concrete or brick (not wood), and concrete floors, thus involving house construction processes and sequences that are slightly different from those typically used in constructing North American wood frame houses.

Livinghouse offers two brand names: Comfort House and Dream House. Although both brands include several different types of houses, the brands are differentiated. The lower-end Comfort House brand provides traditional, rather simple and reasonably priced house solutions to lower income and economy conscious buyers. In contrast, the Dream House provides rather grand housing solutions for middle and upper income buyers; these higher-end houses are priced at the upper end of the price scale and contain many features that can be tailored to meet individual customer preferences. Regardless of the house brand, Livinghouse treats each house construction activity or contract as a unique project.

Livinghouse's customer base can be divided into two segments: private customers and corporate customers. Private customers are ordinary individuals or families that want to contract for or construct a house on a lot (plot) of land they own. In such cases, Livinghouse enters into a direct contract with the private customer to supply the desired house. In our case example, the private customer segment is represented by the Smiths, a middle class family of four now living in a small, cramped apartment on a busy street in London, Ontario. The Smiths have contracted for Livinghouse to supply them with a new, quality single-family house to be built on lot of land the family owns in a one of London's residential suburbs. In contrast to its private customers, Livinghouse's corporate customers are large-scale land and house developers that contract for Livinghouse to construct a large number of single-family houses in urban and suburban residential areas that the corporate customer has under development or redevelopment. Livinghouse deals directly with its corporate customers.

For all its house construction projects, Livinghouse engages subcontractors to supply and install some of the home building components. For purposes of our case example, we focus on ProKitchen, a medium-sized specialist company providing kitchen solutions for homes. Like Livinghouse, ProKitchen's geographic focus is the city of London in Canada and the surrounding area of southwestern Ontario. ProKitchen provides ready-made (standardized) and custom-built kitchen solutions for both corporate and private customer segments. ProKitchen has extensive experience in and in-depth knowledge of constructing and furnishing kitchens, and it receives favorable contract prices from the many kitchen furnishing and electrical appliance suppliers it draws upon. Over the years, ProKitchen has served as Livinghouse's kitchen supplier on many house projects and a close bond has developed between the two companies; both parties have in-depth understanding of the other's product lines and models and working principles.

Figure 2 illustrates the business relationships among the central actors involved in our case example.

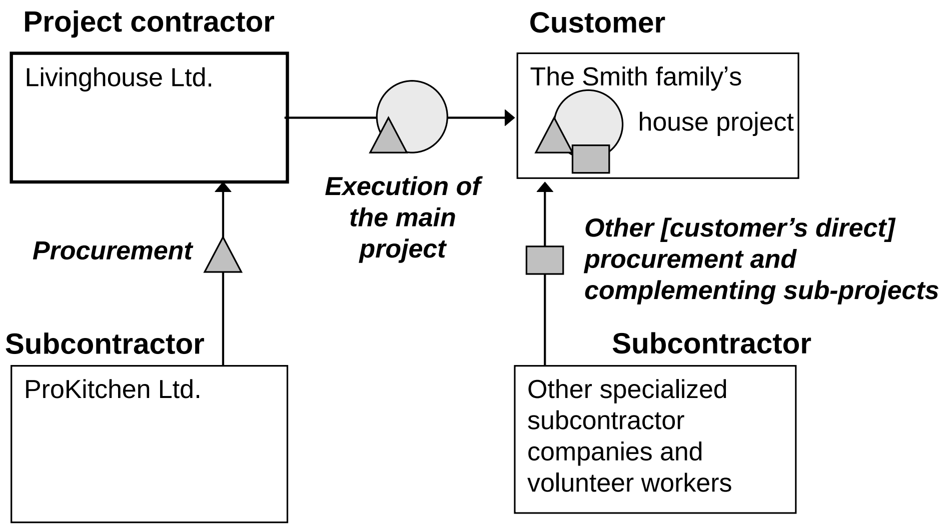


Figure 2. The central actors in the case example and their business relationships

2 BASICS OF PROJECT BUSINESS

2.1 Brief history of projects and their connection to business

Through a process of research and standardization, a relatively coherent worldwide perception has been established regarding factors involved in the management of a single project. The current trend, however, is to study a project as part of a broader context: the entire business of the company and networks of companies. This chapter presents and defines the central concepts of project business: project business, project, project management, project goals, stakeholders, and lifecycle. In addition, various types of projects and concepts similar to projects are discussed. In particular, because projects are performed for various purposes within the broader context of a firm's interconnected business activities, the differences in perspective delivery and investment projects and a variety of development projects are emphasized.

2.1.1 Major historical projects incorporated business concepts

Although research on project business is a relatively new branch of management studies, projects have been created and implemented throughout the world for thousands of years. The development of mankind and society over the past several thousand years is characterized by significant construction projects, the results of which can still be seen: the pyramids, monuments, Roman aqueducts and sewage systems, and fortresses. It is not surprising that projects often have a symbolic, political, or even religious meaning.

Ancient projects, like the construction of the pyramids, required the coordination of a massive number of workers, only a few of whom were so-called managers. The labor force consisted mainly of slaves and others who were compelled to work. Roman slaves were often the property of the government or contractors. Pharaoh Zozer's grave monument construction was completed in 2780 B.C., under the project management leadership of Imhotep, the first pyramid architect and engineer, one who introduced the theory of pyramidal architectural structure. Pyramid Cheops was completed in the year 2650 B.C. It stood at a height of 148 meters, consisting of 2,300,000 stone elements. More than 100,000 workers worked on the project over a twenty-year-long construction period. The work crew was changed every three months. Already apparent at this early stage of project history is use of equipment and tools designed to increase work efficiency.

Purchasing and contracting practices were in use early in history. Contracts were often awarded for complete or partial construction projects. Responsibility for building the Roman Coliseum (in about 70-80 A.D.) was divided and awarded to four contractors. Contract documents included detailed descriptions of and information on the work to be conducted, the material to be used, guarantees, and terms of payment. During the Middle Ages (500-1500 A.D.), the objectives for building medieval cathedrals differed from those of the previous large-scale projects, as they incorporated beauty and aesthetic values, not just engineering considerations, as part of the project objectives. In the Middle Ages, engineering and artistic aspirations overrode considerations of urgency; time and money were not dominant constraints and projects frequently lasted a long time, even for generations.

In the 15th to 17th century, planners and executors of large projects relied increasingly on the emerging concepts of engineering science and, typically, they emphasized the importance of timely completion. The role of architects in restoration projects was not only to act as designer, but also as estimator, purchaser, organizer, inspector, and paymaster. Because the commercial sophistication of society developed rapidly, contractual transactions became a significant part of the execution of most projects. As the 16th century gave way to the 17th and 18th, the engineering sophistication of projects increased steadily. The party building the project was now organizationally and contractually separate from the one designing it. This transition gave birth to the professions of professional and consulting engineering, and architecture. Projects, their parts, and related services increasingly became the substance of business exchange.

Table 1 describes the way perceptions of historical projects have evolved over time. The examples provided illustrate the broadening application foci of projects and the increasing importance of efficiency. As well, over time, the connection of projects to fulfilling business goals, and to developing the business, has strengthened.

Table 1. The development of project business associated with historical project examples

Historical projects	View of project and teachings from the perspective of the development of project business
Pyramid and infrastructure projects	Creating – project management of construction coordination
International Viking projects (9th -11th centuries) and other war-related projects	Conquering – advancement, project management on a strategic, tactical, and operational level
Large technical and commercial construction projects in the 16th-18th centuries, involving contractual systems between parties	Problem solving – striving for a better solution; using problem solving from a business perspective, making activity more effective by collaborating in networks of companies
Projects related to technological development, e.g. the development of the telegraph and telephone systems	Developing – implementing a change that strongly affects the business content and procedures of a project (e.g. changing a product, goal, market mechanism, and organization or procedure)

2.1.2 Moving from project management toward project business

Technical project management, emphasizing planning by engineers and contractual deliveries, dominated far into the 20th century, but by the 1950s a more scientific and methodological approach emerged. The first scientific article on project management (describing systematic way of managing projects) was written in the 1950s, a decade that can be considered the beginning of modern project management.[3] At the same time, techniques to be applied in project management were being developed in various fields.

In the 1960s, techniques applicable to task specification and schedule management were in use, having been developed in various places. Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT), both used for calculating an activity-on-node diagram, were developed separately but for the common purpose of improving project efficiency. In parallel with this methodological development, an organizational and team-centered way of thinking arose, and it became especially significant in the 1970s. Researchers and practitioners discovered that the project team and the actions of the project manager played a critical part in the success of a project. In the 1980s, projects were modeled as larger entities, and computerized tools and followup methods were developed and became commonly used aids for project management. In addition, developments in quality management became linked to project management.

In the 1990s, project management developed a common interface with other business functions, and the business processes related to projects were modeled, emphasizing concurrent engineering, information management, and multi-party cooperation. Projects were being conducted in partnerships, and discussion on project networks started. Furthermore research on project selection and multi-project environments gained momentum. Computerized solutions enabled decentralized projects – projects that could be conducted over geographical borders. The changing emphases or themes used in project management applications in recent decades are summarized in Table 2.

Table 2. Themes emphasized in applying project management in recent decades

Decade	Topical themes
1950	Governance, purchasing, planning
1960	Schedule management, project control systems
1970	Organization, leadership, teams
1980	Models and computerized solutions, quality
1990	Processes, information and communications technology, networking
2000	Collaboration models, virtual organizations, creativity, learning, project business

The collaborative way of thinking that evolved at the end of the 20th century has continued in the 21st century. Today, the creation of virtual organizations and the practice of working in networks are common in many places. Instead of looking at a single project in isolation, a

[3] Gaddis (1959) wrote the first scientific article on project management; however, the modern era of project management is argued to have emerged between the 1930s and 1950s (Morris 1994).

project is viewed in a broader sense as part of its environment. Learning from one project to the other and multi-project management are emphasized. Along with the emphasis on cost effective, technical projects, the need for innovation and creativity has been recognized. Carrying out projects in a broad network of companies brings with it challenges in managing the interfaces between the subprojects of multiple parties. At the same time as the perspective has broadened from a single project to the arena of complex, fast-moving project activity, there is a growing need for project activity and interfaces to become more personalized. Increasingly, trust is required among the people working on a project – trust that people will make the right choices for the project business of the company. Projects are increasingly central instruments of strategic management, not only ways to solve particular technical problems. Thus, projects should be observed in their business environment, not as separate from it.

2.2 Operating environment of project business

2.2.1 Definition and content of project business

Companies do business in order to succeed in the market and fulfill the expectations of their owners and other stakeholders. The business logic can be based upon serial manufacturing or solving the customer's problems, for instance. We can talk about manufacturing business or customer service business, respectively. There are many forms of business, and companies can implement different forms of business simultaneously. *Project business* refers to a company's business or part of its business, in which a goal-oriented change is emphasized.

> Project business is the part of business that relates directly or indirectly to projects, with the purpose of achieving the objectives of a firm or several firms.

The objectives of a company are often related to its survival or success. We use the concept of "firm" or "company" in a broad sense; it can be a corporation, group, private or public organization, association, civic organization, family, or any other organization. When we mention organization, we use the concept of "organization" to refer to the way the activities of a company or project are organized. In practice, the objectives of a company can be related to fulfilling the expectations of the owner, customers, or other stakeholders for growth, profitability, or fulfillment of some type of noncommercial values.

Almost any type of activity that fits the situation can serve to realize the company's objectives. When discussing project business, however, we limit the scope to managed and goal-oriented activity related to projects. Managed and goal-oriented activity means conscious, deliberate, and coordinated choices, behaviors, and procedures. Because this activity serves to attain the company's objectives, there is a direct or indirect link between the activity and the company's strategy. Activity *directly* related to projects may involve, for example, an emphasis on specific objectives of the company during project execution, in addition to the effectiveness of the execution and its accordance to plan. Thus the project itself serves to attain the company's objectives. Activity *indirectly* related to projects can include the efforts to ensure that projects and project ideas are prioritized and guided by the company's strategic objectives. It is necessary, therefore, to review the company's portfolio of projects and make decisions that best achieve company objectives. As implied by use of the phrase, "project portfolio", such a review occurs at the overall corporate business level, not merely at the level of an individual project, and it may involve discarding project ideas that are not sufficiently aligned with the company's strategy, or disrupting or halting projects already in progress because there has been a change in the company's operating environment or a scarcity in resources available to it. Although discarding nonaligned projects is beneficial for attaining the company's objectives, so too is the simultaneous choice of other, more suitable projects.

Projects differ from many other means of organizing activity because of their goal-oriented, temporary, and unique nature. In addition to delivering projects, project contractors often conduct such complementary project-related business activities as offering their customers pre-project consulting services, or post-project services like maintenance, repair, and other support services. The definition of a project is discussed in greater detail later in this chapter.

2.2.2 Various types of project business

Projects serve to achieve the company's objectives and, when studying them, the center of study can be a single delivery, development, or research project, or any other project type, or a larger project group. The practice of management from the perspective of the company is central to all of these project types. A project is rarely a detached part of business, independent of other company activities; therefore, it should be studied as part of a larger entity. Project business can be seen as having two distinct meanings: project business as solutions delivery and project business as solutions development.

(1) Project business involves delivering value-added solutions to external customers. This type of delivery project represents a production (or manufacturing) function in business, which generates added value for the external customer in the form of a solution that solves the customer's problems and satisfies the customer's needs. Solutions may vary greatly; they can range from reorganizing business procedures with supporting information systems to constructing an ocean liner that is customized and designed to the customer's needs. Each project produces unique solutions and, typically, between one project and the next for the same customer there is discontinuity in the customer relationship, the contents of technical solutions, and the production processes. The logic of the business of delivering solutions, therefore, differs from the logic of repetitive, mass production of products or services, which can be described by continuous, repetitive, and seamless flows of materials, information, and money. Delivering solutions to customers' problems through projects involves delivering added value to customers, which, because the customer is willing to pay more for a delivery or solution with more value, often increases the supplier's profitability. Firms that deliver full-scale solutions to customers, typically place strong emphasis on the project-based production or delivery function. The construction industry, for example, is primarily a business sector with projects in construction firms' "production lines". In contrast, project deliveries may be limited to one among many forms of a firm's business. In information technology companies, for instance, one part of the firm's activity can be based upon repetitive mass production of products or automated IT services, another on customer service, and yet another on project deliveries.

(2) Project business may involve developing solutions for the company's own business. Internal projects are a means for developing a firm's business. Development can be seen as an investment. Therefore, in this book, we use the term "investment project" to refer to any internally focused project that is developmental in nature and for which the objective is to realize returns from an investment related to the company's own business. We interpret investment broadly, therefore, investment is not limited to capital investments (e.g. investment into a system or facility), but includes developmental activities (e.g. research, new product development, organizational change, or business process development). One essential part of project business is, therefore, contained in a firm's developmental investment activities. Investment projects contribute to development of the firm's own business through renewing the business by introducing new products or procedures, or through increasing efficiency in existing business procedures. Investment projects that introduce new products or procedures may include ones that modify present products or create new products for the market, with positive implications for the company's growth in revenue, profitability, and market share. Added value is created for customers, for instance, when a company develops and introduces a new mobile phone model in a new product development project. Accordingly, the company's revenues and profits increase when the new product is introduction to the market. Investment projects designed to increase the efficiency of existing business procedures may include improving production processes to achieve increased cost efficiency, acquiring new and more automated production technology, or moving the production to a new production facility. In the public sector, developmental investment projects can be a way to renew a public organization's procedures to provide more efficient and reliable customer service.

In the following sections, project business in organizations is studied both from the (external) delivery project perspective of providing solutions to the customer, and from the (internal) investment project perspective of developing solutions for the company's own business.

Projects are sometimes divided into types, depending on their results. The division can, for example, be:

- constructing buildings, facilities, infrastructure, or equipment;
- developing new products and services;
- designing and implementing new (business) processes;
- changing the organizational structure, resources, or culture;
- developing an information system; and
- implementing a campaign (mission).

Furthermore, there are clear scale differences among projects, and they can be divided into small-, medium- and large-sized projects. A nuclear power plant construction project lasting for several years and requiring billions of dollars in investment and thousands of person years of work, must surely be managed in a different way than a half-year local marketing campaign or the thesis work of one person.

The desire to examine various project types, sizes, and environments, and the drive to develop corresponding management practices, is motivated by earlier research evidence on the context and situation specificity of project management success factors. Project management procedures found to be effective in one environment may not work well in another environment.

Nevertheless, this situation dependence mainly affects the way certain procedures are implemented, and not so much the central ideas of project management. The main tasks, skills, and models of project management are highly similar across various industries and project types.

2.2.3 Investment vs. delivery projects

Projects are used today as means of business in various industries, but their significance, use, and position can differ among companies and industries. The views regarding a single project can differ depending on the party viewing the project and the time at which it is viewed. Project business, and the associated commercially oriented project management practices, is most frequently established in the operating environment of companies implementing large-scale investment projects in such industries as construction, energy, forestry, communications technology, and engineering. In the construction industry, roads, buildings, districts of residence, and renovation work are often implemented as projects. The large investments in power plants and equipment in the energy industry are procured and realized as projects. Equipment procurement and installation in the forestry industry – constructing and implementing or installing a paper machine, for instance – are realized as projects. In this work, the companies producing paper machines and equipment in the metal industry can act as project contractors (i.e. project suppliers) for the forestry industry. In the telecommunications industry, building a communications network and creating a new communications standard can be implemented as a project involving many parties. Projects delivered to an external customer of the project supplier are delivery projects that are connected to the customer's investment project, as described in Figure 3.

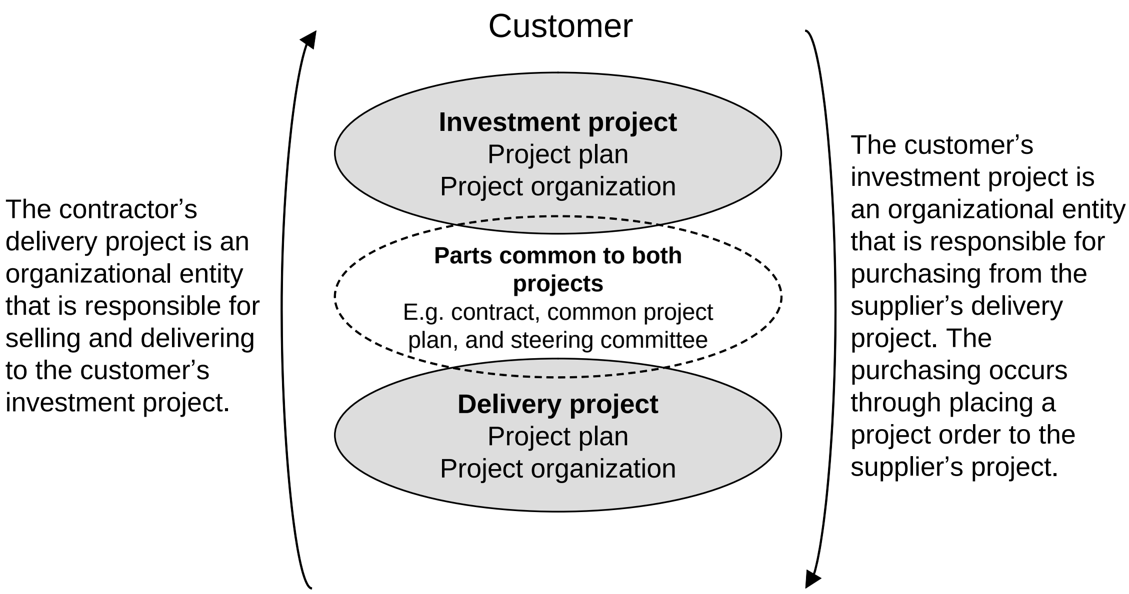


Figure 3. Investment project and delivery project: two different projects to realize the customer's investment

Regarding interconnected investment and delivery projects (Figure 3), both may lead to the same result, but it is a question of two separate projects and project types. The investment project is realized by the customer, who invests in the project and the product that results from the project. The customer anticipates substantial benefits from the investment, and therefore prepares for the project by using thorough goal specifications, feasibility analyses, investment calculations, and other investigations. In order to ensure that it realizes the benefits from the project, the customer is interested in controlling and following the progress of the project. For these purposes, the customer establishes its own project with its own project plan, appoints a project manager, and sets up its own project organization. The customer's project organization concentrates on negotiating and devising the right types of contracts, and on supervising the deliveries, especially if it procures the project largely from external actors.

The supplier or subcontractor has a delivery project perspective regarding the customer's project. The supplier creates and delivers the solution ordered by the customer in the form of a delivery project. The customer's investment project receives the result of the supplier's delivery project. To the supplier, a delivery project is a form of doing business, a form of production activity that entails valuable resources as well as expectations of making profit. The supplier is interested in forming value for the customer and the price is set to serve as compensation. On the other hand, it is in the supplier's interest to realize the project in a cost-effective manner, as cost savings increase the supplier's profits. The project supplier establishes its own delivery project, appoints a project manager, sets up its own project organization, and devises its own project plan.

The difference between the investment and delivery project is highlighted by, among others, the fact that both projects include things that are confidential to the other party participating in the business transaction. The supplier does not disclose to the customer the budget, costs, and profit expectations that it has included in its own project plan. The main, and often the only, financial figure the customer sees from the supplier's bid proposal is the price at which the supplier is prepared to supply the requested product or solution. The customer's cost budget in its investment project plan is calculated based upon the supplier's price. The customer does not reveal to the project supplier the bids of competing suppliers or its own detailed business objectives. The goal of the delivery project is specified on the basis of more general requirements concerning, for example, performance and schedule. Although the objective of the delivery project is to support the customer's goals for its investment project, the delivery and investment projects are fundamentally two separate projects of different scope, each with its own goal.

The investment and delivery projects also have common parts. In the contract, the project delivery is determined and the common terms binding the customer and supplier are recorded, including, in the case of deviations, possible incentives (bonuses) or punishments or penalties (sanctions, fines). The price is influenced by the responsibilities and risks borne by the contractual parties: the greater the responsibility and risk transferred by the contract to the supplier, the higher the contract price. In addition to the contract, a common project plan devised by the supplier and the customer can be used to manage the work included in the project and to ensure that the customer and supplier have a common perspective of the work required. This project plan does not include disclosure of the other party's confidential business information (the supplier's costs for example). In order to support and supervise the work related to the delivery, a steering committee consisting of representatives of both the customer and supplier is usually founded, and it meets at regular intervals.

2.2.4 Development

In such fast-moving industries as electronics, communications, IT systems, and biotechnology, it is abundantly clear that there has been an increase in the importance of project business because projects in these industries tend to be visible as fast and powerful development activity, often involving rearrangement of value chains. Projects are a means to create the desired system or solution, and systematic project management is used to decrease the risks of activities undertaken during the development phase. In the service, chemical, transport, food stuffs, and process-based metal industries, projects have typically been used as a means of developing the organization and its methodologies. As a result of a development project, current activity can be made more effective or completely new business can be generated. We use the term “research and development project” (R&D project) in this context.

Research projects and development projects differ in nature (Figure 4). A research project and a development project can relate to the same content, but the uncertainty included and the goals and results of the projects are different. Research projects aim at creating new knowledge or finding applicable knowledge. Research often occurs in uncertain areas in which it is difficult to know beforehand what the exact results and benefits would be. A research project can be rated as highly successful even though the result would be knowledge that the application of some technology is impossible. In addition to answers and completed solutions, new questions, problems, and opportunities are welcome results of research projects.

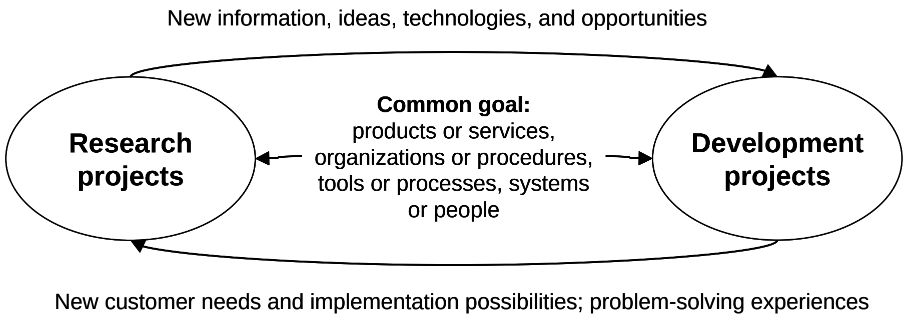


Figure 4. Research and development projects: common goal, different time span

Development projects aim at applying knowledge to create new products, services, solutions, competences, or functionalities, or to enhance old ones. The uncertainty present in development projects is lower than that of research projects, and result expectations of development projects can be determined more specifically. A development project, therefore, may lead to the creation of a new business or product, or the enhancement or elimination of an old one. Criteria can be set beforehand to determine the success of the project. The target of both research and development projects can be a product or service, organization or method, tool or process, or system, or people.

With few exceptions, research and development projects involve an investment for which the benefits, results, and total costs are difficult to predict. Nevertheless, this common occurrence does not mean that one should compromise the goal-orientation and planning activities typical to projects. On the contrary, concentrating on the right things and applying effective methods are success factors in both production and development.

2.3 Project

2.3.1 Definition and content of a project

Projects are assigned many and sometimes contradictory definitions in modern society. Projects may involve a single task common to several parties, a temporary organization, an goal-oriented and defined continuum of activities, or a problem that is scheduled to be solved.[4] For some organizations, a project can involve a general management environment, in which the task is to deliver one or several results included within a business plan.[5] Some definitions of project content emphasize that a project is a unique assignment with respect to such requirements as scope, time, cost, and quality.[6] Other definitions emphasize that, in contrast to other assignments, projects have a separately defined project organization.[7] According to many definitions, projects differ from other types of activity in that they have a beginning and an end – a project does not last forever.

These partial definitions are not mutually exclusive; a project can actually be observed from many different perspectives. Figure 5 presents three parallel perspectives on a project.

- A temporary organization refers to a project organization founded solely for purposes of completing a certain assignment; it is dissolved when the task is completed and the members of the project organization are released to other tasks. According to this perspective, a group of people best suited to do the job is formed for each assignment. This perspective emphasizes, in addition to the possible competences of the people working on the project, a responsibility perspective, in which it is assumed that the project will be completed well or badly, directly as a consequence of the project organization. Organizing a project and managing a project team are discussed in Chapter 5.
- Product or work structure refers to a project that can be seen through the product or work completed as the result of a project. The product produced can be divided into subproducts, forming a product structure. As well, the work done in a project can be divided into a hierarchical description of smaller and more easily manageable units. A term used to captures this type of hierarchical description is work breakdown structure (WBS), which is presented in Section 4.2 as a method related to managing project scope.

---

[4] Lewis (1995)

[5] Prince2 (2002)

[6] IPMA (2006)

[7] IPMA (2006)

- Activities or a phased process refers to a project that has dependencies related to activities and phases, the order between which makes it possible to manage the project schedule. The project lifecycle, dealt with in Section 2.7 of this chapter, provides a phased perspective of a project. In Section 4.3 on the management of schedule and resources, the character of a project as scheduled activities and the interdependence of these activities are emphasized.

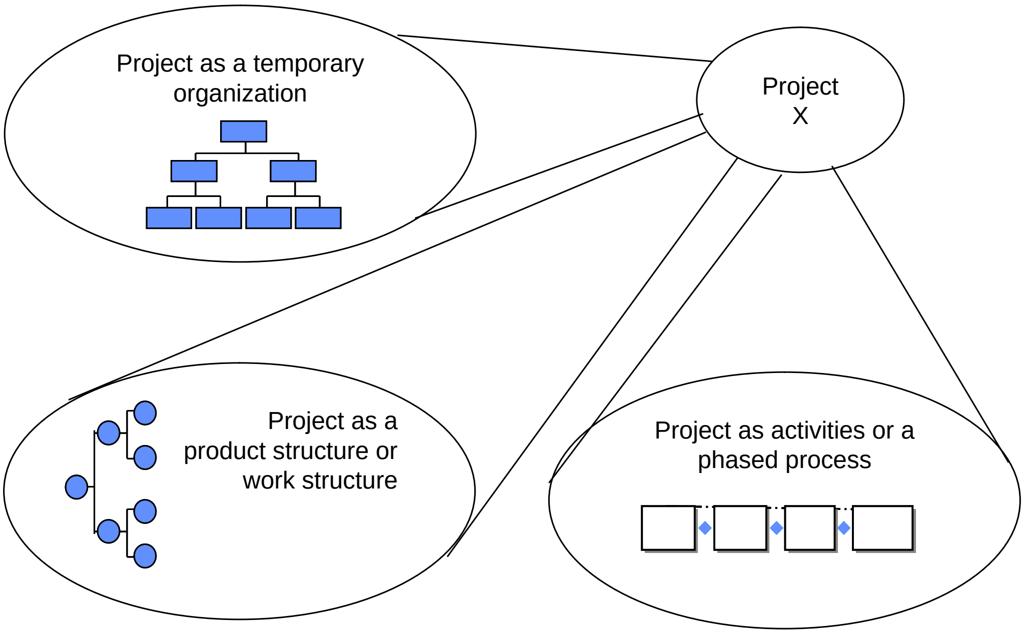


Figure 5. Three perspectives on projects

In this book we adopt a widely accepted definition of a project, which includes some of the factors previously mentioned.

A project is a unique entity formed of complex and interrelated activities, having a predefined goal that must be completed by a specific time, within budget, and according to specification.

A project often has a predefined goal – a goal related to the very purpose for which the project is originally founded. The project goal is a desired future state that is expected to be achieved through completion of the project. The goal of a project is to change the status quo. A project's goal definition includes interpretation of the business-oriented or strategic goal set for the project, thereby providing a clear direction for the customer's and the supplier's activities within the project. The goal may be described at a general level, like a mission for the project, and the interpretation of the goal becomes sharpened when the resulting product, required work, resources, cost, and time requirements are defined.

The characteristic that usually distinguishes projects from other types of activity is the *uniqueness* of the activity structure (unique entity) comprising a project; no project has an identical sister project. Uniqueness can be caused by various factors:

- The project goal and the resulting product differ from the goals and products of earlier projects.

- The way the project is realized, or the project organization differs from earlier projects.
- A similar project has not been realized in the same circumstances.
- The product resulting from the project is made according to specific customer requirements, or the project is to be planned and conducted with the customer in such a way that the needs and requirements of the customer are continually being considered as the project progresses.
- New suppliers are used in the project, or the project's stakeholders differ from previous projects.

A project is **complex** because its activities are not typically predictable, nor can they be repeated. The repetition of simple activities is characteristic of serial production but complex activities, as occur in a project setting, are often new ones, and special skills, creativity, constant evaluation, and clear decision making are required in order to execute them effectively.

An **entity formed of interrelated activities** requires that project activities be conducted in a certain order. The activity can be defined by the work that forms the activity. Activities can be ordered into a logical entity based upon precedence and succession relationships. In addition, the dependencies and relationships among activities form an essential part of the complexity of a project.

A project is **limited in time** (by a specific time), in that it has a predefined schedule, which includes a starting point and an ending point at which the product resulting from the project must be ready and available for customer use.

A project is always **limited in cost** (within budget), signifying that in any project there is a limited possibility of consuming resources like labor, time, and money; a project must be completed within a predefined *budget*.

The **according-to-specification** requirement indicates that the product produced as the outcome of the project must have a specific *scope*. The product resulting from the project must fulfill the technical and operational *specifications* that have been set for it. Such specifications are based upon the needs and expectations associated with the project, and are agreed upon beforehand between project supplier and project customer. *Scope,* therefore, refers to a predefined product that, in turn, causes a *change* that achieves the project *goal*.

2.3.2 Projects compared to continuous processes

Table 3 illustrates the concept of a project. It highlights the differences between projects and continuous processes in a simplified, yet slightly intensified, manner.

Table 3. Differences between projects and continuous processes

Distinctive features	Projects	Repetitive processes
Requirements that the business environment imposes on the activity	Flexibility, renewal, change	Durability, continuity, predictability

Relationship to change	Aims at an extensive change by creating disequilibrium between status quo and the goal	Aims at an incremental change by maintaining and seeking a balance between various requirements
Target, scope	Unique solution according to customer need	Products and batches according to volume and efficiency goals
Time limitation	Limited in time	Continuous
Resources	Specific and varying resource needs according to purpose (scope)	Stable and constant resource usage
Budget	Budget according to purpose (scope)	Annual budget allocation, production volume-dependent or batch-specific budgets
Perspective on effectiveness and efficiency	Doing the right things (effectiveness), seeking novel solutions and differentiation	Doing the things right (efficiency), seeking cost-effective execution and cost reduction
Directing people to assignments	Project goals set specific needs for individual skills; assignments may vary as the project progresses.	Job descriptions and roles regulate work; assignments are relatively stable and predefined.
Predictability of results	Results are uncertain and susceptible to risks. Experience increases ability to take risks; risk management helps in predicting results.	Results are predictable and can be anticipated. Information from previous repetitions allows predictability; risks are minimized through repetition and through reliance on learning curve.

2.3.3 Project-related concepts

The concept, nature, and content of a project can be further discussed by employing closely related concepts – program, contract, assignment, task force, team, job, and task. These concepts are characterized in Table 4.

Table 4. Project-related concepts and their characteristics

Concept	Connection to the concept of project
Program	Program implies a large project or usually an entity formed by several projects; the projects in a program are interrelated and they all contribute to a common goal for the entire program. The term “program” is frequently used in public administration and in research and development environments.
Contract	A project contract is typified by a fixed price, a detailed specification of scope and related work (product or work breakdown structure, see Section 2.3.1), assignment of responsibility and risks to be taken on by the supplier, and details about the customer-supplier relationship. Contract is a term especially used to describe projects in the construction industry.

Assignment	An assignment is a task that one party gives to another to be accomplished according to some predefined terms. A project is one type of assignment.
Task force, team	A task force or team refers to a group of people brought together to accomplish a certain task; the group's task may be to realize a single project, using the authority specified for this task. The task force (or team) is typically part of a temporary organization (see Section 2.3.1) created to achieve the goal of a specific project.
Job	A job can be a narrow or broad entity, perhaps as broad as a project; that is, a job can be accomplished through a project. A job can also include specific work or activity elements that comprise the project's work breakdown structure or its phase or activity structure (see Section 2.3.1).
Task	Broadly defined, a task relates to the mission or the reason for which the project exists. Projects, programs, assignments, and teams can be founded in order to accomplish a certain broad task, like fulfilling a certain customer need. In a narrower definition, a task can have a meaning related to the accomplishment of a specific detailed work or activity element, or a job in its narrower sense. Detailed work breakdown structures or activity structures of a project (see Section 2.3.1) can be considered to consist of specific tasks.

In addition to projects and programs, two closely related terms are often used for projects: assignment and contract. Assignments can refer to almost any matter that is agreed upon between two parties. Contracts deal most often with fixed price, complete deliveries in the construction industry.

Project-type work is performed in working groups as separately named tasks or jobs. Each project has a team, tasks, and jobs, but these entities or activities need not be implemented as projects. Small, usually simple, repetitive entities can be referred to using the terms "task" or "job" (or "development task" or "deliverable") without project management being implemented. A project is therefore not any type of task, it is not ongoing and repetitive work, it is not an entity independent of its environment; nor is it an entity accomplished only as an occasional collaboration between parties. The temporary, goal-oriented type of work that is closely related to projects is usually conducted under the names of task force, committee, or consortium work, and such near projects vary considerably in scale (size), scope (product features and functions), specificity of objective, complexity, and uniqueness.

Activity entities formed of several projects that have large-scale scopes and long execution times are called programs or strategic programs. We define a program with three distinct characteristics:

- A program is an entity consisting of multiple and interrelated projects, all contributing to the program's common goal.
- A program has a start and an end, a predefined goal, and a specific, reserved budget for its execution.

- A program's goal is typically related to large-scale or complex change, which often implies that, at the outset, the goal can only be defined as a mission, and all projects required for goal achievement cannot necessarily be defined yet; therefore, the program's objectives and required projects are often specified in more detail as execution of projects within the program unfolds.

Examples of well known programs are the US Apollo program, in which several manned and unmanned flights to the moon were accomplished between 1963 and 1972; the US strategic defense program (so-called Star Wars) in the 1980's; and the EU-funded national and international programs to develop the EU area. A common example of a program implemented by many international companies is the adoption of a global operations management system in all daughter companies of the multinational firm. A program has a common overall goal; but because of the complexity and duration of the program, the goal may be specified only on the level of an overall mission, not as detailed specifications. A program consists of several projects, each of which has its own objectives, schedule, and content-related task that serves the common goal. All the projects in a program are not necessarily initiated at the start of the program because they may not be known. It is beneficial to coordinate the program as a whole not only because the program has a common goal, but because often there are significant dependencies among the projects in the program. The same type of project management methods apply in programs as in individual projects. In addition, in managing the program, particular attention must be paid to managing the dependencies between the program and its environment, the dependencies internal to the program, and the related coordination, communication, information management, and decision-making aspects of the program.

2.4 Project goal and objectives

As defined a project has a predefined goal.

The project goal is a desired future state pursued through the completion of the project.

A project goal:

- describes the meaning for the project – the purpose for which the whole project was founded;
- describes the *change* to be brought about by the project; and
- acts as a starting point for specifying practical project *objectives*.

The three project objectives are: what is to be done (scope objective, product), when it is to be done (time objective), and with what costs and resources it is to be done (cost objective); the cost objective can also be considered to include qualitative aspects of resources or the project organization – who is going to do it.

When defining the project goal, the business expectations and objectives set for the project are emphasized. According to the definition of project business, the activity related to projects must serve to fulfill the company's goals. If one of the fundamental business purposes of a delivery project is to improve or maintain a customer relationship, it is essential that this fact be written down (in the scope definition) when the project objectives are specified. Similarly, if a company’s central objective for its product development project is to develop a new mobile phone model and launch it on the market quickly before competitors do, thereby assuring market share, this central objective should be written down as part of specifying the project’s objectives. Setting such business-driven goals, helps in the specification, prioritization, and reprioritization of a project’s more specific objectives.

The desired change reflected in the project goal is directly linked to the product being realized in the project, because the product effects the change. The product resulting from the project belongs to the scope objective. The benefits from the change should be available at a certain predefined time, and they should be larger than the costs invested in the project. These requirements set restrictions on the length of the project schedule and the size of the project budget.

As shown in Figure 6, the three objectives of a project can be derived from the project goal and the restrictions on time and cost. The triangulated scope, time, and cost form of presentation symbolizes that each point of the triangle is dependent on the others, and that project results are achieved as a joint effect of all three objectives.

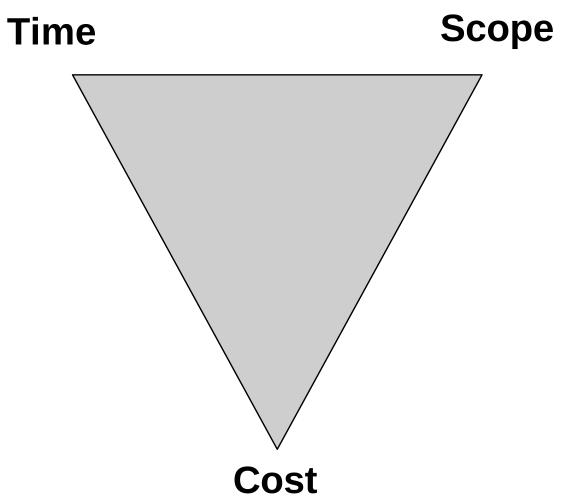


Figure 6. Project objectives

The scope objective is related to the product specifications, including technical and functionality requirements. The project scope objective is described as the *product* being realized as a result of the project and the related requirements that are set for it. The requirements applying to the product are presented as physical or functional parts of the product – as a *product breakdown structure (PBS)*, for example. The scope objective includes the technical, functional, and qualitative features of the product resulting from the project. Technical features can, for example, concern components, materials, measurements, and structures. Functional features include performance, usability, and maintenance. Qualitative features refer to factors that are not directly connected to the production and functionality of the product, but which increase its value to the customer. Examples of such features are the outer appearance and image of the product.

The *product* resulting from the project is a solution by which the project goal will be attained. This *product* can be partly or wholly tangible (material, physical, or concrete) or intangible (nonmaterial, nonphysical). The intangible parts of the product may include ways of working, instructions, services, plans, and processes. The resulting product from an organizational development project can be purely intangible or nonmaterial: it can be a new way of working that personnel should adopt. On the other hand, tangible, material, concrete, physical products like a power plant delivery often include many such intangible or nonmaterial elements as implementation services, instructions, and programs. It is noteworthy that the *product* resulting from the *project* differs as a concept from the *product* the *company* produces and sells to the market.

The time objective relates to the time restriction in the definition of a project, and is reflected in the project's predefined *schedule,* which indicates when the product resulting from the project should be ready and available for the customer to use. Time is clearly a constraint for a project: one cannot stretch calendar time. The time consumed by single activities can be affected by a variety of variables like increasing resources or the use of more experienced resources, which, in turn, has its effect on costs.

The cost objective is linked to the aspect of project definition that stipulates that a project should be completed within predefined financial resources – i.e., within a predefined *budget.* Budgets, such as a work-hour budget, are also prepared for nonfinancial resources. Indeed, it is usually not sufficient that only financial resources are devoted to the project: in addition to the monetary figures, it is crucial to indicate who is going to do the project work. Therefore, the qualitative aspects relating to use of skillful resources or experienced project organization are key, and the cost objective can be broadened further to encompass these qualitative dimensions of the project.

In Figure 7, the cost objective includes a business-related profit objective: in the end the project customer who receives the benefits from achieving the scope objective, pays a price for the project delivery. The magnitude of the price is related to the value produced by the project, and this payment provides sales revenue to the supplier. The project supplier should define cost objectives and, simultaneously, it should budget for revenue from the project. In this way, a delivery project should achieve the profit target, set as the difference between revenue and costs.

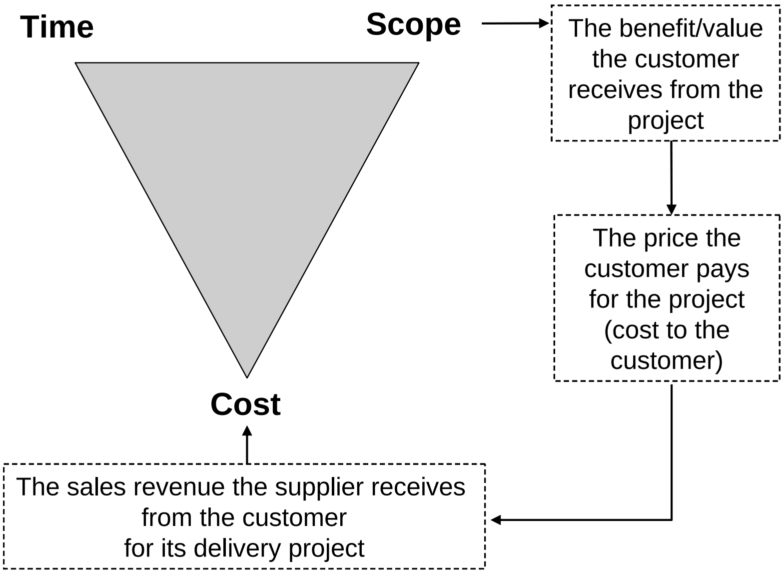


Figure 7. Project objectives: profit objectives are related to the cost objective

The three project objectives are tied to each other. The time and cost objectives of a project may restrict the characteristics that the scope objective indicates should be included in the product. Similarly, decreasing the time objective may cause increased costs or require that some aspects of the scope objective be forgone. Because the objectives are tied to each other and can be in conflict with each other, the objectives should be prioritized.

Example: The goal of a house construction project

The Smith family lives in London, Ontario; it comprises father (Larry), mother (Sally), and two rapidly growing children (a boy Eric age 7 and a girl Lara age 9). The Smiths are a prospective customer for Livinghouse because they intend to embark upon a house building project, thus fulfilling a longstanding dream. This project gained momentum a year ago when Larry's employer agreed that he could spend the bulk of his day working at his mid-management analyst job from home. Although Larry's place of work changed, Sally continued to work as a technician in the local hospital. Working from home was a new experience for Larry, and it rekindled his concerns that their current small, two-bedroom apartment was too confined to properly accommodate a family of four people. He and Sally discussed their current accommodation situation and agreed that it was time for a change. They both felt that they needed a larger living room and a more suitable place than the hall floor for the children's toys and sports gear. Sally wanted to have at least three bedrooms so that the rapidly growing children, Eric and Lara, could each have their own space in the home. In short, Larry's changed work arrangement and their growing children's needs provided an impetus for Larry and Sally to reopen discussions about their mutual dream of having their own new home, a discussion that began before their children were born.

For most families, building a house represents the largest financial investment made in a lifetime and, typically, it affects the life of the family for decades. Larry, Sally and the children discussed the matter at a general level several times. The parents collected basic information from a variety of sources on different housing models and house construction projects. After long consideration, and aided by the fact that the family has recently inherited a house lot (plot of land) in a residential suburb of London, Larry and Sally decided that it was the right time to fulfill their longstanding dream by building and moving into a larger home.

The Smiths decided to have a single-family house constructed. As an early step, they discussed financing with officials at their bank. Because of their savings to date, combined with the level and stability of their careers in mid-management and technical jobs, they were able to get preapproved financing; the bank agreed to lend them the money. At first the funds would be available to the Smiths in the form of a house-building loan that would be used to make progress payments as the construction project proceeded. Upon completion of the house construction project, the loan would be transformed into the form of a house mortgage. With the financing arranged, the Smiths recognized that their dream project would not be planned in vain.

The Smiths' project goal is to live in a new, quality single-family home that is larger than their current apartment. Their overall project goal can be broken down into specific scope, cost, and time objectives. The time objective is clear from the outset of the project: although the bank will allow the Smiths up to two years to have the house completed, the Smiths want to be able to move into their new house within a year, that is, by the following summer. Further work is needed before the specifics of cost and scope objectives can be delineated, however, it can be noted that these two objectives may affect the time objective.

2.5 Project management

2.5.1 Definition of project management

The most central challenge in planning and executing projects is for them to achieve their goal, expectations, and requirements. A project's success is affected by its content and by a variety of technical, social, and financial matters in its environment; but project management and applying appropriate, systematic management practices and methods, are common success factors in all types of projects. The majority of traditional project management literature concentrates on the planning, management, and promotion of single projects. Such elements of project management can be reflected in the definition of project management. Project management is defined as follows.

Project management is the application of management practices aimed at achieving the project goal and objectives.

Management practices include all knowledge, skills, methods, and tools that are needed to achieve the project goal and objectives. The management practices applied during the project, and their emphases, may vary at different phases of the project.

Concerning **achievement of the project goal and objectives**, it is crucial to ensure that the project goal and objectives are defined in a way that the needs and expectations of project stakeholders are taken into account. Project management should aim at fulfilling various stakeholders' needs, demands, and requirements, and ultimately at achieving stakeholder satisfaction. Therefore, communication and information exchange, internally within the project and externally with stakeholders, is a critical part of project management. Such communication helps to articulate various stakeholders' needs underlying the definition of project goal and objectives, and may serve to change stakeholders' expectations and requirements related to the project. Furthermore, employing an effective project communication strategy assists in cultivating a strong supplier-customer relationship, further enhancing stakeholder satisfaction.

Any project has several stakeholders that and they usually differ regarding their needs for and expectations of the project. Project stakeholders are all the various parties – organizations, associations, official and unofficial institutions and consortia, and the people that represent them, as well as other private persons – that are affected by the project or that have the chance to affect the project and its success. Fulfilling the needs and expectations of stakeholders usually requires balancing multiple and possibly contradictory demands. The stakeholders' demands are related to different objectives and they can include identified needs or unidentified expectations. Although the project goal promotes the objectives of the project customer (the customer is always one of the most important stakeholders), the project, if it is to be judged a complete success, must also satisfy the needs and expectations of other stakeholders. The project team is a key project stakeholder; the team affects the efficiency of the project at hand, and is the key vehicle for incorporating learning that may lead to greater success in executing future projects.

In the literature, and among project management professionals, several slightly different but complementary perspectives are presented to form an understanding of the character of project management, as shown in Figure 8.

- Project management can be described as knowledge areas and processes that deal with matters and practices that have been identified as important for the success of a project.[8]
- Project management can be studied as the competences and characteristics of individual people (principally the project manager) that have been identified a critical to the success of a project. [9]
- Project management can be studied as directions, tools, or documentation in which essential matters to do with the implementation of projects have been collected. [10]

---

[8] Project Management Institute (1996, 2000, 2004, 2008) Body of Knowledge; APM, Association for Project Management (1996, 2000, 2006) Body of Knowledge; ISO 10006 (1997) Guidelines to quality in project management; also different types of maturity models.

[9] IPMA (1999, 2001, 2006) International Project Management Association: Complete Baseline; also PRINCE2 (2002).

[10] For example, company guidelines and an IT system provider's applications.

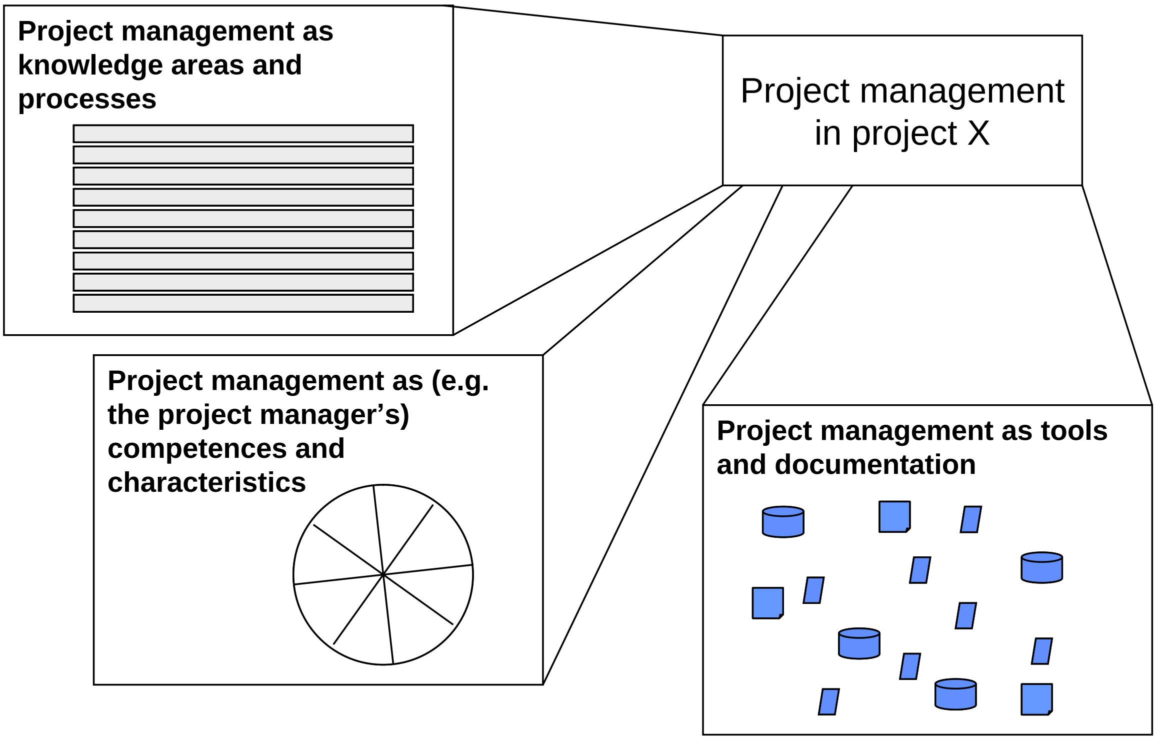


Figure 8. Three perspectives on project management

2.5.2 Project management as knowledge areas and processes

The first and most well known perspective on project management studies project management as knowledge areas that project management should cover. International project management organizations have built their own project management guidelines upon these types of knowledge areas. Project management consists of characteristic project management procedures, methods, and tools.

1. **Project integration management** refers to the procedures that integrate various parts of the project and its management, procedures that help to complete the project as an entity according to objectives. Integration management includes the management of dependencies among various parts of the project. Specifying objectives initially and during the course of the project, and change management, are also parts of integration management. The project plan is a central integration management tool.

2. **Scope management** includes procedures to ensure that the product resulting from the project fulfils the requirements that have been set for it and that the product is realized efficiently, without any extra or needless work [the project's product characteristics are defined in the product breakdown structure (PBS) and the required work are defined in the work breakdown structure (WBS)].

3. **Schedule management** ensures that the project can be realized and finished in the agreed-upon and planned timeframe. Tasks in schedule management include specifying activities (work breakdown structure) and their length, specifying the dependencies among activities, controlling the schedule, and managing changes.

4. **Cost management** includes activities that involve the estimating of project costs, budgeting, and monitoring costs – activities that help ensure that the individual project is profitable and cost effective and supports the overall financial position of the company.

5. **Resource and personnel management** refers to the timely availability of resources, their sufficiency, and their effective use during the project. Resource management supports schedule management, because scheduled tasks require both time and resources. Tasks which are particularly related to personnel management include designing the project organization, identifying tasks and assigning responsibilities, acquiring project personnel, and developing collaboration in the project team.

6. **Communication management** involves transfer of information to and interaction with various internal and external parties and stakeholders.

7. **Risk management** is managed activity by which project risks are identified and evaluated, and the measures affecting risks or related to avoiding or taking risks are planned and realized.

8. **Procurement management** involves the search, choice, and use of resources external to the project or company, managing procurement-related contracts and collaboration, and monitoring deliveries.

9. **Quality management** includes quality design, assurance, and control – measures intended to ensure that the project fulfils the requirements that have been set for it.

A perspective closely related to these knowledge areas features a discussion of project management processes. The International Organization for Standardization (ISO) standard, ISO 10006, includes instructions for project quality and project management processes that are, in practice, the nine knowledge areas we have presented in this subsection. Thus the project management knowledge areas are naturally linked to a company's quality systems. The content of these knowledge areas is further discussed in Chapter 4.

2.5.3 Project management as competences and characteristics

Recalling that knowledge areas and processes referred to the things that should be covered and implemented well in project management, project management can also be treated as competence, i.e., the knowledge, skills, attitudes, and characteristics that the people doing projects should have or do have, and the behavior that is needed for project success. Project management has been approached from a competence perspective, especially by IPMA.[11] The PRINCE2-model[12] also relates to the competences and behavior of project actors, although it includes discussion of processes. We now discuss some characteristics of competence-based thinking, and these matters are explored further in Chapter 5.

---

[11] IPMA (1999, 2001, 2006)

[12] Bentley (2001), PRINCE2 Guidance (2002)

An important aspect of competences is related to their **content**, which can be aligned with the aforementioned knowledge areas and processes or with the behavior of the project manager in the various phases of the project. As a simplification, the content of the competence requirements of a project organization can relate to working as a project organization, the relationship and interaction with the surrounding organization, and the relationship with the external operating environment. In addition to project management competences, there is a need for technical, business, and other competences related to the product resulting from the project; the product is often field specific and is omitted from discussions on project management competences, although the competence in the actual technical substance area of the project's product is key to successful project management. Slightly different competences are needed and used in the various phases of the project.

Various types of competences can be identified, and a distinction is often made between skills, knowledge, attitudes, and personal characteristics. On occasion, the concepts of performance and result competences arise, signifying the result that is created from the use of knowledge, skills, and attitudes. Knowledge – a formal competence that masters certain matters – and skills – the ability to complete a certain assignment – are visible competences. Personality traits, motives, values, and self impression of an individual are part of the attitudes and characteristics theme. These factors guide the individual's interpretations of a situation; they help determine what knowledge and skills the individual applies to a situation at hand, and influence the way the knowledge and skills are applied.

In models aimed at certifying the competences expected from project managers, competences are specified on three **different levels –** for a beginner as project manager, for a project manager experienced in a certain field, and for a project manager that has worked in a broad area of application environments. In practice it has been noted that the more demanding the project entity, the less project managers utilize specific specialist competences and the more they need competences in general management, particularly, business, interactive, and conceptual competences. [13] As different types of competences are required on different levels, the project manager should be able to utilize the competences of the project group and other stakeholders in a suitable way. From the perspective of the entire project, in determining project results, the competences among the team members as a group can be more relevant than are the competences at the level of individual people.

It is relevant to question how **centralized** or **decentralized** the competences are. At a group level, it can be noticed that part of the competences are individual and therefore can be centralized. Typically, some individual competence requirements are placed on the project manager, and it may be easier for the project manager to delegate certain duties than others. Some of the competences are shared, so that nearly every member of the project team can have a similar competence. It can be required for all members of the project team be capable of documenting their own work, for example. Additionally, some types of shared competences may exist; such competence is created in the interaction and collaboration of several parties, and does not reside within individual people. A weekly meeting or brainstorming session can become such a shared competence.

[13] Vartiainen et al. (2003)

In addition, we can talk about **current competences** and **target competences**. The project manager and the members of the project team have acquired some current learning based upon earlier training, experience, and background. The projects and challenges that a person takes part in can require deeper competences or other types of competences, which we can call the target competences. The difference between current and target competences describes a learning or development challenge that can be met with the help of education, practice, and other factors.

Under the competence perspective, a fundamental basis for professional project management rests on the assumption that the project management practices that have proven effective and are used efficiently have been identified and clearly specified, and that they are being implemented. Project managers are the primary group to whom this thinking is applied, and the division into competence levels can be used for educational, certification, and evaluation purposes.

2.5.4 Project management as tools or documentation

The third project management approach is clearly more instructional and tool oriented than the others. Many companies have developed their own project management models and practices comprising different tools and agreed-upon documentations. Project management is charts, visualization tools, worksheets, and tools that are used to decrease the uncertainty and chaos related to projects. Examples of project management tools are:

- **forms**, such as those for project description or intermediary reports;
- **instructions**, such as those for project planning or project management;
- **checklists or templates**, such as those for project initiation or contract outline; and
- **techniques for planning and followup**, used for, among other things, the management of schedules, resources, and costs (e.g. Gantt chart, S-curve, activity on-node diagram, critical path method, or earned value method).

In addition to general purpose office programs, a number of special project management tools have been developed with the help of IT solutions and systems. Many other tools and techniques are used in project management when studying projects and their lifecycles in a broader manner as part of a company’s business. Computerized solutions and other tools have been developed for such tasks as the management of finances, resources, customer relationships, and many other parts of project business.

2.6 Project stakeholders

2.6.1 Definition of stakeholder

A project has various stakeholders that have expectations for the project; the project may affect stakeholders’ actions, and, in turn, these actions may affect the course and ultimate results of the project.

Stakeholders are individuals, groups, or organizations that the project may affect or that can affect the project.

Stakeholders can have a direct or indirect connection to the project, or to the resulting product. The connection can be based upon a possibility to affect the result of the project directly or indirectly. Stakeholders also include the groups that the project affects but that do not necessarily have the opportunity to affect the result of the project. These groups can nevertheless have an indirect connection to the business; they can, for example affect the company image formed in the market.

The needs and expectations of project stakeholders should be identified at the stage of defining the project goal and objectives, as discussed in Section 2.5.1. In addition to taking stakeholders' demands and requirements into account in order to affect their fulfillment, project managers can control the expectations of stakeholders by communicating with them. If a stakeholder is left unnoticed, risks may arise that can later disturb the progress of the project. It is not always self evident which of a project's many possible stakeholders are relevant targets for communication. The effects of a product development project on stakeholders may be highly variable, for example. Are the parties taking care of product disposal, and are the people working on the production line always taken into account?

Typically all projects have at least the following stakeholders, to which the project has a direct connection.

- **Project manager**: The project manager is the person responsible for the project, for achieving its objectives, and for managing its implementation.
- **Project organization**: Project organization is formed by the people, groups, and companies taking part in implementing the project. The project organization is assigned a structure, responsibilities, and procedures. Usually a project organization includes at least a project team, a steering committee, and a customer; suppliers may be included too.
- **Project team**: The project team is the group of people (usually a small group of core people responsible for the project's areas) who work in a collaborative manner to implement the tasks necessary to achieve project objectives. The project team is responsible for accomplishing project tasks in a manner agreed upon with the project manager, and for providing reports to the project manager on issues that concern the project. The project team members belong to the project organization.
- **Organization unit of the company making the project**: This stakeholder refers to the unit of a company or business to which the project is attached, at least in part; the unit's personnel participate in project execution.
- **Customer**: The customer is an individual or organization that orders the project, benefits from the product resulting from the project, and pays the agreed price for the project, or is otherwise responsible for the costs of the project. All projects have a customer and the customer can be either external or internal to the company.
- **User**: Users are the entity that uses the product resulting from the project. The user is not necessarily the same as the customer. The customer of a power plant construction project can be a business unit specializing in implementing investments in a large energy company, but the operation of the finished power plant can be transferred to the production business

unit that acts as the user. In such cases, the role of the user is significant in specifying customer needs.

- **Buyer**: When the project is made for an external customer, the word “buyer” can be used in place of the word “customer” and, of course, the buyer is responsible for paying for the project cost.
- **Sponsor or project owner**: In projects internal to the company, the customer responsible for the investment decision – or the one acting as financer for the investment decision, such as a representative of top management – can be called a project sponsor or project owner.

The project has a number of other possible stakeholders to whom the project has a direct or indirect connection, including:

- **suppliers and service providers,** such as subcontractors or other project parties;
- **officials and authorities** (usually public parties) that regulate matters related to the operating environment, implementation of the project, and the product resulting from the project or its components. Such regulation can occur through legislation, reporting and testing requirements, licensing practices for officials, or other mechanisms.
- **financers –** individuals or organizations that invest in the project and expect a profit from their investment, but that do not necessarily own or use the results of the project;
- **media –** communication sources and channels through which the larger public, or a certain target group, gets information on the project, its results, or other related matters;
- **other target groups,** comprising people and organizations whose business, operating environment, or lives are affected directly or indirectly by the products resulting from the project. People living close to a factory, for instance, are likely interested in its noise levels and environmental effects.
- **competitors,** consisting of other companies offering projects, solutions, and services that can replace the solution provided by the project supplier, or that in some other way compete for the investments of the customer. Competitors can thus operate in the same or different field of business.
- **people participating in the project** whose wellbeing may affect the project or vice versa and such indirect participants as family members who are under the care or influence of these project personnel and may have needs or expectations concerning the time allocation, lifestyle, and income level of the project personnel; and
- **society in a broader sense**. The project’s significance for the state, commune, commercial and industrial life, or employment level can be high. Furthermore, taxation and environmental hazard perspectives can be central. The project can be subjected to political forces and disputes and, in such a case, there may be a need to lobby political decision makers and activists.

This multitude of stakeholders makes it difficult to manage the multiple and varied expectations and requirements of a project. Hence it is critical to emphasize the preliminary phases of a project during which there is an opportunity to build a view of the **common goal** and objectives of the project. The needs and expectations of the customers, users, and financers usually must be considered high priorities, but these needs should not conflict with the factors restricting the project (e.g. requirements of officials and authorities). Other main stakeholders are those who are most visible in a project; they play an active role in the work of the steering committee and the project team.

Example: The stakeholders in a house construction project

Because they are the ones letting the contract for the house construction project, Larry and Sally Smith are both the customers and buyers of the project; they are the future users of the house as well. Many other parties will affect the construction project, including local civic residential building authorities that serve as construction approval officials. These officials are among the stakeholders from the outset of the project because, prior to initiating construction of a single-family home, the homeowners must obtain a construction permit. Other permits and approvals may also have to be obtained from local authorities, particularly if the Smiths need or want to apply for variances in house zoning or other such regulations. Future neighbors are important stakeholders too; if any permit application that the Smiths make involves a variation to existing regulations, the civic residential building authorities must inform neighbors about it before the application is approved. Other matters, such as location of fences, if any, may also be discussed with neighbors. If they so wish, the neighbors can file a complaint or even a lawsuit against the construction permit and this opposition may lead the Smiths to abandon their construction plans or to negotiate and collaborate with neighbors before and during the construction of the house. In the end, the parties must reach a mutually satisfactory outcome that meets regulatory approval.

Financing the project increases the number of stakeholders. Usually, as in the Smith case, a family's personal savings fall far short of the money needed to pay for the costs of constructing a house; financing a house construction project usually requires a house loan from a bank. Thus, the bank is an important stakeholder; it provides the bulk of the money to enable the house to be constructed and usually requires the owners to pledge the house as collateral against the mortgage loan, and the bank holds the primary mortgage. In some instances, the bank requires a guarantor, and, if so, the Smiths plan to ask their parents.

As a consequence of the Smiths' planning and implementation tasks, external experts and contractors, along with their suppliers, become stakeholders in the project. The Smiths' plan to contract with one main or general contractor – the project supplier – who in turn usually uses subcontractors to supply some components or parts of the home. As well, the Smiths' plan to do some of the project tasks and construction work themselves. They are fortunate to have a number of friends and acquaintances that have promised to give advice and help, if needed, on various aspects of project execution. Included among these volunteer workers are individuals who have had their homes built by general contractors in a manner similar to the project the Smiths are embarking upon. Furthermore, a few of these volunteers are experts with considerable knowledge about key components and tasks involved in constructing a residential home, and some individuals are skilled in performing hands-on construction work.

As users of the future house, the Smith children, Eric and Lara, form a stakeholder group; they are the party most affected by the result of the project.

For example, although the construction project itself may be successful, from the bank's perspective the project life cycle continues until the mortgage loan has been paid back. If there are substantial difficulties in paying back the loan or if the bank repossesses the house, the impact on the lives of the children may be traumatic and costly.

2.6.2 Project customer

A project always has a *customer*, be it an external delivery project or an internal investment project. The project customer is usually a company, but it can be represented by a single person or a certain group. The customer and the customer's need is frequently the primary reason for initiating the project, so customer needs and expectations are especially relevant for the project.

As we have mentioned, in the case of an external delivery project, the customer can be called a *buyer*. In small projects, a single person may represent the buyer or customer. If, on the other hand, the buyer is a large company whose operation is strongly affected by the product resulting from the project, there may be multiple influencers and deciders. Consequently the project supplier should be in contact with several of the buyer's representatives; it is essential that the project supplier identify the person or persons in the buying organization who make and influence the critical decisions concerning the project. Responsibilities of both the project supplier (i.e. the delivery project) and the project customer (i.e. the customer's investment project) should be specified clearly to indicate what type and degree of interaction is required from buying and selling parties to achieve the desired result.

The customer for an investment project internal to the company can be called a *project sponsor* or a *project owner*. The sponsor can be the CEO, a representative of top management, or a "patron" appointed by top management. The sponsor makes the investment decision (or at least makes the final preparations for it), requires that the project produce results, and ensures that the money invested in the project be properly used from the perspective of the company.

The *users* are the people, groups, or organizations that are close to the customer; sometimes the customer can be considered to be a user. Users utilize the product resulting from the project in some way. In the case of a paper machine installation project, the users can be the manufacturing unit of the paper factory, the people operating the paper machine, or maintenance personnel. The users of a product development project for a new mobile phone model can be the workers at the mobile phone production line and marketing personnel. The users of an information system investment project can be the people who produce and use the data and tools in the information system to produce services. To some of the users in these examples, the product produced as a result of the project is tangible and directly visible in their workplace, and they may even participate in the implementation of the project. Some of the users do not participate in the implementation of the project but experience the benefits of the project through changes in efficiency, prices, service levels, quality, and other attributes. It is essential to the success of the project that the entire chain of customers and users work as smoothly as possible and that their respective needs and expectations are considered in a timely fashion.

In project cases involving several customers and multiple users, it is sometimes necessary for the project supplier to prioritize the needs and expectations of multiple customers and users. Which is the most important of the parties to be considered: customers or users? Who is the real customer, what is the role of the other customer-like parties, and how should the needs and expectations of these parties be considered? There is no single answer to these questions and no single correct way for the project supplier to act; the supplier can choose from a large variety of emphases, based upon its values, strategy, control structure, and personal preferences. The supplier's emphasis should be transparent so that its personnel and customers obtain a clear picture of its aspirations for the project.

Customers and users can communicate their expectations and wishes related to the project at the beginning of the project lifecycle and at each stage along the process. Sometimes changes in customer's requirements during project execution lead to changes in project content; such changes may precipitate modifications being made to previously agreed-upon, or so-called frozen, plans and specifications. Change management is discussed in Section 4.9.1. In some cases, a customer's individual representatives have conflicting expectations, particularly if the customer organization acts as both the user and the financer of the product resulting from the project. The financer typically wants low costs and high return on its investment, but the user may want expensive operational features, usability, and quality. When participating in a project, the customer may also want extensive communication and reporting, team spirit, smooth project management practices, and an integration of procedures between the customer and supplier companies – attributes that can add to project costs.

2.6.3 Managing stakeholder relationships

Stakeholder relationships should be attended to throughout the project lifecycle and, more generally, as part of the business of a company. Well managed stakeholder relationships bring not only project-related benefits to the supplier company but broader, long-term benefits as well. The same set of stakeholders can be relevant in later projects, so the trust and experience developed during a project may be beneficial in future projects. Less preparatory work may be needed to develop and implement future projects if the parties already know each other. Furthermore, the stakeholders may communicate project experiences to their business associates, and, if positive, this information can be of use in a marketing sense. If the communications are about negative experiences, they may threaten the supplier's future business. Well managed stakeholder relationships may produce good formal references for the supplier, ones that can be useful to it in marketing future projects and in acquiring new customers. Future customers or other business associates may react positively to references a stakeholder has provided regarding a project supplier that has worked in close association with this stakeholder.

Managing stakeholder relationships can be seen as a continuous and repetitive development that consists of, among others, the following subtasks:

- identifying stakeholders;
- collecting information on stakeholders;
- identifying tasks and roles of stakeholders;
- understanding strengths and weaknesses of stakeholders;

- determining a stakeholder strategy;
- predicting the actions of stakeholders; and
- taking practical measures to manage stakeholders by affecting their attitudes and activities, and dealing directly or indirectly with the implications of their activities by, for example, communicating and using power in relations with them, adapting to their demands, negotiating and compromising with them, ignoring or buffering their demands, and building distance from or closer collaboration with them.

2.7 Project lifecycle and project execution

As per the definition of project business, we study a project in a broader environment than simply the perspective of the management of a single project. Although we emphasize that a project has a beginning and an end, it is essential for success in project business that the phases before and after the project are considered, as well as the dependencies among projects in the supplier's project portfolio. Ideation and preparation work are valuable activities to engage in before the project is initiated. After the project is completed, there are a number of key activities and services related to the use and maintenance of the product that resulted from the project. The lifecycle for an individual project is presented at a general level in Figure 9. The predelivery or preinvestment activities in the phase prior to project execution are crucial for designing the project's product and linking it to its ultimate business purpose. Furthermore, the post-delivery or post-investment phase (after project execution) is the time during which the customer derives the actual business benefit from the project product; thus activities in that post-delivery phase may have a major impact on the supplier-customer relationship and on the supplier's prospects for future business with that customer.

Project lifecycle refers to the chain of phases in which the ideas, expectations, and opportunities for a project are identified; the project is executed; and the benefits resulting from the use of the project product are gained and product use is supported.

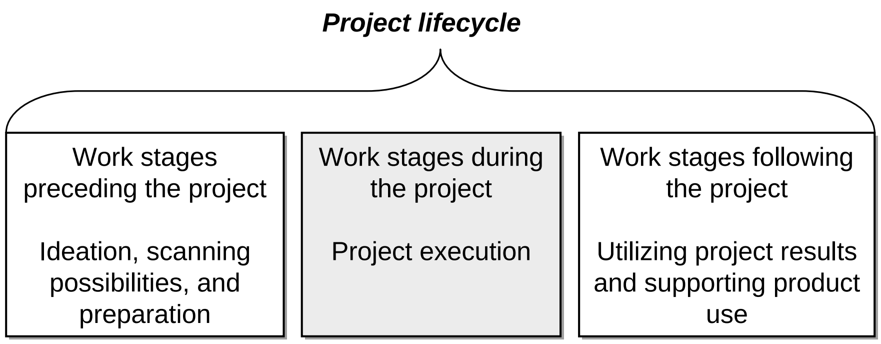


Figure 9. Project lifecycle – general level description

The project is often related to a broader entity, the understanding of which is critical to the successful execution of the project. In delivery projects, it is valuable to understand the importance of the project for ongoing customer relationships. The supplier may have the opportunity to deliver many projects to the same customer, and the support and maintenance services offered to the customer can form a substantial part of the project supplier's business.

2.7.1 Project execution

The actual project consists of different phases (or subprocesses) and the related decisions or reviews.[14] We call this part of the project lifecycle the execution phase. The input to this project execution phase is an identified and, to some extent, planned project possibility or outline, and the output comprises an implemented product that was realized as a result of the project. Project execution includes procedures by which the subproducts and subresults of the execution phase are realized. Figure 10 presents the most common phases of project execution. Each phase has its own objectives, and the results of each phase should be carefully and clearly planned beforehand. A more detailed, project-specific division into phases and the specification of the content of each phase is related to the concepts of work breakdown structure and activity specification; these topics are discussed in Chapter 4, Sections 4.2 and 4.3. To ensure progress, the results and activities of each phase should be visible and demonstrable, and they should be connected to both the scope objective of the project and the product resulting from the project.

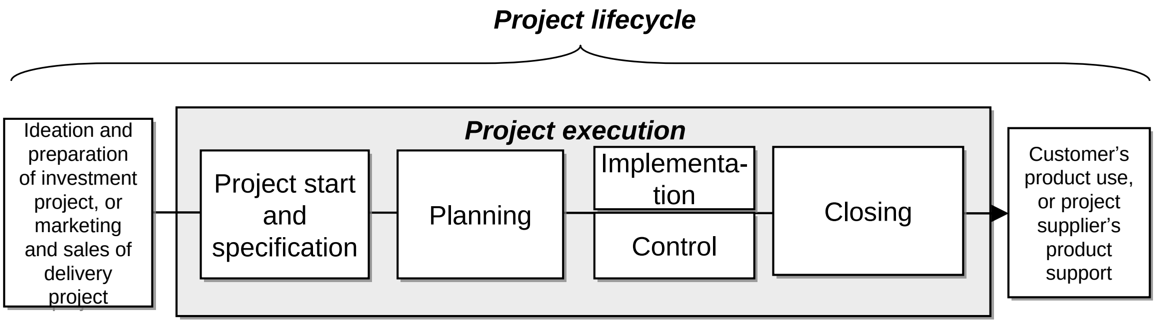


Figure 10. Project lifecycle and project execution

There can be decision points and decision gates between phases or within a phase at which the results of the preceding phase are reviewed, and the ability to continue the project is assessed and choices are made to continue with the project, to make changes to it, or to terminate it. Decision points in product development projects can be particularly decisive: a decision can be made to discontinue the project or to continue according to plan or implement certain changes.

In the **project start and specification phase,** the need for the project, the related needs for the change imposed by the project, and the needs for problem solving are identified, and the project goal and objectives are specified. With the help of risk analysis, risks related to project execution and their effects on project objectives are identified. In this phase, a project description and proposal are drawn up, or a preliminary project plan is derived that includes the relevant description or proposal-related information, and the project plan can be taken to a more detailed level later in the planning phase. As previously discussed, it is imperative to consider the needs and expectations of various project stakeholders. Consequently, objectives should be specified and key procedures discussed in specification and kickoff meetings involving relevant groups of stakeholders; the meetings between the project supplier and the customer, in particular, are crucial.

[14] In some connections (e.g. IPMA), the lifecycle is restricted to the activity taking place during the project (project execution). In this book, the project *lifecycle* is seen as a concept broader than project execution.

In the **planning phase,** activities related to project implementation and the resources needed to complete them are identified. Based upon these inputs, an implementation plan for the project activities and work, a more detailed project schedule, and a resource and cost structure, can be completed. The composition of the project organization with related responsibilities is described and finalized at the latest in the planning phase, but the project manager and the project team members usually are selected earlier, in the specifications phase. The result of the planning phase is a project plan and, if the parts of the project plan were previously developed at the start and specification phase, then a more detailed project plan is developed in this planning phase.

In the **implementation phase,** the responsibilities among the members of the project team are specified, as are the work procedures to be used, the content of the activities, the work in the activities, as well as more detailed resource needs. The required resources are procured according to these specifications and the work is executed according to plan. Implementation involves directing resources to the right things and at the right time from the perspective of project objectives, and producing relevant project deliverables and documents. Implementation in this circumstance involves the planned technical execution and procurement, and working as a project team, thus it should be considered different from the execution of the whole project.

The **control phase** runs parallel to the implementation phase, with a feedback loop to the planning phase. In the control phase, the progress of the project is monitored with the help of cost and schedule reports and by comparing performance with technical specifications. Reporting should be comparative and primarily involves detecting and explaining deviations from objectives and plans. Additionally, reporting should be anticipative, so that it emphasizes exposing future deviations rather than concentrating on previously realized deviations. Focusing on possible future deviations provides a better opportunity for timely corrective measures. Change management and systematic change management methods play a central role in the control phase of the project lifecycle. If the project as a whole does not progress according to plan, the situation should be analyzed and the necessary changes should be made in the project plan to establish a new realistic and updated yardstick for assessing future deviations.

Closing is a critical phase that receives too little attention. The project is typically regarded as handed over when the product resulting from the project has been delivered and implemented, and the customer has formally approved receipt of the product. The finalizing of project documents, their transfer to the customer, and their archiving are essential tasks in the closing phase of a project. After the delivery there is a closing and feedback meeting, and a final report of the project is written as part of the closing phase. The project is evaluated together with the customer, and customer satisfaction feedback is collected. Typically a number of meetings are held to maximize learning, a benefit for future projects. *Post hoc* project meetings or workshops may occur within the project team, with individuals from the surrounding organization of the company, and separately with the customer and other stakeholders. Typically lessons learned are included in the final report, and they may be documented in separate reports, company's databases, risk check lists and repositories, or in other media.

2.7.2 Lifecycles of investment and delivery projects

Perspectives on the project lifecycle and project execution may look a little different to the project customer compared to the project supplier. Figure 11 illustrates progress of a customer investment project and a supplier delivery project through their parallel lifecycles, by assuming that the project supplier delivers a complete system or solution to the customer.

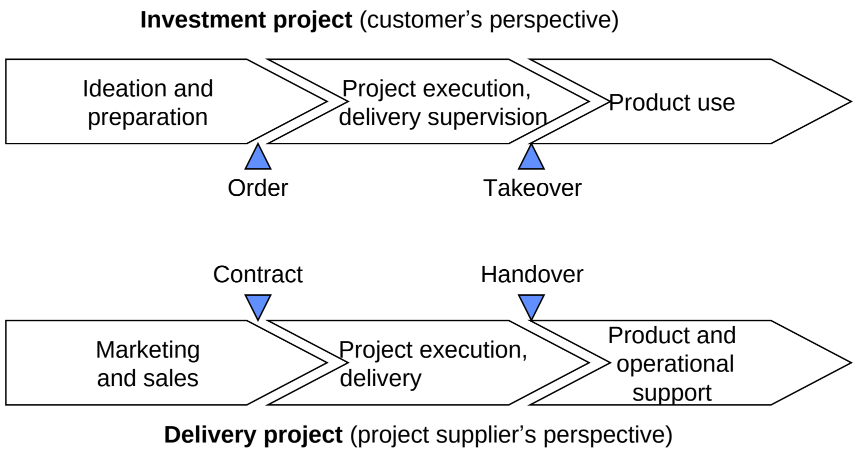


Figure 11. Differing perspectives on the project lifecycle of an investment project and a delivery project

Project management concentrates on the project execution part of the lifecycles presented in Figure 11. A project is closely linked, however, to other activity in the company, especially during its first and final phases.

2.8 Literature

APM, Association for Project Management (1996, 2000, 2006) APM Body of Knowledge. 3rd Edition 1996, 4th Edition 2000, 5th Edition 2006. U.K: Association for Project Management. http://www.apm.org.uk/

Artto, K. A. & Wikström, K. (2005) What is Project Business? International Journal of Project Management 23 (5) 343-353.

Bentley, C. (2001) Prince2: a practical handbook, 2nd Edition. Great Britain: Butterworth – Heinemann.

Gaddis, P. O. (1959) The Project Manager, Harvard Business Review (May-June) 89-97.

IPMA, International Project Management Association (1999, 2001) Caupin, G., Knöpfel, H., Morris, P. W. G., Motzel, E. and Pannenbäcker, O. (Eds.) ICB – IPMA Competence Baseline. 1999-Version 2.0, 2001-Version 2.0b. Monmouth, UK: International Project Management Association IPMA. http://ipma.kingsquare.nl/

IPMA, International Project Management Association (2006) Caupin, G., Knöpfel, H., Koch, Pérez-Polo, F., and Seabury, C. (Eds.) ICB – IPMA Competence Baseline. 2006-Version 3.0. Monmouth, UK: International Project Management Association IPMA. http://ipma.kingsquare.nl/

ISO 10006 (1997) Quality Management — Guidelines to Quality in Project Management, ISO 10006:1997(E), International Organization for Standardization ISO, Switzerland.

Morris, P. W. G. (1994) The Management of Projects. London, G.B: Thomas Telford Services Ltd.

Prince2 Guidance (2002) Managing Successful Projects with PRINCE2. Stationery Office Books.

Project Management Institute PMI (1996, 2000, 2004, 2008) PMBoK, A Guide to the Project Management Body of Knowledge (PMBOK Guide). 1st Edition 1996, 2nd Edition 2000, 3rd Edition 2004, 4th Edition 2008. USA: Project Management Institute PMI. http://www.pmi.org/

Project Management Institute PMI (2003, 2008) Organizational Project Management Maturity Model OPM3, 1st Edition 2003, 2nd Edition 2008. USA, Project Management Institute PMI. http://www.pmi.org/

Project Management Institute PMI (2006, 2008) The Standard for Portfolio Management, 1st Edition 2006, 2nd Edition 2008. USA, Project Management Institute PMI. http://www.pmi.org/

Project Management Institute PMI (2006, 2008) The Standard for Program Management, 1st Edition 2006, 2nd Edition 2008. USA, Project Management Institute PMI. http://www.pmi.org/

PRY (2004) Project Management Association Finland, The Finnish IPMA-ICB-based Project Management Body of Knowledge. Helsinki, Finland: Projektiyhdistys PRY. http://www.pry.fi/ (in Finnish)

3 PROJECT MARKETING AND SALES

The traditional literature on project management is limited to a portion of the project – the part that begins after the design and implementation decisions have been made. Yet the most important choices and solutions are made long before the execution of the project begins. It is essential, therefore, to understand the logic and activities associated with the new project as it is initially created in the interaction between customer and supplier – a realm that in the delivery project environment is referred to as project marketing and sales activities.

This chapter introduces an in-depth discussion of the phases of the project lifecycle, primarily from the perspective of the project's supplier. Project marketing and sales are discussed, first in general terms and then from the perspective of a single identified project opportunity. The entire project marketing and sales chain is studied, including the identification of a project opportunity, the preparation and negotiation of a competitive bid, the preparation of a contract, and the transferring of responsibility to the project organization responsible for the project's execution. We conclude the chapter with a general discussion of the management and organization of project marketing and sales activities.

3.1 Tasks involved in project marketing and sales

Marketing is typically seen to be the systematic management of customer, supplier, and other network relationships related to the development and management of the supplier's business and is designed to achieve the company's desired operational objectives.[15] From a general perspective, these objectives include growth and profitability, but they are specified in greater detail from the perspective of a project supplier's activities. *Project marketing* is related to projects delivered to customers. We use the term "*project sales*" in conjunction with the concept of project marketing; it is a subset of marketing and refers to activity focused on achieving a deal with the project customer. Because the potential customer and the nature of the project opportunity are known, project sales include the activities aimed at making a contract between the supplier and a specific customer. Thus, project marketing is a broader concept than project sales; it spans, in addition to sales activities, the mapping of alternative project opportunities, the management of customer relationships, and the promotion of sales.

A discussion started with one or several customers – activity that can be interpreted as marketing – may eventually lead to the solving of a specific problem for one or several customers. So activity that is initially viewed as marketing may become sales as the discussion evolves toward suggesting a solution for the customer that can be delivered in the form of a project. At what stage in the process the transition from marketing to sales activities or tasks occurs, however, is not always apparent. Consequently we use the combined term of project marketing and sales in some cases to cover both areas of activity.

Because projects are unique and complex, *project marketing and sales* activities differ in many ways from other marketing and sales tasks. Project demand is highly volatile or discontinuous,

[15] Skaates & Tikkanen (2003)

and demand from a single customer may fluctuate substantially; more generally, demand from an entire market area may be highly volatile. A similar project cannot necessarily be delivered to the same customer, and similar needs may be present only in one customer within an entire market area. This demand uncertainty poses challenges to developing and maintaining customer relationships in the time intervals between projects. Many project suppliers have developed such specific business activities as maintenance services, which complement their project offerings and contribute to achieving short-term profitability, business growth objectives, and continuity of customer relationships.

Although every project is unique in some respects, the project supplier should choose solutions that have been developed and proven effective in earlier projects, thereby creating a modular design for the project or the resulting product. Through a modular design, the learning accumulated in previous projects can be captured in standardized processes or product components and transferred to new projects. Projects can make use of separately developed standard product or process/service modules, combining them in a new way to fulfill the functional requirements of a unique project.

As part of project marketing and sales activities, the needs of customers and stakeholders are investigated. The objective is to prepare a project bid and contract in which the project forms a unique or tailored, and therefore value-added, solution from the customer’s perspective, and simultaneously provides profit to and forms a valued source of business for the project supplier.

As indicated, projects usually are technically complex entities. One of the major sources of complexity influencing project sales activities is the number of stakeholders participating in or affecting the project. Executing the project may require a variety of competences that a single company may not be able to offer. If customers are incapable of or unwilling to coordinate the activities of several parallel project suppliers, they can request *a bid for the complete system delivery* of the project. If a project supplier submits a bid for complete system delivery, it bears the responsibility of coordinating the various parties participating in project execution. During the project marketing and sales phase of activities, therefore, the project supplier must decide which subcontractors, if any, it will utilize in executing the project, and what the specific tasks and responsibilities of these subcontractors will be.

The literature on project marketing and sales has traditionally concentrated on project deliveries made to a (corporate) customer external to the project supplier's organization. In this chapter, we adopt this external emphasis and present only the perspective of the external delivery project – particularly the project supplier’s role in it. We realize that similar issues are relevant in the case of internal product or operations development projects, but in such settings marketing and sales tasks and activities are usually more informal and partly invisible. Nevertheless, as is the case for external project deliveries, project marketing and sales activities are valid for internally focused product and operations development projects that involve expending effort to justify the idea, awaken and capture the interest of the right stakeholders, improve the attractiveness of the project description, and sell a project opportunity with the potential to be realized.

3.1.1 Project supplier's perspective on project marketing and sales

The tasks and activities comprising project marketing and sales span all the phases of the project that occur before the project contract is signed; they deal with project-independent marketing and customer collaboration as well. The aim of these activities is to identify potential customers, create an image of the company as a possible supplier, and present customers with suggestions about ways to improve their businesses with the help of the supplier’s products and services.

In the case of a single project, the task of project marketing and sales is to prepare the project before the actual bidding phase starts by preparing for possible *competitive bids*, for example, or by preparing and making *bids*, and *negotiating* with the customer to bring about a project contract that is as attractive as possible for the project supplier.

Continuous marketing, sales, and customer collaboration activities, focused on the customer usually occur throughout the project lifecycle. The people who participate in marketing and sales tasks, for example, may participate in project tasks during the project execution phase as well.

Figure 12 shows the first phases of the project lifecycle specified from the perspective of the *project supplier*. When the project opportunity has been identified, the supplier moves on to customer-specific sales tasks that can be divided into three phases: preparing for competitive bidding, completing the actual technical and financial aspects of the bid, and finalizing the contract in negotiations leading to a contract.

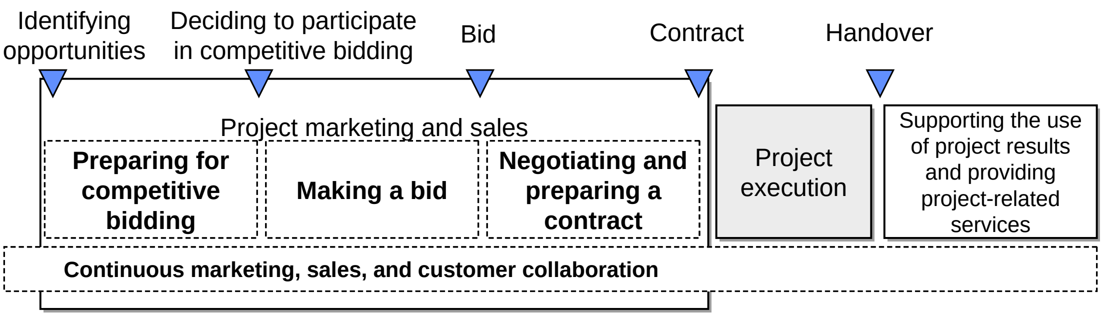


Figure 12. Project marketing and sales in the delivery project lifecycle from the project supplier’s perspective

Many key decisions related to the execution of the delivery project are made before the actual project execution begins. As a result of project marketing and sales activities, the technical implementation and scope of the project, its schedule, and the most central tasks related to execution of the delivery project may already be defined.

The marketing and sales phase is a relevant stage, at which project costs are determined. In addition to recognizing customer needs, their cost effects should be identified in the project requirements specification. During contract negotiations, the project supplier should not promise the customer an increase in project scope in an uncontrollable manner without first obtaining information on the cost effect of such a promise and the resultant effects on project profit. If the project can be designed in collaboration with the customer, cost-effective and profitable solutions optimal for both parties can be found. The project supplier can save costs in many ways, especially by utilizing experiences and ready solutions from similar earlier projects.

Additionally, the customer may even be willing to pay more for the use of a tested and secure solution that has received positive feedback from previous customers.

Although project marketing and sales activities are aimed at making project contracts as profitable as possible, the sales and marketing staff must not agree to projects that do not deliver benefits to their company. If it becomes evident in the sales phase that a project will be impossible to realize because of resource constraints internal to the company or because of unnecessarily extensive requirements of the customer, for example, it is in the best interest of all parties that the sales work be discontinued as soon as possible.

3.1.2 Customer perspective on the ideation and preparation of the investment

The customer and supplier are frequently engaged in tight collaboration during the marketing and sales phase of the project. The terms “marketing” and “selling”, however, are not used to describe the activity of the customer; rather, the customer is viewed as preparing an investment or a related purchase. In the activity of the customer, the work phases and decision-making activities happen somewhat differently than in the sales preparations of the supplier. The customer identifies procurement needs, plans the content of the purchase, receives and analyzes bids from several suppliers, and directs negotiations and contract preparations. In most cases, the customer’s procurement actions lead to an order, which in turn is followed by the execution and supervision of the project delivery, and by the use of the product resulting from the project. Figure 13 illustrates the phases of the customer’s procurement process that are closely related to the project supplier’s marketing work-through phases of responding to a request for bid, preparing a bid, negotiating a contract, and managing the related interactions.

The supplier should understand the customer’s perspective, so that it can offer the customer the best possible solution in the best possible manner.

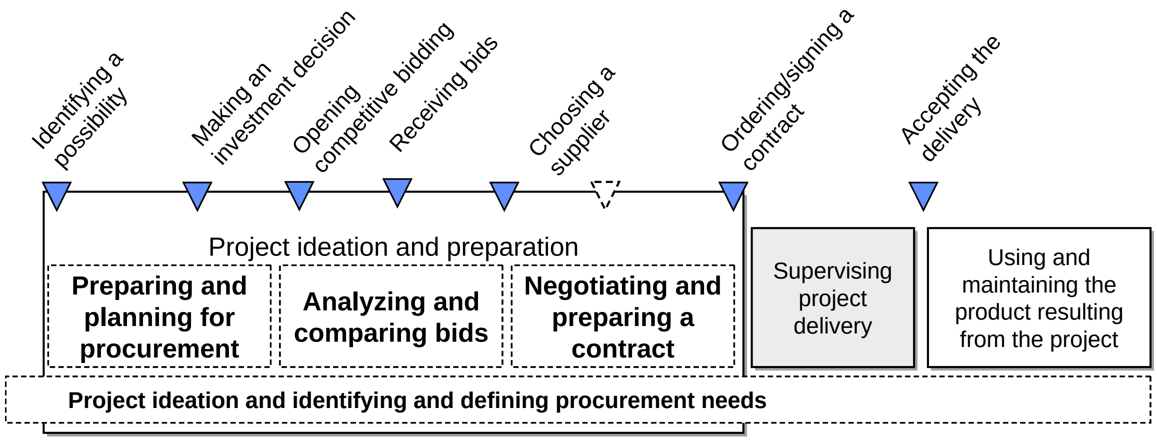


Figure 13. Project ideation and preparation in the investment project lifecycle from the customer perspective

3.2 Continuous marketing and customer collaboration

3.2.1 Preproject marketing

The market area chosen within the strategic choices of the project supplier provides appropriate focus for preproject marketing activities. Illustrative of such a strategic choice is an automation supplier's decision, based upon market analysis, to concentrate on customers in the chemical industry in one particular country. The project supplier must know its operating environment and the related regulations and success requirements in the chosen market area. The task of project marketing and sales is to analyze the customer base in this chosen market area and break it down into appropriate market segments for purposes of targeting company marketing activity.

Having chosen to target its marketing efforts at an appropriate market segment or segments, the company seeks to build a strong position in the network of local companies in the target market areas. For project business, the relevant network of local companies consists of all the stakeholders that may be directly or indirectly involved in future project sales. In every local network, the project supplier analyzes the customers, partner candidates, competitors, and other stakeholders. The project supplier should aim to achieve a position in the network that is consistent with its strategic objectives and should work to ensure that a close customer relationship develops. When the actual request for bid is received, the project supplier can then utilize its position in the network and quickly choose as its partners the type of supplier with which it can define and offer the best possible project. By developing a close relationship with the customer, the project supplier ensures that it will receive timely information on the customer's future projects needs and will be in a position to influence the specifications that the customer sets for the project.

As the project supplier builds a strong position in the network for itself, it may develop the type of technological- and procedure-related competences, modules, and ready-made solutions that could fit a particular market segment. If the project supplier does not have all the required competences or resources, it can procure them from its network partners or suppliers. Figure 14 illustrates the way a project supplier can use its marketing strategy internally to develop its product and service offerings, and simultaneously to create new project opportunities in collaboration with the firm's external stakeholder network.[16]

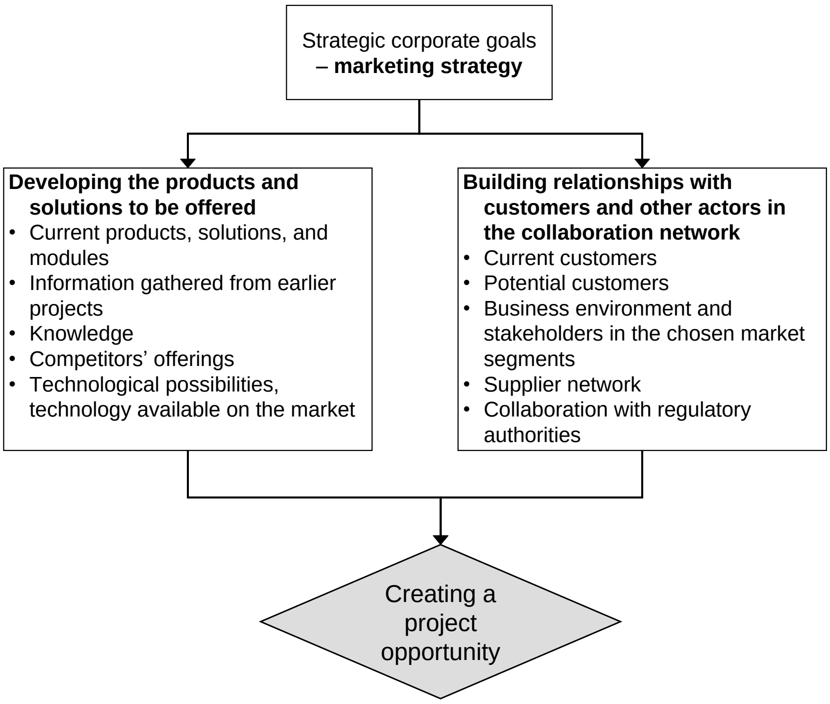


Figure 14. Marketing that precedes project sales and execution is aimed at creating new project opportunities

Example: Developing Livinghouse's products and collaboration network

All the house models within Livinghouse's two product lines of homes, Comfort House and Dream House, are constructed on-site at the customer's chosen building location, a feature that Livinghouse promotes extensively in its marketing efforts. In contrast to some homebuilding firms, Livinghouse has avoided producing pre-manufactured ready-to-move houses, which are constructed in a factory setting and include factory completion and installation of all major interior and exterior finishing components. Once prebuilt, these competitors' factory made homes are sold, moved to a customer's residential building lot site, placed on a foundation, and connected to utility services to make them ready for occupancy. Livinghouse's owners believe that entering the factory manufactured home product market would be a contradiction because attempting simultaneous marketing of two construction methods – on site and prebuilt – would not be a convincing positioning for the company to assume.

In practice, all of Livinghouse's houses are organized and delivered as construction projects. The house is erected on site to a fixed stage of completion, depending on the extensiveness of the contract. Livinghouse has well established relationships with local and regional material and equipment suppliers and subcontractors, so it can contract to supply a house that is virtually turnkey. A turnkey house project is one that includes all interior and exterior finishes and equipment.

---

[16] Adapted from Cova et al. (2002)

Currently, Livinghouse defines its geographic sales and market area as southwestern Ontario, within a radius of 160 kilometers of its main office location, London, Ontario. To date it has not ventured internationally into the nearby USA state of Michigan because it has not yet developed the supplier and partner relationships vital to achieving success in the USA or in any other country abroad.

In southwestern Ontario, some of Livinghouse's suppliers are experiencing excess demand and a shortage of house building materials and equipment. As a result, suppliers' prices have risen and their delivery dates have been extended. In turn, Livinghouse has had to increase the price and stretch the delivery and completion times far beyond original estimates for some of its near turnkey house construction contracts. In the near future, Livinghouse is planning to position itself better in its supplier network by acquiring some new suppliers, a strategy that will improve its control over important supply resources.

3.2.2 Managing customer relationships

It is typical of project management that the group of customers a project supplier faces is finite and well known because of the market area or project content. Power plants, paper machines, or communications networks are procured by a finite set or group of customer companies, for example. When marketing a single project, therefore, it is essential to study the customer in question in a broader sense, taking a longer-term view of the business relationship. The same customers will probably purchase similar projects in the future, perhaps in similar market areas. And some of these customer's may have such stature in their industry sector that they can influence the decisions made by other possible project customers. By concentrating on the management of customer relationships beyond a single project, it is easier to see the project as part of a longer-term business relationship between the customer and the project supplier. Many projects can be delivered to the same customer and frequently supplementary, maintenance-related services can be sold to this customer.

The customer base of a company is formed by its current and potential customers. By segmenting the customer base, the supplier can identify customers that have the same type of expectations, needs, and ways of operating. Project deliverables and operating principles can then be developed, keeping in mind the particular customer segments, in order to offer and implement projects effectively. Segmentation can be based upon the product, project type, or pattern of customer purchasing behavior. Product-based segmentation could be achieved in a factory environment by grouping customers into those who purchase packaging lines, assembly lines, warehousing systems, or a combination of these products. In a power plant environment, segmentation based upon project types can be achieved by grouping customers into those that purchase part solutions, complete solutions, and turnkey solutions.

Segmentation based upon customer purchasing behavior is used frequently. The customer base can be divided into segments. Four segments can be created, based upon the current (known) behavior and the future (estimated) purchasing behavior of customers, for example. 1) Strategic customers are currently good project customers that can be expected to make significant purchases in the future (or otherwise are influential in their field). 2) Current key customers that can clearly be offered projects in the future comprise another segment, as do 3) possible or interesting customers, identified by marketing, that do not yet purchase solutions from the project supplier but may be investing in the future in projects of interest to the supplier. 4)

Groups that are not current customers of the supplier, with purchasing behavior that is not well known, belong to a segment of potential or future customers.

General, nontargeted marketing activity is especially directed at the numerous possible or potential customers. The supplier should collect information about potential customers in order to identify project opportunities and design promotional approaches to create a positive company image. In the case of strategic and key customers, on the other hand, it is useful for the supplier to try to develop a strong and lasting customer relationship with them; in this case general marketing is not sufficient, as these customers should be known thoroughly. It should be possible for the supplier to predict the actions of such a customer, and there should be constant interaction between the supplier and the customer. The relative importance of key or strategic customers can be rated based upon the volume or profitability of business, or on some indirect benefit, like reference value or opportunities for joint product development. The project supplier should be able to deliver value to its strategic and key customers, serving them more effectively than its competitors can. In short, the project supplier seeks to achieve a differential advantage by providing a unique and superior package of benefits to key and strategic customers.

It is not always a simple task to achieve customer segmentation and to identify attractive customer groups. A project supplier often concentrates its energy on customers that purchase large-scale investment projects, but sometimes, for the sake of profitability, it would be better to concentrate on customers requiring small projects, particularly those that require significant levels of service.

When developing a customer relationship, a company must identify the customer's key decision makers and their expectations. The project supplier can try to influence the decision makers by providing them with information on the solutions it offers, its previous successes, and its operating methods. Providing references is an effective way of indicating the applicability of the supplier’s solutions and its ability to deliver projects. By considering the expectations and needs of the decision makers when developing products and services, new competitive solutions can be developed.

Taking care of the customer relationship is a principal assignment for every employee of the project supplier. The supplier and customer, whose relationship has developed during the marketing phase of the project, often engage in closer interaction during the delivery project. By offering maintenance contracts, the customer relationship can be continued in the post-project stage. In managing customer relationships, it is essential that related information be kept up-to-date and easily accessible. Various computer-based solutions have been developed for this purpose, and customer relationship management data systems (CRM-systems) usually play a central role in the project supplier’s customer management activities.

Example: A project supplier’s customer relationship management system

Livinghouse has its own sales offices situated in the major cities in southwestern Ontario, including Hamilton, Kitchener-Waterloo, Sarnia, and Windsor. Several of the company’s representatives communicate with the customer during a single project, so each one needs to be able to access information on the current status of the construction project, including the promises made to the customer.

To assist it in managing customer relationships, Livinghouse uses two linked information systems – the customer management system and the document management system. The customer management system is mainly used as support for marketing efforts. It includes customers' contact information, information on all the meetings that have been held with the customer, memos on all the times the customer has been contacted in the marketing phase, as well as the bids that have been made. Feedback collected from customers after a project has been delivered is added to the customer management system. This information can be used to develop the company's marketing activity and to improve its technical solutions, for example, providing hand-carved, customized wooden decorations in the frames of doors and windows.

The second information system is an Internet-based document management system that contains all the material relating to execution of the project. For example, these documents include summaries of materials and orders, technical specifications, drawings and other documentation concerning the house, and construction progress reports. Suppliers like ProKitchen have limited rights to access the system, but they can add the required specifications and preliminary information regarding the kitchen directly into the system. Based on its experience with past house delivery contracts, Livinghouse has learned that the co-use of its system with subcontractors is beneficial in many ways: it directs the subcontractor to deliver the required documents, it speeds up and eases the information flow, and it improves Livinghouse's ability to monitor and supervise subcontractor's delivery schedules. Because all information related to the technical execution of the project is stored in the Internet-based document management system, project managers primarily use this system.

In combination, these two information systems – customer management and document management – help in managing single customer relationships and in fostering learning from one project to the next. Thus, they provide a clear picture of the whole customer base, including such details as the type of solutions individual customers have chosen and the most frequent changes they have made during the construction cycle. Because they contain information on emerging customer needs, preferences, and behaviors, these information systems also help Livinghouse to modify existing house models and develop new ones. The systems also assist Livinghouse to centralizing its marketing communication and in maintaining a customer-orientated business perspective.

In the future, Livinghouse intends to use these information systems to mount an offering of post-sale equipment, maintenance, and renovation services to owners of houses being built in larger construction projects. With the help of the databases, the required services, add-ons, or renovation works can be anticipated and the customers can be offered new services and products to increase their living comfort. For example, more effective air conditioning equipment with more reasonable operating costs can be added afterwards to most home heating systems installed by Livinghouse. It would be relatively easy for Livinghouse to calculate its bid for installing air conditioning based directly on the technical information to be found in its database.

3.2.3 Generating project opportunities

A project supplier can create a project opportunity based upon weak signals that tell of the opportunities existing in the market or in the field of technology, or through straightforward requests from, and unstated but known desires of, the customer. Project opportunities can be identified as part of targeted or nontargeted marketing actions, in the course of managing current customer relationships, or by otherwise following the changes occurring in the operating environment. In some cases, current or potential customers provide early signals of an upcoming competitive bidding opportunity before the competitive bidding call is formally announced; they can do this by issuing preliminary bid requests, for example – a strategy that enables the customer to investigate possible project suppliers, various implementation alternatives, or price levels. Through its general marketing activity, the project supplier can affect the extent to which it is known as an interested, competent, and competitive project supplier in its chosen market segments.

In the context of project marketing and sales activities, the project supplier can sometimes affect and participate in preparing the project before the customer's request for bid is issued. A project supplier can choose a constructive approach, for instance, emphasizing its experience and willingness to create new projects in collaboration with customers that can be used to benefit the customer's business. This approach requires knowledge about customers' processes and business objectives, and access to appropriate technical solutions. Potential project suppliers that choose a deterministic approach do not participate in the specification of the project with the customer; instead they wait for the request for bid to be issued, and then attempt to respond with the best possible bid.

3.3 Preparing for competitive bidding

An identified project opportunity is not an adequate reason for making a bid; the project supplier should first determine the attractiveness of the opportunity from various perspectives. When preparing to respond to a request for bid, a supplier should evaluate the strategic importance, financial profitability, technological options, and project-related risks associated with the observed project opportunity. Then, with its expert knowledge, the project supplier can help the customer prepare the specifications for the project, thereby influencing the forthcoming request for bid in such a way that it fits the technology and competences available to the supplier. Or the supplier can offer to assist in efforts to sell the project to decision makers within the customer's organization.

The customer usually arranges a two-round competitive bidding process; during the first round it issues a request for a *quotation*. This is not a request for a binding bid; rather, it is a preliminary bidding step used by the customer to collect information on the price level, the interested suppliers, and the suppliers' technological solutions. In this two-round competitive bidding process, the customer receives free information on specifications that are relevant to preparing the actual request for bid; the customer can then pick and choose the best solutions from the preliminary *quotation* round and combine them with its own specification work. It is in the best interest of the supplier to prepare an informative, quality quotation that promotes the benefits of its solution, thereby increasing the probability that the actual request for bid will be specified in a manner favorable to its solution.

3.3.1 Competitive bidding

In the actual competitive bidding round, the customer invites potential suppliers to submit bids on the execution of the project. This request is usually expressed in the form of a written *request for bid*. The customer's objective is to receive the best possible bid for the execution of the project, as measured by the price-benefit ratio.

Competitive bidding is a commonly used form of project engagement, especially for public procurement and for projects that receive public funds from their financiers. Its objective is to increase the transparency of procurement and increase competition in the hopes of decreasing the price level for project work. Competitive bidding is less suitable for situations in which the customer and supplier are engaged in close, long-term collaboration; in fact, in such situations it is more common to use a direct, targeted request for bid rather than to issue a general or broad request for competitive bids.

Competitive bidding processes can be classified into several types – open, restricted, or closed – depending on the firms that have the right to participate, the criteria upon which the customer's decision is based, and whether or not there are negotiations on the content of the bid. These three types of competitive bidding, the restrictions on participation, and the (typical) decisive decision-making criteria used by the customer are presented in Figure 15.

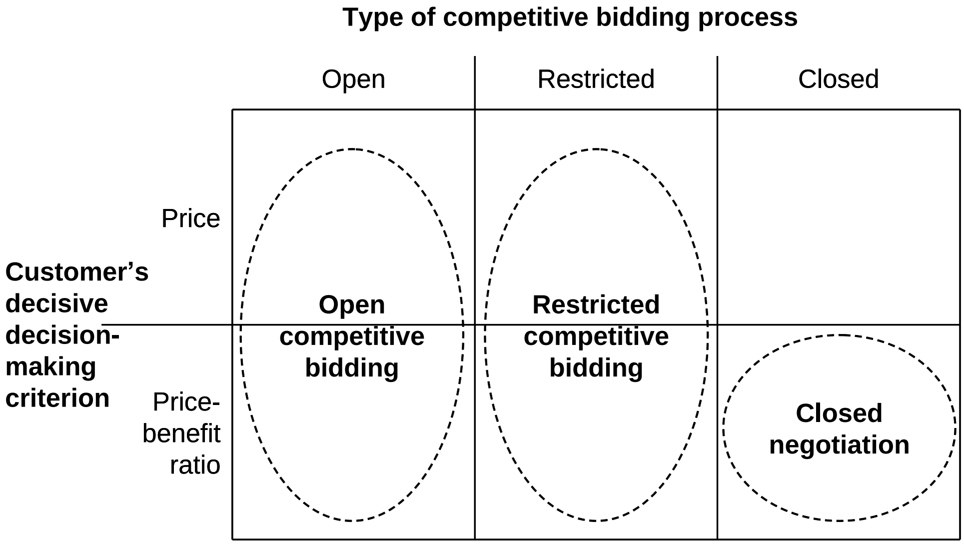


Figure 15. Three types of competitive bidding processes

- An open competitive bidding process is open to all suppliers. The supplier's bids should fulfill the financial and technological terms stated in the customer's request for bid. The customer may base its decision on the best bid price only, or it may make its choice based upon the best price-benefit ratio.

- A restricted competitive bidding process is organized into two rounds. In the first round, the customer compiles a list of suppliers that it considers to be trustworthy and competent enough to execute the project and then invites these potential suppliers to submit expression of interest, inclusive of proof of capability. In the second round, the customer asks all or a selected subset of the responding suppliers to submit formal, detailed bids. The customer's decision may be based solely on the best bid price, or it may be based upon the best price-benefit ratio.

- In a competitive bidding process based upon closed negotiations, the customer invites a single supplier to submit a bid, and together they negotiate the plan and specifications. Closed negotiations are frequently used in situations in which there has been a long history of successful collaboration between supplier and customer.

The customer is free to decide on the most suitable form of competitive bidding process for its circumstances, but usually sends a request for bid to a restricted, deliberately chosen group of companies if there is no specific reason to make an open request for bid. In contrast to choosing a limited group of potential suppliers in it request for bid, the customer may elect to start the first phase of the competitive bidding process by issuing and open call for bids, a process in which the various project suppliers are requested to submit information to demonstrate their trustworthiness and readiness to execute the project. Regardless of the customer's form of bid request, it is in the best interest of a potential supplier to engage in marketing effort before a competitive bidding process is announced; such effort facilitates the supplier's objectives of being placed on the list of acceptable prospective bidders.

A competitive bidding process based only upon best bid price requires that the customer specify the technical part of the task in enough detail that bidders can price their bid. A competitive bidding process based upon the best bid makes it possible for the customer to leave some things open in the request for bid, giving the project supplier an opportunity to develop the best possible technical solution. In preparing its bid, the project supplier must then ensure that the content of the bid is fully realizable, because the customer may accept the bid as is, without entering into negotiations.

In a bidding procedure based upon negotiations, the customer does not need to make the final decision based upon receipt and evaluation of the bids. The customer can choose a set of preferred bids and suppliers for negotiations, making use of information on possible technical solutions and price level it has received from the different bidders. For practical reasons, usually only two or three bidders are chosen to engage in the negotiations. In some situations, the suppliers can be given additional information on the basis of which they must provide a more detailed bid before negotiations begin.

To engage in competitive bidding involves considerable work for suppliers, and can be financially demanding. Suppliers have the right to demand impartial and transparent treatment. In some cases, customers provide financial compensation to entice prospective bidders to participate in competitive bidding procedures. In the competitive bidding for the fifth nuclear power plant in Finland at the beginning of 2000s, for instance, the two best bids were chosen during the first phase. These two bidders were provided with additional information on the basis of which they prepared a more detailed bid for the execution of the project. Although the final supplier was chosen in the second round, both suppliers were compensated in recognition for the work effort they expended in preparing their more detailed bids – work that amounted to several person years for each bidder.

Example: The customer's perspective on preparing for competitive bidding

In most regions of Canada and in the majority of developed countries, prospective homeowners must submit the architectural plans and technical drawings for their proposed house to local authorities before construction starts. Typically, upon review of the plans and drawings, the local authorities issue a building permit, which permits the construction to begin according to plan.

An architect in one of Larry's recreational sports groups helped the Smiths to prepare their house plans and technical drawings in sufficient detail to enable them to estimate the approximate costs of the project and to satisfy local authorities; consequently, the local authorities issued a building permit to the Smiths.

With their architect friend's help, the Smiths were able to specify in considerable detail the technical content and terms of the contract. These items enabled the Smiths to provide the same set of plans and details to all prospective bidders, thereby increasing their chances of receiving relatively uniform bids from suppliers.

Thus, the Smiths are now prepared to ask house suppliers to bid on a house delivery and construction project that adheres to the plans as accurately as possible. Based on the experiences of their acquaintances and on the reputation, location, and offerings of suppliers, the Smiths sent a request for bid to six house suppliers (general contractors), including Livinghouse. But, because they believed that they may make a better overall bargain by ordering as separate deliveries from specialist companies the earthworks, foundations, and the HVAC (heating, ventilation, and air conditioning system), the Smiths asked the general contractors to price these three components separately in their bid. Simultaneously, in order to check out their theory that specialist companies may be more competitive, the Smiths sent their request for bid to several specialist companies in the earthworks, foundations, and HVAC supply and service market, asking them to submit bids on the three components only.

In house construction projects, it is highly unlikely that bids received in response to a request for bids will be so uniform that the customer is able to choose the winning bidder based solely on one variable, the price of the bid. Therefore, it is not surprising that upon receipt of the bids from various general contractors and specialist firms, the Smiths quickly concluded that their eventual decision would have to be made on the basis of their assessment of multiple quantitative and qualitative factors, and after some, perhaps extensive, negotiations with the supplier(s) that interest them the most.

3.3.2 Choosing the supply chain for project execution

The customer has the option of engaging one or more suppliers in the execution of its project. In choosing the supply chain or parties for project execution, the customer specifies the firm or firms that are to take responsibility for executing various parts of the project. The customer's goal is to divide the work and responsibilities in such a way that the total cost of project implementation will be as low as possible. The customer specifies the characteristics of contracts and desired responsibilities of the parties involved in the execution, as well as the procured products and services,

If the customer has the resources and competences to supervise the execution of the project, it can take responsibility for the project as a whole and request subcontracting bids for parts of the project. In this case, the various project suppliers make *partial deliveries* (from the perspective of the customer's procurement packages).

The customer can choose a supplier to take responsibility for the planned execution of certain specific tasks, to execute a major part of the project, or to undertake a complete system delivery spanning the entire project. Such *complete system delivery* can include the responsibility for execution of the entire project, including integration management, coordination of subcontractors' work, site management, contract management, and agreed-upon execution work. In this scenario, the customer bears responsibility for implementing the solution, and assumes the burden of ensuring the functionality of the product resulting from the project in its real operating environment, together with possible related surprises.

The customer may decide to engage in *project management service delivery*, by appointing another company to act as integrator. This integrating company oversees project control and directs the project execution using a network of subcontractors, but does not deliver actual products in the execution of the project.

Yet another method of project execution is *turnkey delivery*, in which the customer orders a specified project in its entirety from one supplier that nurses the project through to its end. The customer thus minimizes its involvement in project execution and awaits the commissioned solution. This scenario requires the customer to perform the least amount of work; the turnkey project supplier carries the risk of completing the project until the resulting product is in full operation. A turnkey delivery project is usually contracted in the form of a fixed-price contract.

With the help of the project scope described in the request for bid, the supplier determines the activities that should be included in project delivery. The scope can vary from specific activity packages to complete project delivery, inclusive of post-execution maintenance and support. Furthermore, the supplier may be responsible for organizing funding or even for operating the resultant product and bearing the associated business risks. Finland’s Lahti highway provides an example of a project based upon a life-cycle contract model. In this project, it was the supplier’s responsibility to execute the project, organize funding, and maintain the road. The supplier is paid according to the traffic level on the constructed road and the availability of the road for normal use, even under difficult winter weather conditions.

Although the customer usually defines the supply chain or parties for project execution, the supplier can, within limits, make its own choices and thereby affect the role or roles it assumes in projects. A project supplier can play the role of main contractor, integrator, subcontractor, subsupplier, or a member of a larger project network or consortium; the exact realizable roles depend on the market position and competences of the project supplier. A company in a strong market position frequently aims to be the main contractor or an integrator because such roles afford it the greatest possibilities of achieving its objectives through the project. Project suppliers possessing limited special competences are usually in the role of subcontractor or subsupplier, either alone or as part of a broader network. The project, and especially the attractiveness of the resulting customer relationship, affects the strength of the role that a company aims for, and if it wants to be part of the project.

3.3.3 Receiving a request for bid and deciding to make a bid

One central decision in project marketing is whether or not to participate in the competitive bidding process in response to a customer-issued request for bids. Entering a bidding process can be viewed as an investment for which there is no certainty of future benefits; a bid can be won or lost, and the result cannot be foreseen. When a supplier makes a decision to participate in a bidding process, it is difficult to retreat without damaging the supplier-customer relationship and the credibility of the, supplier. Furthermore a bid is binding and a carelessly made but accepted bid can result in unprofitable work, which will further damage the supplier’s business. Alternatively, a poorly made bid that is not accepted reflects negatively on company image, lowering the project supplier's reputation.

A prospective supplier must consider several factors in evaluating the wisdom of entering into a competitive bidding process: the probability of winning the bidding competition, the business attractiveness of the project described in the offer, and the likelihood that the project can be realized. When evaluating the chances of winning the project contract, the company's price competitiveness as well as the competitors' relationship to the customer must be considered. A customer may already be tied to a certain supplier and may have issued a request for bids without the serious intention of switching to a new supplier, or the customer may decide not to choose any of the bids. In evaluating a project's attractiveness, the supplier should consider its longer-term possibilities for developing a positive relationship with the customer; a well executed bidding round and successful implementation of a project may lead to other project possibilities with this customer in the future. Examples of the factors to be considered before deciding to participate in a competitive bidding process are listed in Table 5.

Table 5. Factors to be considered by a potential supplier when evaluating a request for bid

Factors to be considered	Specifying questions
Nature of request for bid	• In what stage of the decision-making process is the customer's investment project? • Is it a binding bid or a quotation?
Competitive situation	• What is our relationship to the customer? • Who are the most likely competitors and what is their relationship to the customer? • Have we been able to influence the request for bid during its preparation so that its technical solution offers competitive advantage for us? • What are the customer's decision-making criteria and what is our competitive position related to these criteria (e.g. price and technology)?
Attractiveness of request for bid from a business perspective	• What is the scale and profit level of the project? • What effect does joining in the competitive bidding process have on our customer relationships? • What effect does joining in the competitive bidding process have on the credibility and image of our company in the market? • Does the project have reference value? • Can the project be used to create or maintain relationships with key suppliers and partners?
Technical attractiveness of request for bid	• What is our ability to meet the technical and delivery time requirements of the request for bid? • Does our company need the project to maintain a certain level of capacity utilization? • Do the new technologies and procedures that may be developed in this project support our company's strategic choices?

Table 5 suggests that when deciding whether or not to participate in competitive bidding, the prospective project supplier should consider the broader implications of this opportunity for its business. A group representing a variety of views should participate in the decision-making process in order to avoid entering the bidding process on the basis of the supplier's current workload or on short-sighted thinking focused only on the probability of winning the contract.

If the supplier decides not to participate in the bidding process, it can decline politely, but in order to maintain a positive relationship with the customer, the supplier should communicate its negative decision quickly, informing the customer of its rationale for declining. Furthermore, the supplier should base a negative decision on a thorough analysis, because such a decision can be interpreted as a sign of its weakening competitive position in the market. Alternatively, the supplier can price its bid high enough to be virtually certain that the customer will not accept it. Of course the supplier should realize that there is always the possibility that the customer will accept its high-priced bid if no better bid is received. Should the customer accept the exceptionally high bid, however, the price helps the supplier to acquire extra resources and make alternative arrangements to complete the project successfully.

Example: Decision to participate in competitive bidding

Livinghouse's local, London, Ontario based salesman received the Smiths' request for bid on their house construction project. As noted in the previous section, the Smiths' request for bid included a request to quote on the entire house excluding earthworks, foundations, and HVAC systems. It also included a requirement to include earthworks, foundations, and HVAC systems in the bid as separate options. This type of bid structure would allow the Smiths the freedom to include or exclude the separate earthworks, foundation, and HVAC scopes in Livinghouse's entire scope of delivery, depending on their final judgment of whether or not it is reasonable to buy the earthworks, foundations, and HVAC systems separately from other specialized suppliers. Livinghouse has recently delivered a similar project in the same city, and the project met the estimated budget and completion schedule well. Livinghouse used a certain model of the Dream House product line as a starting point for the project, and it was tailored or customized to suit the requirements in the Smiths' request. Livinghouse has recently had its designers plan a similar house project, therefore it was able to utilize the information on this earlier work and easily draw on these plans in preparing its bid response to the Smiths request for bid. The local Livinghouse salesman, together with a technical expert, visited the Smiths' building lot site, and they noticed nothing in the building area that would present an obstacle in executing the building project.

As Livinghouse has some of its own resources available for the following six months, it is interested in winning the project. Livinghouse believes that it can make a competitive bid to the customer without making any significant compromise in profits, as it can utilize already finished work in making the bid. In fact, because of the possibility of repeating many activities and delivery scopes from the previous similar project, Livinghouse believes it will experience positive learning curve effects and, accordingly, will have lower risks than would be associated with unique projects or projects that have few commonalities with previous company activity. This further increases the attractiveness of the Smiths' project to Livinghouse. Also, Livinghouse could most probably present this project as a successful reference: The Smiths' building lot site is very well situated, presenting a good possibility for Livinghouse to display and present a customized Dream House to potential future customers. The local salesman made a note of the potential to discuss with the Smiths the possibility of holding one or two presentation events at different phases of the construction project. After checking with Livinghouse's management board and the company's supplier situation, the local salesman proceeded to prepare a bid to respond to the Smiths' requests.

3.4 Making a bid

3.4.1 Preparing the bid

When a supplier decides to submit a bid, it should formulate the best bid possible. Preparing a bid can involve many people doing many different tasks, including ideation, planning, calculation, evaluation, and documentation. The designated sales manager usually directs the bid preparation activities, coordinating the group preparing the bid, ensuring the collection of relevant information, and, typically, writing the bid document. Each participant has an assigned role in preparing the bid: Top management may determine the scope, pricing, and contractual terms of the bid; technical and financial experts may prepare the details related to the bid; and, if a suitable project manager candidate has been identified, this person may evaluate the procurement and resource requirements of the project.

It is essential for the supplier to be in contact with the customer during the preparation of the bid. In the request for bid, suppliers can typically ask questions of the customer up to a certain date. There are numerous reasons for the supplier to engage in such verbal or written communication with the customer. 1) It is a way to get answers to open questions and to clarify ambiguous parts in the customer's bid request document. 2) The seller can gain insights into the customer's real needs and perhaps the invisible motives behind the request for bid. 3) Initiating such communication demonstrates the supplier's serious interest in the project. 4) Especially in bidding for delivery projects, it is useful for the supplier to visit the project site (e.g. construction site) rather than rely upon descriptions or pictures in the appendices of the request for bid.

The demands presented in the request for bid must be answered in the bid. The character of the competitive bidding – the options based upon best price or best price-benefit ratio – determines the decision-making process of the customer and the things that should be emphasized in the bid.

In a competitive bidding process based upon price, the bid should fulfill the minimum requirements of the request for bid and should offer the most inexpensive solutions because the competitive forces encourage suppliers to search for cost-effective solutions, and the price criterion is the most straightforward choice criterion for the customer. On the other hand, the customer's price centeredness may, in the long run, lead to inferior solutions that that do become visible until later in the lifecycle of the product resulting from the project.

In a competitive bidding process emphasizing the price-benefit ratio, the supplier is able to add features to its bid that demonstrate its experience and reinforce its ability to deliver superior solutions that will prove beneficial to the customer. The supplier should be careful, nevertheless, in adding such features to the base offer; the customer may not necessarily be willing to pay a premium price for them.

By presenting in its bid options that complement the project, the supplier can keep the bid price low, yet offer the customer additional features; options are considered as add-ons to the bid and separate prices are provided for options. Although the actual bid should fulfill the minimum requirements specified in the request for bid, options in the bid proposal can be used to present additions and changes, complete with the supplier's pricing methods for such complementary work. The separate pricing of options does not affect the price comparison of the bids, but can prove a useful way to increase business with the customer.

If the project supplier needs to engage subcontractors in its work, binding information on supplier prices, resource availability and other project-related issues needs to be available when the bid is prepared. Because many project suppliers have established long-term relationships with experienced, credible subcontractors, basic information about them may already be available. If a new subcontractor needs to be found for a specific task, the project supplier may need to request bids from two or three new subcontractor candidates and, based upon this information, prepare an estimate of the price and benefits of the subcontracted parts.

The project supplier should delay its choice of subcontractor until the latest possible phase of the bidding process, depending on the details to be included in the project contract. Furthermore, when designing the terms of payment, the project supplier should time its payments to the subcontractor to coincide with the payment terms it specifies or faces in the main bid. As the payments must always be conditional on the handover and acceptance of prespecified work components, for example, only after the customer accepts the subcontractor's work component and pays the project supplier for it should the project supplier commit to paying the subcontractor. In this way, the responsibility for reparation and possible compensation is transferred to the subcontractor through the subcontracting contract. If a defect in the subcontractor's equipment prevents the acceptance of the project supplier's delivery, the customer will not pay the supplier before the defect has been removed and the delivery accepted. In short, it is advisable for the project supplier to outline the subcontractor's obligations – obligations that are at least at the level of the terms it faces itself – and to stipulate that the subcontractor carries full responsibility for its partial delivery.

Example: Character of the competitive bidding

The Smiths' request for bids represents a situation of competitive bidding based on the best bid, but it is a process in which all bidders' responses are analyzed by the Smiths and negotiations over more specific details take place with their preferred supplier. As is typical in requests for bid, bidders are asked to provide technical and financial information, and, additionally, are told the decision criteria that will be used in evaluating bids – price-benefit ratio; credibility of project supplier; technology used in solutions provided, quality and maintainability of the completed house; and information on methods and procedures used for project execution, including use of skilful subsuppliers and subcontractors.

3.4.2 Content of the bid

In order to serve the customer's needs fully, the project supplier should create and communicate through the bid a realizable solution to the customer's need or problem. The bid should highlight the problem to be solved and its relevance to the customer's process and business, and the nature, methods, and benefits of the project supplier's technical solution should be described as extensively as the request for bid requires.

The bid should include all the technical and financial matters relevant to project execution. The pricing method for the project is usually stated in the request for bid and project price and payment terms are specified within the commercial terms and conditions. If the pricing method is based upon a fixed total price, all risk related to price is held by the supplier. At the other extreme – cost-plus pricing – the customer holds all the financial risk because it remunerates the supplier the incurred costs plus an added project or percentage profit. The scope of project execution and its main characteristics are outlined in the technical content of the bid. It is valuable to suggest a division of responsibility between customer and supplier in the bidding phase of the project.

In summary, the project supplier must be able to display the value of its solution to the customer in its bid. The technical details, contractual terms, and other supportive material (e.g. references and technical descriptions of products) can be presented as appendices. In the following example, we present a skeleton outline of the bid involved in our case example, a house construction project. Although the summary headings look simple, many parts of the bid, especially the appendices, include considerable detailed information.

Example: Outline of a bid for the house construction project

The sales manager, project manager and some experts responsible for technical areas at Livinghouse together prepare a bid for the Smiths. The outline of this bid is presented below.

1. Goal: Summary of customer expectations
2. Suggestion for solution: summary
   - Description of the customer-specific solution, appendix 1
   - Basic information on the Dream House, appendix 2
   - Technical references and examples, appendix 3
3. Suggestion for project execution: summary
   - Preliminary execution plan, appendix 4
4. Benefits of the solution to the customer: summary
   - Calculations and other additional information, appendix 5
   - References, appendix 6
   - Other information describing Livinghouse's business and strengths, appendix 7
5. Price and other commercial and delivery terms

6. Possible extra works, that were not taken up in the request for bid: summary
   Descriptions, additional terms, appendix 8
7. Contact person, validity period of the bid and signature
8. Appendices

It is critical that the bid serve the supplier's objectives, in the long and short term. Ideally, a project executed according to the bid provides the supplier with a direct monetary benefit, or at least such indirect benefits as a stronger customer-supplier relationship, enhanced company image, and the development of the supplier's competences. The company's objectives can affect the emphases in its bid. If the objective is to increase the supplier's maintenance and repair business, for example, the benefits of the maintenance contract should be emphasized (e.g. in a bid concerning an equipment delivery). In fact, the supplier can offer a free maintenance contract for the length of the guarantee period in the hopes of attracting project customers to purchase its continuous maintenance service contract after the guarantee has expired. The bid should also emphasize the areas in which the supplier has specific competitive strengths. A direct competitive comparison is not necessary because the customer will see the respective offers of the competitors in the bids it receives; however, the supplier must use its bid response to assure the customer that its bid is competitively superior.

From the customer's perspective, it is imperative that a supplier's bid indicate that the supplier fully understands the customer's business, clearly describes the solution it is offering, and highlights the benefits its solution will bring and the competitive advantages it offers. The customer of course notices and may be influenced by the readability and clarity of the bid proposal, and also pays attention to the outward appearance of the bid document. In some competitive bidding processes, the customer wants to meet competing suppliers in person after they deposit their bid. Such face-to-face interaction provides the suppliers with the opportunity to impress the customer and influence its choice.

For both parties, it is desirable to have the commercial terms of the contract and the project's technical execution, scope, and delivery time specified unambiguously.

3.5 Negotiating and preparing a contract

The bid is deposited with the customer by the deadline specified in the request for bid and in the form requested by the customer. The bid is usually a written document, and there may be an official bid opening or presentation event scheduled. The customer may set other requirements or rules for the submission or treatment of the bid, such as a predefined schedule of actions for shortlisting a few bidders, continuing negotiations with the selected bidders, and ultimately awarding the contract to the selected supplier. After the bids have been received, the customer can either choose the most suitable project supplier or initiate negotiations with a set of supplier candidates. The negotiations are aimed at making a contract between the customer and a project supplier.

Because the *project contract* specifies the basic guidelines and responsibilities for project execution, it must document in adequate detail the matters that are critical for project success.

Details on project responsibilities, obligations, sanctions, and rewards are clearly articulated in the contract. The project contract includes unambiguous terms and procedures for risk management, confidentiality, crisis situations, changes and problems, and many other matters crucial to the project parties.

If trust based upon earlier collaboration has been established, it increases the willingness of both parties to support each other’s success in a fair and open manner, with the knowledge that neither party would want to endanger the business relationship. In such exceptional situations, a juridical contract can be a mere formality; the actual contract can be kept general and flexible, and the details of the project can be planned separately after the contract has been signed.

3.5.1 Content of contract negotiations and negotiating position

If a customer accepts a project supplier's bid without changes, the bid automatically becomes a binding contract for both parties. Such a simple bidding procedure can be applied in small, relatively simple projects. But, because many project deliveries are complex entities, both in their commercial terms and conditions and in their technical details, the bid must be specified in a more detailed and modified way in the actual contract. Based upon an evaluation and comparison of competing bids, the customer usually chooses at least two short-listed suppliers with which it proceeds to conduct more detailed contract negotiations.

During project negotiations, the project supplier can be in an advantageous position in relation to project scope and execution, as well as the product resulting from the project and its technical characteristics. The supplier can have the advantage of expertise on various technical solutions and their cost efficiency. Nevertheless, the project supplier must listen to the customer patiently, trying to understand the customer’s business and needs. Ideally the supplier is able to consider the technical and financial feasibility of the project from the customer’s perspective and promote a common benefit in the contract negotiations.

The project supplier and the customer obviously have different objectives in their price negotiations; the customer aims to obtain the lowest possible price, whereas the project supplier aims to achieve the highest possible revenue. The customer usually has a strong position in the price negotiations, particularly if the negotiations are held after the technical specification of the project, a time at which the supplier is unable to use its superior technical knowledge. Because the customer has the possibility of lowering the price by negotiating with several competing suppliers, the profit the chosen supplier will receive from the project can be eroded. By this phase of the process it is difficult for the supplier to abandon the project; money and resources have been spent on preparing the bid and the supplier is committed to winning the bidding competition. For its part, the customer should know how to evaluate the situation correctly; in considering the price level of a contract, it should take into account the benefits and quality level that is expected from project execution.

The long-term strategy of a supplier may be to bid such a low price that winning the contract will not generate any profit. If a supplier chooses this counter-intuitive strategy, it may be designed to elicit a positive reference from the customer, to improve the supplier’s reputation locally, to provide a basis for later invasion of broader markets, and to increase the potential for greater profits from future sales. Or the supplier may calculate that it will generate sufficient future profits from optional work and additional orders, because it is practical for the customer to give the supplier complementary work due to changes and additional orders – perhaps at a higher price. Although the customer may not anticipate that extra work will be required in a clearly delimited project, the supplier may have broader experience on the lifecycle of such projects and a more realistic view on the need for extra work and variations. The pricing principle (e.g. hourly price) for the extra work and variations required by the customer is defined in the project contract and can provide substantial additional revenue to the supplier. Ensuring project profit through expensive extra work, however, can pose a risk to the development of a long-lasting customer relationship. If the customer considers this strategy to be calculated behavior, it may lose trust in the project supplier and search for new partners on this and future projects.

3.5.2 Preparing for negotiations

Both parties must be well prepared for negotiations. The supplier's negotiating team must prepare and agree upon a division of work and a negotiation strategy, including the objective, plan, and tactics for negotiations. It is useful for negotiating team members to discuss their views on the objective of the negotiations. What end results (outcomes) are we attempting to reach through the negotiations? What can we sacrifice in order to make other gains? What tradeoffs are we prepared to make? What is a satisfactory negotiating outcome? What outcome is unacceptable? Everyone from the supplier's organization involved in negotiations should have a uniform understanding of and a common information base on the content of items to be negotiated and the objectives and methods for the negotiations, so they can talk and act according to a common goal. It is unwise to air any differences in opinion between various members of the negotiation team during negotiating sessions; the focus should remain on negotiating with the other party, the customer.

Although negotiation situations and matters to be negotiated are usually complex and difficult to specify in detail, it is essential that negotiations be prepared for in an analytical and systematic manner. With the help of a negotiation-analytical[17] method, the alternatives, valuations, and best possible outcomes for the negotiating parties can be identified. Although, officially, there are only two parties involved in a project negotiation, many different views on the desirable results of the negotiations can be found among negotiating participants from both the customer and supplier organizations. All of the objectives are not necessarily featured as the object of negotiations, but the matters to be negotiated and the related valuations should be analyzed through a hierarchy of objectives, including objectives concerning wider and strategic issues related to the possible long-term business implications of winning or losing the contract. Matters to be considered before the actual negotiations are presented in Table 6.

Table 6. Matters to be considered by the supplier when preparing for negotiations

Matters to be considered	Specifying questions
Alternatives for customer and	• Will the customer realize the project in any case, or is there a chance that the customer will abandon the project if there is a poor

[17] Murtoaro, J., Kujala, J. and Artto, K. (2005)

competitive situation	negotiation result? • What other chances does the customer have to execute the project? What is the supplier's performance compared with the strongest competitors?
Negotiation parties and their objectives	• Who are the parties taking part in the negotiations? What end result or outcome does each party want to reach through project execution? (Note: Members of the customer's negotiating team may have different objectives than do members of the supplier's negotiating team, and these differences should be considered).
Issues to be negotiated, options and their valuation	• On which issues will the customer likely focus during negotiations? • On which issues do we want to focus during negotiations (e.g. optional technical solutions that would be less expensive to execute)? • What options can be considered for the matters being negotiated, and what is the valuation of each option (e.g. how much is the customer ready to pay for a month's decrease in delivery time)? • Can the customer's valuations be affected by emphasizing the benefits of certain technical solutions, for example? • How do we value the matters under negotiation? Do we want to execute a certain technical solution for its reference value, for example, and what is the financial importance of this reference value?
Course and objectives of negotiations	• What are the financial and other consequences if the negotiations do not lead to a contract? In the end, considering all matters, what is the worst contract we can accept? • What issues are not available for negotiation? (The supplier usually insists on including such specific items as matters related to the division of indirect responsibility in the contract.) • What objectives has the customer set for the negotiations, and what is the customer ready to trade off or abandon? What does the customer see as a fair negotiation result? • What objectives do we want to set for single or individual negotiated matters, and are there some matters to be negotiated as part of a larger entity? • At what stage of the negotiations are we ready to make concessions? Who has the right to decide on such concessions?

Example: Family Smith's analysis of the house project negotiations

Before the final contract negotiations are held with Livinghouse, the Smiths' preferred supplier, Larry and Sally held an internal meeting, in which they agreed upon the priorities for the upcoming negotiations. They compared the various bids and decided the highest price that they would be willing to pay. They believed that they would be able to save costs by choosing specialist suppliers for earthworks, foundations, and HVAC systems, rather than sourcing these components as part of the delivery scope of and options prices submitted by general contractors. Regarding Livinghouse, the Smiths were aware that it had recently lost several important competitive bidding competitions for houses and believed that the local salesman clearly had a need to win this contract.

> Among other bid evaluation criteria, Larry and Sally discussed the importance of the delivery schedule because, in almost every construction project they knew about, the construction schedule had been stretched. They made various calculations on technical solutions and evaluated the importance of the technical execution of many details, like the kitchen and the sauna. Additionally, they pondered what own work they would perform, that is, they considered what parts of the project they would do themselves, possibly with the help of friends and acquaintances. Basically, they believed that they could save some money by completing some parts of the earthworks, landscaping, and foundation works themselves, in collaboration with the specialized supplier (or with Livinghouse or some other competitive general contractors, if they accept their options). In addition, the Smiths believed that if they selected specialized suppliers for earthworks, foundations, and HVAC system, they should definitely allocate their time to coordinating the multiple suppliers and their interfaces in regard to their respective delivery scopes and activities. Furthermore, they wondered what procurement form would be most inexpensive for them. For example, regarding the HVAC systems, they received a very good bid from an acquaintance's specialist HVAC company that was included in the list of specialized HVAC system suppliers asked to bid separately on this system component. Although this separate HVAC system bid could prove less expensive than having the HVAC systems done through Livinghouse or another general contractor, selecting a separate supplier for a HVAC system or for earthworks or foundations could cause some interface problems. For example, using a specialist supplier may result in unclear responsibility definitions within the whole project between the deliveries of Livinghouse and several other suppliers, and it would be highly likely that there would be difficulties in assigning total responsibility and risks among several parties. Thus, the Smiths were faced with a very important decision on the method for project execution: Will the project be procured as a complete system delivery from and through one general contractor supplier, or will the Smiths choose several suppliers and assume significant responsibility for coordinating the project work?
>
> The Smiths set clear objectives for the negotiations. Additionally they agreed that both Larry and Sally would take part in the negotiations, but in slightly different roles. The main responsibility for the negotiations would be assumed by Sally, who would become thoroughly familiar with the competing bids and with different systems, product technologies, and materials in houses proposed by the various bidders. Larry would put more emphasis on the project execution methods and processes, and he would attempt to get the most suitable execution without any addition to price.

The customer usually tries to negotiate a contract that suits both parties without specifying a price. The customer may try to add assignments or other characteristics into the contract that were not initially discussed. In this case the supplier must consider the effects of the changes on costs, resources, and schedule. Although an increase in scope may seem small to the customer, it may substantially decrease the supplier's profit, or perhaps eliminate it entirely.

When the object, scope, and technical and execution-related details have been specified, the negotiations shift to financial details. Specification of the final contract price usually occurs during the final phase of the negotiations. The customer occasionally takes financial negotiations to an extreme by simultaneously negotiating with competing bidders. In this scenario, the representatives of suppliers still left in the bidding competition sit in separate negotiation rooms while representatives of the customer organization move from room to room.

Using this approach, the customer can exert pressure on one supplier at a time in the hope that the supplier in question will decrease its price.

General principles related to negotiations are discussed in Chapter 4, Section 4.8; these principles are suitable for both negotiating settings – negotiations between project supplier and customer, and negotiations between subcontractor and supplier.

3.5.3 Choosing a supplier

The customer bases its supplier choice on the bids it receives and on the subsequent negotiations it engages in with one or more suppliers. Its decision is based upon factors related to the objectives it sets for the project or the overall company. These factors can be roughly divided into four criteria. 1) From a financial perspective, the customer is especially interested in the price-benefit ratio. The customer can evaluate the lifecycle costs of the project or the financial benefits that are to be received in the long run, because the project will make its manufacturing process more effective. 2) The credibility of the project supplier is another key criterion. Because project deliveries may involve significant initial costs and substantial long-term costs that extend throughout the lifecycle of the delivered product, the customer is interested in the supplier's ability and readiness to engage in demanding work. References are one way of determining the credibility of the solutions and delivery time presented in a supplier's bid. 3) The appropriateness and quality of the supplier's technology and technical solutions are usually utilized as a decision-making criterion. The customer may look for solutions based upon the latest technology, or for solutions that have been tested over time and have proved trustworthy. 4) Yet another criterion that is typically used relates to the methods and quality of project execution. The customer may be interested in determining the extent to which the supplier expects or requires it to participate in the execution of the project. If the supplier's role is limited to a partial delivery that forms part of a larger project, central questions may focus on delivery time and the procedures to be used by the project supplier during project execution. A summary of the customer's decision-making criteria for choosing a project supplier and more detailed examples, are presented in Table 7.

Table 7. Decision-making criteria used by customers when choosing a project supplier

Criterion	Specific description
Price-benefit ratio	• Total price, terms of payment, and what is included in the price of the bid (scope) • Risk associated with the price (Is it a fixed price for complete delivery? How extensively has the price risk been transferred to the customer?) • Cost of maintenance and other lifecycle costs • The benefit for our (i.e. the customer's) business that we will receive from the supplier's solution
Credibility of project supplier	• Supplier's experience • References • Annual sales revenue and financial standing of the supplier • Length and features of guarantee period, and local support

Technical solutions	• Are there risks associated with the technical solutions? • How long are the products supported? • What is the development potential of the offered product? Is it a standard solution that the supplier will develop and update in the future, for example?
Project execution	• How much involvement is required from us, the customer (e.g. collecting and verifying preliminary information)? • Delivery time • Sufficiency of resources named by the supplier, and their competences and availability

In its supplier choice decision process, the customer can rank the bids by assigning points or scores, reflecting its assessment of each prospective supplier's performance or rating against the various customer decision-making criteria. The customer may assign different weights to the criteria in order to reflect their importance. Then, by calculating a numerical estimate for each prospective supplier, the critical decision-making criteria can be emphasized and compromises about differing opinions expressed in scores can more easily be discussed among members of the customer's evaluating team. It is essential to emphasize, however, that customers' decision-making processes are not truly rational. Like many decisions on such personal purchases as buying a car or an apartment, many project procurement decisions are based partly on qualitative or subjective factors, including emotions. In many cases, decisions are justified in rational terms only after the supplier choice decision has been made.

Example: decision-making criteria of a house project buyer

The Smiths did not want to concentrate solely on price in comparing the bids and in the negotiations with potential suppliers; the quality, scope, and delivery reliability of the project and related services are also important criteria. The Smiths wanted to compare the bids systematically, and for ease of comparison they made the worksheet displayed in Table 8. This worksheet compares three bids (from Livinghouse and two of its general contractor competitors) on multiple criteria, and the comparison was done for the bidder's core scope without considering the separately defined and priced scopes involving earthworks, foundations, and the HVAC system. The Smiths wanted to place slightly more weight on the price-benefit ratio and project execution criteria than on supplier credibility and quality of the technical solution. The scoring was done as a numerical consensus evaluation: Larry and Sally both gave their own score (scale 1…5) for each criterion for each bid and their average was used in calculating the weighted total score. Each bid was thus given a comparable evaluation.

Table 8. An example of a worksheet used to compare bids

Criterion	Specific description	Weight	Bid 1 Livinghouse	Bid 2 SiteInUse	Bid 3 Housemix
Price-benefit ratio	Price and terms of payment, as compared to the	3	3	2	4

	content of the delivery				
Credibility of project supplier	Experiences of acquaintances, hearsay, reputation	4	4	3	2
	Earlier experience on similar projects	2	3	4	3
	Possibility to make site visits to other buildings constructed by the company or otherwise to familiarize oneself with reference cases	2	2	3	4
	Breadth and history of the business of the company	3	3	2	3
Technical solutions	Technology used for project components	2	3	4	3
	Quality and appearance of work	2	3	3	3
	Maintenance services and complementary services while living in the house	3	5	3	3
Project execution	Procedures and principles	3	3	2	3
	Supplier's contacts with collaborative partners and subcontractors	2	3	3	3
	TOTAL SCORE		86	71	80

Each house delivery project is unique. As the suppliers have had only the Smiths' preliminary plans as the basis for their bid, there are many things to be specified in the bids, for example, the materials to be used. In the Smiths' house construction project, the comparison of delivery content and price turned out to be particularly difficult. The Smiths went through specifying negotiations, for which the numerical worksheets were no longer of help. A combination of subjective feel and a specific evaluation of details were needed. An important factor in the decision making turned out to be a friend's bad experience with Housemix, the strongest competitor to Livinghouse. On the basis of negative word of mouth from a friend, the Smiths rejected Housemix as a supplier and, after negotiations with Livinghouse, they decided to make a contract with Livinghouse. The Smiths contracted with Livinghouse for the core bid scope but not for the options. They contracted with specialized suppliers for earthworks, foundations, and the HVAC system, although they assumed some parts from the specialized suppliers' scopes of earthworks and foundations work as their own and their acquaintances' responsibility. Furthermore, the Smiths decided to

> do the interior finishing themselves, including choosing the interior finishing materials for floors, walls, and other surfaces later during the project's execution. The Smiths recognized that they had taken on significant work responsibilities and that they would have to put considerable effort into coordinating the interfaces among multiple suppliers and their delivery scopes. Because the Smiths' requirements for the house and its incorporated products, materials, and equipment was not clear enough to allow for a complete design when signing the contract with Livinghouse, a cost-plus type of contract was chosen. This form of contract granted the Smiths the flexibility to make changes in requirements and designs during project execution.

At the end of contract negotiations, the customer and its chosen supplier sign a contract that is binding on both parties. During the negotiations, some wishes and expectations may have arisen that are not necessarily written in the contract, but there is mutual agreement that they will be considered as possibilities emerge during project execution. An atmosphere of trust makes it possible for some things to be left open, to be decided upon later. In a broader sense, the project contract can be seen to include all the things upon which there was consensus during the bid and contract negotiations. For other suppliers involved in the bidding process, the contract negotiations rarely end positively, unless the customer decides to use several suppliers in parallel. Although bidding success as measured by a signed contract is obviously every supplier's objective, the unsuccessful bidders may have increased the trust between their organization and the customer, a factor that may serve them well in future project competitions.

3.5.4 Contract types

Different bidding situations require different contractual solutions; in this section, we discuss the various *contract types*, the names of which are defined on the basis of the way the contract price is determined.

Contracts can be described on a continuum with fixed-price contracts at one end and cost-plus contracts at the other. A *fixed-price contract* is one in which the supplier promises to make a delivery, within a certain scope, for a fixed price. Usually under fixed-price contracts, the buyer agrees to make partial payments to the supplier as the supplier completes specific parts of the project work. A *cost-plus contract* is one in which the supplier invoices the customer for costs incurred from the execution of the project – for the time, resources, and material prices, plus an agreed-upon profit. The contract may state the hourly wages and material prices to be used, and a handling price may be added to the material costs according to some procedure. The incurred costs, which the supplier usually documents in detail, are paid according to an agreed-upon schedule.

In practice, a contract is used to transfer responsibility and risk from the customer to the supplier. The greater the risk transferred to the supplier, the higher the supplier will price the contract. Nevertheless, because of the competence and expertise of the supplier, the project may be realized with lower costs than if the customer attempted to do all the work and bear all the project risk. From the supplier's perspective, taking responsibility and bearing risk for the right price is profitable business. Such behavior is, in fact, characteristic of business; risk taking is frequently economically profitable, and greater risks are often associated with greater returns.

Division of responsibility and risk between the parties. The contract effectively divides the responsibilities and risks between parties. In a fixed-price contract, the supplier takes a high financial risk. Even if the supplier estimated the cost for the project work and determined a fixed price that includes certain profit expectations, it may take a loss on the project if its cost estimate was grossly or even somewhat inaccurate. The customer's financial risks are low in a fixed-price contract because it pays the same price even if unfavorable events occur during project execution. In a cost-plus contract, on the other hand, the risks facing the parties are reversed: the customer bears a high risk but the contract is virtually risk free for the supplier because it can invoice the customer for all its costs plus a profit component for time and materials.

Figure 16 describes the position of fixed-price and cost-plus contracts, placing them at opposite ends of a continuum and labeling the risk for the supplier and customer at these extremes. In practice, there are several variations within each of these contract types. Table 9 presents the contract types illustrated in Figure 16 and describes their strengths and weaknesses.

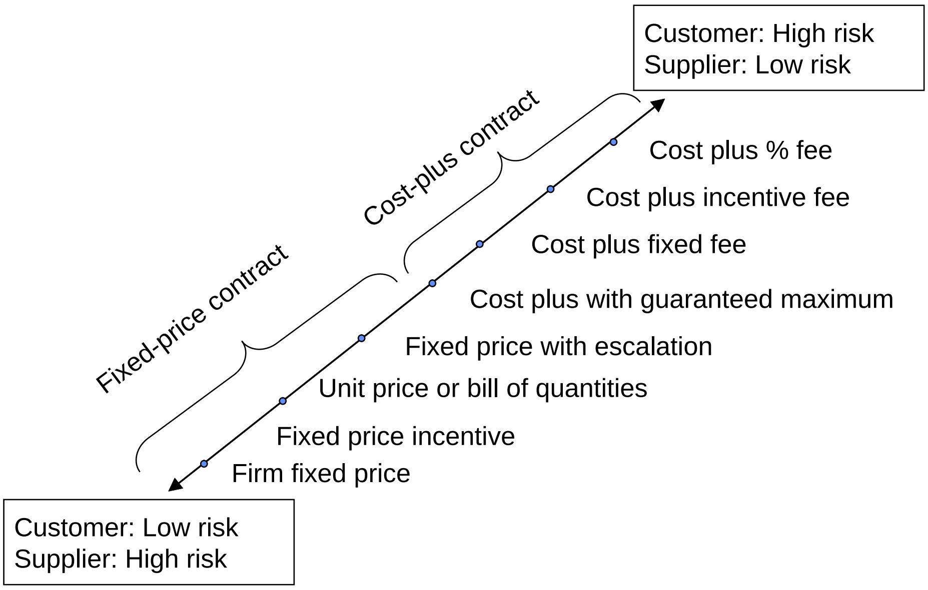


Figure 16. Various contract types and risks from customer and supplier perspectives

Accuracy of scope specification and the project time factor. It is not financially wise for the customer to choose a fixed-price contract if the scope of work cannot be specified accurately, because the supplier will likely overprice the contract based upon the perceived risk of uncertain specifications. If the customer is in a hurry to get the project completed, then, and the work must be started without specific plans, the cost-plus contract is more beneficial. If the work is accurately specified, however, a fixed-price contract will often end up being less expensive than a cost-plus contract because an accurately specified work project can be opened to competition among several suppliers, and the least expensive bid chosen. If we were to include another continuum alongside the existing one in Figure 16 to reflect the variations in accuracy of the scope specifications, it would be a line parallel to the contract type continuum line, and would show increasing specificity of work as it moves toward the fixed-price contract, and decreasing specificity as it moves toward the cost-plus contract.

The relationship between the point at which a contract is signed and the price of the contract is not always a simple one. In the earliest phase of contract discussions or negotiations, it is not always possible for the customer to specify the scope of project work accurately; if a fixed-price contract is signed too early, then, the contract is likely to be overpriced because the supplier is the party that bears the risk of possible cost overruns. From the viewpoint of making the scope specification more accurate, the chances of writing a low-priced, fixed-price contract increases the later the point in the contract negotiation process that the contract is signed. On the other hand, the later the contract is signed, the shorter the time available for the supplier to do the work. If the contract is signed in a relatively late phase because it perfected the accuracy of scope definition, the supplier may consider that a shortened time for project execution increases the risk of delay and delay-related penalties, and may price the contract higher. Figure 17 illustrates this situation. Thus the timing of the signing of the fixed-price contract is critical; signing too early will result in a high-priced contract because of inaccuracy in scope definition and the associated increase in risk for the supplier; and signing too late will result in a high-priced contract because the supplier faces a tighter schedule and increased possibilities of incurring delay penalties. The optimal range is somewhere between these high-priced early and high-priced late signing scenarios. Of course, the customer can affect the contract price by imposing less risk and less responsibility on the supplier in the contract. In the case of a late scenario and tight execution schedule the customer can lower the supplier's penalties for late delivery. Furthermore, in the case of an extremely early start with inaccurate scope definition, the customer may switch from a fixed-price contract to a cost-plus contract.

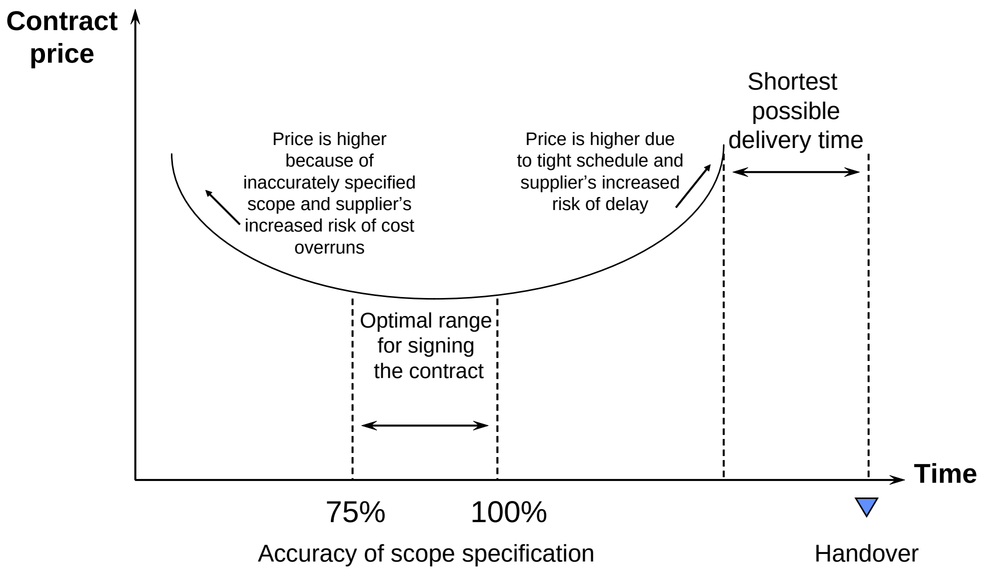


Figure 17. Connection between the timing of signing the contract and the price in a fixed-price contract

The amount of work consumed in managing the project work. Different types of contracts demand different levels of project management inputs or resources from the customer versus the supplier. In a cost-plus contract, the customer usually expends substantial work effort in planning and managing the work executed by the supplier. In a fixed-price contract, the customer's part of project management is usually restricted to supervising the delivery of the supplier and ensuring adherence to the contract. A cost-plus contract demands little planning or management from the supplier, but in order to ensure the successful and planned execution of a fixed-price project, the supplier must put substantial effort and resources into managing the work.

In deciding on the type of contract, the goal is to find a solution that offers maximum motivation for both parties. If the primary goal is to finish the project as early as possible, for example, the solution may be contractual terms and a pricing structure that provides an incentive for both parties to work toward that goal. Bonuses for early delivery or a penalty pricing structure for late delivery are vehicles that can be used to introduce incentives into a contract. If the project schedule was greatly stretched, or if the objectives were not met, it would be reasonable to divide the costs caused by the delay between the parties. Similarly, the customer and the supplier could share the financial benefits of early delivery. Table 9 presents different types of contracts and their strengths and weaknesses.

Table 9. Different contract types and their strengths and weaknesses

Contract type and definition	Strengths	Weaknesses
Cost plus % fee: The customer pays for the supplier's costs plus a certain % fee based upon these costs (e.g. a higher price for an hour's work than the supplier actually incurs).	Flexible for both parties; changes in scope are easy to accommodate.	Costs incurred by the supplier can accumulate without any upper limit; can turn out to be expensive for the customer; can motivate the supplier to concentrate on spending work hours and not on completing the results effectively.
Cost plus incentive fee: The customer pays the costs as well as a fee (commission) that is fixed to a certain objective (e.g. targeted resource spending), the principles of which have been agreed upon beforehand.	The supplier benefits if costs (resource spending) are lower than a certain objective, for example. The customer benefits as the supplier bears part of unanticipated costs (risks) of resource usage.	The objective and principle for commission must be defined in detail in making the contract, and are based upon inaccurate estimates.
Cost plus fixed fee: The customer pays for the costs as well as a fixed fee.	The suppler benefits if the costs are lower than the cost objective, because the fee is fixed. The customer benefits as the unanticipated costs (risks) are shared between parties.	The principles for the fixed fee must be defined in detail in making the contract, and are based upon inaccurate estimates.
Cost plus with guaranteed maximum: The customer pays for the costs according to invoicing, but only up to a certain limit (i.e. maximum price).	The benefits to be received from not reaching the maximum price (i.e. costs are lower than the maximum price) are shared between parties.	The supplier pays the costs that run over the maximum price (i.e. the supplier bears the risk for the customer).
Fixed price with escalation: The price for the project is fixed, but it is checked and corrected by a certain cost index as the project	Especially used for long-term projects; considers economic factors and cost developments (e.g. inflation	The total cost cannot be anticipated.

progresses.	costs or increased raw material costs).	
Unit price or bill of quantities: A fixed price is determined for the project units, and the total price depends on the number of units executed (the number can be flexible). (In practice a fixed unit cost for every m^2 painted by the supplier, for example.)	Flexible: scope can be changed. The supplier accounts for the effective execution of the completed results, measured in specified units, and because of the fixed unit price, the supplier does not account for spending (more) time on those units.	Requires an estimated resource reserve. If the scope changes substantially, execution difficulties may arise.
Fixed-price incentive: Customer pays a certain fixed price plus a provision that is fixed to an objective, the principles of which have been previously agreed upon.	Rewards the supplier, especially if the objectives are reached, in which case the supplier receives larger returns. Benefits are divided between parties.	Determining a fixed price is always a challenge.
Firm fixed price: The customer pays a certain fixed price for the entire project.	Beneficial for the customer if the scope of the work has been specified in detail, and beneficial for the supplier if it can specify tight cost objectives.	Requires a detailed scope specification. Risky from the supplier's perspective. Especially challenging for the supplier in a highly competitive environment.

Fully fixed-price contracts are rare today. Instead, the fixed part of pricing is usually treated in the contract as a separate matter, and hourly wages and material prices are determined for possible extra work. The customer uses provisions, rewards, and sanctions in contracts as incentives and penalties to direct the supplier's attention to the central objectives of the project at hand.

3.5.5 Content of project contract

When a project contract is signed by both parties, it binds the customer and supplier to their respective obligations during the project. In a judicial sense, a verbal contract is binding, but it is difficult to verify in conflict situations. A contractual relationship can be created without a separate project contract if the project supplier makes a binding bid and the customer accepts it with no suggestions for change. Usually, at least in complex projects, the contract is broad and multilayered in its clauses. The contract can be used to prepare for project-related risks by including the division of responsibility between the parties, for example, and by specifying procedures to be used if certain risks or unforeseen events occur.

The contract should be expressed clearly to ensure that both contractual parties understand their requirements and obligations. Clarity should minimize possibilities for contract violations, which could lead to judicial consequences resulting in, for example, monetary sanctions that benefit the other party. Although clarity and specificity are desirable, the contract should have some flexibility that will benefit both parties as project planning and execution unfolds and if circumstances change. At the time of the competitive bidding and during negotiations, all pertinent information required for writing a detailed, seamless contract may not yet be available.

Flexibility can be built into the contract by articulating the procedures to be followed when making changes to the scope, for example. The contract could include appendices that outline procedures for extra work and variations, including price lists that help to define costs created or erased because of changes. Such changes should be documented and officially accepted so that they become part of the project contract.

The most significant contents of the contract are project scope, relative responsibilities of the parties, risks, and pricing. The contract can follow the structure of the bid or it can be a formal document that includes standard terms in the body and presents technical and financial details in appendices, which are easier to change. The contract structure can, for example, consist of the following clauses:

- parties making the contract and their contact persons;
- the objectives, scope, and duration of the contract;
- division of responsibilities and risks; including compensation liability in case of indirect damage, responsibility limit, lateness terms, and guarantee terms;
- rights and obligations of the parties, for example, reporting and followup;
- pricing and invoicing principles and payment terms; including penalties and bonuses;
- confidentiality;
- property rights and transfer of responsibility after the delivery;
- change terms;
- dissolution and contract termination terms and, for example, force majeure;
- other contractual terms;
- number of signed original contracts (for the customer, supplier, and other possible parties); and
- signatures.

A detailed execution plan and technical specification, and price lists and general terms (if referred to), can be presented in separate appendices. In project business, certain contractual matters are repeated unchanged from one project to the next, so the project supplier or customer should add these issues under general terms and focus on project-specific matters in the detailed contract negotiations.

3.5.6 Transfer of project from the sales unit to the executing organization

At the interface between successful project marketing and sales, on the one hand, and initiating project execution, on the other, the project responsibility is transferred to the executing unit of the supplier’s organization: the business unit responsible for projects and for establishing project organizations for the execution of single project. Although the project manager responsible for project execution would have played some role in the project sales work, this person is not likely to possess all the information accumulated during the sales phase about the customer and its needs. The sales manager should communicate the relevant information to the project manager. The transfer of information should include the review and discussion of all accumulated documents, and these should be handed over to the project manager. During the sales phase, tacit knowledge has been developed on the customer’s expectations, the procedures that have been agreed upon with the customer, and the promises that have been made to the customer that may not have been recorded in the contract; all this information should be communicated to the project manager. The tacit knowledge is best transferred or absorbed if the project manager has played an active role in the sales team during the sales stage of the project or if the sales manager is able to participate in the work of the project team or project steering committee during project execution.

A sales review should be a component of transferring the project to the project organization; such a review evaluates the quality of execution of the sales phase and examines possibilities for improvement. The factors that led to winning the contract can also be considered for potential use in ongoing or future competitive bidding procedures. A sales review should also be held for lost contracts, in order to promote learning from mistakes, to increase understanding of the procedures demanded by customer relationship management, and to consider the effects of the lost contract on the company’s business. Especially in companies making large project deliveries, the loss of one contract can have substantial consequences for future strategies and tactics in the company’s project business.

A thorough knowledge of and a continuous interaction with the customer can generate advanced information on project realization and start time. The project manager, and perhaps the project team, has evaluated the probability of project realization and, based on the forecasts received from sales, has prepared for project execution before signing the contract. The more certain the forecast that the project will be realized, the earlier the supplier is willing to commit resources to the project.

3.6 Organizing and managing sales

In practice, the sales manager is responsible for project marketing and sales, assisted by other personnel available to do supporting work. The sales manager plays a key coordinating role inside the company and with external stakeholders, and it is the sales manager’s responsibility to ensure that all required information, competences, and resources are available to sales from different parts of the company, from the customer, and from subcontractors. The sales manager has a demanding role; therefore, it is not uncommon for one sales manager to have several bid preparations and contract negotiations ongoing simultaneously.

3.6.1 Tasks and competences of sales managers

The marketing and sales task field of sales managers is broad and diverse. It includes:

- building a collaboration network that will provide the project supplier with a good perspective on future project opportunities;
- taking part in developing projects at an early phase, together with current and potential customers, thereby enhancing the project supplier's opportunities for expanding its business and improving profitability;
- communicating the market situation and customer needs to corporate management and to the personnel taking part in projects;
- acting in tight collaboration with all the units of the company in preparing bids, in connection with contract negotiations, in developing new services and solutions, and in executing many other tasks;
- taking responsibility, as a central task in their own task area, for the bid and contract work and its success; and
- participating in the development of processes and activity in their own work field.

The sales manager requires diverse competences, including:

- familiarity with the actors in the market area, as well as their objectives and competences;
- an understanding of complex phenomena and a familiarity with the customer's processes and business, enabling the sales manager to sell solutions to the customer's problems and develop the customer's activity;
- familiarity with the products and technologies of the supplier, its partners, and its competitors, enabling the sales manager to find the best, realizable, and competitive solutions.
- strong presentation and organizing skills, diplomacy, ability to influence people and understand their attitudes, ability to create a convincing atmosphere, interaction skills, and stress tolerance in negotiation situations; and
- the capability and will to apply influencing skills with customers and with the supplier's own personnel inside the company.

Sales managers need not necessarily possess all these competences, as other members in the designated sales team may complement these skills. This is especially true in specific bidding processes in which a sales team is assigned for purposes of winning the contract for an attractive project. There are demands on sales managers to be sociable and companionable as well, because their work brings them into continuous interaction with valuable customers.

The sales manager, whose primary task is to bring contracts to the supplier, and whose evaluation is based partly on that ability, should be determined and result oriented. The sales manager must have the ability to take controlled risks, for those who are extremely cautious cannot close the best deals. The sales manager should not brood over unsuccessful sales; there should be enough analysis of lost sales opportunities for learning to occur, and then new project opportunities should be embraced.

3.6.2 Tasks of the sales team

Project marketing and sales require extensive special competences and commitment of the entire organization. Sales activity is teamwork, with the team being led by the sales manager. People possessing relevant competences to work on the project are collected from various parts of the organization and assigned to the sales team. These individuals usually continue to have responsibilities for duties in their respective job positions, and must divide their time among multiple roles, including work on a specific project sales team.

The composition of the sales team and the way team members allocate their time varies by project. In selling small projects, for example, one team member can have several roles, but there is a typical group of project sales team members.

The sales manager has full responsibility for the coordination of project sales and for developing the customer relationship.

The controller takes charge of technical specification and pricing of the project, and often the preparation of requests for bids for the products or services to be procured from subcontractors.

The (preliminarily assigned) **project manager** brings expertise to the project execution phase of the sales process, increases the credibility of sales efforts by convincing the customer of the capability of the project supplier to conduct the project effectively, and plans resources and activities.

Technical experts are needed to support sales personnel and the controller in technically demanding projects in which the other sales team members may not have adequate expertise.

Top management is included in the sales team, which is essential if a direct contact to the customer’s top decision makers is desired. The presence of top managers helps to ensure that the project is aligned with the project supplier’s strategy and that the supplier has the required capability for and commitment to the delivery.

Lawyers ensure that the bid and contract clauses are recorded correctly from the perspective of the supplier, and that the supplier limits its responsibilities by contractual terms, avoiding unnecessary risks or risks that are too large.

In forming the project sales team, it is crucial to consider the personnel that the customer has assigned to participate in the procurement. If, for example, a member of top management takes part in the contract negotiations from the customer's side, the project supplier should include members of top management on its negotiating team.

3.6.3 Contract and bid reviews

The activity during project marketing and sales is followed from the perspective of marketing in general and from the perspective of the single project bid that is under preparation. The most significant checkpoints for quality assurance regarding the project in preparation are *bid review* and *contract review*. The bid review is held before making the final decision to send the binding bid to the customer, and the contract review is conducted before signing the contract. The s*ales review*, which occurs later, when the project is transferred to the executing organization, was discussed previously. If the company follows an ISO 9001 quality standard, holding the reviews is a prerequisite for certification.

The purpose of the reviews is to ensure that the supplier is capable of executing everything that is promised in the bid or contract. Reviews can include documentation, presentations, and hearings involving the right parties as required in the particular quality system. The results of the reviews are documented as a further measure of organizational learning. The reviews can identify assignments that must be completed before proceeding to the next stage of preparation (e.g. before the bid can be submitted to the customer). The reviews do not necessarily involve a common meeting; they can be organized by sending the required documents to the appropriate people to be checked and approved. The scale of the bid and the complexity of project execution affect the breadth of the review and the composition of the group assigned to conduct it.

The company’s quality system determines the personnel that are needed in official reviews. The reviews can be conducted by, for example, the project supplier’s people who will participate in the project execution; these individuals likely possess the best expertise to evaluate the content of the bid or contract. It is usual that, in addition to the people taking part in the preparation of the project, a view from an objective company person external to the project sales team is included on the review teams. In this way, the bid preparation work can be evaluated objectively. A member of top management usually fulfills this role, offering the added dimension of assessing the project from the broader perspective of the company and its strategy. Bids including new technology (pilot projects) are typically risky, for example, and top management may require that the technology be developed and tested to an adequate degree in the supplier's product development unit.

The *bid review* must be held before making a binding bid. If the supplier's bid document does not say otherwise, the supplier is committed to delivering the project specified in the bid according to the content and terms of the bid as expressed by the supplier. If the customer accepts the supplier’s bid as is during its validity period, and confirms that it accepts the bid, it automatically becomes a contract binding both parties.

A *contract review* is held before signing the final contract. In this review, the changes and additions made to the content of the bid during contract negotiations are checked and accepted. The exact content of the review depends on the project to be executed, but usually the following items, at least, are checked:

- price, costs, and estimated profit of the bid;
- terms of payment;
- liabilities and responsibilities in the contract (e.g. sanction for delays);
- delivery time;
- scope of delivery, and accurately defined interfaces with any scopes that are responsibilities of other external parties;
- technical solution; and
- project-related risks.

It is crucial that project costs be determined reliably enough to enable project profits to be calculated, a task that requires the project manager's expertise as well as a commitment to execute the project according to the terms stated in the bid. Furthermore, to determine project profits during the sales phase of the project lifecycle, binding bids must be received from project-related subcontractors. Payment terms should be tied to clear, easily verifiable delivery points in order to minimize risks. In addition, the inclusion of early payment terms helps to decrease the amount of supplier's working capital committed to project execution.

3.6.4 Effectiveness of marketing and sales, and related measures

The management of project business is strongly influenced by strategic choices and related specification of objectives. By following and measuring activity, a project supplier can monitor the extent to which its objectives are being reached and if its personnel are directing their efforts in the right directions to achieve these objectives. This monitoring process helps to communicate the importance of the objectives to the organization and to illuminate the areas that require corrective measures. In short, followup on the effectiveness of project marketing and sales is the proper way to manage the marketing function, as it enhances the supplier's ability to reach higher-level objectives.

The simplest measures for assessing the effectiveness of marketing and sales are the cumulative values of bids made and contracts won in a certain period. These figures can be used to calculate the percentage of bids won, which is one of the key measures to track. It can be used to forecast the share of projects in the list of bids that can be turned into business. The cumulative value of bids, the percentage of bids won, and the order base can also be used in planning resource reservations for projects. The transformation of the list of bids into projects is presented in Figure 18.

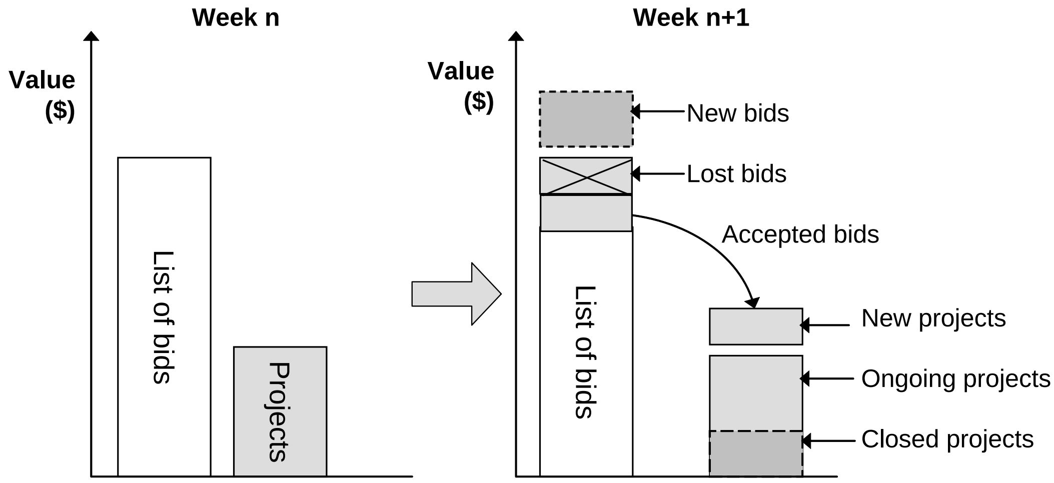


Figure 18. Transformation of list of bids into projects

When choosing the effectiveness measures, there should always be a suitable balance between strategic long-term objectives and operative short-term objectives. It is often dangerous to emphasize short-term project-specific financial objectives, as the marketing and sales efforts can be directed at the wrong things, risking the continuous success of the company. It is also dangerous to concentrate too much on measuring historical data because the mistakes and possible corrective measures are noticed too late. In addition to retrospective measures, there should be an adequate number of anticipatory measures that can be used to forecast future success, enabling corrective action to be taken early. In addition to measuring the company's own activity, the operating environment of the company and the changes that occur in it must be monitored.

In measuring the effectiveness of marketing and sales, the percentage of bids won can be calculated for different market areas, products, and sales managers. In this way the measures can be used to evaluate both the total competitiveness of the company and the effectiveness of its marketing and sales activities. If the share of bids won from the open list of bids unexpectedly decreases, it can indicate the company's weakening competitiveness, its inability to make quality bids, or a declining external market demand.

Merely studying financial figures, however, often provides an inadequate description of the quality and effectiveness of the company's entire marketing and sales activity. For example, a balanced scorecard approach[18], which is an evaluation tool suited to complete performance management, is a useful device for setting objectives and measuring the effectiveness of the company's overall marketing and sales efforts. The balanced scorecard approach includes four perspectives – customer, financial, business process, and learning and growth – that must be considered when managing sales and marketing activity. In the *customer perspective* the supplier is studied from the viewpoint of the customer. The supplier should try to determine if the progress of marketing, and sales and the resulting bid and contract, met the customer's expectations. The key question is how well the supplier provides value to the customer. The *financial perspective* concentrates on the financial result of marketing and sales from the supplier's point of view. The critical objectives or benchmarks are revenue from project deliveries and financial profitability; however, we also include the previously mentioned list of bids and number and monetary value of bids won. In the *business process perspective***,** measures related to (internal) marketing and sales are studied; as well measures related to the management of the stakeholder network external to the company can be considered. In the *learning and growth perspective,* the activity is measured through the development of the company's products, services, processes, and personnel. Every company should specify measures that are carefully aligned to its own objectives. Examples of measures in the different perspectives of the balanced scorecard are presented in Table 10.

Table 10. Measures included in the balanced scorecard for sales and marketing

Perspective in the balanced scorecard	**Examples of measures**
Customer perspective	Customer satisfaction on various phases of the sales process Quality of bid (customer assessment of the content of the bid) Customer retention Number of new customers

[18] Kaplan and Norton (1996)

Financial perspective	Turnover and its distribution by different market areas and product segments Project profit (difference between project revenue and direct costs attributed to the project) Volume of bids in hand Total sales
Business process perspective	Share of awarded contacts as a proportion of open listed bids Number of customer visits or contacts made per supplier Share of projects in which the project manager participated in bidding negotiations
Learning and growth perspective	Satisfaction of sales and marketing personnel Competences of sales personnel (e.g. familiarity with the customer's process, product knowledge) Share of total sales represented by new solutions (in addition to measuring sales competence, this measures the success of product development)

Sales personnel often receive sales rewards or provisions based, at least in part, on their results. The measures used in the appraisal system should provide reliable information, be readily available, and direct the sales personnel to engage in the right type of activity. The measures in the sales appraisal system should be set in a way that does not lead to suboptimization of sales work. Furthermore, the appraisal of the effectiveness of sales activity should be evaluated against the strategic and cross-business-unit objectives of the company. We consider project profit (e.g. measured through the gross profit – the difference between sales revenue and direct costs of the project) to be a good general measure for assessing the effectiveness of sales personnel and other personnel participating in project execution. We believe this because the resulting project profit summarizes the realized impact of successes and problems or failures. Accordingly, measuring the project profit directs sales efforts toward selling cost-effective projects that are designed to enhance opportunities and avoid risks and problems.

3.7 Literature

Cova, B., Ghauri, P. and Salle, R. (2002) Project Marketing: Beyond Competitive Bidding. Great Britain: John Wiley & Sons.

Murtoaro, J., Kujala, J. and Artto, K. (2005) Negotiations in project sales and delivery processes: An application of negotiation analysis. Helsinki University of Technology Industrial Engineering and Management Report 2005/3. Espoo: Helsinki University of Technology. Department of Industrial Engineering and Management.

Skaates, M. A. and Tikkanen, H. (2003) International project marketing: an introduction to the IMP approach. International Journal of Project Management 21 (7) 503-510.

4 PROJECT PLANNING AND CONTROL

This chapter focuses on several crucial project management knowledge areas that are involved in project execution, including project integration and scope management; schedule and resource management; and management of procurement, risks, quality, and information. At the outset of this chapter (Section 4.1), we discuss project integration management from the perspective of the early phases of the project, and at the end of the chapter (Section 4.9) from the perspective of the project implementation phases. For all knowledge areas, we take the perspective of the executing organization (typically, the project supplier) and describe key project planning and control-related concepts, methods, and procedures; and we provide examples of proven tools for use in project management and control. We believe that each knowledge area is important throughout the phases of the project lifecycle, as illustrated in Figure 19.

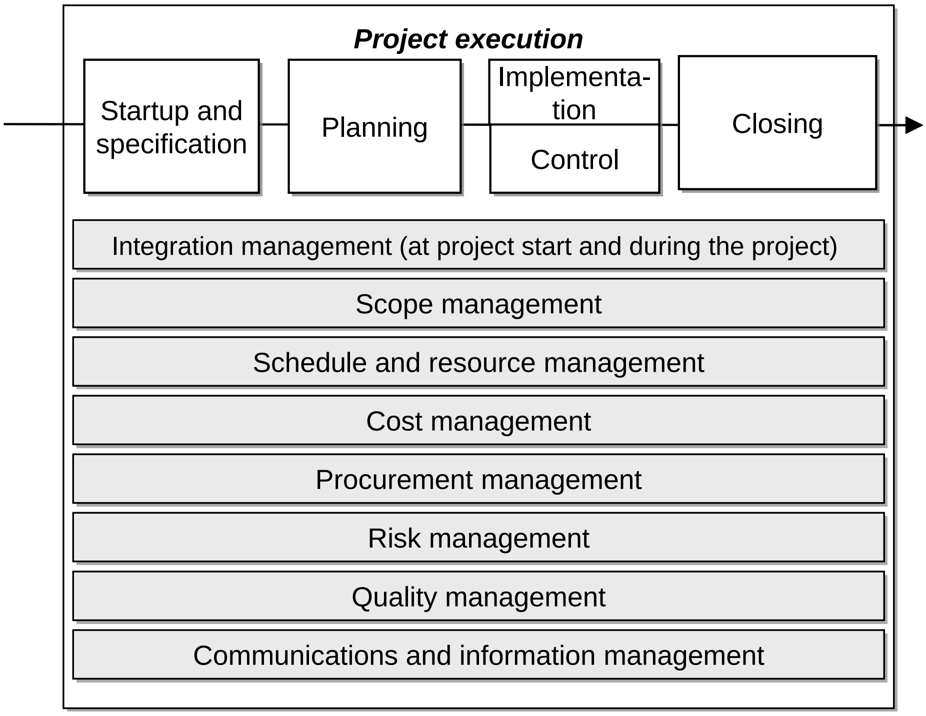


Figure 19. Phases of project execution and project management knowledge areas

4.1 Integration management at the start of the project

Project *integration management* refers to procedures that integrate various parts of the project and its management, and help in realizing project objectives. The tasks of integration management are to coordinate project execution, deal with the dependencies among activities, and manage issues related to various knowledge areas, including specifying objectives, refining objectives during the project, and managing change.

In the early stages of the project, integration management focuses on project feasibility and planning using such tools as *project description*, *project proposal*, and *project plan*. Later in the project lifecycle, during the project execution and control phases, the tasks of integration management is to study and balance management procedures for the project as a whole, across all project parts and knowledge areas. Suitable tools for integration management are, in addition to *project plan*, various methods of project reporting and *change management*, topics that are discussed in Section 4.9 of this chapter.

In practice, integration management is the primary task responsibility of the project manager; done well, integration management ensures that the right tasks are performed throughout the project.

4.1.1 Project start and specification

A project starts when the customer or the project supplier identifies the project opportunity and begins to specify the project in more depth. Project specification tasks include confirming the project's importance and its stakeholders, benefits, and feasibility. Project start and specification is a key phase for the entire project because, at this early stage, key decisions are made about the project goal, objectives, and method of execution. The decisions made during this early phase must be compatible with one another, acceptable to the various project stakeholders, and supportive of project realization.

The specification, feasibility, evaluation, and preliminary planning activities of a project overlap with the marketing and sales phase of the investment project, as illustrated in Figure 20. Either a customer or supplier perspective can be taken on project execution: the phases of project execution are the same for both parties, although there are differences in content and emphasis, and responsibility for the project specified in the contract changes as the work progresses. In Chapter 2 we described the commonalities between investment and delivery project perspectives; they contain common parts regulated by contracts, organizational solutions, and the project plan. Now, in Chapter 4, we concentrate on this common project executor's perspective (the executor being the customer or an external supplier). The same practices and principles suit both customer and supplier perspectives.

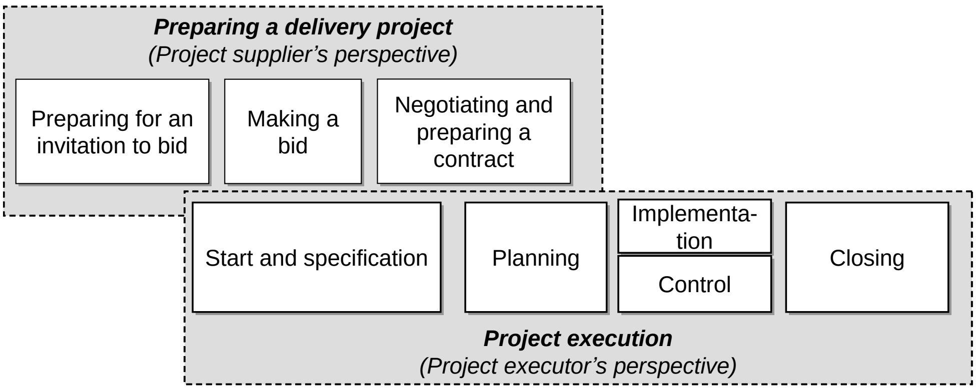


Figure 20. Project sales and execution occurs in parallel in the project executor's (supplier's or customer's) organization

During the early phases of a delivery project the extent of needed collaboration is uncertain and the customer may, in part, transfer responsibility for integration management to a reliable supplier. In such cases, the project supplier is compelled to put content-related and project management expertise into the sales phase, even though it may lose in the bidding competition and thus be denied the opportunity to execute the project. From the supplier’s perspective, however, it is attractive to put substantial effort into the project specification and other early stages of the competitive bidding process because the supplier may be able to affect the project objectives and solutions. The customer benefits from various project bids it receives from external parties as they may provide valuable new ideas and better execution possibilities. In the case of highly uncertain and complex internal investment projects, the internal customer for the project usually carries responsibility for integration management because, for example, the responsibility for product research and development, or for organizational development, is not easily transferred to an external party. In such cases, the internal customer primarily procures clearly defined and specified tasks or parts from external suppliers but keeps responsibility for project coordination.

The central tools used for project integration management in the early phases of the project are the project description, project proposal, and project plan. These documents are preliminary and are prepared before project execution, as part of sales and internal ideation activities. They guide and align the project execution and need to be continuously updated as the project progresses, as described in Figure 21. Project description and proposal are usually needed only once for the decision to plan the project, but they can be developed further and used later as part of project communication, including results presentation. The project plan is also updated as the project progresses and it can be used as a tool to manage the execution and control phases of the project.

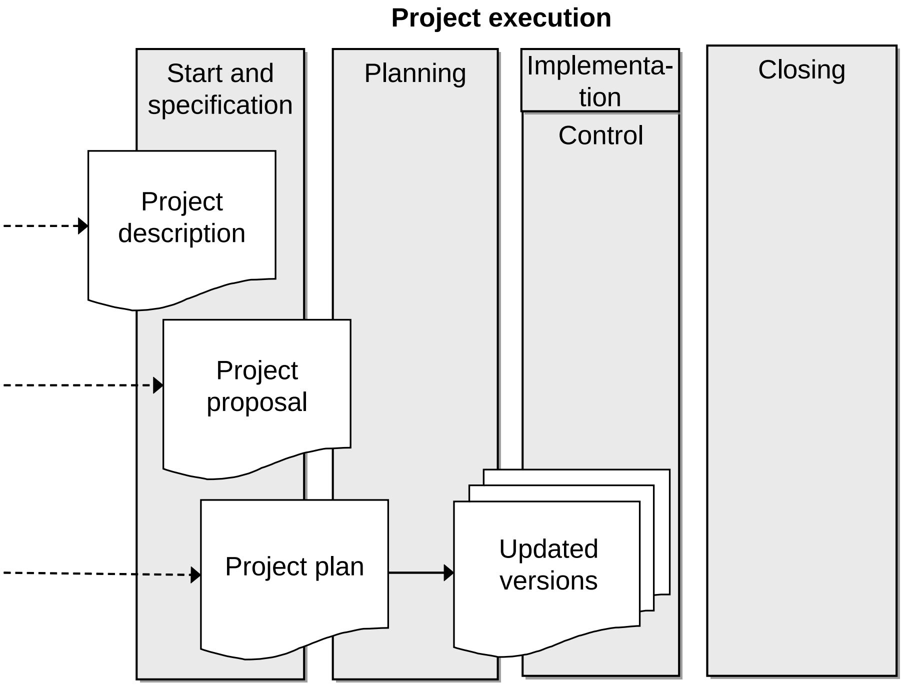


Figure 21. The project description, proposal, and plan are tools for integration management and are periodically updated

Project description

The result of project marketing and sales, or the internal preparation work in a company and the starting point for actual project planning, is usually a project opportunity, which is shaped through specification into a project description. A *project description* is a preliminary sketch indicating why the project is being considered, what the project is about, and how it can be realized. Typically, it contains ideas on the project's scope, partners, expected benefits, and methods of execution, descriptions that provide a good starting point for more detailed planning. However, these descriptions offer an insufficient basis for project execution.

The project description is a useful tool for communicating a project opportunity and initiating necessary project planning. Companies need a project description so they can make initial project decisions, including those relating to procurement. In drafting its project description, the customer often utilizes the competences of various stakeholders and their experiences on similar projects. The customer can use the project description to communicate preliminary procurement needs to potential suppliers. For the project supplier, the project description creates an opportunity to affect project objectives and specifications and to consider whether or not the project is consistent with this company's strategy and future.

The project description can be presented in oral or written form. This preliminary phase is not always realized but it has become typical in large investment projects and for product development projects. An example of a short project description is presented in Table 11. In parallel with the project description, a more detailed technical and financial feasibility estimate is made to establish the requirements for project execution.

Table 11. Example of a short project description[19]

<table>
<tr><td colspan="2">Name of project opportunity or project</td><td>Updated</td></tr>
<tr><td colspan="3">Description, definition, goal, and objectives of project</td></tr>
<tr><td colspan="3">Customer or customer segment</td></tr>
<tr><td colspan="3">Benefits for customer and business</td></tr>
<tr><td colspan="3">Link to strategy (What objectives does the project support and how?)</td></tr>
<tr><td colspan="3">Estimated scope of project
Resource requirement ________________________ person-work months
Procurement need ________________________ $ (or person-work months)
Own costs ________________________ $
Duration ________________________ starting and finishing date</td></tr>
<tr><td colspan="3">Risk level of project (the remaining part of the project): effect of risks on business (check appropriate response)
I The magnitude of risk poses substantial threat to current and future business, and backup plans are needed
II The magnitude of risk can be anticipated in decision-making phases and it does not affect current business.
III The realization of risk can be prevented with project control measures and by implementing the plan</td></tr>
<tr><td>Contact person</td><td colspan="2">Working group or project team</td></tr>
</table>

On the basis of project descriptions and related financial and technical feasibility analyses, the company needs to decide whether or not it will start planning the project and, if so, it must prepare a project proposal.

Project proposal

Often the project manager, or the customer, needs a short project presentation document called a *project proposal* for everyday use to facilitate communication and decision making. The project proposal document is much shorter than the project plan but contains the same basic project information. It is used primarily for negotiation and decision-making purposes by upper management and project leaders – for making central investment decisions and preliminary resource reservations, for example, and in preparing the required requests for bid. As well, the project proposal can be used for general communications about the project. The project description, feasibility estimates, and preliminary versions of the project plan can be used in drafting the project proposal, leaving out operational and technical details from the longer project plan, concentrating on factors needed in strategic decision making, and emphasizing

[19] Martinsuo, M., Aalto, T. and Artto, K. (2003)

project benefits, purpose, objectives, and required investments. Details on schedule, resources, procedures, and communication can be left out when preparing the shorter project proposal.

4.1.2 Project planning

Project planning is a specification phase in which the supplier agrees with the customer and its partners about project objectives, content, execution methods, resources, and other details concerning execution. The preliminarily designated project manager carries responsibility for project planning but stakeholders too participate in the work, according to the requirements of the project content. Project planning can occur in parallel with sales, technical, and financial feasibility analyses as these elements are sometimes considered to be part of project planning. Nevertheless, project planning results in an actual *project plan* and this plan can be presented to the supplier, the customer, or their respective designated project steering committees for approval. In product development projects, the technical, commercial, and production-related planning activities related to the product occur in parallel with project planning.

The *project plan* is a central tool for project management; it helps maintain project work and project management as a balanced entity, ensuring that their content is correct. It includes discussion of the technical execution, but only at a general level sufficient for defining and managing project work; and it includes project content, objectives, work, procedures, and management principles. It is wise to keep the project plan relatively concise so that the project is clearly understandable. The general project management practices common to all projects usually do not need to be repeated in the project plan if these practices are not to be deliberately skipped or specified. Technical solutions, work activities, and the working norms and procedures can be presented in more detail in separate plans and instructions, and drawn upon when needed. The project plan integrates the project work activities into an entire effort, suitable for attaining the project goal. If possible, the project plan is prepared together with the customer and the most valuable stakeholders. The plan is a key communication tool, and through the process of preparing the plan, reading it, and discussing its contents, the project team members acquire mutual understanding of their common tasks, enabling them to work in an integrated manner toward their common goal of realizing a successfully completed project.

To recap, the project plan includes discussion of all the central issues in project management, but the emphasis is on the unique characteristics of the project. Responsibility for executing the project plan rests with the project manager, but all parties participating in the work utilize this plan. The project norms that regulate the project team's work procedures can be agreed upon as part of the project plan or in parallel to it. These rules are called *project norms* or a *project team contract*, and they are described in Chapter 5.

The project plan gets more specific as the project progresses. The first rough drafts of the execution of a delivery project are made during the sales phase as part of the bid. The project delivery schedule, sales price, invoicing principles, and delivery scope are discussed on the basis of the bid. These plans are added to the contract and are specified during the actual planning phase of the project. During project execution, the plans are updated to reflect the actual status in the project. The updated project plan can be used to inform key stakeholders about the changes that have been made in the project

The project plan should be approved by the project's decision-making authority, often the project owner or steering committee. If it is a project ordered by an external customer, it is essential to match the project plan with the project contract. The contract, when signed with the customer, becomes an official document in which the terms and requirements for the approval of the project are stated. Although the supplier's actual project plan is often not shown to the customer for confidentiality reasons, it too should serve the needs specified in the contract.

The accepted project plan should be considered the "law" of the project so that following the plan becomes a habit and deviations from it are handled with change management procedures. Project plan changes can be made if, for example, the customer's need, resources, strategy, or operating environment change. The potential need for changes serves as motivation to write the project plan in an appropriate level of detail so that every small change in circumstances does not require the plan to be changed. If changes are made to the plan, the updated version should be submitted to the correct decision-making authority for approval.

Content of project plan

Typical content areas for the project plan are:

1. Background and benefits. This section describes the project opportunity, a brief history, rationale and initiation of the project, as well as the problem to be solved, and the benefits sought through the project. These contents provide relevant information about the project goal and customer need for the product created by the project.

2. Goal and objectives. This topic includes a short (half to full page) description of the project goal and objectives (scope, time, and cost).

3. Risks and risk management. This section describes project risks, plans for dealing with risks by conducting risk analyses, and taking followup action over the life of the project. It also describes possible negative occurrences, positive opportunities, potential for succeeding beyond plans, and related factors.

4. Project organization and responsibilities. This topic includes a description of project organization, which includes the project team, typically comprising the project manager and individuals responsible for various areas of the project. Project organization also includes the project steering committee and, in some cases, participation of customers and subcontractors can be included.

5. Scope and scope management. Scope management refers to the description of the product resulting from the project. Scope is defined through technical and functional plans and requirements specification. Technical plans become more accurate as the project progresses and as changes, if any, are made to the original plans. Therefore change management practices can be described either in the context of scope management or in the project norms. Issues that can also be included in scope management are the principles for freezing (i.e. fixing the status of) plans or specifications and the acceptances required from the customer.

6. Work breakdown structure. The work breakdown structure (WBS) provides a hierarchical description of the work activities to be included in the project. In WBS, the project work is presented as structures specified at various levels. WBS can be constructed up to a certain rough level of detail for the project plan, and then it can be described at a more detailed level in a separate document, perhaps appended to the project plan. This detailed WBS can describe who carries out the work, and who bears responsibility for it, including delineation of work done by the project organization versus procured activities.

7. Schedule and schedule management. The activities to be scheduled are derived directly from the WBS. In the project plan the scheduled activities are described as rough-level activity packages, for example, as a Gantt chart fixed to calendar dates or milestones. The reporting and control principles used to control the schedule during execution are described as part of the schedule. Data systems can also be discussed in the project plan, for example, a project management system used to plan and report the project schedule.

8. Resources and resource management. The resource plan part of the project plan describes the persons or entity responsible for executing the project activities, however, it is often presented at a rough level, possibly only listing the parties taking part in the project; the more detailed plans can be situated in appendices made for each subproject. The activities in the schedule consume resources and therefore the resource plan commits resources for a certain predefined time. Additionally, the principles that are used to report and follow resource usage in, for example, a project management system or the company’s work time tracking system, are described.

9. Procurement management. The suppliers, subcontractors, and principles used in procurement are described in the project plan. Included in this plan or in the project norms are procurement authorities, acceptance authorities for procurement invoices, contract management practices, and the principles for possible competitive bidding and choice of supplier. Additionally the project plan can contain a description of the way the company’s materials management system is used to store subcontracting contract documents, monitor delivery, and report the progress of procured parts.

10. Budget and cost management. In the project plan, the budget is presented at a suitable level of detail, according to the WBS and, if needed, by identified division of responsibility. Usually it is sufficient to present the budget as one total figure, serving to limit the total expenses of the project. Cost reporting principles, for example, updating forecasts and reporting on progress of activities are also described in the project plan. If needed, the data systems used are described, for example, reporting actual costs in the company’s accounting system or reporting costs bound by procurement contracts in the company’s materials management system.

11. Reporting and communications. Periodic reporting is imperative for project control. Reporting principles and the project team’s communications practices are described in the project plan. The information requirements of all stakeholders should be considered when planning reporting and communicating activities. Reporting of project progress typically includes reporting of deviations and forecasts at regular intervals. Written notice is used when communication is used to reach a wider, perhaps public, audience instead of the usual reporting and briefing communications at meetings, which are directed at people closely involved in the project. A separate plan can exist for other project communication, or the related practices can be written as part of the project norms.

12. Complementary parts and appendices. Some other areas of planning may be included in the project plan or as appendices to it: a quality management plan, a communications plan, and project norms, for instance.

The extent of project planning varies depending on project size; the plans for small projects can be substantially more concise than plans for large projects. In its simplest form, a project plan includes only about half of the 12 table of contents items we have listed. At a minimum, however, the project plan should discuss the rationale or need for the project, what activities it includes, how and when the activities are to be executed, who does the work, and what risks and opportunities are related to the project.

4.2 Scope management

Project scope was presented as one factor comprising project objectives (see item #2 in the previous list of project plan content items). *Project scope* is linked to the product resulting from the project; it is the use of the product resulting from the project that creates the change by which the project objectives are accomplished. Thus, scope includes the specification of requirements, features, functionalities, and performance of the product resulting from the project. Scope is directly connected to the benefit that the customer or the supplier itself tries to achieve with the project.

Project *scope management* includes procedures used to ensure that the product resulting from the project fulfils the requirements that have been set, and that it is produced efficiently without extra or needless work. The purpose of scope management is to transform the needs and expectations of the customer and other stakeholders into a description of the product resulting from the project, and to ensure that the project has been organized and the work planned effectively to attain the specified scope. Scope is defined with technical and operational plans and specifications as well as the follow-on service requirements, which together define the product resulting from the project.

Technical plans become more specific as the project progresses and as changes are made to the plans. Change management procedures have a relevant purpose in project change management. Project scope is thus managed throughout the progress of the project: at the start of the project, in scope planning and specification, in scope checking and assurance, and in scope change management. The timing of scope affects project costs: the later in a project lifecycle that a certain change is made, the more expensive the cost effect of the change, as is illustrated in Figure 22.

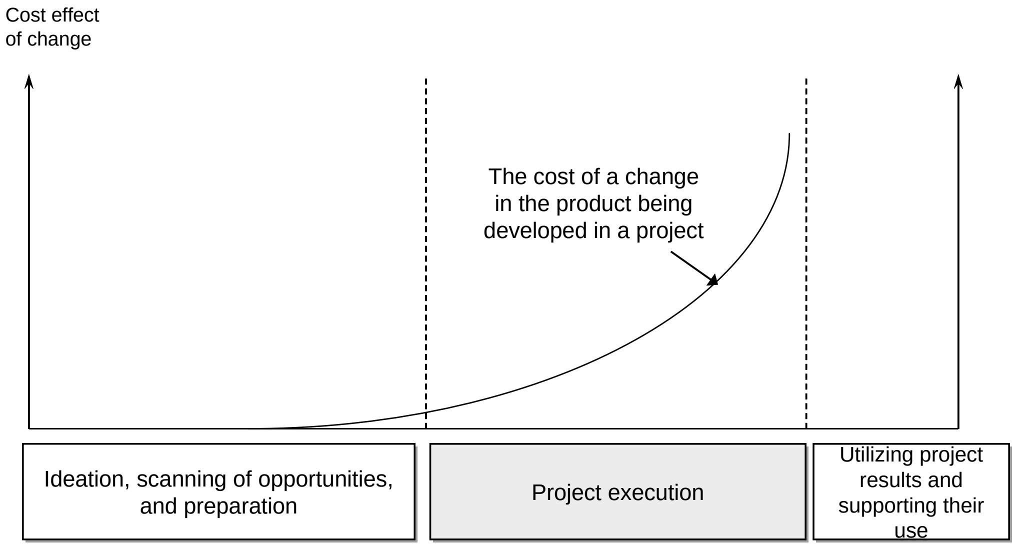


Figure 22. Increasing cost of a single change to project scope as the project lifecycle progresses

Product requirements management, management of test versions (e.g. prototypes), product configuration management, and possibly the lifecycle perspective for the resultant product, are related to scope management.

Example: Scope and objectives of the house construction project

Initially Sally wanted to spend the following Christmas in the new house. But, as the construction could not be started until March, the timeframe for completion of the project would have been insufficient as it would be limited to about nine months. The Smiths' friends pointed out that, in their experience, Christmas is the preferred finishing time for many people constructing a small house, and it may be difficult to get additional labor to finalize the project at that time of year. Another concern arose; the Smiths learned from the construction projects of friends that moving into an unfinished home tends to delay the finishing of the whole house, and they became worried that the last details of constructing their home may never be completed. In order to lessen the stress on the family, the Smiths decided to set the objective of having the project finished the following spring, a date that could be stretched to the summer if needed. Nevertheless, the Smiths's preference is to be able to move into the new house at the beginning of May in the following year, a timeframe of approximately 14 months.

In the Smiths' case, the scope of the project consists of all stages and steps from the planning of the construction of the house through to finishing the house to a fully completed condition suitable for the family to occupy it. The planning work and the construction of the house framework up to a point at which the house structure is closed in and weather proof, is to be done by Livinghouse. The Smiths will contract directly with specialist subcontractors for the HVAC systems, earthworks, ground preparation, and concrete building foundations. In addition, the Smiths will hire a responsible work supervisor to assist them and act on their behalf throughout the entire project. Once Livinghouse completes its contract work, resulting in a closed-in, weatherproof structure, the Smiths with the help of friends will undertake the interior finishing of the home, including installing or applying all wall and floor finishing materials and completing all fine finishing details, including paint. Although the Smiths did not choose to do so, in principle the scope of the project can be specified in project planning to include all the content of own work, and all the detailed features of the house, including choices of detailed finishing materials.

Cost control is a critical objective for the Smiths: they would rather endure a stretched schedule than encounter a substantial budget overrun. The cost estimate for the entire project is $200,000. In addition there is an estimated buffer of +/- $15,000. The budget is set at $200,000. The house is to be a one story structure with approximately 140 square meters living area, and it will occupy less than 25% of the area of the Smiths' 6000 square meter building lot. The Smiths also recognize that there are significant qualitative dimensions associated with costs and resources. For example, people with a highly variable skill and experience levels are participating in the execution of the project. Part of the project is executed by a group of friends, who may be slower at their tasks, harder to schedule, and more difficult to direct than are professional construction workers. On the other hand, there may be many uncertainties related to using professional subcontractors.

4.2.1 Work breakdown structure

To control project scope, the project should be divided into smaller, more manageable parts; for this task we use the term *product breakdown structure* (PBS). In the PBS, the product resulting from the project is divided hierarchically into parts and further into components. The PBS can be presented as, for example, a product concept description, materials plan, or product specification. The PBS can illustrate the scope of the final product, but it does not describe the total work required by the project; rather, it is used as a starting point in specifying the work required to attain the project goal.

The *work breakdown structure* (WBS) is a central structure in planning project scope and the work needed to realize it. In the WBS, the work required to complete the product resulting from the project is illustrated as tasks and work packages. On the lower levels of the hierarchy, the WBS describes at an adequate level of detail the work needed to realize the scope of the project. WBS is a commonly used tool for specifying the activities required in a project. Additional terms identified in this context are the company's *organization breakdown structure* (OBS) and *cost breakdown structure* (CBS). These concepts are dealt with later on in this book.

The work breakdown structure is defined based upon the product resulting from the project. The execution of this product is divided first into groups of activities, then each group of activities is divided into smaller parts, and finally the parts are broken down into single work packages and activities. It is essential that the work parts be:

- manageable (so that responsibilities and ownership can be directed);
- sufficiently independent of each other (so that there are a minimum number of interfaces with other factors);
- relevant to the whole project (so that the whole project is perceived as a combination of its parts); and
- measurable (so that their progress can be monitored).

The WBS should be structured to promote work planning, and to facilitate following up on work progress, monitoring of costs, and managing the project team according to specified objectives. WBS is used as support in both project planning and followup, and it can be considered a central tool for the project. The work breakdown structure acts as a basis for all other areas of planning, including:

- assuring scope;
- planning and reporting on the entire project and subprojects;
- creating and reporting costs and budget;
- specifying and monitoring time and resource requirements;
- matching objectives and resources;
- monitoring the project and creating a stakeholder network;
- directing responsibilities; and
- planning project financing and contracts, if needed.

The mistakes and successes made in the WBS are reflected throughout the project. Typically the construction of the WBS is approached from the top-down direction (i.e. from the general output down to the more detailed activities). This approach is justified because it is crucial to have a full, complete view of the success of the project. If the WBS was started bottom up, first by grouping activities and then ending up in the final outputs, the project would not necessarily meet the objectives set, and part of the work may be forgotten. Aggregation of activities on the lowest levels of the hierarchy is typical for the bottom-up approach, and this feature can reveal dependencies and opportunities for collaboration; that said, the bottom-up approach is not always a sufficient condition for attaining higher-level objectives.

Slightly different principles can be used on different levels of the hierarchy to specify the WBS. When constructing the WBS in a top-down manner, it may prove advantageous to combine several of these approaches. Figure 23 presents a simplified example of a house construction work package in which the breakdown of the product and the work required to complete it are used. These and other typical principles for work breakdown include:

- breakdown of products and partial results;
- breakdown describing the work to be done in the project;
- geographical breakdown; and
- breakdown by department.

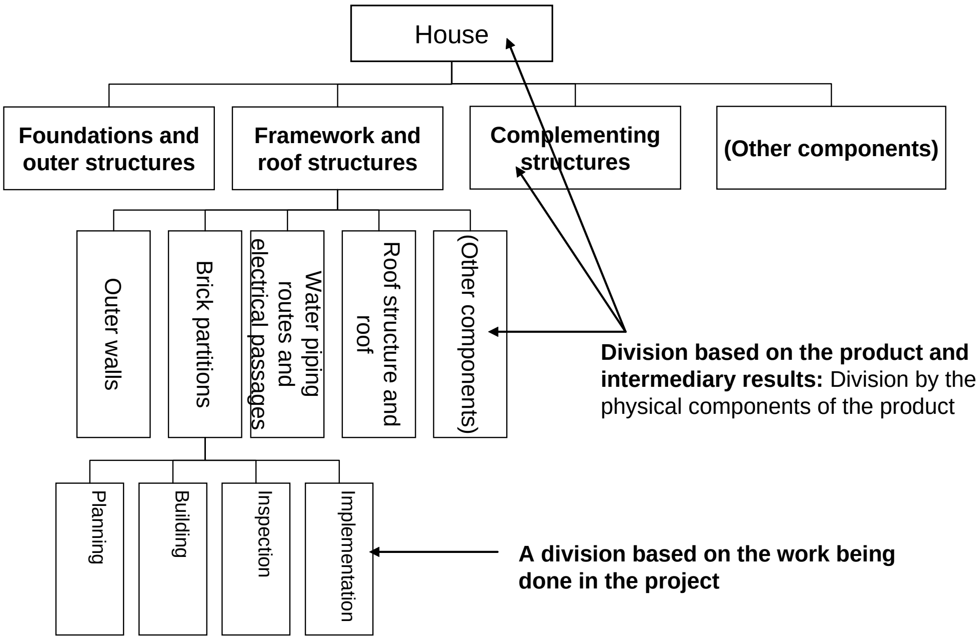


Figure 23. Example of work breakdown structure (WBS) using two different breakdown principles

The breakdown of products and partial results can involve specification of the *physical* or *functional* parts of the product resulting from the project. It is typical in expressing this type of breakdown to use nouns. The highest levels of the WBS structure presented in Figure 23 are specified as physical parts. An alternative would be to label the breakdown structure by the functional systems of the product, for example, in a house construction project labels may include foundations, structures, and HVAC and electricity systems, and all components and activities related to these functional systems.

In a **breakdown describing the work to be completed in the project,** the WBS is divided into activities. It is typical for this type of breakdown that the starting point is a verb. In Figure 23, the lowest-level breakdown represents, in principle, a verb-based breakdown: plan, construct, inspect, and implement. Using such an activity-based breakdown at some level is a prerequisite for realizing the basic idea of the WBS: without describing activity we would not be specifying work. Nevertheless, the breakdown describing the work activities does not need to be on the lowest hierarchy level. For example, the organization, planning, and follow up of information technology (IT) projects is often better supported by a structure in which, at the first hierarchy level, the WBS is specified by activity: planning, execution, testing, and implementation. In this situation, the work is specified on a lower level with the help of the product structure, which describes the partial results that are the target of planning work.

In a **geographical breakdown,** the work can be specified, based upon the locations at which the project work occurs. For example, an international product development project can be broken down by geographical location in the upper level of the hierarchy to include such subproject locations as Oslo, London, New York, and Hong Kong. Frequently, in major and complex projects, the two principles for work breakdown illustrated in Figure 23 are used, in addition to the geographical breakdown. At least the activity-describing (verb-based) specification is necessary so that the lower levels of the hierarchy would consist of elements of the work to be executed in the project.

A **breakdown by department** refers to a breakdown by the departments or business areas of the company or organization and resembles the geographical breakdown. A project can be divided into subprojects for which the different departments hold responsibility. In this case, breakdown by department is justified from the perspective of project organization, planning, and followup.

The number of hierarchical levels in the WBS depends of the scope of the project and the requirements set on the level of detail in the specification of the work elements. It is useful to remember some rules of thumb in making a WBS. The uppermost level of WBS represents the entire scope of the project. In the first breakdown, the work should be divided into a manageable number of parts (about ten) that can be used as the upper level for planning, follow up, and reporting. This breakdown is sufficient to clarify the planning and followup of the entire project. Each part can be divided further into about ten parts so that the project work is divided into more easily manageable subparts for the purposes of planning and reporting.

The purpose of the WBS is, on one hand, to ensure that all work relevant to the project scope is prepared and, on the other hand, to increase the project personnel's understanding of what work is required to achieve project scope. With the help of the breakdown structure, broad and at times seemingly impossible entities can be divided into an appropriate number of parts (at various levels) to enable project personnel to picture and control them.

Example: Work breakdown structure (WBS)

As constructors, the Smiths are ultimately responsible for all the required tasks being identified and performed. Therefore, they must be aware of all own work that needs to be completed; of course it is possible and advisable for them to use professionals to help them exercise their responsibilities for own work.

It is natural to specify the house to be realized firstly through partial results, as the building consists of several product-like partial structures. It is not necessarily advisable to use a geographical work breakdown structure (WBS) as the whole project is located on the same building lot and the house itself covers less than 25% of this area. A work breakdown based on the organizations involved in executing the partial results could also be used as a starting point, whereby the work done by Livinghouse, the Smiths, the group of friends, and the different subcontractors would be specified; such a structure would roughly correspond to a work breakdown by department.

The body for the work breakdown structure can be formed from the breakdown of the product and partial results. The breakdown presented in Figure 24 provides a good basis for defining the actual work breakdown structure. However, in most of its parts, Figure 24 presents a mere product structure that must be detailed with additional levels of work hierarchy to become a WBS that would specify the actual work or activity entities needed to complete the project. Portraying this higher degree of detail would involve applying a verb-based work breakdown. Included in a verb-based scheme or hierarchy would be items that specify actual work or activities using such verb-like words and phrases as plan (or design), implement (or construct or install), test, and start to use (or commission, or take into use). In this manner the various parties (Livinghouse;

the specialized groundwork, foundation and HVAC system suppliers; and the Smiths, and their group of friends) can use the structure in Figure 24 to specify in more detail the work needed to accomplish the partial results, and finally to accomplish the whole scope or product outcome of the project.

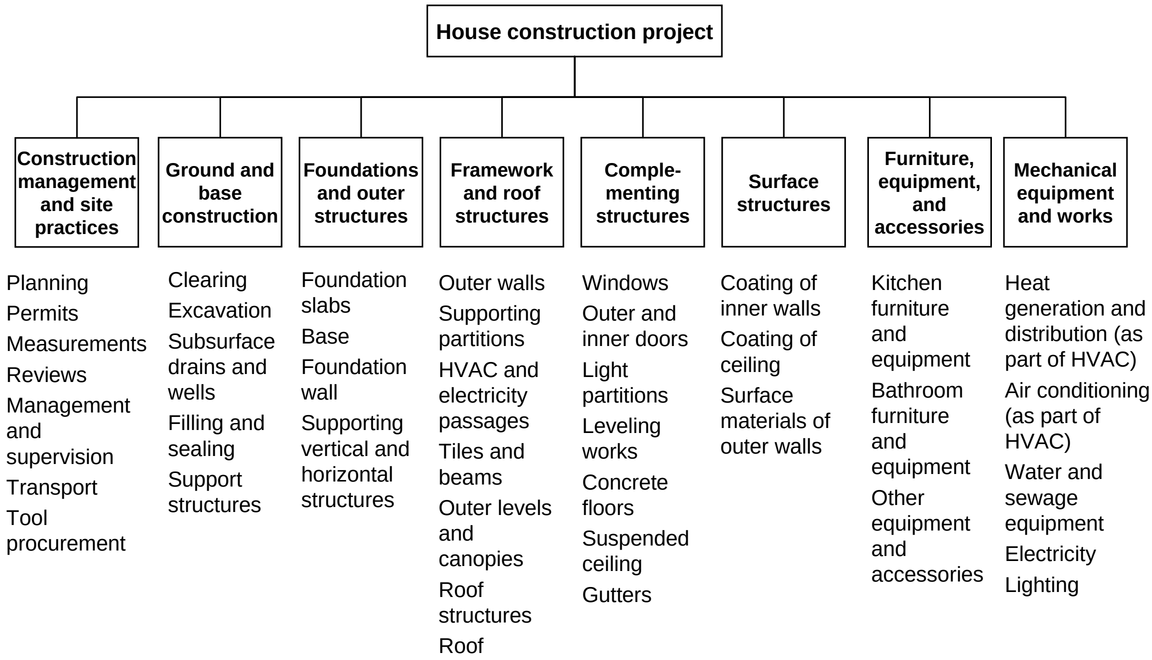


Figure 24. Base for the work breakdown structure (WBS) of the house construction project that can be made more detailed by describing the actual work entities or activities

4.2.2 Specifying activities

The hierarchical WBS divides the lower levels of project work into concrete *activities* describing the work. The lower-level activities in the breakdown structure are typically elements that are used, for example, in schedule planning and in making an activity network. Cost estimation and resource planning is also conducted by activity, as are control and follow up activities that occur during project execution. *Work packages* are usually situated at the level just above activities in the WBS, and they are entities formed by several activities. The elements in the WBS example described in the house construction project at the end of the preceding section, can be thought of as work packages that can be assigned; thus they become the responsibility of various executing parties. Work packages are formed to serve the division of responsibility (or procurement from certain executing parties or subcontractors), or to set objectives, and follow up, and reporting activities. Work packages can be listed as part of the project plan. In large projects, there can be hundreds of work packages, whereas in small projects, a few work packages can form the only level of study.

Work packages and their expected results should be clearly specified so that they can be communicated to and assigned as the responsibility of specific people, departments, or subcontractors. Schedule planning and the preparation and calculation of an activity network on the project level, are based upon studying activities and the dependencies among them. Scheduling and the related calculations can be executed at various work activity levels.

The results of the activities included in the work package are not always described in much detail, but the same rules apply to the specification of the results of lower-level activities as to the results of work packages: the results expected from the activity must be known so that the degree of completion of the activity can be determined. Often persons responsible for specific work packages may specify in their planning work the activities and content of the packages assigned to them. Detailed activity specifications, dependencies among activities, or intermediary results need not necessarily be studied at the project level. The same project management methods can nevertheless be used to specify activities and resources and to schedule small work packages as those applied to larger work packages at the project level.

The level of detail used in specifying work packages is influenced by of the degree of trust between the project manager and project personnel, and by their respective experience and skills in project management. When there is a lack of trust or when the personnel are inexperienced, it may be useful to produce detailed instructions for each activity; however, this approach has its downsides. The closer the specification of the work packages is to a detailed activity level, the greater the administrative work needed to provide guidance and undertake followup activities. On the other hand, the broader the work packages become, the harder it is for the project manager to interfere in them (e.g. in order to prepare for a delay in the project schedule). The specification of work packages at a suitable level of detail makes intermediate reporting easy and helps in assessing the state of the project. In specifying work packages, we recommend defining parts requiring a few weeks in duration, as this avoids excessive administrative work; yet it allows incomplete work and work progress to be assessed in a reasonable manner.

We now illustrate the concept of specifying activities as part of a work package in the final stages of our illustrative case – the Smiths' house construction project. The names of the activities in the work package in this case do not reflect the work as verbs, but in practice the any one of the words "execution", "construction", "installation", "production", "casting", or "completion" could be added so that the names of the activities would better reflect the real nature of the work. A similar study could occur at the project level on work packages and the dependencies among them.

Example: Specifying activities

In addition to Livinghouse and its subcontractor, ProKitchen, several subcontractors chosen directly by the Smiths, plus the Smiths and a group of their friends, take part in the house construction project. Therefore, in order to avoid conflicts and unnecessary delays, the activities and the dependencies between and among them have to be specified at a more detailed level than in the upper-level work breakdown structure presented in Figure 24. Some of the activities included in the house construction project, their duration in weeks, and the prior activities that have to be completed before a particular activity can be started, are listed in Table 12.[20] Table 12 shows activities of a specific work package in the detailed work breakdown structure. This work package represents a part of the project that is Livinghouse's responsibility; through this

[20] In the predecessor column, only the immediately preceding activities are listed. For example, in the case of windows it is needless to mention that supporting structures have to be ready, as they are specified already as predecessors of outer walls, and outer walls have to be finished before work on the windows can start. As the list is detached from context, no predecessors are visible for activity 21, and all of the dependencies of the other activities are not visible.

work package, Livinghouse is executing its final activities. Therefore, in Table 12, even though the name of each activity describes the “product” created as an intermediary result, this “product” must be integrated with the rest of the building when the activity is finished, therefore the names of the activities in the table should be read as implying the idea of verb-based phrasing, for example, one can assume that words such as ‘implementing’, ‘constructing’, or ‘installing’ appear before the respective “product” results phrases listed in the first column of the table. As a further comment on Table 12, the people working on a particular activity have been chosen by the executing organization. After Livinghouse’s work package is completed as shown through the activities depicted in Table 12, the Smiths and their group of friends continue executing the project by performing their interior finishing activities.

Table 12. Activity list for work package of house project that include the final stages of the contractor's work

No.	Activity	Duration (days)	Predecessors
21	Supporting structures	10	
22	Outer walls	10	21
23	Water piping routes and electricity passages	5	21
24	Brick partitions	8	21
25	Concrete floors	9	23, 24
26	Roof structures	7	22
27	Roof	7	26
28	Windows	6	27
29	Leveling works	11	25, 27
30	Suspended ceiling	18	25, 27
31	Plumbing, water piping, and electricity works	20	25
32	Nonsupporting partitions	17	30
33	Inner doors	4	29, 30
34	Intermediary inspection	1	28, 31, 33

4.2.3 Testing and verifying the project scope

Ensuring project scope relates to checking the correctness of the product and work breakdown structures in the planning phase of the project; obtaining acceptance for the scope, for example, from the customer; and managing changes to the scope as the project progresses.

Testing and verifying scope is connected primarily to the product structure and the technical and functional requirements of the product resulting from the project. The focus is on determining the extent to which these factors are able to help in realizing the change that has been set as the project goal, and on achieving the benefits expected from the project. When people with knowledge of the project describe and check the product structure and requirements, it helps create a product structure that corresponds to the project goal. Because the product structure should also be visible in the WBS that describes the project, checking the WBS ensures that the planned work is sufficient to realize the project scope. As well, such checking ensures that there is no extra or needless work performed in the project, for example, to produce product features that the customer does not really need; such excess can be considered as surplus quality that may later become an extra burden when the product is being used (extra work, for example, in the form of added maintenance and updates).

The correctness of the WBS can be tested and verified with the help of a few practical criteria. The WBS should be checked bottom up to ensure that the criteria listed as boldface items in the following paragraphs are fulfilled. If this is not the case, the activity (work package) should be specified again, taking the criteria into consideration. When testing and verifying the WBS, one should ensure that:

The state and degree of completion of the activity are measurable. The state and degree of completion of the activity should be able to be estimated any time the project manager needs information on progress. The state of project completion, for example, stating that 50% of the entire activity is complete, is easy to report if the outputs of the activity have been clearly specified.

The starting and finishing events have been clearly specified. Activities should have boundaries specifying the start and finish of the activity, and they should also be related to the outputs in some manner.

Each activity leads to results. The work performed in the activity must lead to some practical results. The result can be, for example, a concrete product, an intermediary version of the product, a decision, or a document.

Time and cost are easily estimated. Estimating time and cost at the lowest level of the WBS facilitates accurate calculation of the entire project schedule and costs. On the basis of the preliminary estimates, it is possible to set time- and cost-related objectives and, if needed, to assign detailed responsibilities for the activities.

The duration of the activity is inside allowed limits. As the schedule is constructed on the basis of the WBS, the duration of the work packages must also stay inside the limits set by the project manager. In projects with a total duration of several months or years, it is typical to set the duration of work packages at 2-4 weeks.

Activities are independent of other parts of the work. Independence means that, once started, the activity can progress without interruptions; its progress does not require information, intermediary results, or resources from other activities. There should also be no uncontrollable disruptions related to finishing the activity.

When fulfilling all aspects of these six basic criteria, the WBS is ready and does not require specifications. Yet, ensuring scope includes obtaining acceptance which in turn includes collecting comments from the project supplier and customer about the project’s scope specification and the benefits expected from the project. Having both the project customer and supplier accept the scope is a critical part of initiating the project.

The technical and commercial work in the project and managing the changes to scope as the project progresses are central parts of scope management. There are many concrete means for implementing scope management in various stages of project execution, including management of product configuration, test versions, and requirements.

4.3 Schedule and resource management

A project is an entity restricted by a schedule. Time and resource management are tightly linked: a change in one factor affects the other. The purpose of *schedule management* is to ensure that the project can be realized and finished in the planned timeframe. Tasks related to schedule management are specifying activities, work breakdown structure (WBS), defining the dependencies among activities and the duration of activities, schedule control, and change management. *Resource management* is used to ensure that resources are available at the right time and that they are sufficient and used effectively as the project progresses. Resource management supports schedule management as the scheduled activities require both time and resources. Various methods and tools have been developed to ensure effective execution of schedule and resource management, and we address them in the following subsections.

4.3.1 Schedule planning

Schedule and timing activities are among the key questions in project planning, and they include specifying detailed activity, determining the duration and order of the activities, and creating a total schedule. Creating the schedule is based upon task duration estimates, a schedule objective is stated based upon the result of these estimates, and the schedule may be updated as the project progresses. In a broader sense, time and schedule management also includes making sure that the schedule objective is met through control and followup actions as the project progresses.

In general, schedule planning can be approached in two ways: from details to total schedule, or from total schedule to details. These approaches can be used separately or together. When proceeding from detail to total schedule, project activities and work packages, and the time required by activities, are defined. The time requirements can be combined through various techniques to form a total schedule and a justified schedule objective. When starting from a rough project time objective, the project objective schedules (and milestones) can be identified for the project phases. On this basis, the activities, work packages, and their schedules can be specified to form the total schedule.

The bases for schedule planning are a WBS, activity specifications, and total objectives for the project. The first versions of schedule planning are often rough estimates that are specified during planning. Once the costs and resource usage aspects of the schedule can be confirmed, the phrase *schedule objective* can be used and it can be set (i.e. frozen or fixed) and fitted together with other objectives.

The more critical the project time objective is for achieving project benefits, the more careful planning and schedule followup activities must become, because it is increasingly difficult to (positively) affect the project schedule as the project progresses. The time for execution must therefore be planned well in advance and commitments to keeping the schedule must be made in the planning phase. A large number of projects with stretched schedules result in deficient benefits or fail completely solely because of insufficient planning. It is easy to promise quick execution to a demanding and hurried customer, but unfounded promises do not necessarily come true.

The schedule objective, once fixed, must be managed and adhered to as the project progresses. If there is slippage from schedule, corrective action must be taken and the effects of slippage on realizing schedule objectives must be assessed; substantial deviations may need to be rescheduled as the activities may be dependent on one another. Sometimes it is necessary and possible to speed up the schedule as the project progresses, which can require additional resources. In any case, schedule management can also require change management.

4.3.2 Basic techniques for schedule management

Gantt chart

The earliest scheduling techniques were based upon Gantt charts, and today this method still applies. The chart name comes from Henry Gantt, the developer of a bar-like marking style for tracking project progress. The core idea of a Gantt chart is to represent project activities and their timing as bars set on a time axis, as illustrated in Figure 25, for the Smiths' house construction project case example.

Example: Gantt chart

The activities in the final phases of Livinghouse's part of the construction project (Table 12) can be presented as a Gantt chart, as illustrated in Figure 25. This is analogous to presenting the schedule of a whole project in a Gantt chart form. The length of the bar beside the name of the activity signifies the duration of the activity. Each bar has been situated at the earliest possible place on the timeline at which the activity could be started. In practice, this time occurs when all the predecessors of the activity have been finished. Choosing the earliest possible starting time is a choice made in this example, but, in practice, it is not always sensible to try to achieve the earliest possible start because an early start binds costs into an early phase. Furthermore, some activities have to be started later because there are insufficient total resources available for simultaneous execution of activities or because the same resources are required to execute two or more activities. The Gantt chart helps both Livinghouse and the Smiths to follow the progress of the project and to prepare for future activities.

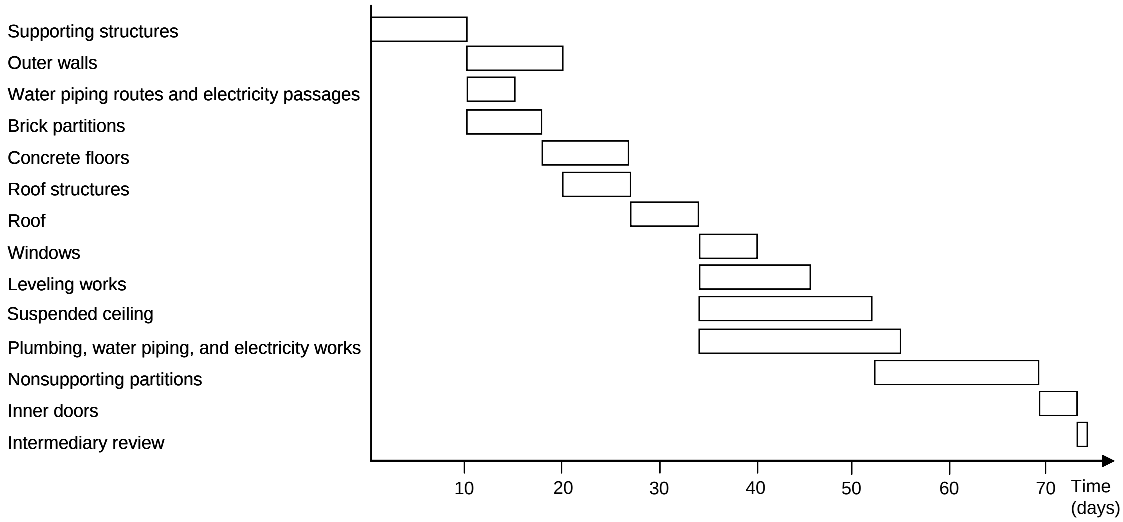


Figure 25. Gantt chart describing the final stages of the contractor's work in the construction project

The starting point for Gantt charts are the activities specified in the WBS and the work packages for which duration can be estimated. It is essential in making Gantt charts, as in other planning techniques, to set the activities (or work packages), that are assigned as responsibility of certain executing groups, in time spans of a few weeks, not much more and not much less. Longer times are hard to control, and shorter times may involve undue followup efforts and administrative burden. Generally speaking, the estimates should be taken to at least the level of specification at which objectives are set. In small projects lasting a few weeks, the schedule can nevertheless be highly detailed but, in such cases, project management is typically executed in the form of active supervisory work rather than as excessive planning and followup of activities. In large projects lasting for several years, schedule planning can occur on several levels: on a strategic annual level, on a tactical level of work packages spanning a few weeks or months, and on an operational-week schedule level. The strategic level plans are also specified at the tactical and operational levels. This type of planning applies a principle called the rolling wave, which is described in the cost management section, Section 4.4.5.

As the Gantt chart does not use the dependencies among activities, it cannot be used alone to determine the best total schedule. Nevertheless, Gantt charts communicate clearly the time at which each activity should be executed and they are popular because of their simplicity and readability. They serve as an effective communication tool among the parties: project team, customer, subcontractors, and other stakeholders. In spite of the introduction of many more developed techniques, the Gantt chart is recommended as an excellent visual tool, particularly for communicating and agreeing upon issues and followup actions.

Milestones and gates

In large projects, the Gantt chart may become too cumbersome and unclear. If activities can be executed simultaneously it is no longer crucial to describe all activities in detail in the same chart. In this case, it may be sufficient and useful to recognize the milestones relevant to achieving the project objective. A *milestone* is an event or a state that is related to project objectives. The milestone is binary in nature; it is either labeled as passed or not passed, and it does not consume time or resources. It is a central point for the project, at which some defined project part or work result has been completed (or shall be completed), or at which some critical stage (e.g. installing the roof) has been started (or shall be started). A milestone can also represent a key decision-making point, for example, an investment decision.

Example: Milestone diagram

The Smiths' entire construction project can be presented with the help of milestones, as presented in Figure 26. The most important points of the project, which will take over a year to complete, can be seen clearly from the diagram. Reaching these points is central for the progress of the entire project. Milestones can also be used as distinct strategic timing points that can be used to force dependent activity groups to 'meet' at a specific milestone. For example, the requirement for the 'framework and complementing structures complete' to occur in January can be forced contractually to be the contractor's responsibility, and penalties may be applied if there is a delay in achieving this milestone, or bonuses may be set for meeting this milestone or reaching it earlier than required. In addition, this milestone can be used to contract with another supplier to start from this point, requiring that the framework be completed as indicated in this milestone. Because obtaining permits and conducting inspections require reviews, they can be marked as important points in the milestone diagram. The inspections and reviews require resources, so their execution should be planned and scheduled as activities.

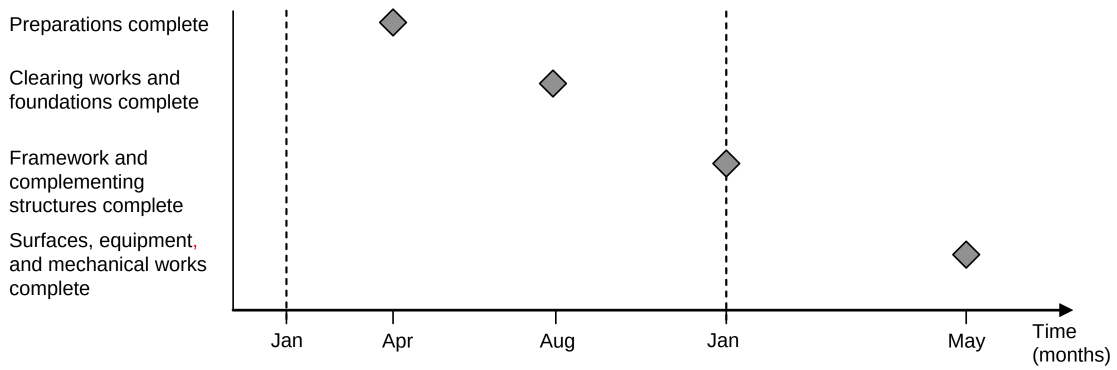


Figure 26. Milestone diagram for Smiths' house construction project

A term closely related to milestone is *gate*, which refers to a decision-making point. The term "gate" is commonly used in product development project environments. The decision to discontinue the project entirely, to continue it as planned, or to modify it, culminates in a decision gate. Thus the project progresses from gate to gate if the decision to continue has been made at each successive gate (decision-making point). The gate and its related decision, requires actions; passing a gate is not self evident, and gates can be considered as resource and time-consuming activities. The term *review* is also used in the project environment; it refers to a point at which the intermediary results of the project (e.g. bid, contract, product concept, or product plan) are assessed and accepted.

Milestones should be understandable, controllable, relevant (for certain decisions), logical, and on the same level from the viewpoint of strategic objectives. Planning milestones can require iteration and simultaneous resource planning. Setting milestones allows degrees of freedom in organizing and executing work between milestones, but complements rather than replaces detailed activity planning. Planning milestones often starts from the final results of the project and move backwards, that is, proceed from finish to start. Creating a milestone plan should involve teamwork and the planning should progress from sketching to detailed description in the following manner:

- deciding on the final milestone of the project (i.e. the project finish);
- engaging in ideation of milestones, for example, through brainstorming;
- going through milestones, finding a common level of description, and choosing among options;
- trying out optional execution paths, and illustrating them by using, for example, figures and charts;
- drawing logical dependencies in the form of a chart, and updating chosen milestones (if needed); and
- finalizing and fixing (freezing) the status of the milestone plan.

The prospective timing of the end result of the project and planning the project milestones, often forces one to think about the entire project schedule in a new way. Certain milestones can be included as schedule requirements in the subcontractor’s contract terms so that the dependency between attaining the intermediary results of the project can be controlled. For example, in the context of a house construction project, attaining on time the milestone, at which the floor installation is ready, can be required from the floor supplier so that an agreement can be made with the wall element supplier that the wall installation will be started immediately after the floor milestone. If, on the other hand, the floor and wall elements must be installed simultaneously, the work for these two elements should be awarded to the same supplier who should then strive to achieve a milestone described as the simultaneous completion of both activities. Thus scheduling through milestones is closely related to concurrent engineering, which is particularly applicable to product development projects.

Determining activity duration

Activities have no single absolute or objective duration that could be identified as ideal or standardized. Rather, activities have some probable or intended duration and a range of time in which the activity will be realized. This range of time associated with activities in the schedule is referred to as *float*, and the activity can be situated on the time axis in various points inside the float without it delaying the entire project. If an activity has float, and if it appears that the activity will be delayed, it should be scheduled at an early enough time within the float so that it will not delay a critical activity and thereby delay completion of the entire project. A realistic and accurate estimation of activity duration is essential; and, through learning and experience, companies can improve their ability to determine activity duration.

The duration of activities can be anticipated and estimated in various ways. They can be estimated as **an expert estimation through comparing** the activities to other similar activities conducted in earlier projects that were executed in similar circumstances. If the company has had experience carrying out several similar projects, project managers and experts can estimate activity duration, taking the character of the project into consideration: how much time a prototype design will take in a product development project, for instance.

Estimating activity duration can be improved by collecting, classifying, saving, and using **historical data** on the nature of activities that occurred in several similar projects. If information and data on resource types, competences, and the nature and time usage of activities are recorded and saved in an information system, these data can be utilized again later and can be subjected to statistical analysis.

The estimate of a project- and activity-specific expert can be used in determining activity duration, particularly if the project differs from earlier projects in, for example, the technology being used or the object of application. In these cases, it may be necessary to find experts from outside the company who have information and experience in similar projects. For example, subcontractors or companies working in another field, but using the technology in question, could be neutral enough sources for estimates and information on likely activity duration.

Making an estimate within a group of experts, or requesting an estimate from several parties (the term “Delphi-method” can also be used), is a way to collect the views of several evaluators and search for a common view on the estimate. Each member of the group makes a first estimate based upon their best judgment, after which the estimates and justifications of the various evaluators are discussed in the group. If they apply this procedure of iterating estimates and changing views, the group can end up with one common estimate.

These expert evaluation methods can be applied to provide a subjective probability estimate. One way to do this is to use the **three-point estimate** applied in, for example, the PERT method and the associated derived risk evaluation. In determining activity duration, the extremes – minimum and maximum – of the probability distribution are first estimated. Next the most probable duration is estimated and it is situated somewhere between the minimum and maximum. The minimum duration is the shortest possible duration, and the assumptions in its estimation are that the most favorable events can occur and will lead to such an extreme value. The minimum value for duration can also be considered to be the optimistic duration estimate. Underlying the estimation of the maximum duration is an assumption that everything possible will go wrong, resulting in a significantly prolonged schedule. The maximum value for duration can viewed as the pessimistic duration. The value of the most probable duration is the one value, out of all possible duration estimates, that is deemed the most probable to occur. In the probability distribution, the most probable value is the highest point in the distribution. When these three estimate values (points) are interpreted as parameters of a skewed distribution, the parameters can be used to determine a special case of the beta distribution, as presented in the PERT-method. The stochastic calculation of the activity network is also based upon the PERT method, and it utilizes the evaluated three-point estimate and the approximations for the mean and standard deviation based upon the aforementioned assumptions for each activity in the network. The mean and standard deviation for the duration of each activity is calculated with the following formulas:

Mean (M) = (Minimum + 4* Most probable value + Maximum)/6;

Standard deviation (S) = (Maximum – Minimum)/6.

The stochastic calculation of the activity network will produce a probability distribution of the total duration of the project. That is, the probability that the project will be finished in the set schedule can be deduced from the probability distribution.

In addition to the content of the activity, its duration depends on the available resources, on the realities present in calendar time (e.g. holidays), and on other situational factors. The real amount of resources, the timing of their availability, the competences and effectiveness of the personnel, and the share of effective working time out of total working time must be considered in schedule planning. The competence level and amount of resources can be relatively simple to determine on the basis of the WBS, but as objectives or other circumstances change, the estimates may also change.

Although the word *resource* sounds measurable and concrete, the skill level and effectiveness of the personnel, and the effectiveness of the equipment and tools available, can be highly variable. The estimation of activity duration can be based upon some assumptions about the competences of the personnel and equipment capacity. At this phase of the project, people are often optimistic, for example, the project manager may feel that there is enough capacity and that the personnel are already well informed. In reality skills, capacity, and effectiveness vary considerably as does the suitability of various people to specific tasks. There can be an error in the estimates in both a positive and negative sense. Overestimating the competence and capacity of resources typically leads to schedule slippage, mistakes, and decrease in quality.

Effective working time is often different from the total time available for the project, which easily causes errors in estimation. In determining activity duration, calendar time does not tell the whole truth. An activity requiring an uninterrupted working time of one week is not necessarily finished in one calendar week because a week’s calendar time may be estimated at the normal weekly working time of 37.5 hours, but in project scheduling it must be recognized that, for each employee, working effectiveness is less than 100%. This inefficiency occurs because, during the project, many anticipated and unanticipated interruptions arise, such as illness, vacations, meetings, training sessions, transfers from one place to another, and phone calls. These interruptions cause the mean effective working time of project personnel to drop to about 70% of total working time.

Additionally many unanticipated forces and events can affect the schedule and activity duration. There are always some mistakes and misunderstandings in projects that force fully or partially completed work to be redone. At the planning phase of projects, over optimism about activity duration can cause major disappointments to various parties, if and when the first intermediary results indicate that the work schedule is not being met. Furthermore, over pessimism or over conservatism in estimation can be harmful – the customer will not necessarily accept a delayed schedule and can quickly turn to a more optimistic project supplier.

4.3.3 Activity network

In many situations more specific information than can be conveyed in a Gantt chart is required about the relationships among activities, and about possibilities for flexibility. This more specific information can also be a prerequisite for placing the activities and their target timing at the correct time on the Gantt chart. Schedule management has become one of the most central objects of research and development in project control. The majority of techniques used for schedule control is based on the work WBS and the identified activities or work packages.

Perhaps the two most utilized techniques for scheduling are PERT (Program Evaluation and Review Technique)[21] and critical path method (CPM)[22]. These methods were developed at the end of the 1960's to make schedule management more effective, and they emphasize the dependencies among activities. The most central difference between the two techniques is that PERT utilizes statistical calculation in activity networks, whereas CPM does not. An *activity network* is a graphical presentation of the activities and the dependencies among them.

Activity networks utilize generally known principles. A project is depicted as a series of interdependent activities that are drawn from left to right according to the chronological order of the activities. The basis for modern activity network techniques is the so-called activity-on-node depiction method, an example of which is illustrated in Figure 27. The activity is depicted as a rectangular node and the connecting arrows illustrate the dependencies between activities. These types of activity networks are also suitable for describing more complex activity networks. In the 1960s, a technique called activity-on-arrow began to be used, in which activities are depicted as arrows and the events that separate them as circles. The events in the activity-on-arrow depiction method do not have duration. They connect the ending points of the arrows depicting the preceding activities and the starting points of the arrows depicting the following activities in a way that the dependence between activities becomes apparent when an activity passes or travels through a certain activity point.

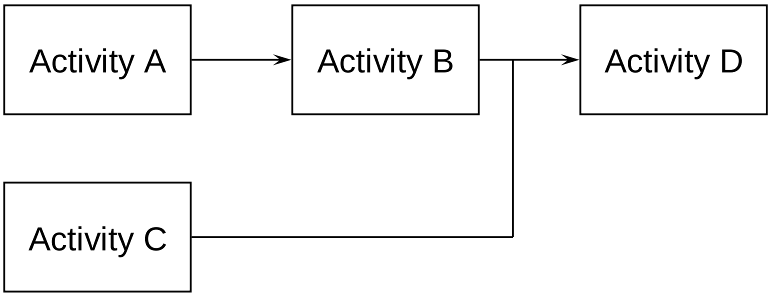


Figure 27. A method of depicting an activity network

We use the following terminology in describing activity networks.

- An *activity* is a work package that must be completed, and thus it consumes time and resources. An activity can be allocated duration, cost, and resource requirements, and it can be divided into subactivities. An activity can be inactive (not started), incomplete, or completed.
- A *critical activity* is an activity situated on the critical path of the project and it affects the total duration of the project. A critical activity must be completed at a certain time to avoid delaying the whole project. The float (see second paragraph below) for a critical activity is therefore zero.

[21] Booz, Allen and Hamilton

[22] du Pont

- The *critical path* is the path in the activity network consisting of the critical activities that determine the earliest possible completion for the project. If even one of the critical activities is delayed, the whole project is delayed.

- *Float* is the timeframe in which the activity can be set to start and end without it affecting the duration of the entire project. The difference between the earliest and latest start (or, respectively, earliest finish and latest finish) determines the float for the activity.

- *A milestone* can be marked into the activity network as a principal event important in the project, and it is one that has no duration and consumes no resources. It is a binary event that describes the state of project progress: the milestone is either realized or not realized.

The dependencies among activities can differ. The dependencies are marked as arrows in the activity network and the start and end point of the arrow is of importance. As illustrated in Figure 28, the four alternative dependency types are:

- FS: When activity A finishes, B may start;

- FF: When activity A finishes, B may finish;

- SS: When activity A starts, B may start; and

- SF: When activity A starts, B may finish.

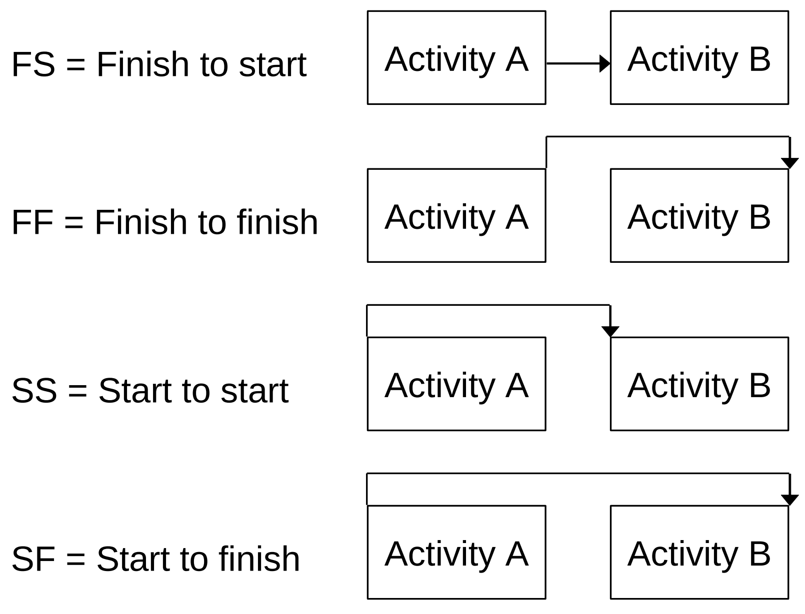


Figure 28. Four different dependencies in an activity network

The finish to start (FS) dependency indicates that activity A must be fully completed before activity B can be started, and it is the most common dependency type in scheduling. For example, in a house construction project, building the walls cannot be started before the foundation has been laid.

The finish to finish (FF) dependency indicates that activity A cannot be finished before activity B has been finished. For example, lifting the roof beams in place with a crane in a house construction project cannot be finished before attaching the beams to the supporting structures has been entirely completed.

The start to start (SS) dependency indicates that activity A cannot start before activity B has started. For example, painting the walls at the end of a house construction project cannot be started before application of the required wall board, cement, or other wall covering material has started.

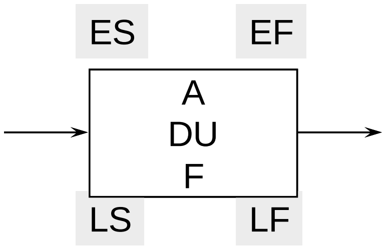
The start to finish (SF) dependency indicates that activity B cannot be finished before activity A has started. In the house construction example, attaching the underlying roof boards or sheeting must start before the weatherproof roof covering material can be applied.

There are many optional ways to depict and define dependencies, and the dependency types referred to in Figure 28 are not necessarily mutually exclusive. Dependencies can be of various sorts. The activity network is not necessarily always completely linear, as there can be pauses between activities, or some activities may be executed in parallel. Dependencies can also have a duration, which can be positive (pause, delay) or negative (parallel). Positive dependency duration occurs, for example, when the paint on the walls must be let dry about one day before the walls can be repainted. Negative dependency duration occurs, for example, when hanging artworks on the walls or cleaning the windows can start even though the final floor surfacing is still incomplete. It must be noted that a pause does not consume resources, and execution of activities in parallel can require interaction between resources.

The sequencing of activities in the activity network is affected by many things, in addition to activity duration. For example, management can impose certain restrictions on duration and schedule, the availability of resources can be dependent on time, or the dependencies between projects must be considered. Clear time-based restrictions can be set for the project, for example, it can be stated that a certain activity must be taken care of after day dd.mm.yy, or executed at the latest dd.mm.yy, or completed exactly on day dd.mm.yy.

Depicting an activity network

All the activities to be included in the activity network are depicted as nodes. The activity, its expected duration, and its float can be marked in the node. Additionally, calculated estimates of the start and finish times for the activity are used, and they are marked outside the corners of the node, as illustrated in Figure 29. The following four points explain the way the activity network is determined.



A = Activity
DU = Duration
F = Float

ES = Earliest start
EF = Earlierst finish
LS = Latest start
LF = Latest finish

Figure 29. The data to be marked on the activity nodes of the activity network

1. Determining the activities, duration of activities, and dependencies in the activity network

The starting point for the activity network is the WBS, in which the various activities and a chart describing the duration of the activities can be seen. As a first step, the dependencies between the activities (i.e. the activities preceding and following a certain activity) must be determined. The first relevant question is: What activities must be completed before this activity can be started? When this activity is completed, it produces some intermediate results that become input for the next (following) activities. The second relevant question is: What subsequent activities require the completion or results of the preceding activity? The WBS describes the order among activities, but it does not necessarily communicate the nature of the dependencies, and it is not illustrative. The Gantt chart describes the duration of the activities and these are also needed in determining the activity network, but a Gantt chart does not reveal dependencies. When dependencies are known, a sketch of the activity network is drawn.

2. Calculating earliest start and earliest finish for the activities

Calculating the earliest schedule for the activity network begins at the start of the project, that is, at the first activity, and moves toward the last activity. The earliest finish of an activity is always earliest start plus activity duration, so the first activity (that has no predecessors) starts from zero, and its earliest finish is the time specified by its duration. When moving in the direction of the end of the project to a subsequent activity that has multiple predecessors, the earliest start is determined by the longest of the earliest finish times of the predecessors. When all the activity paths have been studied, the earliest finish of the last activity describes the earliest finish for the whole project. The relevant time numbers are marked in the upper corners of the nodes in the activity network.

3. Calculating latest finish and latest start for the activities

Calculating the latest possible schedule begins with the last activity and moves toward the first activity. The starting point is the shortest possible completion time (i.e. the total duration of the earliest possible schedule). The latest finish of the last activity is therefore the same as the earliest finish of this activity. The latest start of an activity is always latest finish minus activity duration. When moving toward the project start to a predecessor with multiple followers, the latest finish of the predecessor is the smallest of the latest starts of the followers. The relevant time numbers are marked in the lower corners of the nodes in the activity network.

4. Calculating float for the activities and identifying the critical path

The float of an activity is calculated by subtracting its earliest start from its earliest finish (the same result should be reached by subtracting latest start from latest finish). If the difference is zero, the activity is a *critical activity* and forms part of the *critical path*. The activities situated on the critical path can be marked in the activity network with, for example, a color code.

The critical path is a path formed by critical activities that travel through the entire activity network and determine the completion time of the project. Delays in the activities located on the critical path will delay the whole project. In project control, special attention should be paid to the critical path and its critical activities. Nevertheless, it must be noted that delays in activities that are parallel to the critical activities may cause other noncritical activities to become critical. Thus the critical path can change during the project and the project manager should not ignore the activities that lie outside the critical path; indeed, the project manager should constantly monitor the dependencies in the entire activity network, the completion of activities, and the possible changes in the critical path.

We now illustrate these activity network concepts and techniques using our case example, the Smiths' house construction project.

Example: Drawing the activity network, network calculations, and the critical path

Livinghouse's part of the final activities in family Smith's construction project, and their durations and preceding activities, were presented in Table 12. On the basis of this information, Livinghouse's project manager can draw an activity network and estimate the criticality of various activities so that the work done at the end of the project can be scheduled correctly and appropriate resources can be reserved accordingly. In a similar manner, the activity network of the whole project can be drawn and the network of the project can be calculated accordingly. For simplicity's sake, the dependencies used in this example are only FS (finish to start) dependencies, that is, the preceding activity must be fully finished before the activities following it can be started. In reality, activities in construction projects have other kinds of dependencies. Dependencies are assumed to have zero duration.

In Figure 30, the name and duration of each activity is marked in its own activity node or rectangle. Also the float of the activity can be marked inside the rectangle when it has been calculated. Activities are placed in the logical completion order from left to right, based upon the dependencies between and among activities. Dependencies are arranged such that, if activities A and B have to be completed before C, then A and B are situated to the left of C, and arrows depicting dependencies are drawn from both A and B to C. Figure 30 has been drawn using these placing guidelines.

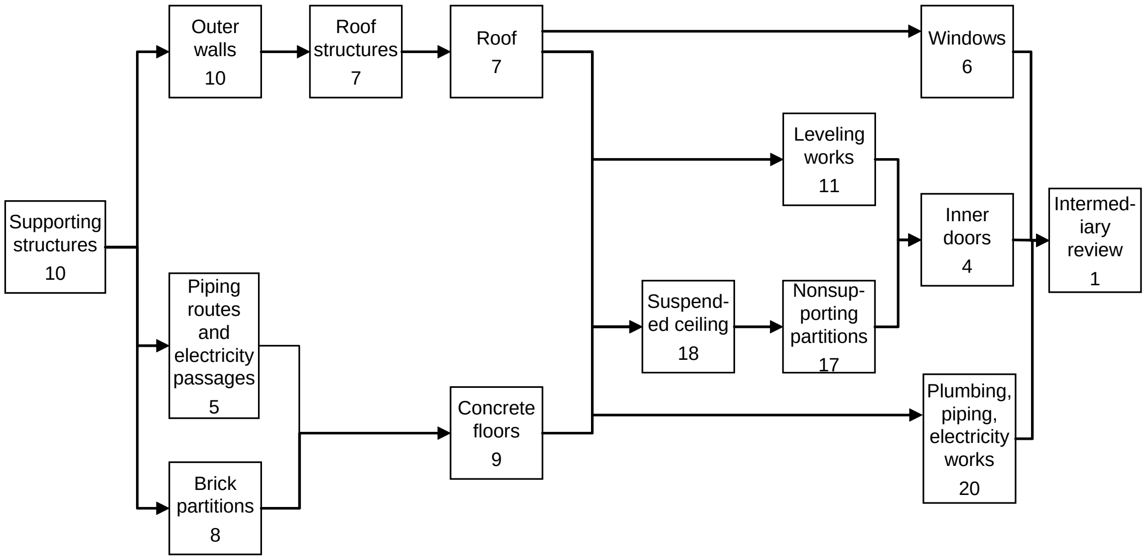


Figure 30. Placing the general contractor's final activities in the activity network

To find out the criticality and float of each activity, the earliest and latest schedule must be calculated for the entire activity network. The earliest schedule is calculated through a forward pass calculation of the network, and the latest schedule is calculated in a backward pass calculation of the network. After the calculations, the execution of these activities can be planned and a Gantt chart with the planned schedule can be drawn. The Gantt chart serves as a clear means for communicating the activity execution times to the relevant parties and stakeholders.

The earliest schedule, of course, describes the earliest time at which an activity can be started. As mentioned, the earliest schedule is calculated through the forward pass calculation, which involves starting from the network's first activity(ies) that has (have) no predecessors. The earliest schedule is calculated as follows:

First, the activities without predecessors are studied. The earliest start (ES) for these activities is marked as 0 and earliest finish (EF) as ES + activity duration. In the example, supporting structures is such an activity. Its ES = 0 and its EF = 10.

The next (successor) activities to be studied are those that can be started when the aforementioned activity has been completed. The ES of a successor activity is the EF of its preceding activity. The successor's EF is then again ES + activity duration. In the example, such successor activities are outer walls, water piping routes and electrical wiring passages, and brick wall partitions. Their ES is 10, that is, the same as the EF of the predecessor, i.e. supporting structures. The EF for outer walls is 10 + 10 = 20.

If an activity is preceded by two or more activities, its ES is the same as the latest of the earliest finishes (EFs) of all preceding activities, that is, the largest of the EFs of the preceding activities is chosen. In the example, such an activity is concrete floors, which can be started at the earliest on the 18th workday (ES), because at this time the requirement is satisfied that both of the preceding activities [i.e. water piping and electricity passages (EF = 15), and brick partitions (EF = 18)] have been finished in the earliest schedule.

By calculating the network forward from the beginning to the end, using the rules explained above, the earliest possible execution time for each activity is determined. Time EF of the last activity (intermediary inspection) is the shortest possible duration of the project. In Figure 31, the ES and EF have been calculated for each activity. The shortest possible duration for this activity network is 74 days.

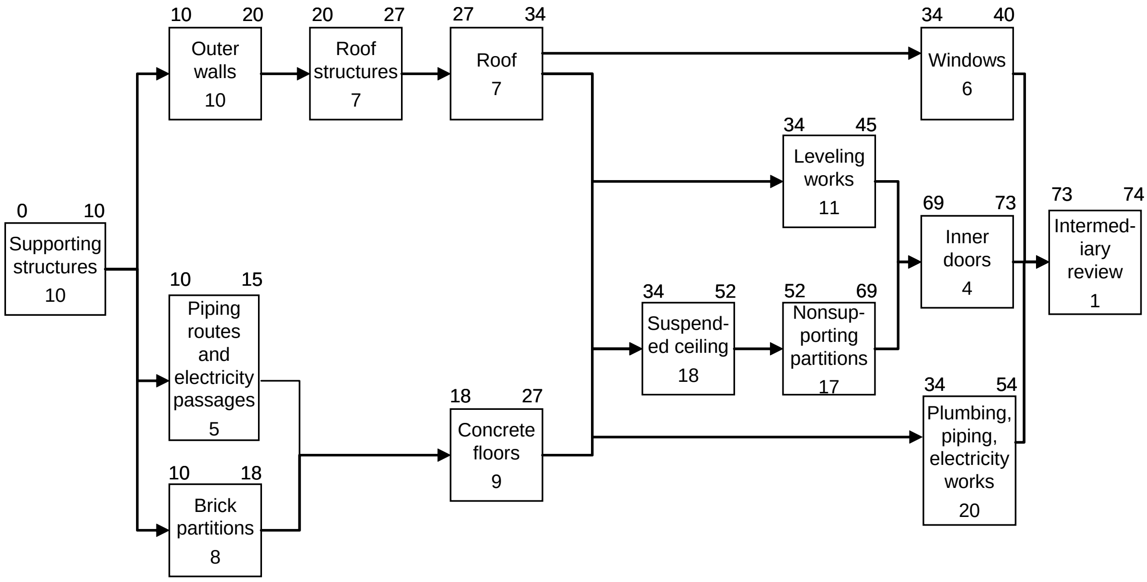


Figure 31. Earliest schedule for the final stages of the general contractor's work

The latest schedule describes when each activity should be executed, at the latest, so that the total duration of the project does not increase from the target duration for the whole project. Usually the shortest possible execution time calculated in the earliest schedule is set as the target duration for the project. In our example, this would produce a targeted duration of 74 days. The calculation of the latest schedule is based on a backward pass calculation of the network, that is, the starting point for calculation is the last activity and the calculations move toward the project start.

Latest finish (LF) for the last activity is set at a targeted duration to constrain the latest possible finish time of the project. As contractors and customers typically want to complete the project in the shortest possible time, the latest finish (LF) for the last activity is set to the same value as its earliest finish (EF) of the same last activity; in the example, the latest finish for the intermediary review LF is set as LF = EF = 74. The latest start (LS) is calculated by subtracting activity duration from LF, in the example, for the last activity LS = 74 - 1 = 73. If there is no single last activity, a collective final dummy activity with duration of zero should be added for calculation purposes as the final successor of several last activities. This last dummy activity collects the several 'loose ends' together and serves as a single final activity of the project.

The next step is to move from the end in the activity network backwards towards the start of the project. The LF of the activities preceding the last activity (in the example, windows, inner doors, and plumbing, water piping, and electricity works) is set equal to the LS of the following activity (intermediary review). This means that windows, inner doors, and plumbing, water piping, and electricity works must be finished at the latest when the intermediary review is started in the latest schedule. For each (predecessor) activity, LS is again LF - activity duration. For example, for windows LS = 73 - 6 = 67.

If an activity has more than one successor activity, the smallest of the LSs of the successors is marked as the predecessor activity's LF value in the backward pass calculation. This imposes a requirement for the predecessor to be finished early in the latest schedule so that the predecessor would not constrain any of its successors' latest starts by finishing later than when any of the successors are expected to start (indicated by the successor's LS). For example, the successors for concrete floors are leveling works, suspended ceiling, plumbing and water piping, and electricity works. The smallest LS of these successors is 34, which, indeed, is marked as the latest finish (LF) of the predecessor activity (concrete floors) in the backward pass calculation.

In Figure 32, the latest schedule for each activity has been calculated through a backward pass calculation of the network. The float of an activity can now be calculated with an equation LF - EF (or, LS - ES, which brings the same result). For example, the float of brick partitions is 17 - 10 = 7 days. An activity with a float of 7 days can be scheduled to take place within a 7-day time window, without resulting in any delaying consequences for the whole project. For example, brick partitions activity can be started in between time points of 10 days (ES) and 17 days (LS). There are activities in the activity network for which ES = LS and EF = LF. These activities do not have float (their float is zero), and they are critical activities. The critical activities form the critical path and are marked in gray in Figure 32. The execution of critical activities must not be delayed; should any of the critical activities be delayed, the whole project would be delayed accordingly.

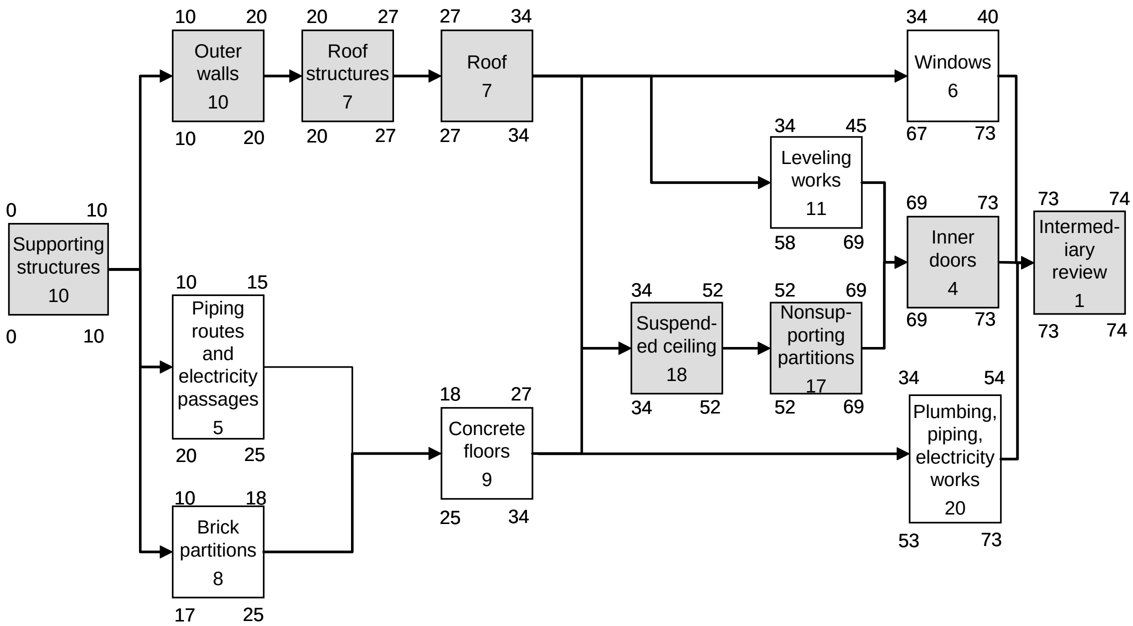


Figure 32. Complete activity network with the critical path in the final stages of the contractor's work

Example: Gantt chart based on the results of the network calculation

When the earliest and latest starts and finishes of the activities have been determined in the network calculation, Livinghouse's project manager can draw a Gantt chart. In this chart the execution times of the activities are set on the time axis in a way that permits the activities to be executed with the present dependencies. Figure 33 presents the Gantt chart with the critical activities marked in gray. The other activities have been marked in white and all activities are shown as starting at the earliest possible time, indicated by earliest start of each activity. A straight line projecting to the right after the activity has been used to mark the floats of these activities. The length of the float line describes the time span determined by the float, inside which the activity can be moved forward, that is, it can be scheduled to start and end later.

Although the Gantt chart was presented earlier in the description of this case example, at that time, not having calculated the activity network, Livinghouse's project manager would not have been able to determine whether it was possible to execute the activities they had planned. We noted earlier that it is not always sensible to try to achieve the earliest possible start because an early start binds costs into an early phase. Furthermore, it would not be sensible to start activities at their latest possible start times, as project activities always include risks that may cause delays in activity durations. In other words, deterministic values for activity durations used in network calculations are not realistic, but these durations can be depicted in stochastic terms by probability distributions. Using this probabilistic approach, allows for possibilities of an activity finishing later or earlier than what a single deterministic value would indicate. Starting activities at the latest possible start times would make all activities critical after their start, and delays in any activity would cause further delays for the project, and may jeopardize the schedule of the whole project. Finally, resource constraints may force scheduling the start of activities at specific times, as the specific resources used by activities may be scarce and, accordingly, resource constraints may imply that there are no options other than to execute an activity in a specific (and only) time window when the resources for its execution are available. This situation resembles that of a critical activity, except that the activity's position is not constrained by dependencies with other activities but by availability of resources for that activity.

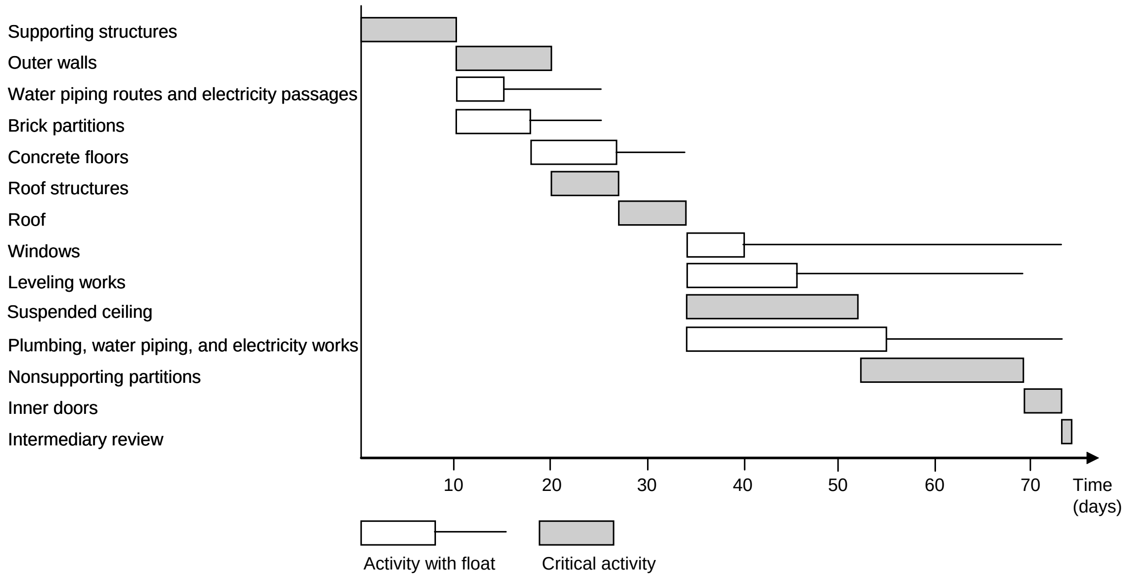


Figure 33. A more detailed Gantt chart, making the critical activities and floats visible

It should be understood that in preparing the activity network and the Gantt chart depicted in Figure 33, weekends and other holidays have not been taken into account. The timeline describes, therefore, the number of workdays and, when it is known that no work will be done on certain days, this should be factored into calculations of the total schedule. In this project, the supplier,

> Livinghouse, and the subcontractors only work during weekdays, so the previously calculated project length of 74 workdays would increase to 104 calendar days, taking weekends into consideration.

The activity network is usually not finished in one attempt. Possible restrictions imposed on and objectives set for the schedule must be checked in the planning phase. Frequently the company's management (or the customer) demands that the schedule be shortened and, if so, it is essential to direct attention to the activities situated on the critical path. Attempts can be made to shorten the duration of activities or to change the dependencies between activities by changing work methods.

In some situations, the following type of thinking can be applied. The desired shortest schedule finishing time can be set as the latest finish (LF) of the last activity so that the earliest finish (EF) for the preliminarily calculated activity network is different from its LF. It can happen that the LF is smaller than the EF for this activity, indicating that it is necessary to force the project to end, at the latest, at time LF. The float for the last activity is therefore negative. The activity network can then be calculated from finish to start according to these procedures and the forced finishing and starting times can be calculated for each activity. When the floats for the activities are calculated, the float figures reveal how critical each activity previously on the critical path has become. Additionally it is evident whether or not some other activities on different paths have become critical. The float figure describes the degree of criticality. Activities having a negative float are called supercritical, and it should be possible to decrease their duration in order to complete the project in the forced time.

Float is often utilized so that activities having float are not set to start at the latest possible time. If the activity is started early, then the duration of the whole project does not suffer the effects of single faulty estimates, the realization of single risks, or unanticipated problems. It is dangerous to schedule, based upon the earliest possible schedule because, for example, people tend to start activities later than planned if there is a possibility of doing so. Nevertheless starting too early may cause capital to be tied up unnecessarily and, with a slightly later start, some financial benefit could be gained. When starting later, the information needed for accomplishing the activity may also be of better quality. Starting an activity late increases the risk of delaying the whole project. Flexibility in starting times may lessen the effectiveness of resource planning and usage, for example, resources may not be available at other times than those that have been set in the preliminary objective schedule. The project manager should take such matters into account.

4.3.4 Resource planning

Identifying resource requirements

Planning of the WBS and schedule is tightly linked with resource planning, because, for example, activity duration and execution method can vary substantially depending on the person executing the activity and on available equipment capacity. Although, a rough resource estimate or rough plan for activity specification and schedule may have been sketched, a more detailed resource plan is needed in order to stay on schedule and to ensure that the right resources are available for use at the right time. The resources needed in projects can usually be divided into five groups.

People. People and their competences are resources that particularly affect the schedule. In order to perform the activity properly, it is necessary to specify the skills and performance levels required of the people.

Facilities. The facilities and location required for project execution (e.g. offices, testing laboratories, and trial or demonstration facilities) should be identified as part of resource planning. If the project requires facilities administered by others, the availability of the facilities should be ensured well in advance.

Equipment. Equipment requirement is similar to facility requirement: the equipment needed, and when and where it is available, affects resource planning.

Money. The necessary money must be available to cover project costs; therefore money needs should be planned and scheduled with care. Often this involves negotiations with financial institutions to obtain funding for the project.

Materials. Materials include all raw materials, tools, and components that are needed to produce products and other physical outputs of the project. Often services purchased from external companies are treated in the same manner in the company's information systems as material purchases.

Acquiring resources

Ensuring that the right resources are acquired and allocated to a project is the central goal for resource planning. Often a large part of the project's human resources can be found in the project supplier's own organization, however, it is typical that the customer also assigns some resources to the project and that some additional people come from outside both companies. The same principle is valid for the other resource groups, although there may be differences in the way costs accumulate among various types of resources. Rented resources are paid immediately, but large equipment and facility procurements may require investments that have their own typical calculation principles. The procurement of external resources is discussed separately in Section 4.5 of this chapter.

Each company has its own way of maintaining the resources that projects use for short periods or for the entire duration of the project. Often suppliers have a number of resource units contributing to the project; resources can be drawn from various organizational units within the supplier company, for example, and directed to projects. Of course funds from the project budget must be transferred (usually based upon a transfer price) to compensate these various units for maintaining and providing the resource. In return, the project receives benefits from using the resource to realize or successfully complete the project.

Clear principles for resource usage should be agreed upon in the company, including principles related to pricing resources, division of costs, and competition for resource usage.

Loading resources

When suitable resources have been identified, they can be matched together with the WBS. Figure 34 illustrates the way the activities specified in the WBS or work packages can be directed to or loaded on the resources working in various organizational units.

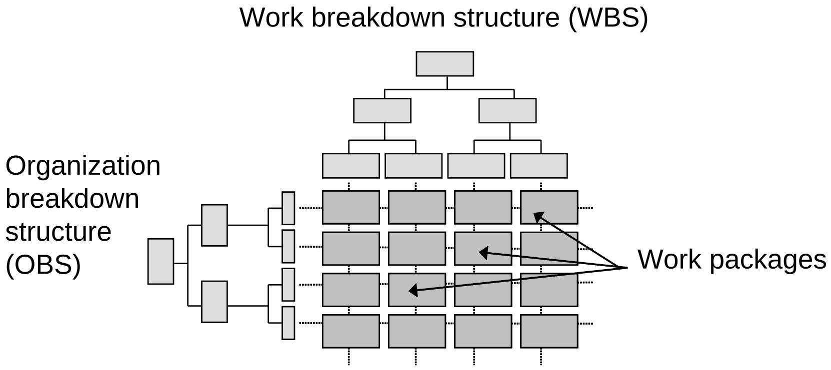


Figure 34. The work breakdown structure (WBS) meets the organization breakdown structure (OBS) when loading resources

Once resources are identified and loaded to organizational units, more detailed questions of loading resources can be considered. Resources can be loaded with activities in three ways:

- An even resource load is set on the resource for the entire duration of the project (e.g. 50%);
- A full resource load is set on the resource for the entire duration of the project (i.e. the resource is fully dedicated for use of the project); or
- An activity load profile dependent on time is set on the resource (e.g. 100% during first and last week; 50% at other times).

The amount (capacity) of resources can be determined as person-work hours, -work days, or -work weeks, depending on the size of the project. The total resource requirement may have been identified when making the WBS and, during more detailed resource planning, the resources may have been assigned to certain activities that are fitted into the schedule. There is often a known resource limit, which the momentary resource usage cannot pass. If there are four people available, for example, there is a maximum of four person-work days available in one day. Figure 35, presents an example of a resource histogram for a relatively small project in which resources have been assigned a greater activity load near the beginning of the project than later on in the project lifecycle.

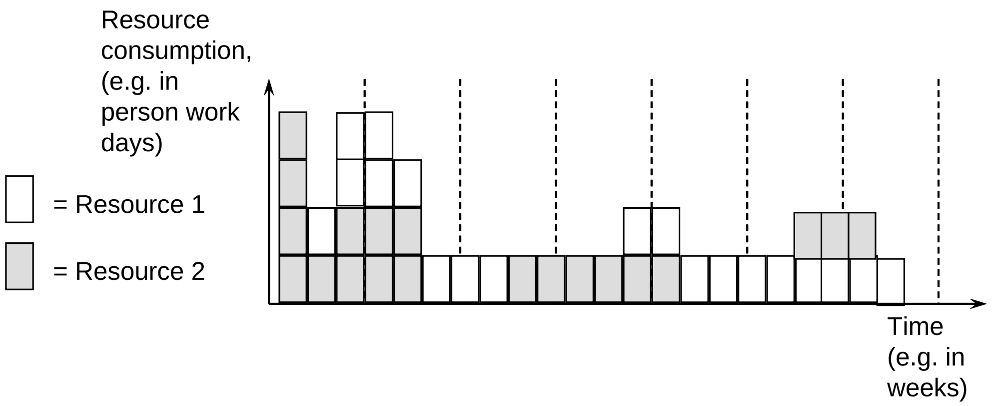


Figure 35. Example of a resource histogram

After activity resource needs have been preliminarily identified, they can be fitted into the preliminary schedule for the project. In this context, the resource histogram should be studied together with the Gantt chart, and various scheduling options should be tried out in the resource histogram. As part of this experimentation, resourced can be overloaded or under loaded in order to find out how realistic the schedule is and what needs to be changed. In leveling (equally distributing) resources for the entire duration of the project, some changes may also have to be made in the activity network and total schedule, particularly if the real resource restrictions and requirements are considered. If the project is highly dependent on a single resource, the resource may become a bottleneck that slows down activity execution.

Leveling project resources

One objective of resource planning is for the use of resources be leveled or equally distributed over the duration or lifecycle of the project. If there are resource dependencies among activities, they cannot be executed simultaneously. One person cannot perform ten activities simultaneously, but must do them in succession. Leveling resources involves dividing the workload among resources to execute them in a sensible way. Attempts must be made to avoid under loading and overloading resources and this presents a multifaceted optimization problem, as various resources may have differing restrictions and, possibly, different cost sources. In the planning phase, a balance should be found between an ideal schedule objective, the costs due to delaying activities, and the additional cost due to obtaining additional resources.

In practice there are four different ways to level resources, each of which has its effect on project execution.

Using float. The use of resources can be leveled by making use of the float of activities. The starting time of an activity can be changed inside the float, for example.

Moving the time of finish. Within the constraints of earliest start and latest finish, the staring and finishing days can be altered somewhat in order to level resource usage. If the duration of an activity is stretched, it can proceed part of the time with more limited resources. Nevertheless the starting time should not be lesser and the finishing time should not be greater than those allowed by the float for the activity.

Dividing activities into parts. An activity can be divided into parts, if necessary. An activity originally lasting for four weeks can be divided into two activities lasting two weeks each. In the time gap between these two activities, the resource can be detached and allocated to other work. If this change can be accomplished within float or by changing the dependencies among activities, it will not necessarily affect the total project schedule.

Using replacement resources. If the right competences are available and there is a rush to complete the project, part of the work can be performed by replacement human resources. The downside of using replacement resources is a decrease in efficiency: a new person needs time to learn the project situation and its inherent requirements, and often someone already working in the project must guide the new person initially.

The result of the resource plan should be clarity on what resources are available, and when and how they can be assigned to the project activities and schedule. After figuring out the possibilities for leveling resources, a final version of the project schedule can be completed, as can the resource plan and, possibly, the work breakdown structure. Because it is known who is responsible for what actions and when, the schedule for realizing intermediary objectives can also be confirmed.

4.3.5 Monitoring and controlling schedule and resources

As described in the previous subsection, resource availability, capacity, and leveling can affect the duration of activities, the activity network, and the critical path. Preliminary schedule estimates are iterated in parallel with studying resource constraints and alternatives. It is customary to finally set or freeze the schedule objective so that the scope of the project is no longer altered. The schedule objective is used in project control as the basis for execution and as an element for comparison in monitoring project progress. If there are disturbances or changes in the execution that are likely to affect the realization of the total schedule or other objectives, change management should be implemented.

The same tools are used to monitor the schedule as are used in the planning phase (e.g. histograms). The planned schedule is often compared with the realized schedule and, if there are substantial differences between the two, it is necessary to check how realistic the schedule is, to rearrange the total schedule, and, possibly, to agree on procedures to speed up the schedule. Figure 36 presents an example of schedule monitoring in the context of our case example, the Smiths' house construction project.

Example: Monitoring the schedule with the help of a Gantt chart

> The work on the family Smith's house construction project has progressed 15 days in Livinghouse's final work package part of the project. Figure 36 illustrates how a Gantt chart can be utilized to help monitor the progress of the schedule. Each activity's real degree of completeness – expressed as percent complete – is checked and compared to what it should be at time now, referring to the current moment. In Figure 36, a bold vertical fraction line passing through the activity bars has been used to mark the real degree of completeness of project activities.

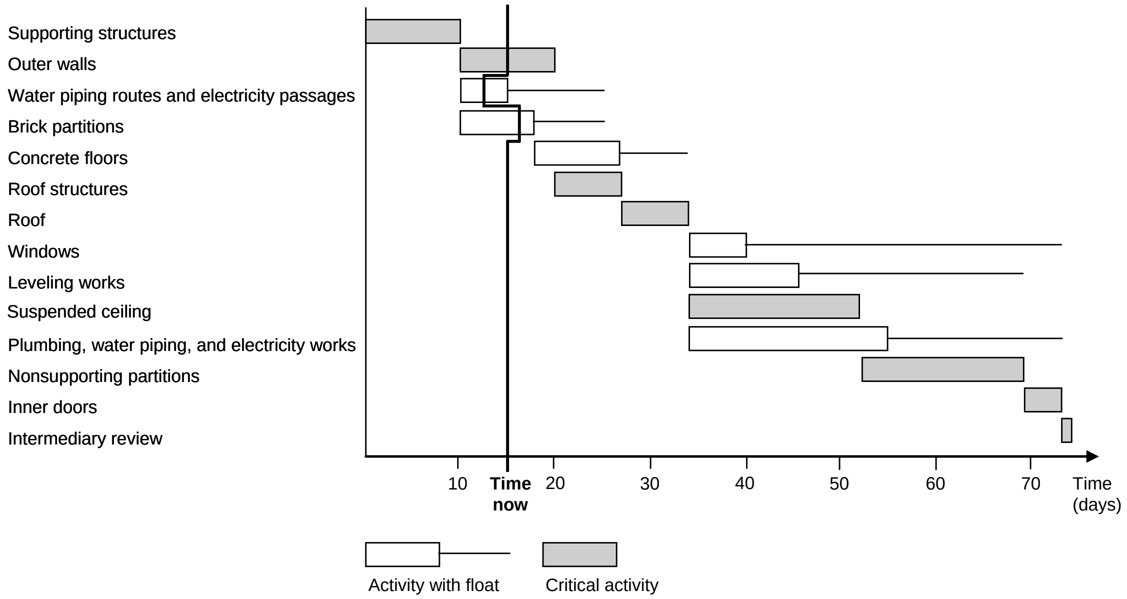


Figure 36. Monitoring the degree of completeness of activities

The supporting structures have been completed as scheduled (or have at least have been fully completed at time now, the current moment), and 50% of the outer walls have been completed, so this component is also on schedule. Only 50% of the water piping routes and electricity passages has been completed, however, these activities should have been fully completed at this moment. The brick partitions, on the other hand, are ahead of schedule: they are 75% complete, although, according to plan, their degree of completeness should be just over 50%.

In practice this means that float must be used to advance the stage of completion of the water piping routes and electricity passages. In the event that their completion is delayed beyond the estimated start of the concrete floors, the concrete floor construction activity will be delayed as well. The delay of one non-critical activity can thus accumulate to affect its successors and the entire project, and the delays in an activity may cause its successors, which were originally in a non-critical path, to become critical; thereby another path becomes critical instead of the path that was originally considered as critical.

If the water piping routes and electricity passages are completed before the 18th workday, the concrete floors can be started on time. In principle, the water piping routes and electricity passages would have more float than this, but if the completion of the activity were to be further delayed, it would decrease the float for the concrete floors. At time now, the water piping routes and electricity passages that are executed as a subcontract by Livinghouse are causing considerable stress for Larry because, if further delayed, project work components that the Smiths have arranged with other specialized subcontractors may be delayed. Specifically, Larry has agreed with Livinghouse that they prepare routes or create the route reservations for the HVAC air pipes for heating and cooling, and that they include this HVAC air pipe route reservation work in the 'water piping routes and electricity passages' activity; in other words, Livinghouse performs the work simultaneously as it prepares the routes for water piping and electrical wires. Larry has agreed with the specialized HVAC system subcontractor that they must start their HVAC system installment work on the 20th workday. Larry's stress occurs because he recognizes that, although Livinghouse could easily delay the completion of the 'water piping routes and electricity passages' activity beyond the 20th workday within the floats (and thereby there would not be any impact on the scheduling of the part of the project that is under Livinghouse's responsibility), the Smiths' specialized HVAC system supplier could penalize the Smiths if it is not allowed to start its installation work on the agreed date, a date for which they have already reserved and scheduled resources to work on the Smiths' project. Consequently, Larry devoted considerable time and effort to negotiating with Livinghouse's project manager to have Livinghouse prepare the routes for HVAC air pipes for heating and cooling before the 20th working day.

The construction of the outer walls is a critical activity for Livinghouse. If this activity appears as if it may be delayed, some additional resources should be assigned to it or its completion should be expedited in some other way to prevent a delay of the entire project. On the other hand, both favorable and unfavorable changes will happen during every project, and some setbacks may be compensated by a future success. Therefore it is not necessary to react to every small change in project work component schedules.

In the schedule and resource usage, project completion should be monitored at the most detailed level possible, perhaps, in more detail than in the original estimates. Marking the completion levels with modern data systems solutions does not cause an additional burden, and proper followup information helps in preparing for future projects. The minimum requirement is nevertheless that the followup on completion levels be performed at least at the same level of detail as in setting the objectives.

With the help of schedule and resource planning information, it can be determined whether or not the realized schedule corresponds to original plans, and questions about whether or not work is being completed on time, ahead of schedule, or behind schedule can be answered. Furthermore, the company can analyze the progress at a more detailed level (e.g. in terms of the length of delay or forecasted project completion).

Every change or deviation from schedule does not involve checking the whole project schedule. Projects in which the planned schedule holds 100% are rare – there are always changes in details. Furthermore, the delay problems in one work package can be compensated by the preceding activity having been completed ahead of schedule. It is often possible to come up with actions that can be used to cure delays and remain within the time span of the project.

The S-curve is a frequently used tool for tracking project resource usage and costs; when needed, it is also a suitable tool for planning, as illustrated in Figure 37. The S-curve depicts the accumulation of resources and costs over the course of the project. This accumulation occurs as the project actions are executed and the needed resources and funds are consumed by these actions. The term "S-curve" comes from the usual form of the accumulation curve: it resembles a slanted letter S. Typically resources are utilized and costs are incurred the fastest during the middle stages of the project, and more slowly in the starting and finishing stages.

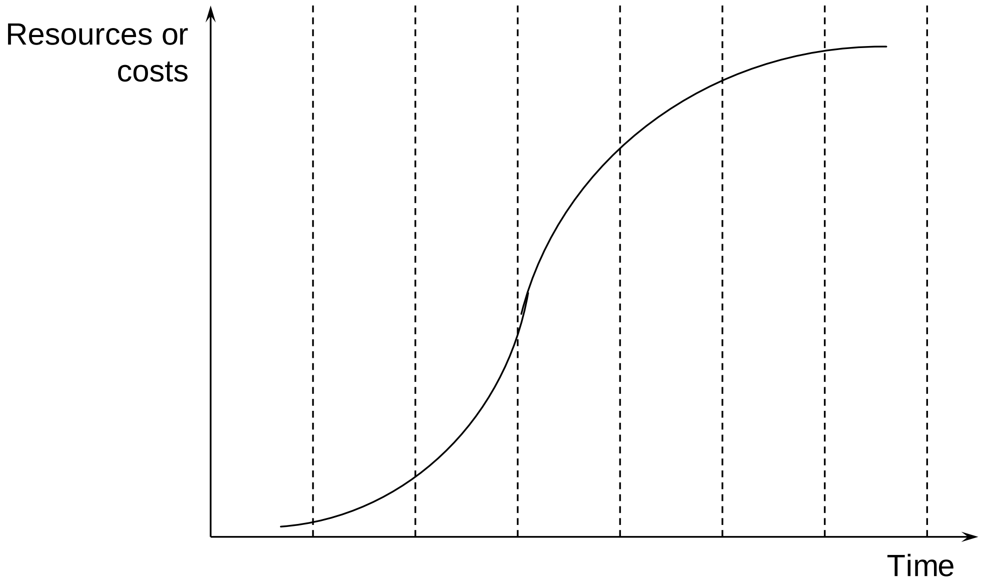


Figure 37. The S-curve illustrates the accumulation of resources or costs over the progress of the project

Speeding up the schedule

There are several means of speeding up project execution, if necessary. Concurrent engineering can be used to execute the project actions in parallel, simultaneously. Instead of scheduling activities one after the other, they can be scheduled on top of each other, but, of course, within the available resource limitations. Some activities can be started before the preceding ones have been finished and several activities can be conducted simultaneously.

Concurrent engineering is perhaps the most common way to speed up a project's execution and shorten its total duration. It can be used to shorten non-value-adding waiting times, and it shortens the total schedule by decreasing the number of unnecessary links between independent activities. Nevertheless, in concurrent engineering single activities may become critical in determining the total duration of the project. If activities are delayed, they are more likely to have an effect on the total schedule because of dependencies between activities. These dependencies, therefore, must be considered when planning concurrent engineering. Figure 38 presents the preliminary total schedule for a project and compares it with a schedule in which concurrent engineering is used.

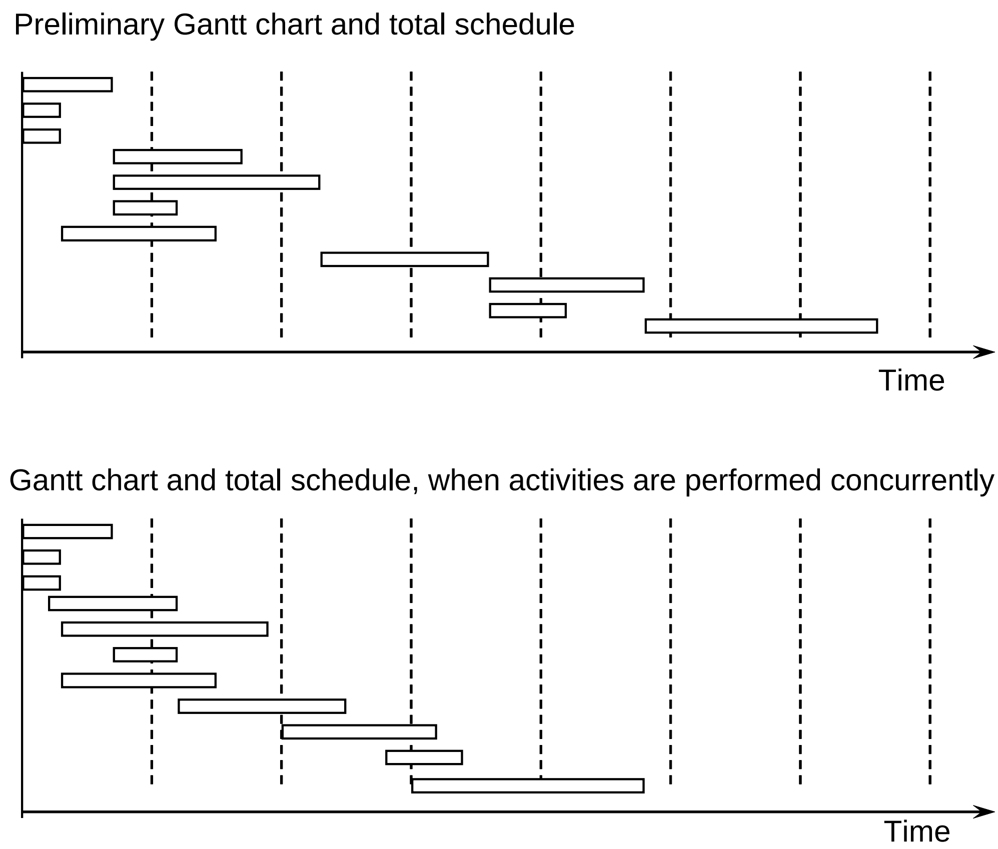


Figure 38. Concurrent engineering (executing activities simultaneously) can speed up project execution

Fast tracking is another principle used to speed up the project schedule. Fast tracking involves a compression of the project schedule in any way possible: simultaneously executing activities, making effective use of results from earlier projects, taking risks in certain solutions, or procuring external resources to speed up the execution of the project. Fast tracking was first used in large capital-intensive investment projects and frequently included delaying investment costs to the latest possible time. In the fast tracking principle, it is essential to keep a reasonable balance between the risks and expected financial benefits from the quickened execution.

4.4 Cost management

Cost management includes activities related to estimating, budgeting, and monitoring project costs in order to ensure that the project is executed in a cost efficient, profitable manner, according to business principles and from the perspective of the entire company. Thus cost management is not restricted to executing the project according to budget. Rather, it includes setting the budget and executing the associated cost estimation and related activities; pricing the delivery project; budgeting revenue; planning cash flows and funding; and ensuring profitability.

In order to ensure project profitability, a perspective spanning the entire lifecycle of project revenue and costs is required. This perspective is achieved through lifecycle cost calculations, in which the revenue received through the benefits that accrue from using the product resulting from the project, and the expenses of use, are taken into account, in addition to project execution. Cost management also affects other areas of project management. It is essential to balance the planning of schedule, costs, and resources. All actions in the project are economic activities that ultimately affect revenue and costs. Studying activities through their costs and revenue makes the activities comparable in monetary values.

The crucial cost management activities in the project execution phase are planning resources (labor, equipment, and materials), estimating costs, setting a budget, recording actual costs, and following up on and reporting revenue and costs. Cost management in the execution phase also includes billing the customer, tracking the profit that accumulates through revenue and cost recordings in the balance sheet of the company, planning cash flows, and ensuring funding is available.

4.4.1 Affecting total project costs

Possibilities of affecting total project costs

Cost management is particularly focused on the specification and planning phases of a project. Decisions in these phases related to scope, resources, and schedule, among others, are essential because they define the cost structure and budget of the entire project. Such decisions affect the lifecycle costs of the product.

Figure 39 emphasizes the importance of cost management at the beginning of the project lifecycle because a large part of total project cost is determined by decisions made in the early phases of the project, although these costs are realized later on in the project. The possibility of affecting project costs decreases radically as the project moves into the execution phase because, in making the investment decision, a commitment is made to certain preplanned solutions and constraints. From the project supplier’s viewpoint, signing the contract substantially limits project scope and the range of choice in subsequent stages of the project process. Additionally the purchase contracts for the main subcontracted parts are usually signed with the largest subcontractors, right at the beginning of the execution phase.

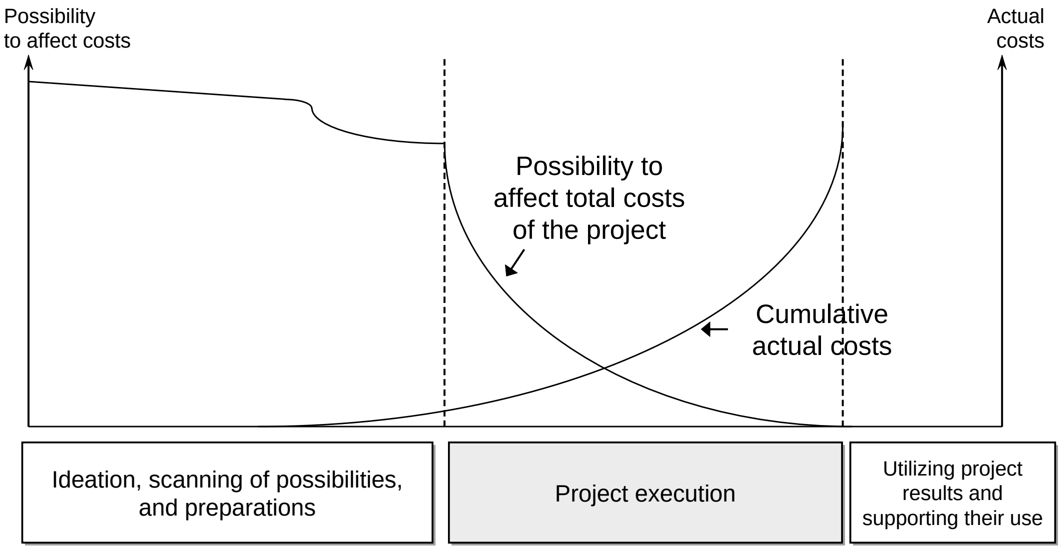


Figure 39. Actual total project costs and possibilities to affect them over the project lifecycle

When the project starting points have been determined, and new solutions have been planned on top of previously determined design solutions, making changes to solutions already implemented becomes more difficult and expensive as the project progresses. The costs of a certain change increases the later the change is made because the change may affect many other activities. At its worst, the change can affect already signed purchase contracts, requiring the project supplier to negotiate with the subcontractor and to bear increased costs because of change work billed by the subcontractor. The situation is even worse if the part of the product to be changed has already been built or installed. In these situations, dismantling work is often necessary, producing additional costs, which must be incurred before something new can be constructed.

Decisions that effect total project costs

Figure 40 describes the importance of decisions made in various phases of the project lifecycle and the change in the number of decisions made during the project. At the beginning of a project, the number of decisions is low, but the importance of a single decision is high. In accepting the project scope and investment decisions, for example, the framework for future costs is created (see also Figure 39). If the project supplier underestimated costs when preparing its bid, it may set too low a bid price, which in turn leads to the project generating a loss. As the project progresses, the number of decisions increases, but the significance of a single decision for the project as a whole decreases. During project execution, decisions can be made in order to specify the practical procedures of the project team, for example, which are things that do not have as significant cost effects as do the key decisions made in the planning phase.

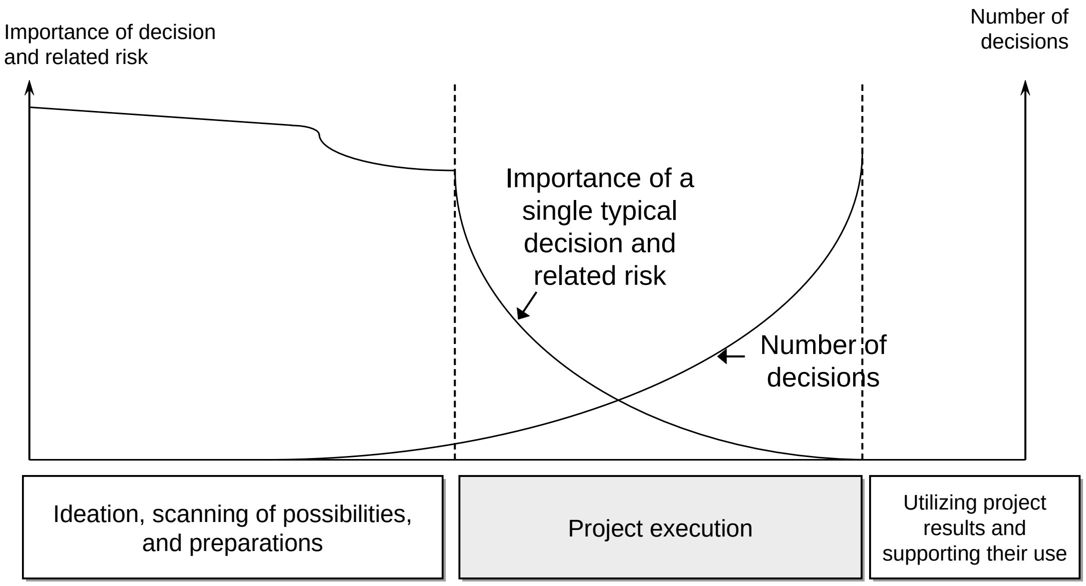


Figure 40. Importance of a decision and number of decisions in different stages of the project lifecycle

Our discussion of cost management and behavior of costs was restricted primarily to the phases of the project lifecycle that precede handover and implementation of the product resulting from the project. But the financial aspects of the after-handover phases of the project lifecycle – the costs resulting from the operation of the product, for example - must be considered. An inexpensive product can be realized as a result of a project, which nevertheless is expensive to operate, perhaps because of high fuel consumption or a constant need for repairs or maintenance due to failure sensitivity. Thus it is natural that the customer is interested in the business benefit that the project as a whole will bring over its entire lifecycle.

Figure 41 illustrates the elements of lifecycle costs. Although, in reality, costs are incurred in the ideation, planning, and execution phases, in Figure 41, the project cost has been marked in total as a purchase price to be paid at the end of the execution phase. In the operation phase, several maintenance and, finally, disposal costs are incurred; however revenues are received at the end of the operation phase because the investment produces a realized salvage value (revenue) as the used machine is sold.

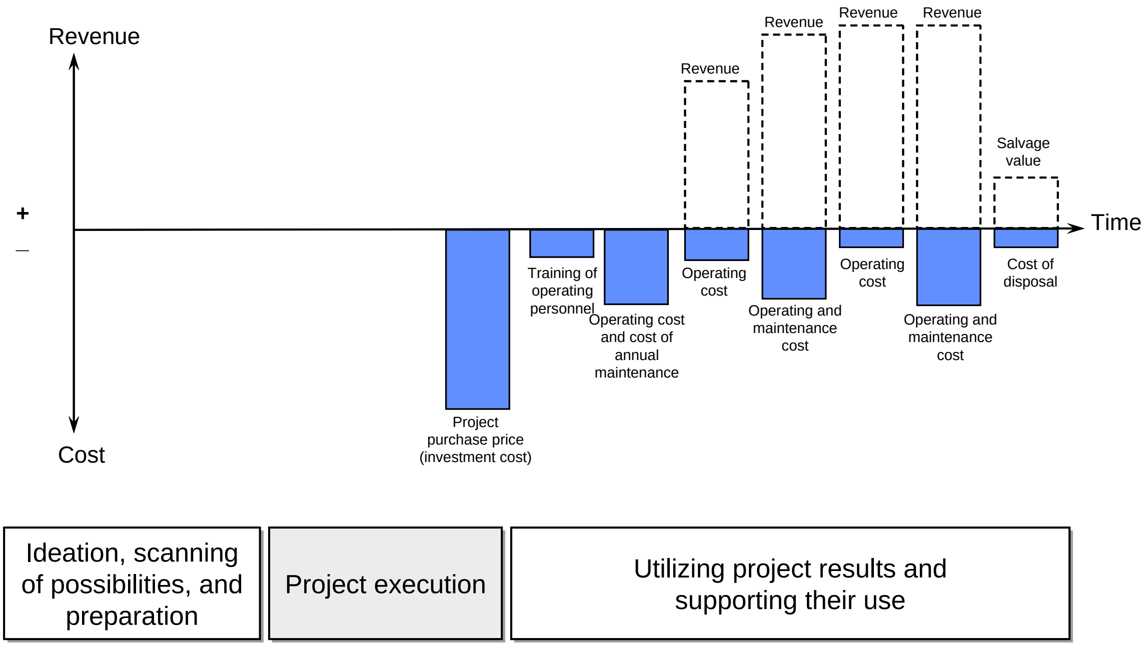


Figure 41. Illustrating elements of lifecycle costs

According to the known investment calculation practices, there is a time value to money – a dollar today is more valuable than a dollar one year from now. This concept is applied in calculating the net present value of lifecycle costs and in methods used for such other investment calculations as internal rate of return and payback period.

Target costing

Project costs can be affected substantially through the choice of the technical-, functional-, and execution-related solutions of the product resulting from the project. Here target costing can be applied.

Target costing can be used to ensure that financially sustainable solutions are applied in the design phase. In target costing, a target cost is determined for the overall project or its part at the start of the project, and this target figure is used to guide planning and to ensure profitability. The target cost is usually divided into subtargets so that each person involved in designing part of the product knows how much project money is available within the project budget for that particular part, helping designers to make choices about technical solutions based upon a known cost limit.

Target costing is used to avoid a widely known problem called feature creep. Feature creep relates to a phenomenon whereby project team members, particularly designers responsible for technical design, add features to the final product without the approval of the customer or project managers. Because of their professional competences and ambitions, team members typically attempt to surpass quality requirements, often adding unnecessary, time consuming, expensive, and technically and functionally impressive features to the product resulting from the project. Quality is not necessarily improved by this process. A programmer may add fine functionalities, causing many challenges, including the customer not accepting features that have not been approved in advance, compatibility problems arising with other parts of the program, failure to add the additional features to product documentation, and others being unable to maintain and update such a program. Such added functionalities may also cause other effects that make maintenance more complex or add costs that the customer may not pay.

4.4.2 Itemizing costs

Cost accounts and cost types

Project costs (cost estimate, budget, committed costs, and actual costs) are itemized according to the work breakdown structure (WBS). They can also be itemized by the organization breakdown structure (OBS) of the company which describes the units, groups, or people that participate in the project. Figure 42 illustrates the itemized dimensions of the WBS and OBS of the company as a matrix structure, in which cost entities, called cost accounts, represent the financial perspective on work packages. A cost account describes what organizational unit provides the resources for particular work packages, and contains the relevant costs. There is a responsibility related to work packages as well as cost accounts: some person or party is responsible for each entity. This responsibility is agreed upon at the time division of responsibility is decided for the project.

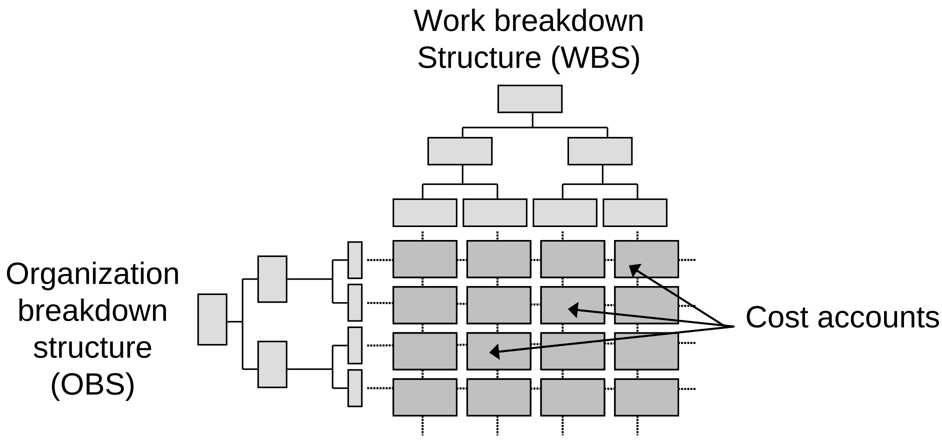


Figure 42. Cost accounts in the intersection of a matrix formed by the work breakdown structure (WBS) and organization breakdown structure (OBS) of a company

Many different types of costs can be recorded in cost accounts, which are usually grouped into cost components in companies. A company's cost breakdown structure forms the third dimension for itemizing costs, as illustrated in Figure 43. The figure can be called a cost cube because of its three-dimensional nature. Typical cost types are personnel costs (salaries, training, and other benefits with indirect costs), travel costs, and purchases. Purchases usually refer to external procurement of such items as raw materials, components, products, and services. The level of detail of the cost breakdown structure of companies can vary, and cost types can be formed into an hierarchical structure, if needed, whereby the highest level of the main cost types are divided into detail on the lower levels. As the cost breakdown structure is specified to lower and lower levels, eventually the accounts of corporate accounting are reached, which often correspond in level of detail to the elements of a detailed cost breakdown itemization.

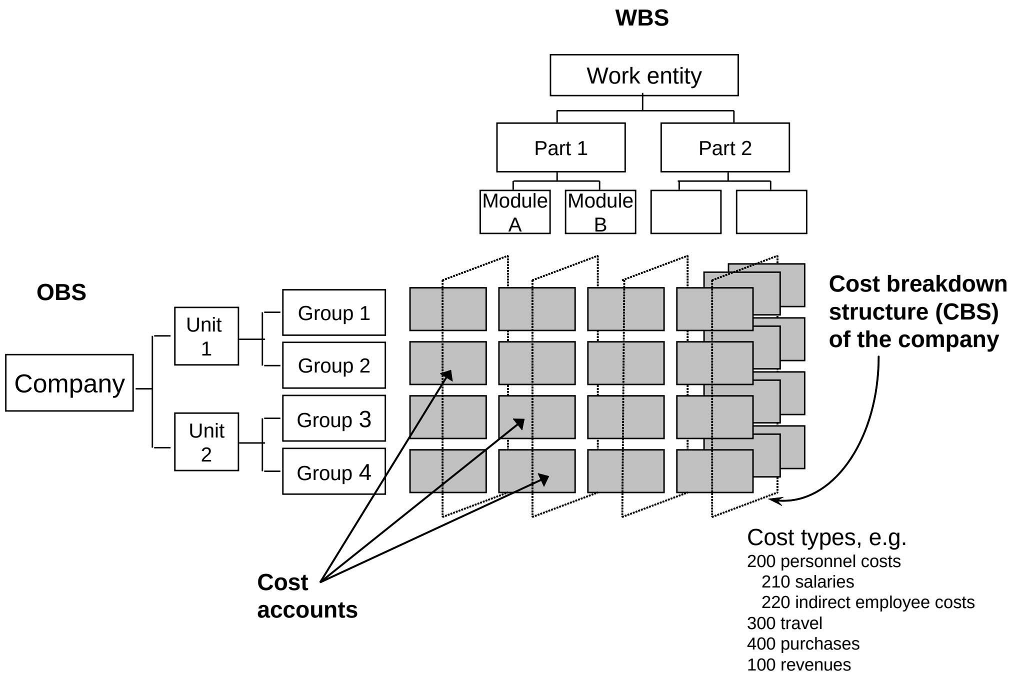


Figure 43. Cost cube formed by the work breakdown structure (WBS), organization breakdown structure (OBS), and cost breakdown structure (CBS) of a company

Project costs are recorded in a project account opened in the company's accounting system and are attached to a certain element of the WBS (e.g. to a subproject, work package, or lower activity level). In practice this is accomplished by recording a code that describes an element in the WBS as the cost registration is made. Additionally the organization code of the person that has executed the work or made the purchase is recorded, as well as a code referring to an element of the company's cost account structure. By recording costs in this manner, the project is linked directly to the other control systems used by the company.

The right cost itemization and registration levels must be chosen so that sufficiently accurate information is received to support project management. If itemization is too detailed, there may be thousands of cost accounts, a situation which makes it impossible for managers to concentrate on managing the project because they are overloaded by constantly having to spend time updating cost estimates. It is advisable to keep cost itemization at a relatively aggregated level to support effective use of resources during project management. Committed and actual costs can nevertheless be recorded at the most detailed levels without expending extra effort because they must, in any case, be recorded and the accounting system sums up lower level costs to the higher levels.

4.4.3 Cost estimation

The staring point for cost estimation is the WBS and work packages. Cost estimation is needed in every phase of the project. It is a continuous task, and its objectives change as the project progresses.

- When studying a project opportunity, the purpose of cost estimation is to find out whether or not the project can be executed profitably. The cost estimate is included as part of the project proposal and it is used as one basis for making the investment decision.
- In preparing a bid, cost estimates are needed to help a potential bidder decide whether or not to bid and, if so, what price to bid.
- In setting the budget, cost objectives and possible budget contingencies – in case of unexpected costs – are decided on the basis of cost estimates.
- In project execution, cost estimates are continuously updated to ensure that the latest information is always available for estimating future costs. Thus cost estimates can be used to anticipate future events and to facilitate changes before actual costs are recorded in the information systems of the company.
- After the project is completed, operating revenues, payback periods for investments, and costs and revenues from project-related services can be calculated.

Ideally, during project execution cost estimates should be updated immediately after one of the people responsible for the project has new information on project costs. In practice, however, the checking of estimates often occurs as a separate and regular (e.g. monthly) event, and the updated information does not become visible until the following reporting period.

Information used in cost estimation

Project costs are composed of different cost factors: personnel, material, facility, and equipment costs. Project revenue should also be assessed as part of the cost estimates. The initial data needed for estimating project costs can be collected from several different sources. Information collected in previous similar projects, or price estimates provided by suppliers, can be used as bases for estimation. The company or its partners may have experienced experts whose opinion can be used in making the cost estimate. If the company has been able to utilize modular product or work parts in a previous project, its existing cost information records can be used for these parts. Identification and estimation of risks should also be utilized effectively in estimating costs. Many external and internal factors may change as the project progresses, and such changes may affect the final costs.

The cost estimate can be based upon various models that have proved effective. As initial data, these models require information about the characteristics of the product resulting from the project. In estimating costs for international projects involving commitments made in a foreign currency, possible currency rate fluctuations must be taken into account by using various financial instruments or by pricing the risk in the contracts.

Cost estimate and estimate contingency

The cost estimate can be used as a predictor of project costs. An expression of accuracy is often associated with cost estimation, like +/- some percentage range, and the accuracy range is communicated in conjunction with the estimates made at various phases of the project.

Example: Cost itemization and cost estimate

In a house construction project, some of the costs can be estimated with high accuracy at the outset of the project, but other costs contain larger uncertainties and are difficult to estimate with precision. In practice, there is a degree of uncertainty related to each activity, and the Smiths are looking for a realistic objective in forming their project budget. Figure 44 presents the cost estimate for the Smiths' house construction project with materials and work itemized according to the work breakdown structure (WBS). The framework and roof structures, as well as the complementing structures (such as windows, doors, floors, suspended ceilings, and gutters) are estimated with high accuracy because most of these construction components and products are included in Livinghouse's house package. On the other hand, there is considerable uncertainty about the magnitude of costs for mechanical equipment and works; furnishings, equipment and accessories; construction management; and miscellaneous site practices (such as obtaining necessary permits, taking site measurements, and obtaining tools for own work) because many of these items entail a large amount of subcontracted work that has yet to be agreed upon. Furthermore, some additional specifications and requests for bid must be made for the materials, products, systems, and accessories. The Smiths' cost objective (total budget) for the construction project is $200,000. This amount can be allocated to the various activities.

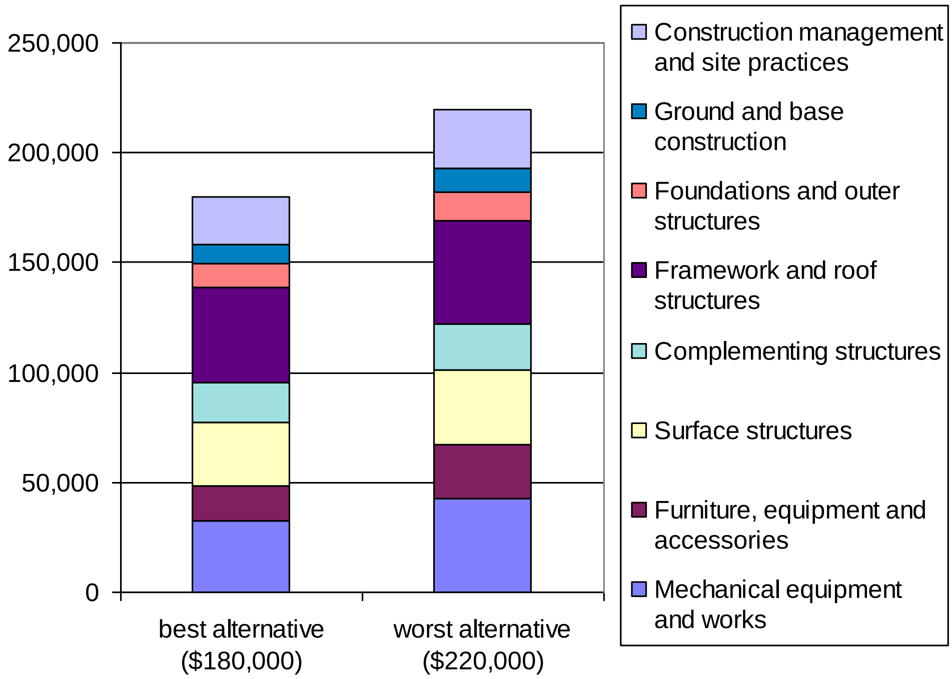


Figure 44. Cost estimate for Smiths' house project itemized according to the work breakdown structure

The cost estimate will be specified more accurately as the details of project execution and subcontracting contracts are finalized. On the other hand, for house construction projects, especially in the major cities, there is often a need to cover several types of unexpected costs and miscellaneous cost items that cannot be itemized at the outset. Failing to take such cost items into account would cause budget overruns. Therefore Sally and Larry want to prepare in advance for possible additional costs and form a realistic, not an optimistic, total project budget.

Ideally, cost estimates would always represent the expected value of costs. Because of human factors related to the person making the estimate, estimates can also represent the most likely estimate. Or a category or range of estimates such as pessimistic, optimistic, or speculative estimates may be provided, resulting in skewed estimates. Because it is often difficult to represent the estimate as a single value, a probability distribution is typically used, revealing a range covering all possible values and the probabilities related to each value. Figure 45 represents a cost estimate in a probability distribution form.

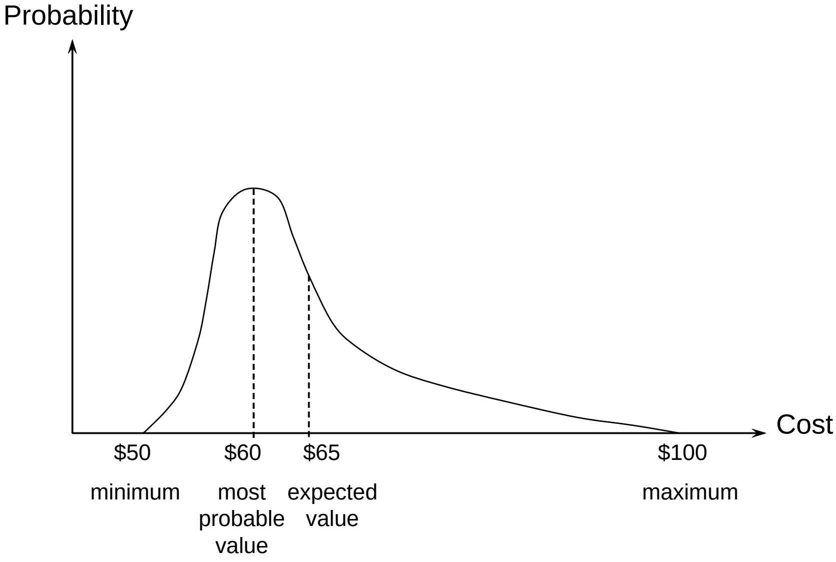


Figure 45. Various estimates based upon a skewed probability distribution of costs

A relevant part of a cost estimate is a contingency, called an *estimate contingency*. This term is not to be confused with a *budget contingency*, which is explained in Section 4.4.4. If the cost estimate is $65 and the contingency is $10, the cost estimate with contingency would be $75. With the help of the cost probability distribution, a suitable contingency can be determined depending on the preferred certainty for covering actual costs. Two types of occurrences are covered by a contingency.

Cost effects of risk-related unfavorable events: Contingencies can be established to cover changes in plan; problems in execution; such changes in the execution environment as delayed deliveries, weather conditions that are worse than expected, or problems with obtaining resources.

Effects of estimate inaccuracy: Contingencies can also be set to cover effects of imperfect information, use of deficient information when making the estimate, and inaccurate estimation methods.

A project may have some nonitemized costs that are known to actualize or occur on the basis of earlier experience – general costs incurred in the project, for example, or costs related to a specific part of the project that have not been more specifically itemized and recorded in a cost account. Although not itemized, these costs should be estimated as realistically as possible, and they should not be included in the contingencies but in the actual cost estimate determined by an expected value calculation. The inaccuracy in estimating nonitemized costs can nevertheless be taken into account in the contingency.

It is central in presenting estimated contingencies that they be justified. In making such justifications, it is helpful to describe risks and uncertainties in estimation and to present the situation as a probability distribution. The probability distribution estimate already includes a description of possible contingency sums and the related possibilities for realization. The cost estimates should be realistic. There should be an open and honest exchange of opinion in calculating and presenting estimates concerning what costs can be expected to be realized, and with what assumptions and in what cases the cost estimate can be exceeded or undercut. If cost estimation is not realistic and if estimators consciously, and without telling others, include *hidden contingencies* in their estimates, the cost estimate becomes a fallacious basis for arriving at a decision (e.g. the decision of setting the budget). This may lead to wrong decisions or to ineffective project management.

Accuracy of cost estimate and level of detail for cost itemization

The accuracy of the cost estimate is affected by the definition of the project scope and related risks. The estimate for project total cost becomes more accurate as the project progresses. In various phases of construction projects, the accuracy of the estimate typically develops as follows:[23]

- In the project description, the accuracy of the cost estimate is approximately +/- 50%.
- In the starting decision phase (go/no-go), the accuracy is approximately +/- 20%.
- After basic design and agreeing to the principal contracts, the estimate has gained in accuracy to a level of approximately +/- 10%.
- In the execution and monitoring phases the accuracy level is +/- 5%.

These views on accuracy development as the project progresses deal with the total cost estimate. The level of accuracy depends on the magnitude of the estimated total cost of the entity, and the level in the hierarchies (determined by the WBS, OBS, and CBS) at which the estimation is being made. For example, the accuracy of the cost estimate for the entire project is +/- 10%, but at the work package level it is +/- 50%.[24] The itemization accuracy of the estimate does not necessarily mean that it would be possible to estimate more accurately the costs of the smaller and more manageable entity (with its more detailed itemization level) than the total costs of the project. Often it is the other way around: on the level of the entire project the estimate can be accurate even if estimates based on lower level itemizations were grossly inaccurate.

Because of these factors, costs should be estimated both top down and bottom up. In the top-down approach, the central entities on the upper levels of the WBS are estimated, providing the basis for estimating the entities on the other levels of the WBS. In the bottom-up approach, the

[23] Turner (1999). The Association of Advancement of Cost Engineering AACE (formerly the American Association of Cost Engineers) recognized a “rough estimate” (accuracy -30% ... +50%), a “budget estimate” (accuracy -15% ... +30%), and an “accurate estimate” (accuracy -5% ... +15%).

[24] Turner (1999)

costs of the work packages on the lowest (i.e. most detailed levels) of the WBS are estimated and, on the basis of these estimates, cost estimates are made for the upper levels, up to the total costs of the project. If only the bottom-up approach is used, the whole estimating results may become fuzzy and some focal areas may not be noticed. Using both approaches is therefore recommended in order to get the best total result.

4.4.4 Setting the budget and recording costs

On the basis of the *cost estimate*, the *cost objective* for the project is set, that is, the *budget* is set. The budget can be itemized on a lower level (i.e. on a more detailed level) of the WBS than the total budget for the project. When the budget has been determined, the cost estimate is maintained and specified over the entire duration of the project. Thus the cost estimate becomes a forecast that constantly describes future costs and at any moment is the best estimate for total project costs. The total cost estimate can therefore be compared at any point with the budget so that staying within the cost objective can be estimated, anticipating future events.

The budget and cost estimate should be presented in such a way that they are fixed in time. It is relevant for the planning of the project and the finances of the company that management knows when the costs will be incurred. Thus the budget and cost estimates are itemized for specific periods – usually by month.

Setting the budget and using contingencies

The budget is a quantitatively expressed cost or resource objective. The project budget is determined to a large extent in the sales phase when, as part of pricing the bid, the first cost estimate is made for the project. In the beginning of the execution phase, the cost estimate used in sales is updated and, on this basis, the project budget is formed. The budget offers a quantitative basis for measuring and following up on the activity of people and units involved in the project. The budget and its contingencies, together with the schedule and resource plans, form the primary tools for monitoring project progress.

Figure 46 illustrates the way the cost estimates for the parts of a project are used to create the total cost estimate. In estimating contingencies, it should be remembered that generally accepted accounting principles and, in many jurisdictions, accounting regulations, may apply strict guidelines, determining what can be recorded as project costs in delivery projects. The use of contingencies, as illustrated in Figure 46, are best suited for budgeting investment projects in which extra funds can be reserved for project execution. Thus budgeting approach may reserve a certain amount of money for investments, which the manager responsible for investments allocates to various projects. The manager can nevertheless leave a portion of the money unallocated and use it later on when unexpected extra project costs arise. The project manager can act according to the same principles in dealing with the various parts of the project.

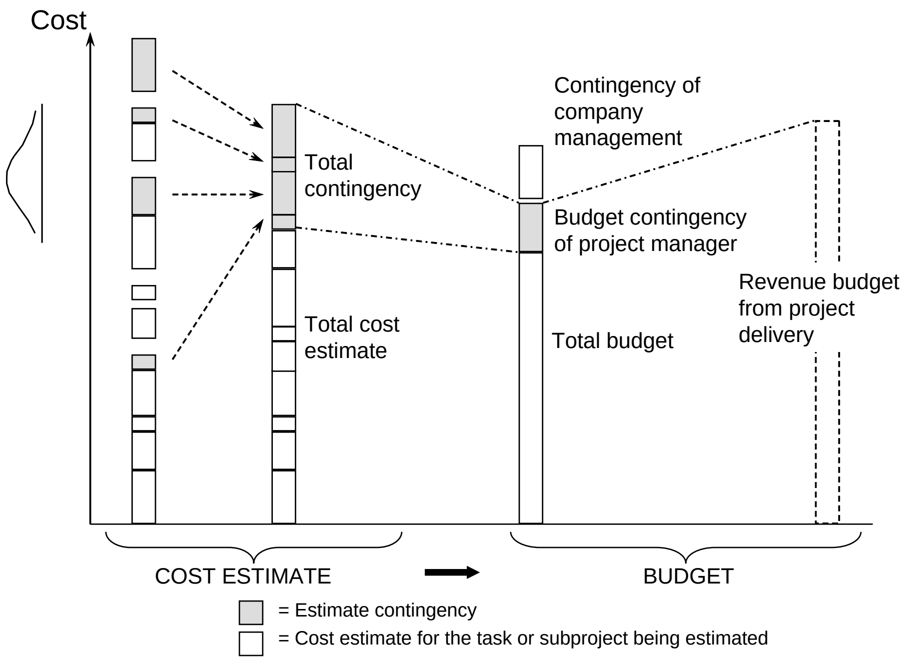


Figure 46. Formatting total contingency from estimate contingencies, total cost estimate, and set project budget

The total contingency of the cost estimate is formed from cost contingencies related to parts of the project or the entire project. The estimated contingencies are based upon estimates of possible risks or uncertainties in risk evaluation. The total cost estimate and total sum of estimate contingencies are calculated by adding the cost estimates and contingencies of the project parts. Nevertheless it is possible that total contingency is not always formed by a simple sum of the contingencies of various parts. All the risks that the contingencies are based upon cannot be realized in the same project, for instance. In addition, the effects of different risks can be opposite to one another; therefore the effects of the risks (favorable or unfavorable) often balance each other. The probability distribution of the estimate related to total costs is depicted on the left side of Figure 46, and it can be used instead of the contingency elements drawn in the figure. On the basis of the probability distribution of the cost estimate, one can determine the effect of risks and can calculate the magnitude of the total contingency needed to cover actual costs at an acceptable probability level. The decision on the contingency can be based upon the probability distribution so that the degree of certainty about the sufficiency of the contingency is strongly related to the way the decision maker regards the risks.

As Figure 46 illustrates, the total budget should not be exactly the size of the total cost estimate. It is essential that the budget be set at a magnitude that is challenging but realistically attainable, providing the project manager and project team with appropriate motivation to execute the project efficiently. In defining the budget contingency available to the project manager, the principle described in Figure 46 should be considered, recognizing that all the risks and estimate uncertainties that underlie the contingencies are not realized as unfavorable simultaneously; therefore, on the level of the entire project, a much smaller budget contingency is sufficient to cover the unfavorable effects due to risks and estimate uncertainties. The contingency of company management covers project-related risks that are not included in the project budget.

Although the project's total budget may not be met after utilizing the contingency of the project manager, the project can be ensured sufficient resources through management of contingencies.

Estimate contingencies and budget contingency differ in nature. In the estimate, the contingencies represent an estimated cost at a certain probability, sufficient to cover the consequences of risks and unexpected events. The project manager's budget contingency is, on the other hand, a project management tool that enables this manager to define and issue challenging objectives to subordinates, and to use contingency money to cover unexpected costs, if such appear.

The budget contingency of the project manager has been estimated on the basis of the risk and estimate uncertainty situation in the various parts of the project, but the cost accounts have each been assigned strict target costs. The project manager allocates the accepted budget to project parts (on the basis of the work breakdown structure that has been assigned to managers of the respective project parts), and to those people responsible for certain cost accounts. Budget contingencies are thus not allocated to the project managers responsible for part projects because it cannot be known in which parts of the project the contingencies will, in the end, be needed. If the budget contingencies were allocated directly to the various project parts to ease the cost target, it would be assumed that the contingencies would be used because, usually, all the money provided is used. As the project progresses, the project manager can decide to transfer funds from the contingencies to the budget for the particular project part that has experienced a cost overrun.

If the project fails, alternative use of management contingency funds can be approved; often the decision is to transfer the funds to one or several projects within the company's overall project business portfolio.

Assigning costs to a project

The costs that are directly related to the execution of the project should be assigned or allocated to a project (and recorded as costs of the project of course). For example, direct salary costs from labor hours and material costs should be recorded as project costs. Assuming that a designer working on the project is paid a gross hourly salary (wage rate) of $10/hour, additional direct costs assigned to the project would include obligatory social security and insurance payments (illness, accident, and unemployment insurance), salaries for vacation time, and additional holiday pay. The magnitude of such direct costs is accurately known, and can easily be allocated to the labor hours of the employee. These additional direct costs for employee labor typically comprise about 50% of the salary; therefore the direct cost of one labor hour is 1.5 * $10 = $15.

In addition to the direct costs associated with hourly salary, the employee causes indirect costs in the form of office space, equipment, training, accessories, and other costs. These costs can be computed as mean costs and attached to labor hours considered as productive project work. In practice this is accomplished by applying an overhead cost coefficient to the hourly salary cost, thus producing an hourly cost covering the direct and indirect cost of the labor hour. If the overhead cost coefficient is 2, the cost for one labor hour for the project would be 2 * $10 = $20.

If the designer working for the project belongs to a resource unit from which the project borrows resources, the computed $20 hourly price covering direct and indirect costs may be used as an internal transfer price. The coefficient applied to the gross hourly salary of the employee is determined according to what indirect costs the company wants included in the hourly price. If all of an employee's productive project working hours are devoted to the project, in a large company, the overhead cost coefficient may be as high as 4, raising the hourly cost for this designer employee to $40 (4 * $10 = $40).

As for labor hours, indirect costs can be assigned to materials and purchased services as a processing or purchase fee. The processing fee is usually set so that it covers the indirect cost load of the purchase, which is usually set at a few percent – usually 0.5% – 2% of the value of the purchase.

In addition to covering all the indirect and direct costs allocated to the project, project revenue must cover a share of several other costs, including costs of sales and marketing activities, costs involved in developing processes and products, training costs, and the indirect costs of general management that are associated with the project. Because it is often difficult to assign these costs to single projects, however, they may only be followed at an overall company level as part of cost followup actions. Activity-based costing (ABC) offers one method for assigning indirect overhead costs to projects based upon the actual occurrence of costs tied to the specific activity. Costs of the sales function can often be allocated in the appropriate proportion to each project, for instance.

Timing principles in recording costs

At the beginning of the project, the estimate of final costs is inaccurate. Nevertheless, costs can be assigned and recorded in advance. Usually the concept of assigning and recording costs is connected with actual costs. From the perspective of project management and project business, we believe it is essential to broaden the concept of assigning costs so that estimate sums and committed costs can also be allocated and recorded to cost accounts. This view enables anticipative cost control to be practiced, under which actual costs are recorded after a delay.

There are significant timing principles related to recording actual costs. For example, recording the revenue and costs of the project and its parts as items in the income statement is essential for calculating revenue for the entire company, and for managing cash flows. The timing principles involved in recording costs and the related central concepts are now presented in the context of our case example; we describe the perspective of the project supplier for the Smiths' house construction project.

Example: Recording costs related to Livinghouse's subcontracting activity

Livinghouse Ltd. estimates, records, and monitors the costs incurred from the subcontracting activity that occurs during the entire length of their house construction project, for example, subcontracting of the hot water heater system. Let's assume that all work regarding this subcontracted hot water heater has been completed and that the tank has been installed and handed over to Livinghouse at time zero (0). The timing of the registration and availability of cost information can be described chronologically as described below.

Time: -8 months: recording an estimate

At the start of the project, the first estimate can be made on the ordered work entity (installed tank). Based on earlier information on similar house deliveries, Livinghouse estimated that the procurement price of a hot water heater system would be $10,000. Price estimates are maintained in Livinghouse's project accounting system.

Time: -6 months: recording a new estimate based on quotations

Requests for bid are sent to potential heater system suppliers and quotations are received. In this phase, discussions with suppliers have helped to specify the estimate for cost of the hot water heater system, which is now $12,500. This cost estimate is entered in the "cost estimate" field or column in the project accounting system, in which the project has its own project code and cost accounts. The cost entries can be recorded at the cost account level, or at a more detailed cost item level in the work breakdown structure.

Time: -5 months: Recording (specifying) the estimate based on bid comparison

The judicially binding bids of its subcontractors arrive and Livinghouse enters into negotiations with the most promising suppliers. The estimate of costs is further specified at this point and it is recorded at $12,000 in the cost estimate field in the project accounting system.

Time: -4 months: recording committed costs

At the end of the contract negotiations, Livinghouse and the supplier sign a contract for $11,000 and this confirms the respective committed costs, although the cost will be actualized later. The cost is recorded under the appropriate project code in the company's procurement system, and it is reported as a committed cost Item.

Time: -3 months: recording an advance payment

The supplier sends an invoice for a $1,000 advance payment, as agreed in the contract. Livinghouse accepts this invoice and pays it immediately. The advance payment is recorded under the project code and cost account code in both the company's accounting system and procurement system. Committed costs for this purchase are still $11,000, consisting of the $1,000 paid advance payment and $10,000 that has yet to be invoiced.

As the accrual basis is used when recording costs in the accounting books, the advance payment has not been recorded as an actual cost. Acting on an *accrual basis,* means that the advance payment has not been recorded as an item in the income statement because the actual performance of the subcontracted activity has yet to be executed. The advance payment is thus recorded as a receivable on the balance sheet, and the sum will be recorded in the cost account of the income statement only after the work has been completed and received.

Time: -0 months: accrual-based registration of costs in the accounting and project management systems

The work has been completed and received, and the costs of $11,000 are recorded in the income statement, according to the *accrual basis.* Consequently, the advance payment for $1,000 is recorded from the balance sheet as an actual cost in the income statement as follows: Actual costs of $11,000 are recorded in the income statement so that as reversing entries are recorded, namely a) taking away $1,000 from the receivables in the balance sheet, and b) recording a $10,000 yet-to-be-invoiced debt to the supplier in the balance sheet.

Time: + 1 month: recording invoice-based costs

Livinghouse receives the supplier's invoice for $10,000 at this time because the supplier's practice is to send out the invoices collectively each month and it did not manage to send the invoice in the preceding invoicing period. Purchasing invoices always arrive first at the company's accounts payable desk, at which they are recorded as accounts payable. As the just-received invoice does not yet have an internal project code assigned to it, it cannot be recorded immediately in the cost accounting portion of the accounting system. The invoice is transferred to the member of the project team responsible for the purchase; this person checks the invoice and marks the project code and cost account code (or perhaps a code for a more detailed level WBS element) on the invoice. This person then sends the invoice onwards to the project manager for acceptance.

Time: +2 months:

The project manager accepts the invoice by signing and sending the invoice back to the accounts payable personnel. The staff of accounts payable record the invoice in the accounting system, the invoice is directed to the project, and it is visible as recorded in the project cost reports. From a financial statement perspective, the invoice remains in the accounts payable (item in balance sheet) until it is paid on its due date.

Time: +3 months:

The reporting cycle is one month so Livinghouse's project manager does not see the record for $10,000 in the project cost follow-up system until about one month after the invoice has been recorded.

Time: +4 months:

As the supplier for the hot water heater system gave three months of payment time from the time the invoice was received, the invoice is paid only now.

Our case example concerned assigning and recording costs from external purchases and illustrated central concepts and practices involved in recording costs that connect the project to the financial control system of the supplier's organization. In recording and monitoring costs, there should be an appetite for anticipative followup. If followup is delayed until received invoices are recorded in the company's accounting system, such recording would often be at such a late stage that nothing could be done to affect the work in question.

Similarly, internal costs should be estimated anticipatively and recorded in cost accounts. The degree of anticipation or delay in registering such internal costs as labor hours depends on the company's reporting cycle for projects. A weekly recording of labor hours would make up-to-date cost followup possible. If the payment period for salaries is one month, an anticipative salary cost estimate based upon weekly recording of labor hours would be sufficiently accurate in relation to the monthly salary payment based upon actual labor hours.

4.4.5 Cost followup and reporting

Reporting of *actual* and *committed costs* is a relevant part of cost followup and cost-control principles. *Actual costs* include, in addition to incurred costs, unfinished work that has generated costs, therefore the degree of completion of each activity and the costs recorded to the activities must be known. When comparing the budget and actual costs, some inferences can be made about the magnitude of future cost overruns or undercuts over the entire project. *Committed costs* are formed by actual costs incurred, plus the costs linked to parts of purchase contracts and orders that have yet to be invoiced. In monitoring and reporting committed costs, the overlap in the company's cost information systems must be taken into account.

The value of the project's purchase contracts and orders can be calculated from the company's materials management or purchasing system, in which the final sums and payment terms for order and purchase contracts have been recorded. Actual costs can be received from the company's accounting system.

Usually the followup of actual costs does not provide an anticipative perspective that supports proper decision making because information on actual costs becomes available too late to affect the work or purchase that has caused the costs. Monitoring committed costs provides a more anticipative perspective for project followup as it produces information that enables committed costs to be affected. An even earlier anticipative followup is achieved when the development of the constantly updated cost estimate is monitored. In this way costs (estimates) can be monitored long before costs have been committed or actualized.

Rolling wave principle

In effecting cost management, the time currency of costs must be remembered; in particular, it must be noted how near to current time the costs are expected to be actualized.

The rolling wave principle describes cost estimation that is specified gradually; it focuses on the near future and includes gradual setting of objectives. The near future costs have detailed itemization so they can be estimated accurately, but the parts of the project further in the future have only rough itemization and consequently less accurate estimates.

Under the rolling wave principle, the project rolls or progresses as a wave on the time axis. In Figure 47, we illustrate the rolling wave principle for specifying budget itemization.

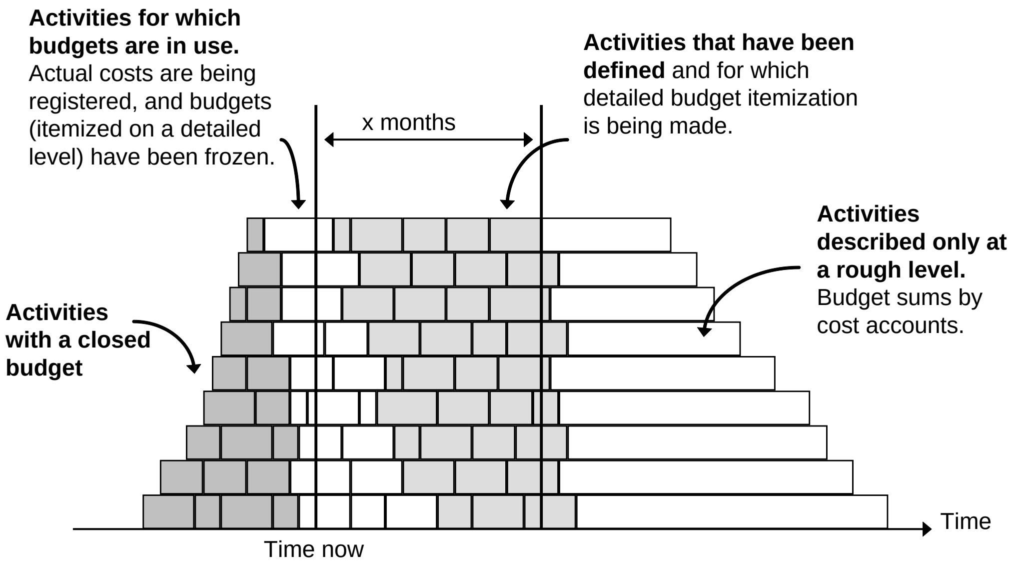


Figure 47. Rolling wave principle used in specifying budget itemization

As the project progresses or rolls forward on the time axis, the finished work packages are left behind. The near past is closed so the remaining open elements of budget itemization are closed and costs can no longer be recorded to them. In the moment marked as “now” in the figure, there are open budget elements, and the actual costs associated with these elements are recorded in the company’s cost monitoring system. Work packages to be executed in the near future are each allocated a detailed budget on the basis of the total budget. Cost accounts that are far in the future have only been specified as upper level sums, but these become more specific as the project timing rolls closer to them.

Cost reporting

As cost estimates are updated, actual costs are monitored and reported in order to assess the progress of the project. The most generally used reporting and monitoring methods include cost charts and graphs. Figure 48 represents a chart-type project cost report for our house construction case example. Again we use the viewpoint of the project supplier, Livinghouse. Figure 49 represents the graph-type cost report for this same project. Many central viewpoints presented in this section are related to accuracy of cost itemization, cost estimation, budgeting, and followup; and the timing principles used for recording costs are visible in the reports.

PROJECT COST REPORT (Livinghouse)

Project identifier:	DELIVERY-007	Cost type selection:	100-400	Reporting period (NOW):	yymm
WBS, LEVEL:	1	Organization structure, CODE:	- (all, no selection)	Reporting date	dd.mm.yy
WBS, CODE:	- (all, no selection)			Unit:	$

		From inception to time now					Project total			
WBS, code	WBS, description	Current budget	Estimate	Committed	Actual	Difference: Budget - actual	Original budget	Current Budget	Estimate	Difference: Budget - actual
01	Mechanical equipment and works	10,014	11,436	31,234	7,522	2,492	32,400	32,400	37,000	-4,600
02	Furniture, equipment and accessories	4,504	10,565	15,132	2,589	1,915	16,200	16,200	38,000	-21,800
03	Surface structures	9,001	9,064	24,768	3,756	5,245	28,800	28,800	29,000	-200
04	Complementing structures	3,240	3,240	15,480	7,335	-4,095	18,000	18,000	18,000	0
05	Framework and roof structures	19,010	17,602	37,152	20,036	-1,026	43,200	43,200	40,000	3,200
06	Foundations and outer structures	5,010	5,010	9,288	5,210	-200	10,800	10,800	10,800	0
07	Ground and base construction	9,100	10,111	9,500	5,111	3,989	9,000	9,000	10,000	-1,000
08	Construction management and site practices	1,506	1,464	21,321	2,013	-507	21,600	21,600	21,000	600
99	Revenue	-73,000	-73,000		-68,000	-5,000	-200,000	-200,000	-225,000	25,000
	Total	-11,615	-4,509	163,875	-14,428	2,813	-20,000	-20,000	-21,200	1,200

Figure 48. Project cost report

PROJECT COST REPORT (Livinghouse)

Project identifier:	DELIVERY-007	Cost type selection:	100-400	Reporting period (NOW):	yymm
WBS, LEVEL:	1	Organization structure, CODE:	- (all, no selection)	Reporting date	dd.mm.yy
WBS, CODE:	- (all, no selection)			Unit:	$

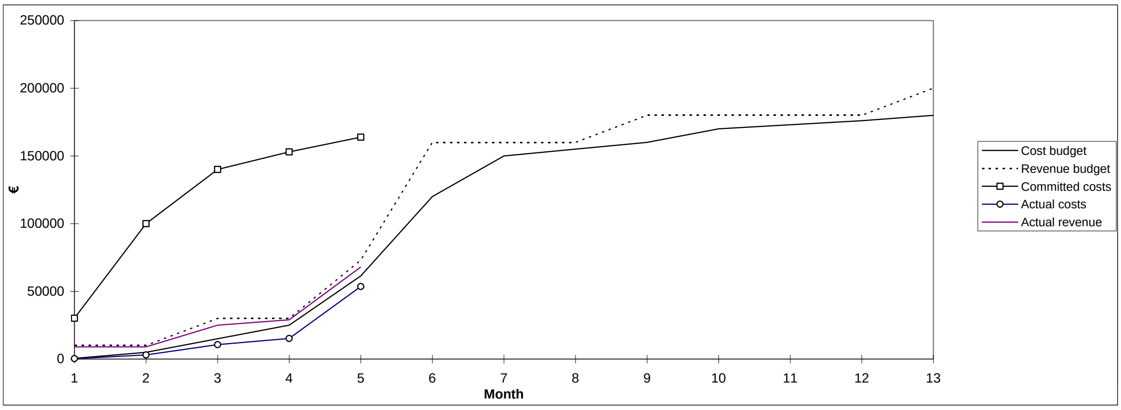


Figure 49. Project cost report as a graph (S-curve report)

Although we have emphasized the importance of anticipative estimation of costs, in monitoring actual costs the followup information on activities being executed can be utilized as an information source for predicting the future. In addition to recording costs, estimating the degree of activity completion is often central in monitoring actualization. If the degree of completion of an activity being executed with a stable resource load is 50%, but 70% of the budgeted costs have been expended to date, it can be deduced that the final cost estimate for the activity is 140% of budgeted costs.

Estimating the exact, interval-scale degree of completion of an activity is often difficult. The progress of realization is aided if the work breakdown structure and budget have been provided at a detailed level of itemization. In estimating the degree of completion of activities that have been specified at a sufficiently detailed level, simple reasoning rules can be used without the reasoning causing large estimation errors at the total cost level. An ordinal-scaled reasoning rule for the degree of completion of an activity can be labeled, not started (0%); started (25%); almost ready (75%); received and accepted by the person responsible for the subsequent activity (100%).

Projects cause the company to experience financing and capital costs, or revenues, depending on whether money is received from the customer to the cash account slower or faster than money is paid out of the project. Thus, in addition to the cost tables (Figure 48) and graphical reports Figure 49), a report describing the cash flow forecast is required. In the cash flow forecast, the cash flows are actualized with a lag compared to the performance-based revenue and costs presented in the cost report. If, for example, cash flows were drawn in the graph-type cost report as in Figure 49, the revenue flows would be situated to the right of the revenue curve, and the cost flows would be situated to the right of the cost curve. The lag depends on billing delays and the due dates of the bills.

Usually the objective is to agree upon a balanced payment schedule with the customer so that the customer is billed for executed work as the work is completed. In this way the customer's payments are somewhat in proportion to and synchronized with project costs and the accumulation of profit. If the payment flow is not in balance with the progress of work, either the supplier's project is funding the customer's operation or the customer is funding the supplier's project. As such an imbalance in payment schedule causes financing and capital costs to the other party, the resulting costs should be considered in the price of the delivery. There can nevertheless be deviations from the balanced payment schedule principle for a short period. The supplier may want the customer to commit to the project and pay a large advance payment even though the work has not necessarily started. With such an accelerated payment schedule, the risk related to the paying capability of the customer can be decreased. On the other hand, the customer can demand that the supplier commit to an accelerated schedule for work execution if it perceives risk about the degree of solvency of the supplier.

4.5 Procurement management

The more complex the project, the more probably the company will need external resources and partners to execute it. Even small projects usually require some level of external resources. Procurement management refers to search, choice, and use of external resources; management of contracts and collaborations related to procurement; and monitoring deliveries. The entity – company or individual(s) – procuring the project is considered to be the *customer*. The customer is the *buyer* and the other party in the procurement collaboration is the *seller;* the *supplier* or subcontractor can be called a *seller*. If the seller delivers complete projects or subprojects, it can at the same time be called a *project supplier*. In the present chapter, we use the terms "supplier" and "subcontractor" as synonyms, and a subcontractor can thus, in addition to projects, deliver smaller work packages or components.

Suppliers that are related to each other by supplying to each other can together form a supply chain. The supply chain is a network formed by companies through which the customer investing in the project procures resources or through which a full project supplier procures the additional work packages and resources it needs to enable it to deliver a full project to its customer. As external resources are not necessarily under the direct supervision of the project supplier's resource planners and project manager, they must be handled using various project management methods. Judicial commitments related to contracts, and several risks pertaining to the external organization and its activities, are features associated with the use of external resources. Thus, procurement management also includes the management of such risks, the activity of the suppliers, and the commitments related to suppliers.

4.5.1 Tasks of procurement

There can be several justifications for including procurement as a major task to be performed within a project. At its simplest, procurement involves obtaining the raw materials, components, tools, or equipment used in the project. The need for resources may be temporary: some resources, competences, or equipment needed for the project can be borrowed or leased from outside the company less expensively than if they were purchased and owned by the company. Furthermore, companies often strive to concentrate on the core areas of their business and draw on subcontractors from outside their company for other work and resources. It may also be that there is a desire to learn about new materials, methods, and procedures by drawing on external resources, or sharing risk with another party. Subcontractors may have some competences or resources; they may possess the only conveniently located test equipment. The project may benefit in other ways from networking among businesses; a local subcontractor may bring to the project, in addition to the goods it provides, a relevant understanding of the local environment.

Overall, the procurement objective is to purchase required materials and services in the most advantageous manner possible, and this objective is not necessarily accomplished by hunting down the lowest price; rather, the focus should be on achieving the best cost-benefit ratio by balancing and trading off several factors. Procurement costs can include, in addition to the monetary price, the time consumed in procurement management, the risks included in procurement, the pressures on communication caused by procurement, and the time invested in developing trust with other members of the supply chain. The beneficial effects from procurement can extend beyond a single project. In addition to benefiting from the immediate product resulting from the project, the purchaser can derive longer term benefits from utilizing a subcontractor. Such enduring benefits may include learning about new materials and procedures, experiencing greater efficiency and quality of workmanship, and developing increased trust in a supply network.

In summary, procurement management includes study of whether or not resources should be procured from outside, in which way this procurement should be conducted, how much should be procured, and how procurement should be timed and coordinated.

Procurement management from the perspective of Livinghouse, the project supplier in our case example about the Smiths' house construction project, is now discussed.

Example: Procurement at Livinghouse

Although the Smiths made a cost-plus type of contract with Livinghouse, Livinghouse concentrates, according to its strategy, on full or near turnkey deliveries, in which the construction project is based on effective, modular, solutions; a higher profit is expected from full or near turnkey projects than from partial deliveries. The buyer is not able to evaluate or compare the contracts effectively, so the price for the turnkey solution can be justified on basis of the magnitude of the project management and organization expenses related to full or near turnkey deliveries.

> Because of the sensitivity of its business to economic fluctuations and the resultant strong variability in its order book, it is not sensible for Livinghouse to possess all the construction-related competences and capacity within the company. There are only a few projects in a year that are located in the same area, so it is beneficial for Livinghouse to use local subcontracted resources, especially for some parts of the project. Livinghouse usually does planning, project management, procurement, and certain technical solutions itself, but it purchases the other subprojects from small local companies.
>
> Livinghouse announces a competitive bidding for a part of its purchases separately for each project, especially for the part involving certain standard services, for which pricing can be based on the amount of work to be performed. The supervision of the delivery of these purchases, and the procured work, is easily accomplished and no additional benefits are received from close collaboration with suppliers. Livinghouse has annual contracts with some suppliers at agreed price levels and, for this reason it gets substantial discounts from normal prices. Nevertheless, in the end, the project manager makes the decision on project-specific procurement and is not bound to the suppliers listed in the annual contracts.
>
> Lately Livinghouse has started closer collaboration with ProKitchen concerning kitchen deliveries. ProKitchen has developed partly standardized, partly customizable kitchen solutions that fit Livinghouse’s house models. Livinghouse can offer these models to its customers at a pre-defined economy price. If the customer wants a fully customized kitchen, Livinghouse can ask for bids from several suppliers. The partnership between Livinghouse and ProKitchen brings benefits to all parties. Livinghouse can trust ProKitchen’s competences and good prices, and ProKitchen benefits from Livinghouse’s marketing and sales efforts. Livinghouse’s customers are spared extra planning costs and the extra efforts that would be involved in separately subcontracting for their kitchen package. The partnership also has negative effects on open competition: other kitchen suppliers have tended not to bother to submit bids to Livinghouse for kitchen packages and, because of this lack of competition, ProKitchen may start to raise its prices to Livinghouse without substantiation, or it may use overdriven standardization in its products and thus pose risks to Livinghouse’s price competitiveness and product line renewal.

The activities of procurement management to be described in more detail in the following sections are:

- preparing and planning procurement;
- choosing potential suppliers and competitive bidding;
- choosing suppliers and contract preparations; and
- managing and closing contracts.

Procurement is initiated in the specification phase of the project lifecycle, a phase in which procurement packages are preliminarily designed and possible suppliers are typically asked to submit quotations in order to determine price levels and availability of suppliers. In the planning phase of the project, contract preparations and negotiations can be undertaken, and choosing suppliers and managing contracts can start in the planning or execution phase – phases at which procurement management becomes a critical part of the work assigned to the project team.

4.5.2 Preparing and planning procurement

Identifying needs for procurement

Actual procurement starts with identifying and evaluating the need for procurement – the buyer must decide whether or not it is beneficial to procure resources from outside the company and, if so, what options are available to execute the procurement, how much is procured, in what packages, and how procurement is timed and coordinated.

Each alternative – deciding to procure or not procure – has its costs and benefits. The most advantageous option for a buyer is certainly not always to do all the work on the project itself. It may be beneficial for the buying organization to enter into discussions with possible suppliers before the work packages to be procured have been defined. For example, the scope of the procurement package may affect its attractiveness in the competition among subcontractors.

Describing procurement packages

The package to be procured is defined and described on the basis of the procurement need. Thus the buyer must determine which project activities are best executed by procuring materials, products, workforce, or services from outside the project organization. A good starting point is the work breakdown structure (WBS) in which the activities requiring external resources can be identified and defined. Defining the work package is imperative so that discussions can be started on its procurement with suppliers unfamiliar with the project. Typically a competitive bidding process is arranged, so the various potential suppliers must be provided consistent information about the package to be procured.

Figure 50 is derived from the picture depicting the WBS presented earlier. Included under the elements of (WBS) are the initial, relatively detailed, activity specifications. The boldfaced lines in Figure 50 describe the way the activities have been grouped or batched into procurement packages. Then, instead of relying solely on internal company resources, a competitive bidding process is held to obtain external suppliers for these work packages.

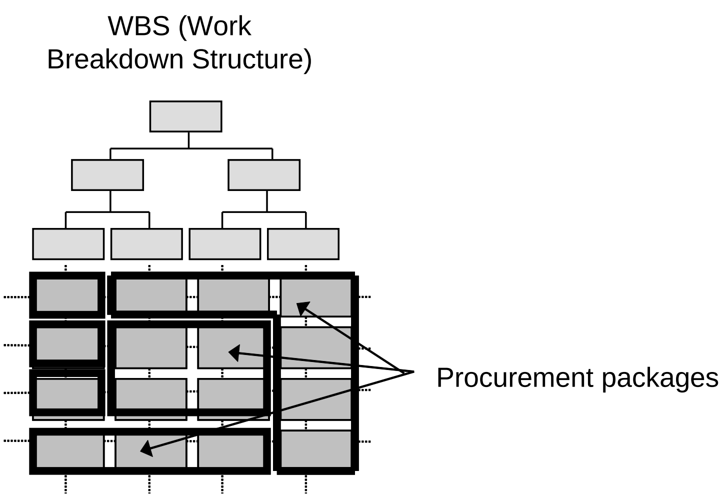


Figure 50. Batching work packages into procurement packages

The capability and availability of potential competitive suppliers must be taken into account when forming procurement packages. If a purchase order includes a large or complex procurement package requiring various competences, for instance, there may be a risk that no supplier will take responsibility for the package. If there is only one willing supplier on the market, the situation affords the supplier a monopoly position and its bid price may be high.

The scope of the procurement package should be defined so that the division of responsibility is clear, taking into account schedule dependencies among parts of the procurement package. Work packages that have many interfaces, and thus require considerable coordination in planning and execution, should be awarded to the same supplier. This action usually results in decreased costs because a single supplier can more easily coordinate the work inside its own organization than would be the case if separate supplier organizations were used.

Purchasing in small parts requires more procurement, supervision, and coordination effort for the buyer. On the other hand, such a purchasing breakdown may bring added value to the project because there may be many small, specialized suppliers that can be engaged, producing a greater cost/benefit ratio for the buyer.

The planned procurement packages are usually recorded in the company’s materials management system, in which information on procurement-related contracts, suppliers, inspections, deliveries, approvals, and payment terms are later specified.

4.5.3 Choosing potential suppliers and competitive bidding

When planning procurement, information may be collected on various suppliers so that the content, benefits, and cost of their offerings can be compared. The type of contract may also affect the choice of supplier. In some situations a long-lasting contractual relationship is required, whereas in other situations the need for flexibility and the possibility for interruption are emphasized. The customer may have greater means to influence familiar suppliers than completely unfamiliar suppliers. It may still be necessary to create backup plans, particularly for critical activities. If the supplier for a crucial activity experiences delays, for instance, it may be useful to have knowledge of other suppliers and their delivery schedules. Having such backup plans can significantly reduce risks related to suppliers.

The various steps or phases involved in the competitive bidding process were described in Chapter 3, Section 3.4 in which we emphasized the perspective of the buyer on the work required to define the item to be procured, compare suppliers, compare actual bids, and negotiate a contract. The progress of the purchase process, however, is not necessarily straightforward, as many factors affect procurement. In fact the entire purchase process may be truncated if, because of project timing needs, the buyer chooses one of its regular suppliers, thus executing procurement based upon an existing collaboration contract; in this case the next step in procurement is to order from this known, regular supplier.

If the procurement function is established in the company, it is natural that people specializing in procurement, and possibly a lawyer familiar with professional contract negotiations, participate in planning and preparing purchases.

Choosing potential suppliers

Assessing and choosing potential suppliers involves obtaining and processing information on them. A typical process consists of three stages or phases, as indicated in Figure 51 – assessing the suitability of the company to act as supplier, requesting and processing a *budgetary quotation* (project price) from each of the potential suppliers, and requesting and processing the actual bids received.

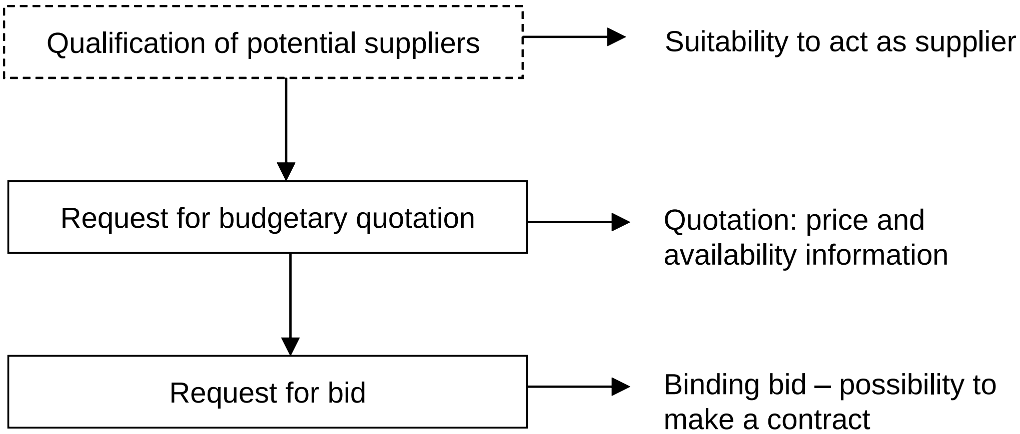


Figure 51. The three phases of bid processing

Procurement packages, particularly those for large projects, may be substantial, and using a two round, stepped bidding procedure (Figure 51) helps reduce the amount of resources (time and costs) expended on actual bid processing. Round one permits preliminary screening of suppliers, ensuring that bids are received from those suppliers best suited for the situation. By asking a set of suitable potential suppliers for preliminary budgetary quotations early in the planning phase of the project, the buyer obtains pricing and resource availability information. If there are data on repeat deliveries in the buyer's project procurement database, there may be sufficient information on acceptable suppliers and their offerings and, in many cases, a set of acceptable potential suppliers may have been formally prequalified annually.

Choosing a potential supplier is never unambiguous as it is affected by many factors internal and external to the project. Making the choice is easier if choice criteria have been agreed upon beforehand and if the request for bid clearly states what issues require suggestions or answers. If a uniform format is called for in presentation of the bids, it can be of help when comparing bids.

Request for quotation

It is customary during the first round of the request for bid, the request for quotation, to check the potential supplier's suitability to execute the procurement and to delete unsuitable suppliers from the actual bidding competition. Assessing supplier suitability can be based upon multiple criteria that can be weighted to emphasize their relative importance. A number of key questions should be asked, including:

- Is the subcontractor a suitable partner for the company (e.g. strategic fit, right competences, right type of supply, serious enough attitude to the request for budgetary quotation)?
- Is the procured resource available at the time it is needed in the project?
- Is the subcontractor interested in collaboration and willing to make a binding bid?
- What is the subcontractor's pricing principle and price level?

- Is the subcontractor differentiated positively from the other possible bidders?
- What is the relationship of the subcontractor to the end customer of the project?
- Can the subcontractor ensure continuity, that is, is it a stable, well resourced organization capable of performing, years in the future, any needed large-scale changes or reconstruction efforts on the product delivered in the initial project?

Request for bid

Suppliers considered to be the most suitable after the preliminary, budgetary quotation phase (typically 2-5 suppliers, depending on the situation), are requested to submit actual, final bids. The objective is to find the supplier that provides the greatest overall benefits. Typically, general, commercial, and technical bids are requested and they may be highly detailed in nature. Sometimes the bidding phase is initiated using negotiations, so details of the bid request are often specified verbally, in addition to the written bid document.

Although the request for bid can be presented orally, a written and uniform request for bid is preferable as it helps ensure comparable results. The request for bid should not favor one supplier over another; it should serve the particular needs of the project.

The general part of the request for bid may contain:

- introduction to the request for bid, and directions for making a bid;
- description of the target of the bid (definition, commitments, schedule);
- description of the responsibilities of the subcontractor and the customer;
- content-related requirements of the bid;
- inspection and approval requirements;
- reporting requirements;
- rights of the subcontractor (e.g. to use external resources or to use the project as a reference);
- draft of the contract (if it exists); and
- general contractual terms as an appendix (companies typically use general contractual terms in which such matters as confidentiality, patent rights, and inventions are defined).

The commercial part of the request for bid should include:

- contract type;
- suggestions on payment terms;
- possible penalties and bonuses; and
- guarantee terms and securities.

A technical description of the project, in which the following items are presented, can be added as an appendix to the request for bid:

- technical specifications (as far as they exists) for the work being procured;
- necessary designs;
- estimate of the number and timing of components or work parts or packages to be procured;
- pricing information; and
- detailed schedule.

The request for bid may be structured to reflect the topics or items desired in the content of the prospective contract, inclusive of appendices; thus the bid documents received will be in the same format as the contract. Nevertheless many things are usually still open at the time the request for bid is issued; consequently there should be active conversation about the project between the buyer and the individual prospective suppliers throughout the bidding period.

Collaboration with suppliers, and maintaining a competitive environment

It is often beneficial for the company to form long-term collaborative relationships with subcontractors, particularly when procurement packages are complex and must be tailored to the specific needs of the company. Collaboration makes it possible for the company and its subcontractor to develop joint working methods and to get to know each other's competences and strengths. There is danger in too close collaboration, however, in that the price level of the subcontractor may rise in the absence of competition, or the subcontractor may concentrate on efficiency at the cost of innovation. A fair, multi-bidder competitive situation is preferable, particularly when procuring relatively simple, easily available solutions.

To create a fair competitive environment, it is essential that suppliers be offered uniform opportunities to make a bid. It is customary to state a specific deadline, after which bids are no longer accepted. Sometimes all bidders are offered the same number of occasions for discussion and enquiries before making the bid, particularly in public procurement, a setting in which procurement-related legislation often exists and must be taken into account.

Another factor promoting sound competition is equal treatment of all the bidders. In practice, this suggests that when one potential supplier requests additional information related to the bid, the same information is provided to all potential bidders. Furthermore, the buyer may receive new information from the potential bidders that require it to modify its plans, and the change should be communicated to all bidders. The openness of the competitive environment may continue until the suppliers' bids are submitted. Receiving and opening the bids can be organized at a public opening event, at which the bid prices are announced. This disclosure enables the buyer to place the bidders in a preliminary order, although a quick comparison based only upon the price factor provides only a rough ordering. Typically the bid request includes specific information on the scope and content of the bid and all bidders usually provide their responses to it. In some cases, however, the customer does not provide detailed requirements because it wants to obtain new ideas from the submitted bids ways to execute the project, including various technical methods for executing specific work components. By including *options* in its bid request, the customer may, in addition to the basic solution, attract creative, innovative ideas for executing the project and these ideas may cause the customer to broaden or change the project.

The openness we call for does not apply to the details of the bids: the customer should keep the contents of suppliers' bid documents confidential (except for the possible disclosure of the respective bidders total bid prices as, for example, in some government procurement contexts). Confidentiality includes using the bids of each supplier only for the purchase in question, not showing or distributing documents or information related to the supplier's bid to other companies or even to other suppliers. In this way, ethical conduct is ensured, preventing the spread of suppliers' business secrets (e.g. solution, method for execution, or pricing principles) to other companies.

Once submitted, a bid is legally binding – it can act as a contract if the customer accepts it inside the timeframe stated in the bid. Nevertheless, many details may need to be specified in the contract, and this is achieved in contract negotiations.

4.5.4 Supplier choice and contract preparations

Analyzing and comparing bids

After opening the bids, the buyer analyzes and compares them to make a justifiable choice of supplier. The criteria for analyzing and comparing bids should be defined and carefully weighted in advance to ensure that secondary issues do not lead to choosing the wrong supplier. Although the buyer's various existing collaboration agreements and project contracts should be taken into account when comparing bids, the main focus should be on the importance of the procured service in the execution of the specific project in question. The same principles that the project customer uses when choosing the supplier for the entire project can be used in analyzing and comparing bids (see Section 3.4 of Chapter 3).

Price may be the critical choice criterion for off-the-shelf raw materials and components. On the other hand, the total cost covering the entire lifecycle of the product resulting from the project, may be substantially affected by issues other than cost – availability or timing, for instance. Thus the criteria should be properly weighted for the project in question. It is not always beneficial for the buyer to drive the price so low that the supplier, desperately wanting the contract, hurriedly takes too large a risk and may go bankrupt as the risks are realized. Driving the price too low may also lead to a situation in which the supplier is unable to allocate sufficient resources for the work, resulting in underachievement of project scope and quality objectives. Failure of even a small procurement package may ruin the entire project.

In choosing suppliers, it should be remembered that not all procurement needs can be supplied by one supplier; typically collaboration between several suppliers is required, and their respective capabilities and inclinations to collaborate should be assessed. In some cases it is appropriate for the buyer to ask suppliers to suggest suitable collaboration partners.

Choosing the supplier and preparing a contract

For simple and small purchases, the supplier is often chosen directly on the basis of the bids, and there is no need to prepare a separate contract. In this case the bid is answered with an order confirmation, and the supplier's bid becomes a contract binding both parties. The unsuccessful bidders should be politely informed that their bid has been evaluated and, this time, has been rejected.

For complex procurement packages, the buyer may conduct contract negotiations with one or several suppliers. If so, the procedures described in Chapter 3, Section 3.5 are followed in choosing the supplier, carrying out contract negotiations, and specifying the content of the contract. In this process, it is typical that the buyer negotiates over price or some other terms, and that bidders' final positions on these factors are compared, resulting in the most beneficial contractual terms for the project.

If the procurement is part of a larger delivery project, the payment terms in the supplier's procurement contract should be aligned with those of the main contractor. Accordingly, the supplier would not be able to invoice its deliveries until after they have been approved by the main contractor's customer and the main contractor has invoiced the customer for its part of the work. In the context of our Smith family's house construction project, for instance, Livinghouse should define the payment terms of the ProKitchen subproject so that ProKitchen can invoice its share only after the Smiths have accepted the partial delivery and paid the respective share to Livinghouse.

4.5.5 Contract management

After a contract has been made with a subcontractor, the contractual parties should work together in the agreed-upon manner to fulfill the commitments specified in the contract. *Contract management* includes procedures and activities used to prepare a contract, to monitor conduct to ensure that all contractual commitments are fulfilled, and, finally, to end the contract and the contractual relationship in a project. The concept of contract management is broad, often including negotiations and contract preparations for choosing the supplier and making a contract. Contract management also includes collaboration between the subcontractor and the project team, fitting procured components in with the other work in the project, coordinating the work of the subcontractor, and monitoring results.

The purpose of contract negotiations and contract preparation efforts is to ensure that both parties have the same perception of the procured work and the compensation to be paid for it, thereby avoiding incorrect assumptions and conflicts due to differing understandings and interests. The subcontracting contract and its terms also act as a means for the project supplier to transfer certain responsibilities to the subcontractor, or to share them in a way specified in the contract. It should nevertheless be remembered that the overall supplier of the project is responsible for the project in its entirety and cannot appeal to the customer in the event that a subcontractor has not fulfilled its responsibilities as specified in the subcontracting contract. The following subtopics related to procurement management provide amplification on the discussion on contracts begun in Chapter 3, Section 3.5.

Contracts as a tool for transferring and sharing risks

Transferring a risk related to responsibilities to another party, or sharing the risk with another party, must be considered closely as part of contract negotiations. As a general rule, risk should be carried by the party that can best control it and survive the damages that it could cause. It is not always clear how the respective parties should act if an error or accident that hinders the progress of the entire project happens in the subcontractor's work. Such dangerous situations must be anticipated in the contract phase and the appropriate contractual terms should be included in the contract so that the division of risks between the parties is clear and any pricing implications related to assuming these risks are reflected in the contract price.

Figure 52 illustrates the use of a subcontractor as a risk buffer. The upper part of the figure describes the ways the customer can carry the responsibilities and risks originating from the project, for example, by performing all the work and taking responsibility for everything. In the lower part of the figure the customer has contracted with a subcontractor, hence gains a risk buffer. The subcontractor assumes responsibility for the work related to the project, and the related risks. This is accomplished with a contract between the customer and the subcontractor, the division of risks and responsibilities being described in the contractual terms. The subcontractor sets the price according to the magnitude of risk and responsibility it must assume: the greater the risk transferred to the subcontractor, the higher the subcontractor prices its services in the contract.

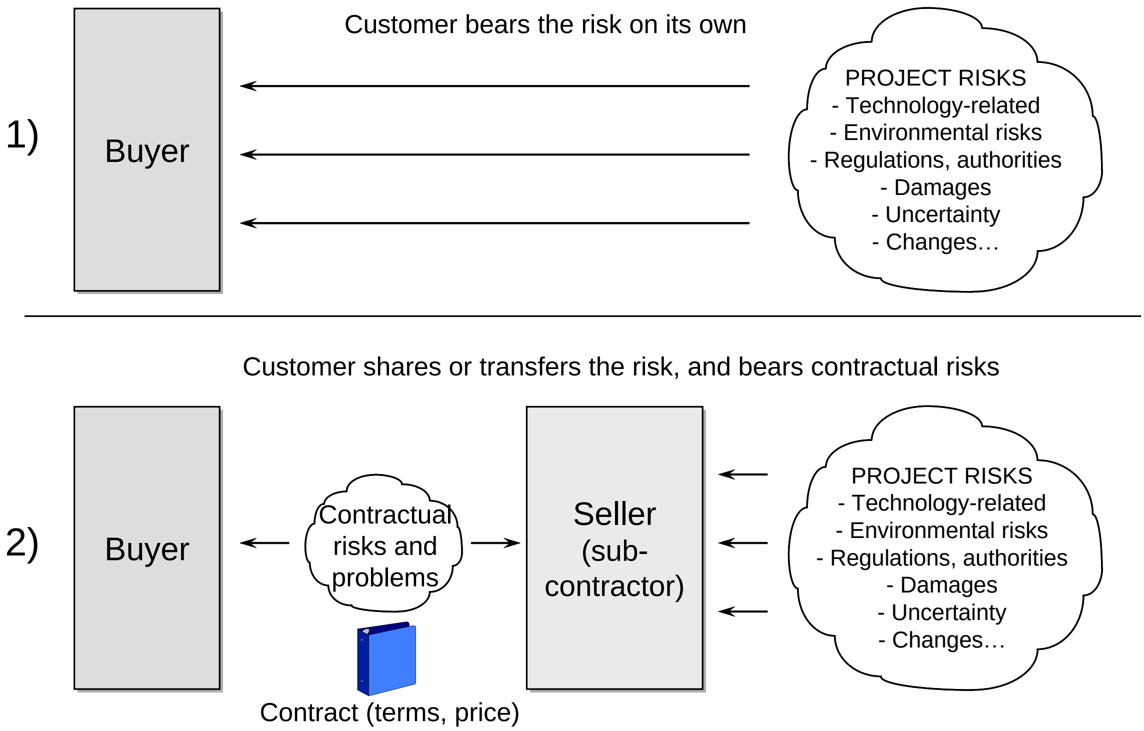


Figure 52. The use of a subcontractor as a risk buffer

Although the risks related to executing the project were partly or fully transferred to the supplier, there are always new risks for the customer associated with signing the contract. In Figure 52, the expression "contractual risks and problems" is used to describe these risks. Contractual risks can be related to lack of clarity, inaccuracy, or other deficiencies in the contractual terms, and to weak communication or other problems in contract management. Contractual risks are primarily caused by the other party and its activity, and by the fact that a commitment has been made to the other party through the contract. The chosen subcontractor may not be able to perform its work properly, for example, which may lower work quality or delay work execution. The consequence may be disagreements and conflicts that, in extreme cases, may need to be settled in court.

We now illustrate contract risks using our ongoing case example.

Example: Risk related to the house project supplier

> If Livinghouse were to go bankrupt in the middle of the Smiths' construction project, the unfinished house would be situated on the Smiths' lot but would not be handed over to the Smiths; instead the ownership would be transferred to the estate of the bankrupt company and the Smiths may not be allowed to touch the property, for example, by continuing the work with some other supplier, unless they arranged an agreement beforehand with that estate to sell the unfinished work to them. This process may be extremely long and difficult. For example, it may take years to locate all the creditors, find out the demands of the estate, and learn what compensation or other solutions will be offered to the creditors.
>
> In such rare but severe occurrences, it is important that the contractual terms have been thought out in detail, particularly regarding the unlikely, but potentially severe, risks. It is necessary to describe in detail the respective responsibilities of the parties and any restrictions on these responsibilities, rights, and opportunities (for example, conditions and procedures for terminating the contract). The Smiths can gain some level of estimate of the risk of bankruptcy by obtaining information on the financial situation, project order base, reputation, and other background of the supplier.
>
> As in the rarely occurring but extremely consequential situations described above, the contract will always have to be regarded from a judicial viewpoint. Thus, an experienced attorney familiar with the contract law application area and the related responsibility issues should be engaged to help prepare the contract, which, in the Smiths' case, would be someone specialized in the construction of single-family houses. The contract and its terms should be written to ensure that the judicial interpretation of the contract corresponds to the understanding that the agreeing parties had when entering into the contract.

When making a contract, the buyer should consider in detail what risks and responsibilities it wants to transfer to the supplier and what risks and responsibilities are most beneficial for it to bear internally. The following items should be considered concerning a single risk.

- Which party is better able to affect the events that can lead to a risk being realized?
- Which party can better affect the consequences of the risk if it is realized?
- Is it sensible for the customer to retain some type of opportunity to affect the risk or its consequences?
- Is the party bearing the risk able to bear the consequences of the risk if it is realized?
- Is the price the supplier takes for bearing the risk reasonable?
- If the risk is transferred to another party, what new risks arise?

Various risk situations should be predicted as accurately as possible and the responsibilities for them should be described clearly in the contract. If a contractual party does not fulfill its obligations and responsibilities, the other party can present a *claim* for redress, including financial compensation. If a delivery is delayed because of the customer's circumstances, the supplier can demand monetary remuneration and fairly suggest a change to the delivery schedule.

Contractual terms should often be written to provide the supplier clear financial incentives to act according to the interests of the customer. Incentives may include *bonuses* for achieving specific positive performance results that exceed expectations. If performance is negative, *penalties* should be assigned. To ensure that the supplier acts as desired and that risk is managed properly, the contractual terms should include appropriate guarantees for project work completed, guarantee of bank financing, binding payment terms for part deliveries, force majeure, transferring damage risks to insurance companies, and other practical measures.

Collaboration during delivery

Because procurement scope is key, all areas of project management should typically be covered in the contract, including: executing the project plan, monitoring results, exercising quality management, and implementing change and risk management. From the buyer's perspective, procurement management after the contract has been signed and is in effect is often accomplished by monitoring the extent to which obligations stated in the contract are fulfilled, and by carrying out delivery supervision. If the subcontractor is assumed to employ certain reporting or quality management practices, for example, these are often made clear in the contract phase. Additionally, if the customer wants to carry out delivery supervision, for example, by making inspection visits to the subcontractor's factory to assess the progress of the delivery, the right to conduct these types of visits should be stated in the contract. In factory inspections, such items as quality of raw material, correctness of the manufacturing process, and quality of the resultant product or deliverable can be measured and verified. The tightness of monitoring and collaboration activities between parties is determined by the type of contract and the content and criticality of the procurement for the entire project.

Procurement collaboration in the delivery phase may extend throughout the project lifecycle or may concentrate on a certain part of delivery. Contract management continues throughout the collaboration period, and is therefore not restricted to the phase during which the contract is written and signed.

The purchase order is recorded in the company's materials management system. The contract price, subcontractor identity, time of inspection and receipt, acceptance of the delivery, and payment terms are recorded in the materials management system, and part of this information can be used to report costs committed to procurement. Events related to the progress of the delivery are recorded in the system – inspection, receipt, and acceptance events, for example. Information from the supplier's invoice that indicates material quantities can be recorded in the materials management system and compared with the quantities specified in the contract. Changes that are made during the validity period of the contract are also recorded in the materials management system. Before part payments are made to the supplier, verification of acceptances and receipts is usually required.

Receiving and supervising partial deliveries

It is essential for both customer and supplier that the supplier hand over parts of the project to the customer and get them accepted. The supplier benefits because previously accepted parts cannot later become entailed in conflicts and disagreements, and the customer benefits because it can receive complete goods that can be verified as acceptable. Contract payments should always be tied to predefined parts that the supplier has handed over to the customer.

The prerequisites for accepting a partial delivery for work that meets measurable performance criteria must be described in the contract. Upon acceptance by the customer, the supplier is granted a right to submit an invoice for payment corresponding to the terms of the contract. The supplier's invoice is recorded in the buyer's accounts payable, and then its relevant data are recorded in the accounting and materials management systems. The invoice is checked and accepted before the payment is made.

During the contract period, the parties communicate with each other using agreed-upon reporting practices. Communication also occurs in connection with delivery supervision and inspections related to receiving deliveries. For large purchases, there may be a need to include a concrete information exchange schedule as an appendix to the contract. This schedule describes what information the parties must send to each other, in what form, and when. Furthermore, the customer is obligated to provide information to the supplier so that the supplier can prepare for the delivery at the right time.

The parties can present each other with *claims*. Claims closely resemble the legal term "notice" regarding incorrect actions or neglect of contractual obligations. The presentation of a monetary claim to the other party, or a notice that the party presenting the claim frees itself of its obligations for some work parts due to the actions of the other party, is often associated with the claim. Claims are related to the judicial contractual relationship. The presented claim is answered quickly, but often the other party is presented with counterclaims regarding the neglect it has committed. Because of different judicial systems and practices in different countries, *claim management* can vary from informal interaction to arguments between lawyers representing the contractual parties. Project suppliers that are used to an open and informal operating culture should find out in advance the delivery supervision practices and claim management principles in the target country.

Complaints made by the other party must be followed with a quick response. A letter or message of complaint, for example, should be answered immediately in written form. If the matter requires investigation, the immediate response should include statements indicating when the matter mentioned in the letter of complaint will be commented upon. If the contact or question is not answered, it can be interpreted as silent acceptance; usually the contract defines the expected response time. Timeliness of response is critical; if the question relates to transferring responsibility or freeing the other party from responsibility, it should not be ignored or neglected because of indifference, haste, laziness, or other factors.

The matters that are agreed upon during the delivery should always be confirmed in writing so they can be verified later. For example, a memo should always be written of meetings between the customer and supplier. The progress of the delivery should also be followed actively. Although the subcontractor is often required to report the progress of a partial delivery, it is necessary for the customer to check the validity of the report; such delivery supervision can include an inspection of the subcontractor's factory or the request for a demonstration of partial results. In this way the customer learns of possible subcontractor delivery problems at the earliest possible stage.

Contract closure

Contract collaboration related to a single purchase ends when the parties jointly state that their respective commitments have been fulfilled. In the event of conflict, the resolution of the court must be requested to determine what type of obligations the parties still have toward each other. The contract can also be dissolved in advance of execution or it can dissolve during the contractual period, but the latter requires specific grounds that are specified in the contract. Situations in which the supplier has not completed its work, or the customer has not paid its bills, are usually not sufficient grounds for dissolving a contract; in such cases, the term “breach of contract” is used, which may include applying sanctions defined in the contract. The payment of sanctions must be discussed between the parties.

In principle the same type of closing actions that are related to closing a contractual relationship apply to closing a project: transferring results to the customer, reporting the work in an agreed-upon way, archiving the documentation, paying the final invoices and possible bonuses, closing the billing account. In practice closing a contractual relationship includes handover and receipt of the entire delivery and acceptance of it by the customer. If the customer cannot accept the delivery as is, it doesn’t mean that the customer cannot accept parts of it. The customer may have accepted some parts earlier in the project delivery, and only the measurement and acceptance of the performance during a specified testing phase may be left at the end of the delivery. Usually a *list of defects* is written at delivery or at the time of project handover, and the customer accepts the delivery on all other parts of project work except those stated in the list of defects. The parties agree on a schedule and procedure for the supplier to resolve all of the items on the list of defects.

In addressing defects, the supplier can, in part or fully, repair, complete, or otherwise correct the defects during the operation phase of the project, if operating is possible with the listed defects. When the customer has accepted and received the items stated in the list of defects, the only remaining obligations of the supplier are those relating to the guarantee period that is stated in the contract. The supplier's delivery project nevertheless does not continue during operation, and the project is closed upon handover to the customer. Depending on the situation and the breadth of the commitments resulting from the list of defects, the project can be closed before the items on the list of defects have been addressed. To address the obligations during the guarantee period, the supplier organizes a procedure by which it can take care of the required tasks. The types of project-related services and collaboration possibilities during the operation phase of the product lifecycle are discussed further in Chapter 6.

The buyer should record information on suppliers’ performance and use it for future decision making. If the supplier proved to be a strong performer, it may be necessary to update the list of qualified subcontractors, adding the name and profile of this supplier. If the supplier was a disappointment, the customer can provide negative feedback to it, and the buyer can assess and improve its competences in choosing and using suppliers.

In this section procurement, management has been described mainly as management of the delivery relationship between a customer and one subcontractor. In large projects, procurement management in the delivery phase can also include management of interfaces with several subcontractors simultaneously, and fitting the results together.

4.6 Risk management

Projects are seldom realized fully according to plan. Even well planned projects may fail to reach their objectives, and plans may change as opportunities arise during the project to create a superior project to that envisioned in the original project objectives. Because of the uniqueness of projects and the often incomplete information on future events related to them, it is understandable that not all factors affecting the project can be taken into account in the project planning phase of the project lifecycle. Therefore, risk and risk management become important parts of project management. The term "risk management" refers to managed activity that identifies and evaluates potential project risks, plans and executes responses that will affect the likelihood that risks will occur, and takes steps to mitigate the effects of actual risk occurrences.

Only by taking some degree of risk is it possible for a project to succeed as anticipated or, perhaps, better than anticipated. Often project managers experience positive risk outcomes and they are rewarded for having assumed a risk. Unfavorable risk outcomes also occur, however, and they must be managed by assessing and choosing among various options for subsequent project activities and stages.

Because of project uniqueness, statistics compiled beforehand on risk realization frequencies (i.e. so-called objective estimates) cannot be used in evaluating risks. Often in evaluating risks it is necessary to make a subjective estimate of risks, The best source for subjective estimates may be personnel participating in project planning and work because they are highly familiar with the project situation and its likely future. Producing a subjective estimate is difficult, and risk evaluators vary in their knowledge, evaluation skills, and accuracy. Thus risk evaluators should be realistic in assessing the level of their knowledge (or ignorance) so that an allowance for inaccuracy due to a low level of knowledge or ignorance can realistically be added to the risk estimate.

Risk management responses affect the types of risks and their magnitude, in a preventive manner before the potential risk is realized. When a potential risk becomes real (realized), it usually evokes crisis management in order to adjust effectively to the consequences of this unexpected risk outcome. So it is prudent for management to have plans prepared in advance for the ways they will deal with various types of possible risk occurrences.

4.6.1 Different types of risk

In the context of project management, a *risk* is an event with a certain probability of realization that may affect the project schedule, cost, or scope. Once the risk event occurs or is realized, the risk becomes a firm fact with no related probability for realization. Project risks vary in type and magnitude and their effects may be negative or positive. *Uncertainty* is closely related to the concept of risk. Again, in the context of project management, uncertainty may be attributable to imperfect information about the future, and the information can be imperfect because it does not exist, has not been acquired, or cannot be applied to the project. On the other hand, uncertainty can arise because of circumstances or events that include risk. We can talk about decision making under uncertainty, in which risk has a central role. In some circumstances uncertainty is interpreted as a neutral term that does not describe the goodness or badness of a situation. In this case, uncertainty can contain both unfavorable risk and favorable *opportunity*. In this book we do not distinguish between the concepts of risk and uncertainty: a risk can be unfavorable or favorable and a risk may exist because of the stochastic nature of project events, imperfect information, or their combined effects.

Risk types affecting a project

The various risks related to projects can be divided into four different *risk types:* pure risks, business risks, financial risks, and area-specific risks.

Pure risks refer to such unfavorable events as accidents or losses. The probability of realizing a pure risk can be calculated using objective statistics derived from large datasets. Pure risks can be affected in more indirect than direct ways through management or project management practices. A fire caused by an accident cannot always be forecast or avoided, but a fire alarm and a fire extinguisher can be purchased and placed at the project site to detect a fire in case one occurs. The probability of a fire occurring and the breadth of its effects can be lowered by keeping the site clean and in order; if flammable decommissioning waste at a site is quickly cleaned away it is less likely that a welding spark would start a fire and, if a fire occurred, it is less likely that the flames would spread quickly, making it easier to extinguish the fire. A company can protect itself against pure risks by purchasing insurance. Insurance companies analyze data on realization of this type of risk and are able to price the insurance so that their bearing the risk is profitable.

Pure risks, by their very nature, arise suddenly and unexpectedly; thus they can be characterized as on/off risks (the risk is either realized or not realized). The probability of the realized alternative occurring is typically extremely low (e.g. 0.00001% or 0.001%) but, when realized, the consequences or effect of the risk is typically extremely high (e.g. measured in money, the effect can be $1,000,000 or more). Conversely, in this example, the probability of the not realized alternative occurring is high at 0.99999 (i.e. 99.999%), and its consequences or effect is $0.

Business risks in a project environment refer to a variety of risks that may affect the overall project, its objectives, or its benefits, and they include all risks except the ones that belong to the other three risk types – financial, pure, and area-specific risks. Business risks may be related to the use of the product resulting from the project, and include:

- functionality of a built factory during its operation;
- technical quality of a developed mobile phone model, and functionality of the technological user interfaces and other solutions; and
- the extent of demand for a newly developed air conditioning system, the revenue and profit generated from sales, the functionality of the unit after its installation, and the need to maintain the unit.

Business risks may also occur during the execution of the project and may hinder or promote reaching a profitable result. Such risks include:

- feasibility of technology or technical solution;

- change in external technology and opportunities for technical solutions during the project that may cause the project to become out of date;
- the support and resources the company provides to the project, and the experience and competences of project personnel;
- inadequate information in decision-making situations; and
- mutually conflicting expectations and objectives (e.g. between customer and supplier).

In contrast to the case of pure risks, insurance cannot really be taken out to prepare for business risks. But such risks can be managed using project management practices. In Figure 53 business risk and pure risk are compared. The on/off nature of pure risk is visible from the figure, as is the extremely low probability that the risk will be realized and the extremely high consequences or effects if the risk is realized. The probability and effect dimensions of business risk can often be illustrated with a continuous probability distribution.

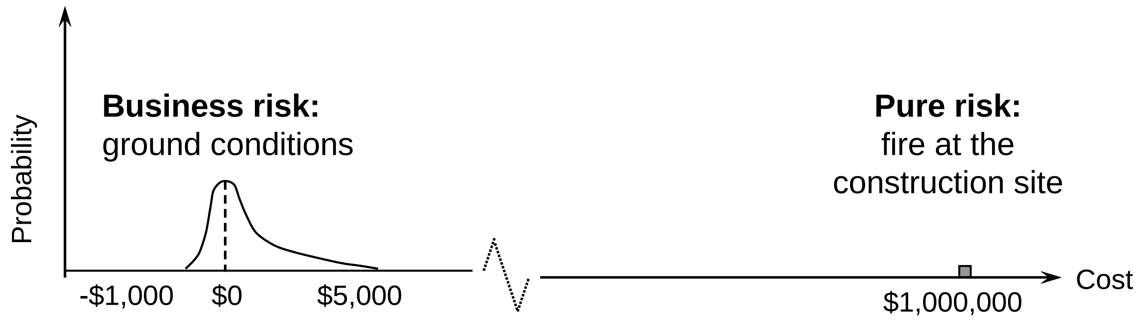


Figure 53. Comparison of business risk and pure risk

As illustrated in Figure 53, surprises may arise with ground conditions at a construction site; although ground inspection at the site may have been thorough, it cannot be accurately known how much explosion and excavation work must be performed, or how many poles or foundation piles are needed to support the foundations to be set on the soft soil. The estimate of business risk related to ground conditions, as displayed in Figure 53, describes negative and positive dimensions to this risk. In the worst case, the costs will be increased by $5,000 compared with the most likely value but, in the best case, the costs will be $1,000 less expensive than the most likely value.

Financial risks are related to managing project financing. Financial instruments can be used to prepare against these risks; the availability of cash flow could be ensured and credit loss risks decreased by using various banker's guarantee arrangements. The company could protect itself from risks related to fluctuations in currency rates through such financial instruments as futures or options provided by banks and other financial institutions, thereby guaranteeing the sale or purchase of an otherwise unprotected share of currency at a predefined rate.

Area-specific risks are risks caused by the circumstances in a certain geographical, political, or administrative area. Political risks and geographical risks usually involve events that occur because of the environment or such extreme conditions in the country as threats of war or terrorism. In addition to such catastrophic threats, the area's political, legislative, national, cultural, and natural environment can pose risks to successful execution of projects.

Magnitude of risks

Risks have two dimensions: probability (of occurrence) and effect (consequences). Probability and effect together determine the magnitude of the risk, as illustrated in Figure 54. The magnitude of risks, at least for on/off risks, can simply be calculating and set as the product of risk probability and risk effect. In this way the product is an *expected value* (or average) describing the magnitude of the risk.

Magnitude of risk	Unfavorable effect of event	Probability of event
Low	Low	Low
Medium	Low	High
Medium	High	Low
High	High	High

Figure 54. Risks of various magnitudes in the case of on/off, unfavorable pure risks

Risk magnitude is a key factor in decision making. The decision maker's capacity for risk taking and attitude toward risk affects whether the decision is to take or to avoid a risk. The effects of two different (pure on/off) accident risks are compared in Table 13. It is assumed that the effects of both risks can be carried (handled within capacity) if realized (i.e. there are no related additional effects such as the threat of bankruptcy). In Table 13, the expected value of each risk (calculated by multiplying its risk probability by its monetary effect if the risk is actualized) is of the same magnitude (i.e. $10). If the two risks were alternatives, it would make no difference to the business which risk is realized (actually happens).

Table 13. Comparison of the magnitude (i.e. the expected values) of two accident risks

Event	Probability that event is realized * unfavorable effect	Expected value (magnitude of risk)
Fire on the construction site (assumption: no fire insurance taken)	0.00001 * $1,000,000	$10
10 liter can of paint drops from the scaffold when painting the wall, and the paint runs to the ground	0.1 * $100	$10

Risks can be decreased through a variety of procedures, each of which creates an added cost for the project; thus, a decision must be made whether or not it is worth attempting to decrease the risk. In the situation presented in Table 13, it would be worth paying for fire insurance if it cost less than $10, but the payment requested by the insurance company is likely to be $10 or more. Based simply on the quantitative expected value calculation and the cost of the insurance, it would not appear to be rational to buy the insurance. However, a company in this situation would often opt to purchase the insurance because the effect on the company is great and, if the risk is realized, the consequences may include bankruptcy.

It is most realistic to describe the magnitude of business risks by using a continuous distribution, instead of a dichotomous (on/off) variable. Risks of different magnitudes are presented in the form of continuous distributions in Figure 55. We can consider that the three risks are related to three different options, of which one must be chosen (e.g. choosing one from among three subcontractors). The three risks all have the same expected value of $65 but their symmetrical probability distributions have different spreads. It is possible that the actual costs are larger (more unfavorable) and smaller (more favorable) than the expected value of costs. In this case the spread of the probability distribution is used to describe the magnitude of the risk; the larger the spread, the larger the risk.

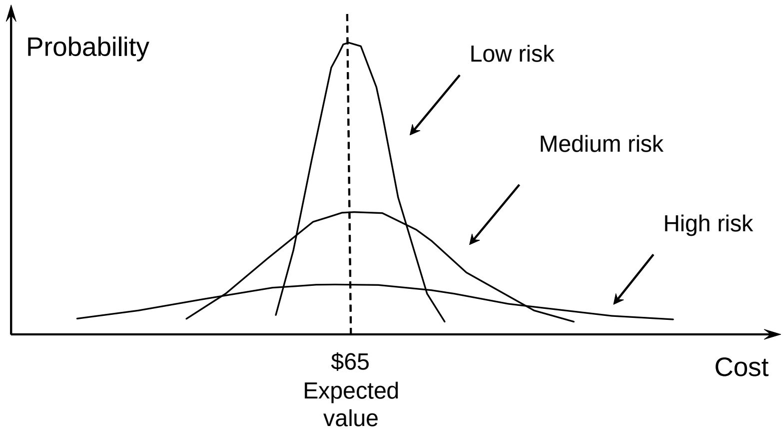


Figure 55. Business risks of various magnitudes portrayed as continuous distributions

In Figure 56, the risks presented in the previous picture are presented as cumulative probability distributions instead of probability distribution density functions. The cumulative probability distribution is often a better and more informative presentation format than is the density function when making decisions on responses to bids.

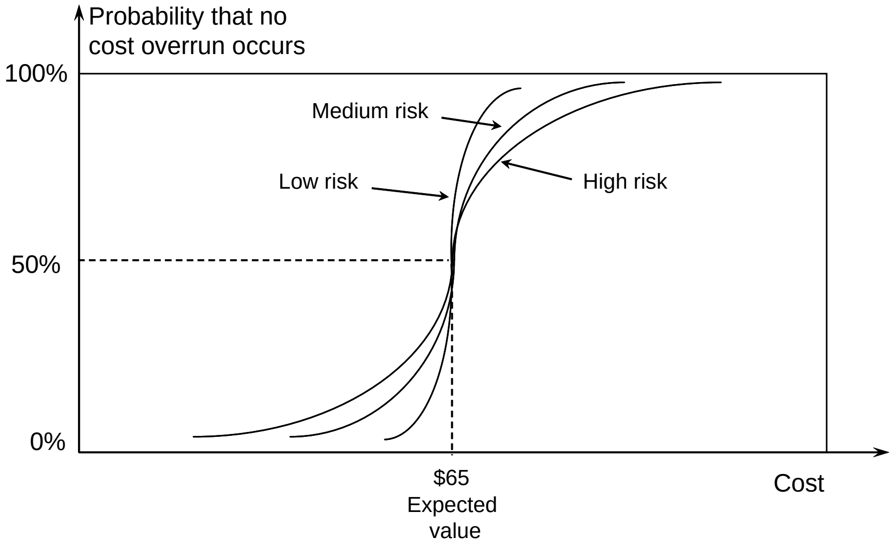


Figure 56. Risks of various magnitudes (based upon the risk distributions in Figure 55) illustrated as a cumulative probability distribution

We now discuss risks in the context of our case example, the Smiths' house construction project.

Example: Magnitude of risk and related decision making

The Smiths are considering using a specialized subcontractor for their project's earth-moving works and landscaping planning, components of the project that are not included in the contract with Livinghouse. On the basis of preliminary investigations, the Smiths have two good alternatives: TransferTech, a firm that offers pricing based on a certain fixed price, and a cost-plus hourly rate for extra work; and Landenix, a firm that does its work entirely as a cost-plus contract by the hour. Because it is difficult to accurately estimate the number of hours in advance, the Smiths want to analyze the risk included in subcontracting. They estimate that TransferTech will invoice a minimum of $ 7,000 and a maximum of $9,000 for the delivery, whereas Landenix's price will be $5,000 at minimum and $10,000 at a maximum.

The Smiths are not able to evaluate the probabilities related to the price options within the range or spread of possible prices. They assume that any option inside the spread is equally probable. Thus the probability distribution for price is a flat distribution with equal probability for all price values. The cumulative probability distributions of the subcontractors' prices, according to the Smiths' assumptions, are linear, as presented in Figure 57.

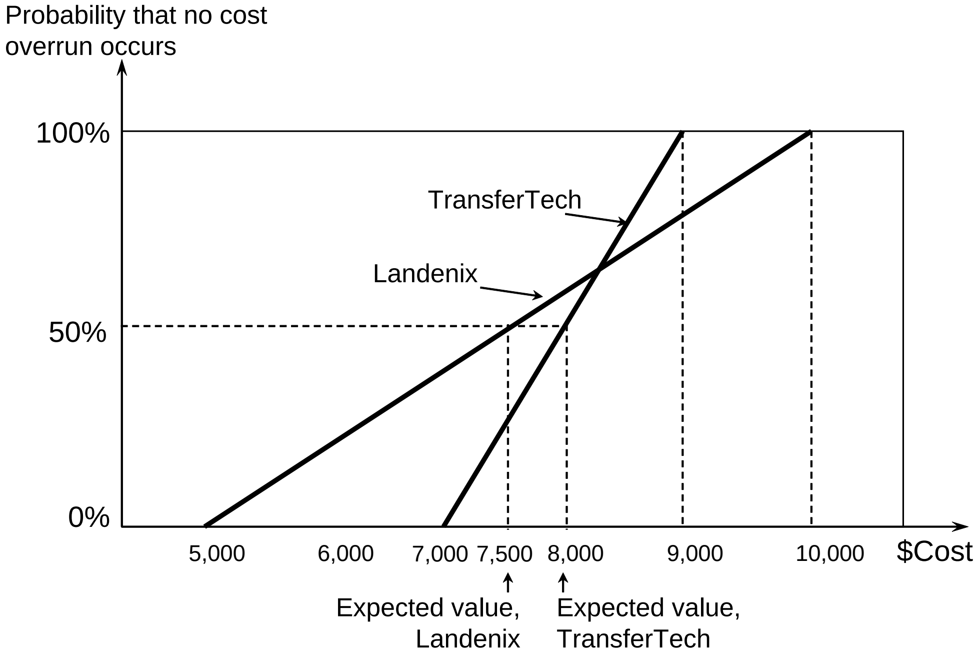


Figure 57. The cumulative probability distributions of the prices of subcontractors Landenix and TransferTech

> Because a flat distribution is assumed, the expected values of the subcontractors' prices are exactly in the middle of the minimum and maximum values. It can be seen from Figure 57 that the expected value of TransferTech's price is $8,000 and Landenix's is $7,500. There is nevertheless greater risk in choosing Landenix, as there is a greater probability that Landenix"s price will be higher or lower than TransferTech's price. That is, the variance of the price with Landenix is greater than in the case of TransferTech.
>
> Rationally thinking, it is still advisable for the Smiths to use expected value as the central basis for decision making. In the choice situation presented in the example, it is better to take the larger risk, namely Landenix, because the $7,500 expected value of Landenix is $500 lower than the expected value of TransferTech's price.

The way risks are evaluated depends on the nature of the risk. Two types of risks have been described in this subsection: on/off risks, for which a so-called one-point estimate (probability and effect) is sufficient; and risks described with the help of a probability distribution. Although it may be difficult to estimate risks, the distributions can be deduced by making certain assumptions about the values on the probability continuum. Minimum and maximum risks are often identifiable and, with the help of these values, additional points on the probability distribution can be located. The probability distributions of many risks may turn out to be skewed and, in these cases, more detailed information must be sought on uncertainties in order to describe the risk distribution.

When the magnitudes of various risks are evaluated using the common quantifying metric of costs, managers must prioritize them and to achieve the most effective utilization of scarce financial resources. If the project schedule or other uncertainty factors related to project duration are critical, risks can also be made commensurate by using time as the common quantifying metric, and by employing a time axis instead of a cost axis in the probability distributions. Nevertheless all risks cannot be measured through their effects on costs or time, thus qualitative description, evaluation, and decision making is required. Examples of risks that are hard to quantify include loss of company reputation or loss of human lives.

4.6.2 Activities of risk management

As illustrated in Figure 58, risk management consists of four activities, the purposes of which are to strengthen and utilize the positive effects of risks and weaken and prevent the unfavorable effects of risks.

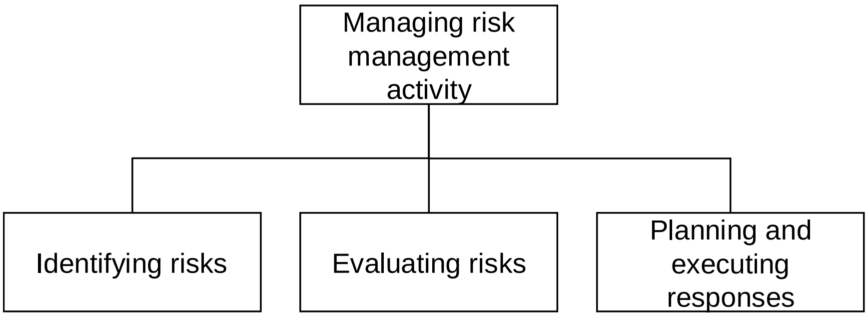


Figure 58. Four activities of risk management

The purpose of identifying risks is to define and document the risks that can affect the project. The task of evaluating risks involves describing the magnitude of risks and their effects on the project and its results. The planning and executing aspect of risk management refers to using forward thinking to plan for possible risk occurrences and to identify and implement actions that can be used to take advantage of favorable opportunities of risks and to mitigate the unfavorable effects of risks. The purpose of managing risk management activity is to ensure that risk identification and evaluation, and the planning and executing of responses to actual risk occurrences, is conducted at the right time, in the right areas, and in an appropriate manner. Additionally, in managing risk management activity, it is wise to use and learn from experiences inside and outside the company and, based upon this learning, to increase the risk consciousness of company personnel for future projects.

4.6.3 Identifying risks

Identifying risks refers to searching for, defining, and documenting them. Once risks are identified, their nature and magnitude can be communicated with systematic methods over the various stages of a single project, and from one project to another.

The degree of uniqueness of projects varies considerably. In some serial-production-type environments, projects progress according to an established procedure and the inherent risks progress in a similar fashion, presenting a relatively unsurprising environment in which an experienced person such as a project manager is able to see the risks, assess their magnitude, and prepare the required responses realistically, based upon experience and learning from earlier projects.

Nevertheless risk management in context of project management, is fundamentally a question of the creative ideation of potential future events in projects that differ from each other. Project uniqueness always presents a serious risk management challenge. Project risks increase with the degree of project innovativeness or newness; therefore, new, highly innovative projects require considerable creativity, communication efforts, and collaboration in carrying out risk management. Each member of the project team has their individual perspective on the project and its operating environment, so each member is able to produce relevant information related to risks. Executing risk management activities together as a group increases team spirit, motivation, and attentiveness, all of which can be used to anticipate unfavorable events and make use of favorable opportunities.

Project plans and estimates are always based upon assumptions. The assumptions can be clearly expressed and known by everyone, or then they can comprise the silently deduced or even unnoticed assumptions of each person making a plan or evaluation. It is useful to discuss and document such assumptions, to ensure that their relevance to risks is recognized by everyone. The bid made by a house contractor can be based upon the assumption that the roof of the house is constructed in sunny weather. A substantial risk can be hidden behind such an assumption. If the weather is rainy the week the roof is supposed to be installed, the installation schedule must be delayed or the construction site must be covered by a waterproof material during the installation. Delays in schedule and the increased costs of covering the site can negatively impact attainment of project objectives.

Typical risk sources

Typically the risks present in projects are related to the same phenomena regardless of project type. The term “risk source” can be used to describe the more general-level events, phenomena, or factors that cause risk. Generally the most substantial risk sources in a project are:

- customer, user, financer;
- supplier, subcontractor;
- new technical, functional, or methodical solutions;
- decision-making speed and content of decisions (in a company related to the project), and the degree of management support and amount of resources provided to the project;
- communication, transfer of information, availability of information;
- changes to plans;
- human factors, such as excessive optimism in preparing estimates, lack of information and knowledge, or change resistance due to other factors; and
- coordination problems due to the dependencies among activities or the complex dependencies among parts of the project.

External parties such as customers, financers, users, or subcontractors are the most substantial risk sources. The order of importance of risks can vary somewhat by business or project type. The most substantial risks in an information systems product development project differ from those in a house construction project. In developing an information system, risks are caused by such factors as the unexpectedness and complexity of customer needs and market forces, whereas in a single house delivery project, the key risk sources may be the availability of labor and ground and weather conditions at the construction site. In general, risks vary by project phase, so risks that require attention in the sales phase of the project lifecycle are different from those that should be attended to in the execution phase.

Risks can be analyzed and grouped in many ways, such as external versus internal risks, or risks that can be affected versus risks that cannot be affected. Whether the potential effect of a risk is unfavorable or favorable is central in risk identification because only the events leading to unfavorable events may be emphasized. This causes distortion in risk management: the entire risk management effort is concentrated on preventing unfavorable events. Risk avoidance or prevention is not always the most inexpensive alternative; taking risks may be more profitable in a business sense. The perspective of favorable effects (i.e. the success factors or success criteria of projects) can be used as sources for ideas in risk identification.

Procedures supporting identification of risks

Systematic procedures can be used to identify project risks, and we can group these procedures into checklists, creative ideation, modeling, and research.

Checklists and question lists. In its simplest form, a checklist contains a list of risks or themes. In its broadest form, a checklist can be a database in which risks and risk-related learning from prior projects have been recorded. Such databases may include ready-made estimates of the magnitude of risks, suggestions for actions that may lessen the possibilities of an actual risk materializing, and actions that may mitigate the effects when an actual risk occurs. Using a simple checklist may compromise creativity and initiative if, when going through the checklist, project personnel conclude that nearly all the risks apply to the project and neglect to separate things that are relevant versus irrelevant to the situation. A question list may be a more flexible and creativity-promoting method for systematically identifying project risks. Question lists can be constructed to direct the thoughts of the person or group reading the list to identify the most central matters that include risk. The questions may include: Who is the actual customer of the project and how important is the project for that customer? The project risks identified when going through the checklist or question list can be recorded in a project-specific *risk list* that is updated in later stages of the project.

Creative ideation (e.g. brainstorming). All the information and insight that is available on the project's future operating environment, stakeholders, and internal factors should be utilized in identifying risks. Often project risks are considered in an interactive teamwork situation and many systematic ideation methods designed primarily for other kinds of ideation and problem-solving situations can easily be applied in identifying project risks.

Modeling, describing, and visualizing techniques. In this context, modeling refers to analyzing and classifying project risks or describing the relationships between risks, so that the entire risk situation, formed by the various risks, can be illustrated. Most often modeling includes a visual presentation of risks, the starting point of which can be the project's operating environment from which requirements and expectations are set on the project and in which the project is executed. In such approaches, the overall risks affecting the project are described instead of concentrating on the detailed risks revealed by the product or the work breakdown structure.

Figure 59 represents a risk matrix, which is one way of analyzing or modeling risks and promoting creative thinking in identifying risks. The purpose of the risk matrix is to offer an empty table for the ideation of risks occurring in a group. Grouping risks into rows and columns should encourage greater breadth and variability in expressing and analyzing risks. Identified risks can be described and analyzed in greater detail with the help of an agreed-upon teamwork method. After risks have been identified within the risk matrix, they can be transferred, for example to the project-specific risk list, or can be used to construct a model for evaluating and calculating risks.

	What does the risk affect?			
What does the risk deal with?	Scope or technology	Schedule	Costs, resources	People and communication
Internal to the project team	*Description of risk 1. Description of risk 9.*			
Internal to the company		*Description of risk 2. Description of risk 7. Description of risk 10.*		*Description of risk 3.*
External		*Description of risk 5.*	*Description of risk 4. Description of risk 11.*	
Other				

Figure 59. Risk matrix

Research, broad analyses, and studies. Risks can be identified and evaluated through broad investigations or studies that require familiarizing oneself with material concerning, including the project, technology that is applied in the project, local conditions in the country of execution, activity of the customer, and regulations made by authorities. There can be several methods for collecting information, including performing technical calculations, modeling and calculating project risks, and conducting inquiries or interviews. Identifying and evaluating risks and planning responses can be assigned to a designated risk analyst or to a larger group of experts. In assessing risks, the use of external consultants may be justified, particularly in matters requiring special technical expertise or concerning the conditions of the country in which the project is executed.

Describing risks

Regardless of the way risks are identified, it is advisable that they be described in complete sentences. A short phrase like “the schedule is not met” does not provide a sufficient picture of the risk or its nature; rather, it merely signals the effect of the risk measured in time. The description of the risk using a few sentences could be: “The subcontractor does not have enough professional manpower. This can lead to careless and unprofessional installation and technical faults. The delivery of the subcontractor may be delayed.” This fuller description includes logical chains and references to cause and effect, from which the nature of the risk can be better assessed than if a short two or three word phrase were used. Risks are often chained together revealing one risk as the cause of another, revealing relationships and interactions among risks, and facilitating understanding of a complex matter. Visual charts are often used as tools to portray relationships among risks, illustrating the cause-and-effect chains and risk interactions.

4.6.4 Evaluating risks

Qualitative and quantitative evaluation

Risks can be evaluated qualitatively or quantitatively. Qualitative evaluation refers to a description of the magnitude of the risk probability and the effects of the risk in words and through various types of visual description methods. In written descriptions, the magnitude of the probability and effects can be illustrated with a detailed description, or can simply be described in such ordinal categories as large, medium, or small (Figure 60). The probability and effect of risks can also be assigned ordinal-scaled numerical points in what can be called a quantitative evaluation. The scale 1 = small, 2 = medium, and 3 = large, is such a scale. Thus qualitative ways of making an evaluation can resemble quantitative ones. Risks can also be assigned evaluation-related meanings by estimating risk magnitudes. The small effect in Figure 60 could therefore mean a loss of $10,000 to $20,000; a medium effect a loss of $20,001 to $30,000; etc.

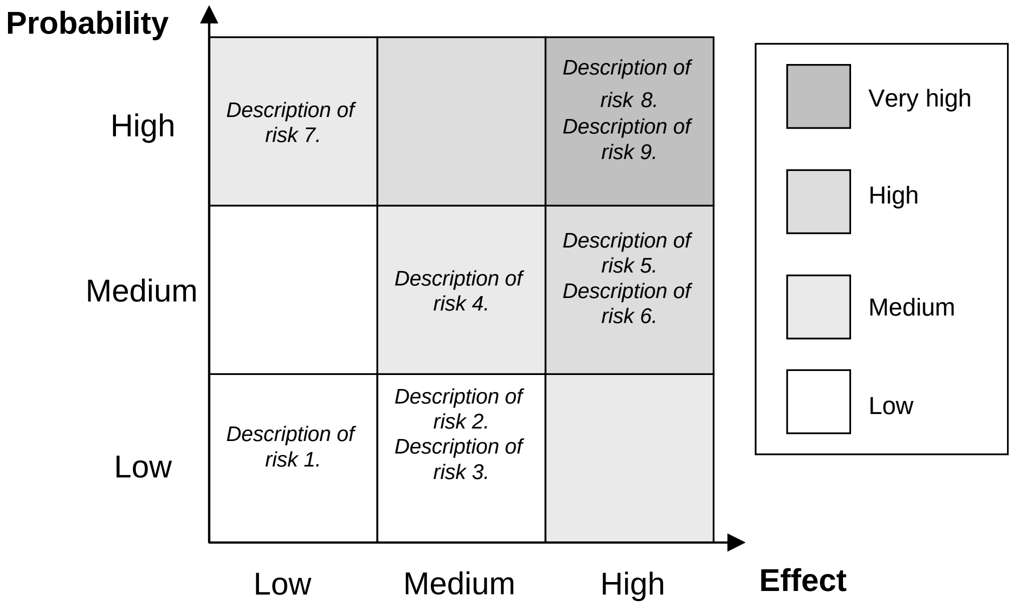


Figure 60. Risk probability-effect chart

Quantitative risk evaluation, conducted in definite and understandable quantities, is highly recommended. The effects of risks (or the points on the distribution, like minimum and maximum points) could be evaluated, in monetary terms or in time units affecting the duration of the project. This type of evaluation is beneficial because it facilitates comparison of risks and the communication of their relative values to others. Such presentation often leads to questions and discussions about the risk estimate and deepens understanding of the nature of the risks, perhaps leading to a better (maybe even quantitatively revised) risk estimate and improved plans for responding to risks in the event they materialize. Using a simple categorical qualitative expression (e.g. “large risk” or “small risk”) is often an inadequate basis for communicating the likelihood of a risk occurring, and its possible effects on the various parties involved in the project.

Performing sensitivity analysis on the risks is one way of evaluating possible fluctuations in risk probabilities or effects, and it can be performed by changing the value of a certain variable in the risk model, utilizing “what if?” questions, and then studying the way the change affects the results variable. In the context of constructing a house, the question, “What if constructing the framework of the house takes 30 days”, can be asked. In this situation, the model would be the activity-on-node diagram, from which the schedule plan, complete with durations, can be calculated. Because, generally, the probability of the “what if” events occurring is not assessed in the sensitivity analysis, the analysis cannot be considered direct risk evaluation.

Calculations used to quantify risk

As mentioned in this subsection, risk probabilities and effects can be evaluated by assigning them points using a scale of 1 to 3 or 1 to 5. We now describe methods for evaluating and calculating risks using two metrics: time or costs (monetary units).

The so-called one-point estimate was presented previously, demonstrating the evaluation of an on/off-type effect and its probability. The two-point estimate, based upon an estimation of the minimum and maximum effects, was also presented. Now the three-point method is presented with the help of the minimum value, most likely value, and maximum value. In the Project Evaluation and Review Technique (PERT) project planning method, the three values (points) are interpreted as the parameters of a skewed probability distribution. These parameters can be used to determine a special case of the beta distribution in a way presented in the PERT method. Employing these assumptions, the quantitative calculation of risks based upon the PERT method uses the three values to approximate the mean and standard deviation of the distribution. Thus the following calculation method can be used in evaluating the quantitative magnitude of total risk.

1. Identifying and describing risks

In itemizing risks, it can be assumed that the various risks are mutually independent.

2. Evaluating minimum, most likely, and maximum value for each risk in the chosen metric

The minimum, most likely, and maximum value of each risk can be estimated, for example, in the metrics of costs or time units.

3. Calculating the mean and standard deviation of each distribution, assuming a special case of the beta distribution used in the PERT method

Mean (M) = (Minimum + 4* Most likely value + Maximum)/6

Standard deviation (S) = (Maximum – Minimum)/6

4. Calculating the magnitude of total risk

As mentioned, calculating total risk is based upon the assumption that the risks are mutually independent. Thus total risk can be calculated from the mean values and variances of the separate risks, whereby the mean value and variance of the probability distribution describing the total (joint-effect) risk are the sum of the mean and variance of the individual risk parts.

$M_{\text{joint effect}} = \Sigma M_i$

$S^2_{\text{joint effect}} = \Sigma S_i^2$

Using these joint-effect values, a cumulative probability distribution describing the total risk is constructed. As in summing up several independent probability distributions, the total distribution is assumed to approach a normal distribution[25].

Earlier, in Figure 45 (presented under the cost management topic in Section 4.4.3), we presented a skewed probability distribution. Such a skewed distribution of costs typically attributes project risk to the fact that possible unfavorable effects, at the worst, reach much further from the most likely value than do the favorable effects, at the best. Additionally, a greater number of events lead to unfavorable effects than to positive effects because there are only a few effects that could lead, for example, to savings in costs, and the savings that could be made are relatively small. It is unrealistic to assume in practice that the project could be executed in such a way that costs would be halved. However, the project can go wrong in various ways, and it is realistic to assume that there are many events that can increase costs by a factor of two or more (although the probability of realizing such extreme situations is small). This disparity in the favorable and unfavorable effects skews the probability distribution for project costs, which, in mathematical terms, means that the expected value of the probability distribution is weighted on the unfavorable side of the most likely value (the highest point on the distribution).

Similarly the revenue from a project and the related risks can be evaluated on a probability distribution as costs, duration of activities, or duration of the entire project. Figure 61 illustrates a skewed probability distribution for revenues. Although this distribution is skewed in the opposite direction to typical cost probability distributions, it is similar to the cost distributions, in that there is a larger number of unfavorable effects than favorable effects, and the unfavorable effects are larger. In practice this outcome is due to the improbability that the supplier will experience revenues that are much larger than expected (e.g. much larger than the most likely value), but the project can fail badly in many ways, forcing the supplier to pay the customer penalties for lateness, poor performance, or other factors. Furthermore, the supplier’s revenues may erode because the customer retains revenues that would normally be paid to the supplier in order to fix faults caused by the supplier’s poor performance.

[25] Central limit theorem

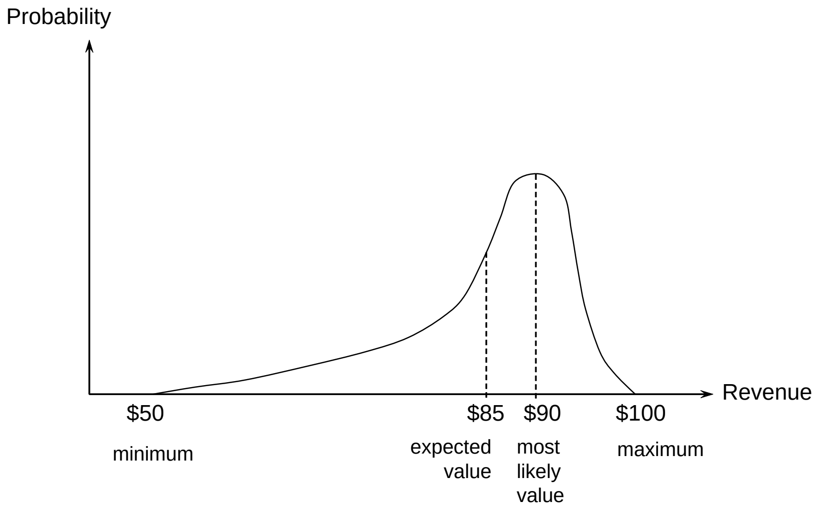


Figure 61. Example of a skewed revenue probability distribution for calculating total risk

In order to calculate the total risk, or to form a picture of the relative magnitudes of the risks and the effects between them, *modeling of the risk structure* is required. The shorter term, *risk model*, can be used. Using this model, the probability distribution of project profit can be calculated from the probability distribution estimates for the model's revenue and cost risk variables. We now illustrate these concepts in the case of the Smiths' house construction project.

Example: Modeling risks for evaluation and calculation purposes, and calculation of total effect of risks

The Smiths want to ensure that the costs for the house construction project do not exceed their available budget of $200,000. They are conscious of the risks included in a large project so they asked an expert for an estimate of the risks related to costs.

The expert identified risks related to the project for both Livinghouse and the Smiths. This expert evaluated each risk and, based on experienced in making such estimates, produced the risk model presented in Table 14. The estimates for the risks and the calculation of the total risk based on the estimates are presented in the table. The several small risks identified in the risk model are estimated as one entity in the "other risks" element.

Table 14. Project risk model, risk estimates, and calculation of total risk

Risk	Minimum (min)	Most likely (ml)	Maximum (max)	Expected value (M) M = (min + 4*ml + max) / 6	Deviation (S) S = (max - min) / 6	Variance (S^2) S*S
Ground conditions	-5,000	0	13,000	1,333	3,000	9,000,000
Construction permit processing and requirements of authorities	-1,000	0	5,000	667	1,000	1,000,000
Weather conditions	-500	0	500	0	167	27,778
Attitude of customer	-10,000	0	20,000	1,667	5,000	25,000,000
Professionality of important subcontractors	-7,000	0	15,000	1,333	3,667	13,444,444
Staff motivation	-5,000	0	10,000	833	2,500	6,250,000
Other risks (according to itemization), estimate of total effect	-1,000	0	1,000	0	333	111,111
			Σ M =	5,833	Σ S^2 =	54,833,333
				5,833	7,405	= $S = \sqrt{\Sigma S^2}$

The mean of the distribution describing the total risk is $5,833 and the standard deviation (square root of the variance) is $7,045. The starting point of the project was a base cost estimate of $200,000, to which the risk effects must be added. Thus the expected value of the costs of the project is $200,000 + $5,833 = $205,833 and the standard deviation is $7,405. A cumulative probability distribution can be formed from these parameters of the cost distribution, assuming a normal distribution; the result is presented in Figure 62.

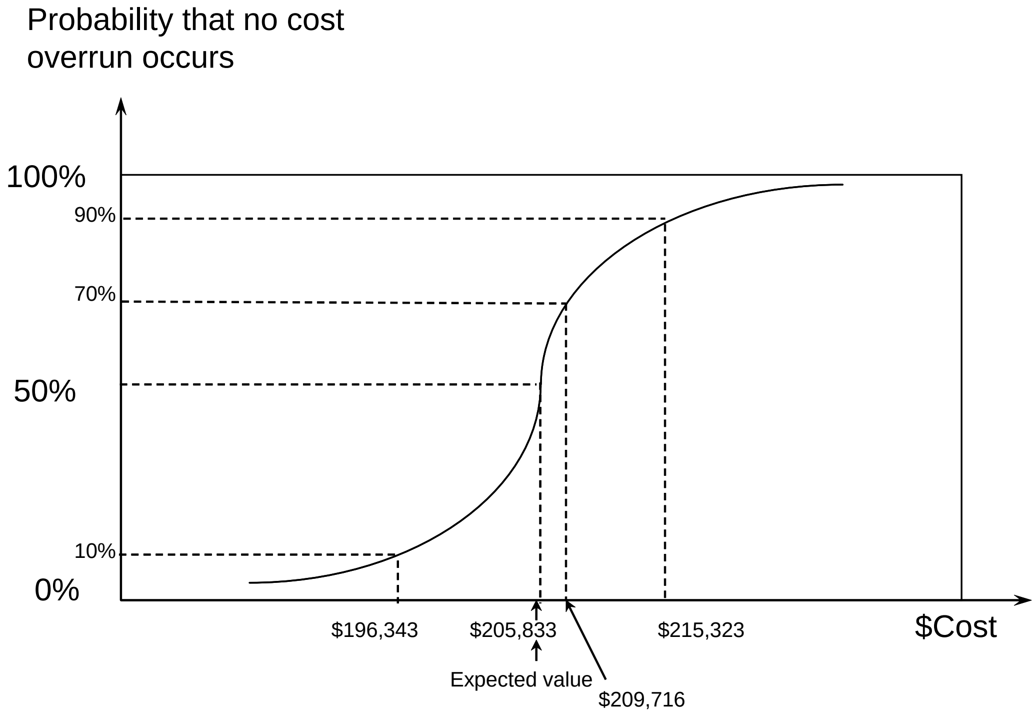


Figure 62. Total effect of risk as a probability distribution of the costs of the entire project

Because it is much more informative, the distribution in Figure 62 can be used as a *cost estimate* to replace both the information presented in the form of the deterministic estimate and the related estimate contingency presented in Chapter 4.4.4. The distribution in Figure 62 can be used in setting objectives – in this case setting the overall budget of the project. This type of decision making is based on the results of evaluating and calculating risks, and it belongs to the activity referred to in risk management as ‘planning and executing responses’.

According to Figure 62, the 50 % fractile for project cost is at $205,833. It is therefore equally probable that this sum is exceeded or underachieved. It is common to set the project budget without adding contingencies to this amount. In Figure 62, the 70 % fractile is $209,716, indicating that there is a 70 % probability that the cost does not exceed $209,716, and therefore only a 30 % probability that the sum of $209,716 is exceeded. If the budget with contingencies is set, for example, at the 70 % fractile, the contingency of the project manager can be set at $209,716 - $205,833 = $3,883.

Subjective risk estimates and biases

In an uncertain environment, an experienced and insightful person is often the best possible source of information; therefore, knowledge-based subjective estimates of people taking part in project planning and project work are frequently used as risk estimates. In practice the beliefs in people’s minds are being measured instead of the frequencies of real phenomena. Subjective estimates for probability distributions are nevertheless considered to include objective elements. The evaluator’s real perception of the future includes assumptions about changes and stability within the objectively studied environment, the imperfectness of the information, and the evaluator's degree of ignorance. In producing subjective estimates, both the *quality of the estimate* and the *bias* present in the estimates become central areas of interest.

Evaluators form their subjective belief about the estimate and its related probability by using various deduction principles, which may include conscious or unconscious bias. Conscious bias is based upon the evaluator's motive to skew the estimate for such reasons as speculation or in pursuit of personal benefits. If project personnel are assigned too tightly set objectives and there are penalties for not reaching the objective, or if reaching the objective is rewarded on the wrong grounds, they may consciously skew their estimates. Such conscious bias can appear in estimates as hidden contingencies by which the evaluator overtly presents an overly large cost estimate or an overly lengthy time estimate in order to loosen the objective, making it easier to achieve. Unconscious bias is caused when an evaluator uses faulty deduction principles that lead to erroneous estimates without the evaluator noticing it.

Other central reasons for bias include factors related to the roles or the ways of thinking of evaluators, and the role or general setting of the estimation. Evaluators can draw inferences from the perspective of their narrow roles in the project, or from their limited initial information, and disregard the broader situation of the project. Evaluators may be inclined to optimism or pessimism, which is reflected in their estimate, or they can study their own projects in a better light than projects that are unfamiliar or distant to them. In addition, group behavior can cause individuals to make errors in interpretation and to distort the interpretation of a single person.

Evaluators' deduction principles and attitudes toward evaluation may change with experience, and they may try to use experience to correct the evaluation methods they use. The effect of feedback is central, but feedback is often incomplete. Feedback cannot be received from optional, unmade decisions, for example.

In short, a number of factors can reduce the quality of risk estimates. Fortunately, there are a number of ways to improve the quality of such estimates, including:

- developing evaluators' risk management competences – through feedback and training, for example;
- increasing the amount of information available to evaluators about the content of the target of estimation (e.g. project and project business), and instructing them on probability theory,
- making estimates a teamwork exercise in which various perspectives and expectations are taken into account;
- engaging an objective (usually outside) consultant or facilitator to support the group in creative ideation, in applying systematic risk evaluation methods, and in using the group's broad experience and analytical capabilities; and
- using objective external parties to help produce information for risk evaluation and for preparing objective reports.

When evaluating risk, it is essential not to confuse evaluation with decision making. Although experiencing a certain risk may seem unbearable, estimates should not include weights or other factors that would increase bias. Rather, estimates should provide a truthful picture of the risks. In decision-making exercises, however, the attitude to the risk can be taken into account. If it is perceived to be beneficial to avoid certain types of risks, for example, the decision can be made easily based upon a realistic and nonskewed risk estimate.

The quality of estimates can be measured in various ways, such as studying the decision made on the basis of the estimate and calculating its value to the decision maker. Another practical criterion for judging the quality of an estimate is to compare the estimate with the corresponding real perceived value. In the case of a unique event, there is not much that can be deduced from the single feedback value, which suggests, for example, that the real value was situated at a certain point on the estimated probability distribution describing the risk. Furthermore, the consistency of the estimates and their conformance to the axioms of probability calculations (e.g. is the sum of the estimated probabilities of the alternative events = 1, i.e., 100%) can also be used as criteria for quality. Through the principles of probability calculation, the estimate's reliability can be studied further. Reliability means that the estimate can be repeated with the same results and that the estimate can be generalized. Expert feedback on the quality of the risk estimate can be requested if needed. The quality of an estimate can be ensured by deducing it from the estimates of several experts, weighting each estimate to reflect each expert's level of expertise. The estimate can also be formed on the basis of conducting discussions among a group of several experts using the Delphi method.

4.6.5 Planning and executing responses

Risk strategy and attitude to risk

The starting point for planning responses to risk should be a clear idea of what type of attitude the company encourages; the company may want to avoid risks or to overtly find and take risks. Risk taking and risk management procedures may be affected by the type, nature, or magnitude of the risk. In projects, a risk strategy chosen by the company can be applied that includes predefined principles for planning and executing risk responses. A risk strategy addresses such issues as when it is advisable to take risks, which risks should be transferred to another party, and what type of procedures should be used to decrease risks. The risk strategy may state, for example, that: "we will bear full responsibility for the entire house construction and the related risks; we will price bearing in mind the risks inherent in the contracts we make with our customers and our desire to generate a profit despite the risks"; or "we will not bear responsibility for the quality of the sauna facilities of the houses we construct, and we will transfer all risks related to the quality of the sauna to the subcontractor that supplies or constructs the sauna". If it does not have a stated risk strategy, a company may unnecessarily avoid risks and make unduly rash responses if a risk event does occur.

A stated, risk strategy directs risk-related decision making and serves as a clear statement about the decision-maker's attitude to risks. There may be a benefit for taking a risk, but the unfavorable effects resulting from the risk being realized may be too large, relative to the benefit. Risks that can be measured using qualitative criteria can be described clearly in the risk strategy. For example, the strategy may state that risks which lower company reputation in the eyes of clients should not be taken, whereas risks that may produce a favorable effect in the future (e.g. broadening the client base) should be taken.

In the end, planning risk-related responses involves decision making, and realistic estimates of the risks are needed to facilitate proper decision making.

Types of responses to risks

Four different types of responses can be used in dealing with identified and estimated risks, and these are: bearing responsibility for the risk, transferring the risk, avoiding the risk, and decreasing the risk.

Bearing responsibility for risk. Responsibility for risk can be borne within the project, and this may be the most inexpensive, and sometimes the most profitable, option. If they choose this option, project managers must have a realistic idea about the type and magnitude of risk they are facing. The development of the risk, and changes in its nature, must be monitored constantly. By employing normal project management procedures, project managers can avoid unfavorable effects of risk and strengthen the benefits from favorable effects. The unfavorable deviations caused by the risk are prepared for through setting objectives and contingencies. Tight but realistically reachable objectives motivate project personnel to work toward achieving the objectives. Risk evaluation and setting objectives can be seen as indirect procedures that may also affect the magnitude of the risks.

Transferring the risk. Risks can be transferred in the contract to the responsibility of the customer or subcontractor. Transferring a risk to a subcontractor, sharing a risk with a subcontractor, and using a subcontractor as a risk buffer are discussed in Section 4.5.5 of this chapter, in the context of procurement management. The risk can also be transferred to an insurance company by purchasing an insurance policy.

Avoiding risk. Project risk as a whole can be avoided by executing the requested functional product using a different technical solution, for example, or by choosing another method for executing the work. Although these approaches would avoid the risks present in the original plan, a different technical solution or method of execution brings with it different types of risks. Thus new solutions may turn out to be more risky than familiar, tested technical solutions and working methods that have been used on prior projects.

Decreasing risk. Risks can be decreased by using procedures that affect either the probability or effect component of the risk. Ensuring that flammable materials are not kept in the open at a construction site substantially reduces the probability component of the risk of accidental fire from a welding spark. The effect or consequence component of this same risk can be reduced by keeping foam fire extinguishers and a sprinkler system at the site, for example. In the case of business risks, procedures directed at decreasing risks often involve monitoring and supervising the development of situations, taking preemptive actions, ensuring project management procedures are used, and preparing optional procedures to be initiated if a risk is realized.

4.6.6 Managing risk management activity

Managing risk management activity refers to the processes managers should use for identifying and evaluating risks and for planning and executing risk responses, at the right time, in the right places, and in the required way. In managing risks associated with present and future projects, managers responsible for risk management should draw on internal and external experiences that have accumulated from prior projects.

Risk management over the project lifecycle

Risk management is continuous activity. Ideally, risk identification, evaluation, and response planning should be ongoing over the product lifecycle, and the risk management plan should be updated continuously. However, in practice, such continuous risk management may not be achieved because of the time and concentration effort it requires from project personnel. The risk management plan includes a plan for when the identify-evaluate-plan and execute-cycle is to be repeated over the project lifecycle. Although an accurate and detailed risk identification and evaluation exercise would be conducted at the beginning of the project, all the risks and probabilities are not necessarily perceived correctly at this point. Additionally, new risks may appear and the magnitude of risks may change over the project lifecycle. Therefore, frequent identification, evaluation, and response planning activities are usually conducted at several stages in the project lifecycle, and they typically occur before such critical decision-making points as the competitive bid, the submission of a bid, the signing of a contract, and the beginning of a certain phase of the project; or they can be conducted after the risk situation has changed significantly.

The earlier risks are identified and evaluated, the more likely that key decisions and responses can be made to affect, avoid, or take risks. The customer may demand that the supplier prepare certain responses to the risks it faces under their mutual contract. In some cases, the collaboration among stakeholders in estimating risks is essential in order to reach agreement on the division of work, and on common attempts to affect risks.

Only part of the planned risk management responses can be executed immediately. Usually the responses must be scheduled as they are planned for a time at which it is beneficial or possible to execute them. In addition to scheduling the responses, it is important for the project team to agree on the person responsible for each response.

As the project progresses, the actual intermediary results of the project become known and the activities and objectives of the yet-to-be-completed project work are specified in the light of available new information. Risks are realized or are left unrealized, and the magnitude of the remaining total risk becomes smaller than at earlier assessments. This lessening of risks should occur, at least for the risks related to the execution of the project, however, some external risks may appear larger than before in the context of new information. Questions related to taking and avoiding risks should be considered over the course of the entire project.

Figure 63 illustrates the decrease in total risk as the project progresses over the project lifecycle. The vertical axis describes the estimated total cost of the project and the horizontal axis presents the points in time at which risks are evaluated (t_1, t_2, etc). At every point in time, the total risk effect has been estimated as a probability distribution based upon risk estimation. The figure describes the confidence interval of costs at each point in time and displays the way this confidence interval evolves using the distance (+ or -) of the standard deviation (S) from the expected value (M) of total costs. It can be inferred from Figure 63 that the standard deviation decreases as the project progresses, signifying that total risk decreases. At time $t_{5,}$ the project finishes and the actual cost is known; thus there is no more standard deviation. If time had been used as a quantitative metric or measure in evaluating risks, the figure could have been drawn with the estimate focused on project duration, and with the standard deviation of duration at different times (t_1, t_2, …) on the vertical axis. The decrease in risk could also be described using two dimensions, a combination of the probability distributions of time (duration) and cost.

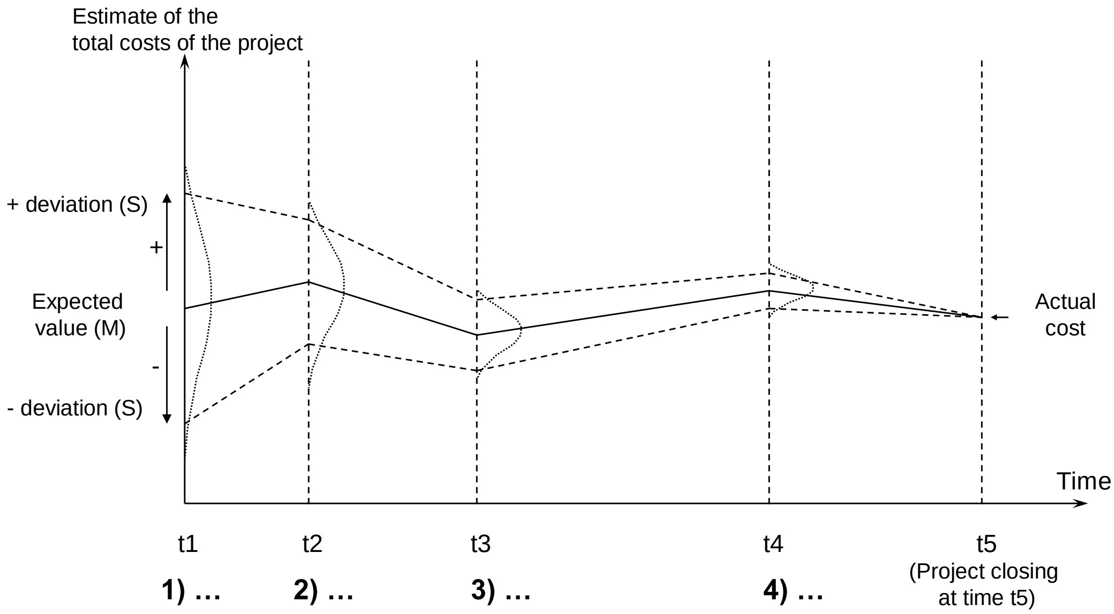


Figure 63. Decrease in total risk as the project progresses over its lifecycle

Responses in the project, and maintaining a project-specific risk list

The models and descriptions made in the context of identifying risks, and the modeling done in risk estimation, provide an overall picture of risks, the factors that affect them, and the related cause-and-effect relationships. This overall perception facilitates development of a comprehensive response plan. Sometimes it may be more effective if risks are affected indirectly through a response directed at the cause of the risk. For example, responses that affect several risks simultaneously because of a common cause or some central background factor should also be identified.

A project-specific risk list is presented in Figure 64, which supports identification and evaluation of risks, planning of risk responses, and monitoring of risk response execution over the project lifecycle. A risk list can first be created when risk identification and evaluation is conducted at the beginning of the project, and this list can be continuously updated as the project progresses. A central part of the list is the description of responses, the name of the person responsible for the response, and the agreed-upon time of response execution. Thus the risk list is the project manager’s tool for supporting continuous risk management over the project lifecycle.

Identification: Description of the risk	Evaluation: Probability, effect Or: minimum, most likely, maximum	Response: Description of the response	Response: Person responsible	Response: Time of execution
Risk 1				
Risk 2				
Risk 3				
Risk N				

Figure 64. Risk list

The feasibility and business profitability of the planned risk responses should be ensured by estimating the costs of executing a response, for example, and then estimating the cost of the risk assuming that the response has been executed. If the cost of executing the response is higher than the financial benefit that can be received by using it to affect the risk, the response should not be executed. Studying the profitability of the response can be added in the risk list as additional columns, which could be labeled, cost of response; new risk estimate, assuming the response is executed;, and final decision on executing the response (yes or no).

Teamwork in risk management

It is most effective in communicating and developing a common understanding of risks if the identification and evaluation of risks and the planning of risk responses are conducted in a teamwork setting of common meetings or workshops, a topic we discussed in Section 4.6.3 in the context of identifying risks. To ensure a systematic approach to risk management, the responsibility for coordinating risk management activities should be assigned to one person, typically the project manager or a separately appointed external facilitator. This person should ensure that the required advance assignments are completed before the meeting, the objective and agenda for the meeting are prepared, teamwork proceeds well throughout the meeting, and suitable methods for describing and estimating risks are used. Furthermore, this facilitator should ensure that progress is made on further actions identified in the meeting.

The meeting result – for example, a risk list that has been jointly developed and appropriately documented – can easily be communicated to a higher-level decision maker or to other stakeholders, if needed. Increased consciousness of project risks is as a significant meeting result, as it may have a substantial effect on risks, particularly on avoiding unfavorable risk effects. Teamwork fosters development of mutual trust, commitment, and team spirit in the meeting group.

Learning for future projects

Lessons learned from one project can benefit future projects, and developing risk consciousness in the entire company can enhance the degree of learning. Organizational learning is enhanced as checklists and question lists are updated. The worksheets used for making risk estimates and lists, and the responsibility and frequency for making updates, should be set to fit the company's particular project management customs. In addition, attention should be paid to estimating the actual realized risks and their effects after the project has been closed, even though the project team's interest in such post-project discussions may be low. Although this post hoc analysis may not benefit the project in question, it increases the knowledge and competences of personnel and improves their effectiveness in contributing to future projects.

Knowledge about risks is best transferred personally through people. Working as a unified project team throughout the entire project, promotes the development and transfer of understanding about risks. There may be changes to the membership of the project group over the course of the project, and these changes may hamper accumulating an understanding regarding risks. On the other hand, inviting experts from outside the group to project group meetings may bring new information for identifying and evaluating risks and for planning responses. These external-to-the-group-people may be responsible for other projects within the company or they may be experts drawn from outside the company.

4.7 Quality management

Quality refers to a group of characteristics of an entity that can fulfill detected or undetected customer needs. In projects, achieving high quality occurs if the product resulting from the project fulfils customer expectations. Notably, achieving high quality is not synonymous with number of product features (although features are part of the definition of the product resulting from the project). In short, more features do not mean more quality, or vice versa. The objective of *quality management* is to ensure, through quality planning, assurance, and control procedures that the project fulfils the requirements set for it.

Expectations are usually associated with the product resulting from the project: adherence to specification, flawlessness, reliability, convenience, durability, and predictability, for instance. Many such expectations are open to interpretation, however. In an uncertain project environment, quality must be studied in a broader sense, not merely as a narrow, mechanistic conformance-to-standard exercise. Because the expectations and standards of customers can change as the project progresses, the achievement of high quality cannot be completely determined in advance. In order for the project to produce high quality outcomes, the customer's expectations must be identified and described, and the supplier must be able to manage and control these expectations during the project by exercising project scope management.

Compromises and quick decisions must often be made in projects, making it difficult to achieve high quality and meet customer expectations. If a project has multiple customers, expectations of some customers may need to be emphasized at the expense of other customers' expectations. If technical and commercial personnel from the customer organization communicate expectations separately, the expectations may differ. Furthermore, if the customer's circumstances change, or if initial customer expectations are unclear, adjustments and respecification may need to be made during the project. Notwithstanding these examples, customers and suppliers should jointly agree upon and specify the project's qualitative scope objectives, and then they should work together to realize them in the best possible way.

Two slightly different perspectives on quality can be recognized in the project environment, both of which are essential for quality management: the quality of the product resulting from the project – its ability to fulfill customer requirements; and the quality of project management – its adherence to plan.

The quality of the product resulting from the project and project management quality are connected in many ways. If the quality of the product is overemphasized, the workload will probably increase over what was planned, increasing the danger that project personnel will become overloaded with work and will encounter difficulties in obtaining resources, circumstances to which the personnel are likely to react negatively. On the other hand, if painstaking, detailed quality control measures are included in the project, there is increased danger of encountering delays, expending resources on the wrong activities, and experiencing difficulties in reaching objectives. Alternatively, if the project management is deficient (e.g. the project personnel hurriedly go over the agreed-upon reviews without proper preparation and quality control), small but substantial errors may go undetected and may decrease the quality of the results. Thus it is necessary to concentrate on *overall quality* and not on single factors. Although maximizing the quality of the product resulting from the project would be the primary objective, its prerequisite is quality in project management.

Quality management includes all the actions in the project environment that are directed to ensuring that the expectations set for the project are realized. Quality principles, objectives, and responsibilities at the company level are also reflected in projects. In addition, quality management appears in the project environment as three main activities: quality planning, quality assurance, and quality control (see Figure 65).

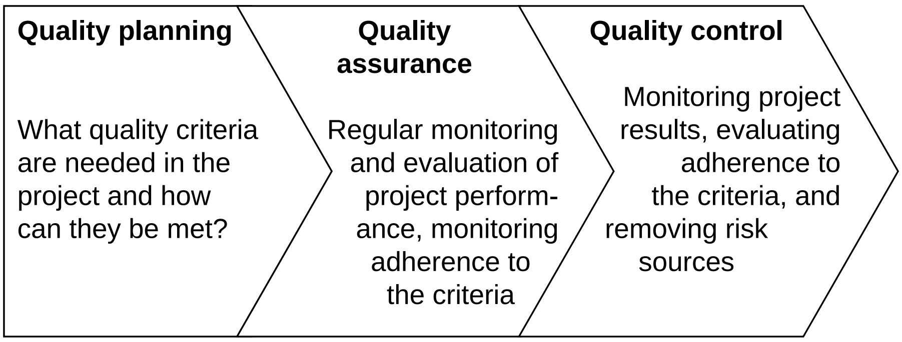


Figure 65. Quality management activities in projects

In recent decades, quality management has evolved into its own interdisciplinary perspective, and it has been broadly studied and written about. Modern quality management has much in common with project management; for example, the idea of knowledge areas and processes is common, as is the importance of the customer, planning, and clear responsibilities. Nevertheless the application of quality management in uncertain project environments has, to date, been challenging because quality systems in companies are still based upon conformance-to-standard thinking.

4.7.1 Quality planning

In the context of project management, quality planning refers to identifying quality criteria to be used in a project, and preparing the actions needed to meet the criteria. Quality planning can occur as part of project planning – alongside scope specification, for example. A quality plan (or quality management plan) can be added as part of or an appendix to the project plan; it should describe the project-specific approach to quality management. The quality plan includes quality criteria for the project and the structures, responsibilities, procedures, practices, and resources that are applied in the project to execute quality management. In addition to these project-specific aspects of the quality plan, there may also be a common, general quality planning practice in the company that is applied as part of project management.

The starting point for quality criteria is customer expectations and project scope specifications. Quality criteria should be considered from the perspective of quality of product resulting from the project and project management quality. From the perspective of overall quality, it should be noted that some criteria may be more relevant in one phase of the project than it is in other phases. In product development projects, for example, the conformance of the actual product to standard (yield or share of defective products out of all produced products) can be evaluated only after the product is in mass production. Prior to this time, the quality criteria should be different and should relate to the quality of documentation and the contentment of stakeholders, for example.

Various techniques can be utilized in quality planning, including analyzing earlier projects (postmortem analyses), quality function deployment (QFD), cost-benefit analysis, benchmarking, test arrangements, cause-effect diagrams, failure mode-and-effect analysis, and flowcharts. At the planning phase of each project, the techniques and equipment chosen should be those that best serve the objective of creating high quality. Quality is thus created during project planning and execution – not during postmortem inspection.

As part of quality planning, a number of questions may be considered.

- What factors does high quality consist of in this project? What are the quality objectives?
- Which quality criteria are followed over the course of the project?
- How should quality develop over the life of the project, and how does this development manifest itself in the quality criteria?
- How is high quality evaluated at the end of the project?
- How is quality reported, and how are quality problems communicated and documented?
- What are the responsibilities related to quality management?
- How is it ensured that personnel commit to creating high quality?

4.7.2 Quality assurance

Quality assurance comprises systematic, planned anticipation activities designed to ensure that the quality criteria are fulfilled as the project progresses. The objective of quality management is to ensure that the requested quality is reached with 100% certainty. Thus quality assurance involves performing followup, evaluation, and anticipation activities according to the quality plan.

The following requirements apply to quality assurance procedures both for the product and for project management:

- setting clear specifications;
- defining criteria that can be monitored easily;
- following good practice or a standard;
- utilizing prior experience;
- utilizing competent resources;
- conducting impartial reviews; and
- engaging in active change management.

If the company adheres to the International Standards Organization's (ISO's) quality standard ISO 9000 or equivalent, or the quality award criteria of some quality association (e.g. Malcolm Baldridge Quality Award, or European Foundation for Quality Management Business Excellence Model), it will benefit from approaches and tools that are particularly effective in ensuring product quality. Usually these ISO systems emphasize reviews, active measurement, followup, and good documentation. The standards, nevertheless, do not guarantee good practice; project personnel must take care to apply the standards properly.

In ISO 10006, the guidelines for project management quality are presented, and many other project management associations have prepared their own standard-like guidelines.[26] Although these guidelines primarily describe the content and areas that should be considered in project management, they do not provide much guidance about the way work should be conducted in a project. Thus the company's project managers must choose the practices to be applied in performing project work to ensure highest possible quality. It is advisable for a company's senior management, or its personnel who are involved in a single project, to agree on and commit to common project management quality principles.

4.7.3 Quality control

Quality control refers to the corrective and controlling actions involved in monitoring realized quality and in removing any detected quality variations or problems. By monitoring intermediary project results, the degree of achievement or realization of quality criteria can be estimated. The objective is to find deviations from quality standards, determine the causes of the deviations, and take active measures to remove problems and their causes as soon as possible.

[26] Project Management Institute (2004) PMI Body of Knowledge, IPMA (1999) International Project Management Association Competence Baseline, and standards of other similar associations.

The intermediary results can be analyzed in relation to the product resulting from the project or to project management performance (e.g. costs and schedule performance).

There are many ways to identify quality deviations, including comparative analyses and visual checking, items typically presented as part of project reports. Statistical process control is one method of implementing quality control and it is particularly applicable in production environments. Although large-volume manufacturing entities are not necessarily treated as projects, the ideas of statistical process control used in such settings and involving sampling, probabilities, tolerances, inspections, and random and process variations, can usefully be applied to projects. There are many other methods for quality control presented in the project management literature, including quality circles, methods for continuous improvement, various problem-solving techniques, and six sigma. In a project environment, the methods most suitable for handling the uncertainties in the project should be chosen.

When controlling both the quality of the product resulting from the project and project management activities, audits (reviews) can be applied, in which the quality criteria are studied in an interactive followup meeting. The audits can be formal or informal and anticipated or unexpected, and their content may be planned in advance or treated as situation specific. Matters that can be reviewed as part of the audit include the situation of the project, recent results, utilized methods, emergent problems, and plans for the future. Ideally people participating in the audit should include individuals from the project group, as well as other, perhaps more neutral, representatives of the supplier and the customer. Thus different viewpoints on the project results and events can be discussed during the auditing process, simultaneously enhancing project communication. Furthermore, problems requiring acute decisions can be solved and changes and further actions can be agreed upon.

The control of overall quality can be equated to good management practice. Although we have described a simple approach to quality management, and have made recommendations to choose and develop project management practices that best fit the company or project, these matters are hard to separate from the company's culture – its way of acting. The term "total quality management" (TQM) can be used in this context, and it consists of the following factors, among others.

- Quality thinking should start with the company's management, and a commitment to quality must apply throughout the organization.
- The company should recognize the most critical quality problems, direct enough resources to solving them, and interfere in them in a timely manner.
- The company should recognize the factors that signal high quality and use them to make central processes measurable.
- Quality is created through information and processes; quality problems are solved with the help of statistical analysis and followup actions.

Project management and models for project work maturity have been developed as part of quality systems, in which the activities and processes of the company or a project are described, utilizing certain assumptions. Maturity models describe the level of activity (i.e. maturity) of projects, and without exception, all models employ five levels. Level 1 indicates that the activity in the various projects of the company is highly incongruent. Level 5, the other extreme, represents ideal activity. When acting at level 5, the activity spanning the entire company is highly congruent, measured, and constantly developed on the basis of experience gained from projects and their management. The core purpose of maturity models is to identify the maturity level of the organization's project activity and to help company management move forward in performing their project activities. The description of each maturity level, as presented in the maturity models, provides good ideas on what to do to improve project-based management, with a view to achieving the next level congruency in the company's project activities.

Maturity models developed for different purposes are naturally based upon certain assumptions about the application environment and about what type of activity is ideal, and worth pursuing. Thus prior to applying a maturity model, the company should make sure that it is based upon the right assumptions about its application environment.[27]

4.7.4 Cost of quality

Although we have emphasized quality from the viewpoint of customer expectations, quality also has implications for or impact on project costs. On the one hand, quality management creates costs, but, on the other hand, it serves to decrease them. The cost of quality consists of four factors.

Costs of self-detected mistakes, scrap, and rework. If mistakes are made in the parts of the project or in the resultant product or if there are material problems, costs can be incurred. Additional costs may result from such activities as searching for the mistake, expending extra materials and work, making extra repairs, disposing of the faulty material, handling delays and rescheduling, and performing extra paperwork.

Costs of faults reported in customer complaints. If a faulty solution or component ends up in the product resulting from the project, and if the customer discovers and complains about the fault, the supplier may incur such additional costs and losses of revenue as extra transportation or installation costs, guarantee payments, and return of funds to the customer. Product faults and consumer complaints may create indirect and intangible costs for the project supplier because they may lower the supplier's reputation, lessen its new business opportunities, or create other intangible losses. Such losses are difficult to quantify, but they may be substantial.

Costs of quality assurance and control. Costs are involved in maintaining the quality system, including costs associated with inspections, audits, testing, and troubleshooting.

Costs of preventing and avoiding mistakes. It may cost a company a significant amount of resources to mount training, communication, and procedure development activities that will help prevent or avoid mistakes, and thereby improve quality. Developing tools and processes, collaborating with subcontractors, and analyzing quality trends are some specific ways to avoid

---

[27] E.g. Software Capability Maturity Model (CMM SEI / www.sei.cmu.edu), Systems Engineering CMM, Software Acquisition CMM, Project Management Institute (2003) OPM3 (www.pmi.org)

quality problems, however, these steps are not all calculated as expenses of quality management; they may be part of a more general development of the company.

The various sources for the costs of quality are often interdependent. For example, an investment in preventing mistakes and in mounting quality assurance programs decreases the costs due to rework and lowers the number of potentially costly customer complaints.

It must be remembered, however, that investments made to improve quality bring benefits with a medium delay. The effects of quality management practices in a single project do not necessarily produce cost benefits over the course of executing the project in question. Preliminary improvements can be detected after about 18 months, and the costs from preventing quality mistakes will only start to decrease after a few years. The actual benefits are received as longer-term savings for the company, increased effectiveness in future projects, and development of new competences. Thus the investments in preventing and avoiding quality mistakes should be funded from the overhead costs of the company rather than from the funds of a single project.

4.8 Communications and information management

Communications management is a separate project management knowledge area. In this section, project communication and information management are described briefly, mainly through frameworks and procedures. An alternative view of communication – in which it is seen as a competence of project personnel, particularly the project manager – is presented separately in Chapter 5 in context of discussing the competences of the project manager.

Project *communication* refers to the transfer of information to and the interaction among various parties and stakeholders in the project. There are many dimensions of communication: There are always two, and often more than two, parties taking part in communication, and communication can be one or two way, formal or informal, oral or written, planned or spontaneous, and factual or emotional in content. Regardless of its particular form, communication is a crucial means of influence within a project or in any other objective-oriented activity, because, in addition to the transfer of information, communication involves interpretation, adoption, and feedback regarding the information content. We can also discuss *information management* in connection with project communication; information management refers to creation, storage, and distribution of information, knowledge, and documents related to the project. Although communication is one field of information management, it includes broader social and emotional meanings than are typically associated with information management.

Various communication means or media can be used in project management – for example, paper, e-mail, Internet, oral presentation, and discussion. Communication can occur in various situations (i.e. contexts or locations): at meetings, seminars, conferences, work desks, coffee tables, or in the hallway. Communication can be conducted as part of everyday work on a project or a separate, targeted communication event can be arranged.

Various project stakeholders have differing expectations of communication. A typical expectation, both from inside and outside the project (i.e. from the customer and other stakeholders) is that communication should be continuous, truthful, and properly targeted. Nevertheless, in urgent, goal-oriented project work, a balance must be found between the quantity and quality of communication. Confidentiality issues related to project communication may also occur; therefore, communication must be planned with caution.

Project communication is most visible when it is defective and erroneous, and this situation is likely to occur when other quality problems are revealed. In project communication, as in quality management, it is advisable to use anticipatory and systematic ways of working. Ideally, project communication occurs as a smooth, continuous part of everyday project work and management activity.

Successful communication occurs when the recipient of the information clearly understands the content of the message and the sender knows that the recipient has understood it. In a unique, complex project environment, achieving this communication outcome is more easily said than done because communication content is open to interpretation and the social skills of the communicating parties vary considerably. To increase chances of having the project message understood, the communicator should tailor message content to suit the target audience. Recipients of the project communication message should interpret the information on the basis of the situation, the sender, and many other factors, and they should provide feedback to the sender indicating whether or not the message has been understood, the way it has been interpreted, and what their response is to it.

4.8.1 Communication planning

The purpose of communication planning is to anticipate the project's communication content, to understand the information needs of the stakeholders, and to choose the proper channels to execute the communication. Although communication planning typically concentrates on the formal communication in a project, informal and spontaneous communication always occurs during projects. Communication planning is often conducted early in the project lifecycle as part of project planning, but the plan should be updated as the project progresses. A communication plan can be presented as an integral part of the project plan or as an appendix to it.

Communication planning spans project communication relatively broadly; it includes such matters as who needs information, what type of information is needed, when the information is needed, who will transmit the information, and what channel is used to transmit the information. Experiences from earlier projects and their communication activities can serve as a basis for communication planning. Communication requirements related to project scope, and the stakeholders' expectations for communication, should be studied as part of the planning. The stakeholder analysis completed in the preparation phase of the project is also useful for communication planning: the information needs related to the project can be studied for each stakeholder group. Additionally the various technical communication vehicles or channels available in the company should be considered in communication planning. Decisions should be made regarding the communication channels that are to be used for what purposes. It can be agreed that the primary communication channel used in the project is weekly meetings, for example, but that change proposals are made in the electronic database available to all.

Communication planning can be conducted as part of the natural teamwork of the project team, and the planning may be extremely detailed or relatively general depending on the characteristics of the project. Typically, it is necessary to plan for certain repetitive communications (e.g. regular reporting) as well as special case or situation-specific communications (e.g. communicating project results through a public medium).

The communications plan can be presented in text form or as a summary table. Typically the following components are included in the communications plan:

- content of communication (and link to an activity or part of the project);
- stakeholders affected by communication;
- desired communication effects (i.e. why is there communication?);
- method: means or channel of communication;
- timing of communication, and possible repetitions; and
- the person responsible for communications.

4.8.2 Processing, distribution, and storage of information

It is necessary to process, distribute, and store information created in a project; this information can be related to the product resulting from the project, intermediary results, or project management. The term *project documentation* is often used to capture these three aspects of project communication. Documentation related to the product resulting from the project may include such items as specifications, designs, concept definitions, simulation reports, and perhaps test versions, samples and demonstrators. Documents related to project management may include the project plan, complete with appendices; customer and subcontracting contracts; intermediary reports; forecasts, agendas and memos from meetings; project-related proposals; and results from customer satisfaction surveys.

Project documentation serves four functions. 1) In practice, part of project documentation may be the product resulting from the project. For example, the designs and user manual of a new papermaking machine are valuable to the customer and form a required part of the product. 2) Written documentation is one means of communication, particularly for large projects, as all matters cannot be communicated orally or personally, and written documentation makes it easier to disperse information. 3) Written documentation is a means of quality management, as it increases visibility of project activities and events, making it easier to compare planned and realized actions and events. 4) Written documentation enables learning from one project to the next; things that have been developed in one project can be utilized in subsequent projects and documentation helps to process these matters.

There are many procedures and tools for information management, and the members of the project team should agree on the information management procedures that are to be applied in the project. It is also useful for them to agree on the type and content of information that will be documented. Because information technology has become common, it is typical for the project team to agree on common electronic documentation tools, storage locations, and even project-specific databases or directories. Often the customer has certain requirements for project and product documentation, but these requirements do not cover all the information management areas relevant from the perspective of the supplier and the activity it is executing in a project.

As for communication in general, information management should be properly planned. This information management plan may be described as part of planning the phases of the project and should include description of what documents are to be created in the various phases of the project, and the way the documents are to be developed. The typical project management documents and their phasing over the project lifecycle are presented in Figure 66. Additionally, technical and commercial documentation created during the project (such as a business plan, product and solution descriptions, and testing reports) must be planned separately by business area, or by project case.

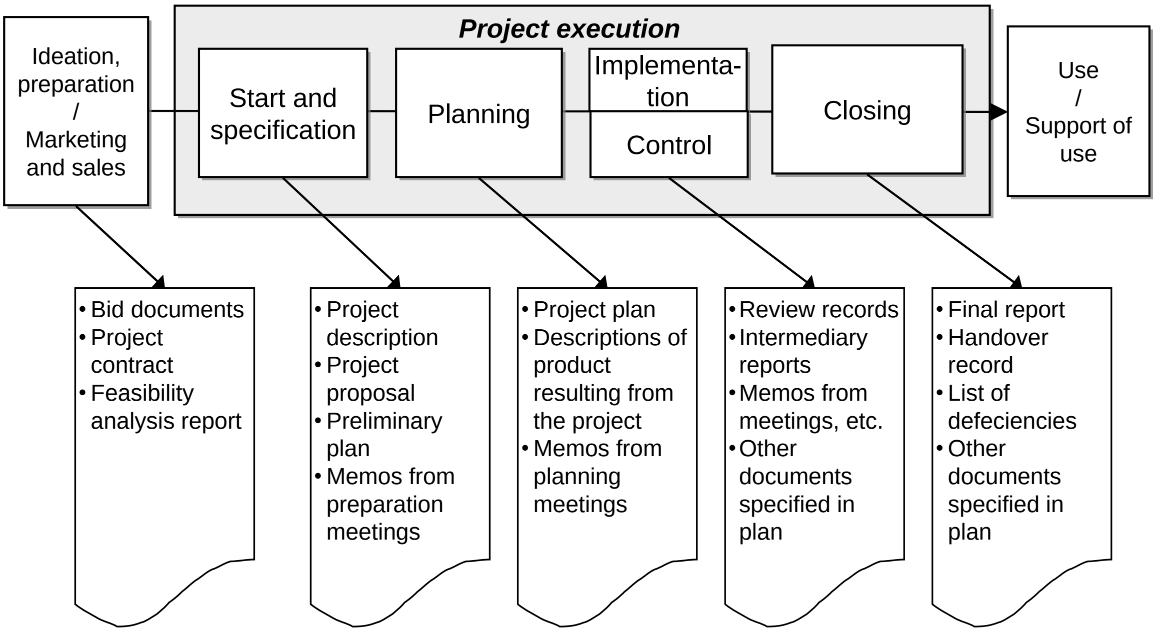


Figure 66. Example of project documentation produced at various phases of the project lifecycle

As the project team initiates its work, team members should agree on the way in which documents are to be managed, including answering such questions as: Where are the documents to be stored? Who is responsible for what documents? How and to whom are the documents to be distributed? In highly technical projects, for instance, various versions of the technical designs and plans may be processed, and the way these plans and designs are to be managed should be agreed upon in advance. Additionally, from the perspective of the entire company, it may be necessary to keep track of the status of individual documents on a specific project. If project documents are located separately on desks or computers of single employees, they are not usable by other company employees, making it difficult to form a general picture of the project among many or all employees.

Issues regarding confidentiality and ownership of information are particularly salient as information technology has become common. The project contract may require that the information processed in the project be kept confidential only among those directly involved in the project, or among members of some other separately defined group. If this information is revealed to persons outside the project, the contract will be breached and penalties may result for the guilty party. Understandably, confidentiality clauses are common in project business contracts. Such clauses can also define that ownership of the product resulting from the project, and the inventions created while developing it, belong to the customer, and that the inventions in question must not be applied elsewhere. Alternatively the project supplier can apply its own inventions in the project, in which case contract clauses should be written to ensure that the customer may not use these inventions elsewhere; and the contract should specify the sanctions that apply if one party breaches the other party's intellectual property rights.

4.8.3 Meetings and workshops

Meetings are among the most valuable tools used to manage and coordinate the activities of an organization. Certainly, they are a commonly used tool in managing projects. Project meetings are planned in advance and, when convened, provide time-restricted events at which issues relevant to the project are to be solved. It is useful to make distinctions among project meetings, discussion events, and briefings. *Meetings* concentrate on processing matters and making decisions; *discussion events* do not result in decisions but are useful for preparing decision proposals; and *briefings* involve communicating matters, often to a larger group. Project workshops are a form of activity broader than a meeting, and combine characteristics of both meetings and discussion events; they are useful in preparing for and solving matters central to the project. For example, the project team can prepare the project plan in a common workshop.

Meetings (and workshops) are used to implement and monitor project activities, distribute and process information, and make project-related decisions. Meetings are a valuable way of communicating and making decisions in a project. Instead of being all inclusive, meetings concentrate on a few such highly relevant matters as achievements, deviations, problems, and issues requiring responses or decisions.

Various types of meetings may be required over the course of a project. For small projects, it is typical to hold project team meetings, and, in some cases, issues relating to the project are discussed at project portfolio or corporate steering committee meetings. If several different stakeholders are involved in the project, there may be a need for meetings and negotiations between supplier and customer, supplier and subcontractor, or supplier and other stakeholder groups. For large projects, in addition to meetings of the project team and project steering committee, there may be a need for such subproject meetings as hardware, software, or service subproject meetings.

Meetings can be classified by their function: planning meetings, followup meetings, and negotiating meetings, for instance. Furthermore, meetings can be periodic (e.g. weekly or monthly), ad hoc (held when needed), or tied to project milestones (e.g. design review meetings, product approval meetings, or production ramp-up meetings). Different types of meetings are emphasized in different phases of a project. In the project start phase, informal planning meetings and negotiating meetings may be held; whereas in the execution and control phases, regular followup meetings may be held. A plan for project meetings is made in conjunction with the project plan, and meetings are timed to ensure that the key resource personnel and decision makers can attend, facilitating timely decisions.

As a general rule, a group of people relevant to the issues to be processed in the meeting should be convened. The composition of meetings of the project team and the project steering committee are relatively stable because membership comprises the group in question. At times, however, it may be necessary to call other people to join these group meetings for discussion of the content of some matters to be processed at the meeting. Such outsiders do not need to participate in the entire meeting; they may be excused after discussion on the part of the project relevant to them. A subcontractor's representative can be called to report on the state of the subcontracting package at the beginning of a project team meeting, after which this representative leaves the meeting. In the interests of effective meeting management, the number of members taking part in a meeting should be kept as small as possible, preferably to fewer than ten people.

Typically, every meeting has a chair and secretary. The chair is responsible for the meeting agenda, delegating preparative tasks, and keeping the meeting on schedule. The secretary is most often responsible for convening the meeting and recording minutes. Other tasks and roles can also be defined in a meeting; for example, individual team members can be asked to serve as communication links and gatekeepers toward management, subcontractors, or other stakeholders.

To be successful, meetings should progress in a systematic manner, utilizing effective meeting practices. In preparing for the meeting, an agenda should be defined, a time should be allocated to each agenda item, and responsibility for each agenda item should be assigned to a specific person. The material related to items on the agenda should be prepared in advance. As the purpose in a meeting is to concentrate on relevant issues requiring decisions, total meeting time should be restricted. Participants should be informed of the meeting at least a week in advance and, if possible, the material that participants should familiarize themselves with before the meeting should be distributed at this time, or at least a day or two in advance of the meeting. The people responsible for presenting material at the meeting should, in advance of the meeting, prepare a short presentation of the issue, timed to fit the meeting schedule; well prepared preparations enable meetings to proceed concisely, according to the agenda and schedule.

Every meeting should have a clear opening and closing. The chair should lead the work of the committee according to the schedule and agenda. The agenda should be checked at the beginning of the meeting, and any new issues should be added under the news items or miscellaneous items part of the meeting agenda. In the interest of conducting efficient meetings, the people responsible for presenting matters should introduce the material (often a proposal) to be considered, and discussion should be focused on the decision options and recommendations. As matters are discussed, the chair should ensure that the discussion on an agenda item does not digress to irrelevant issues. Furthermore, the chair should, in advance of the meeting, ensure that highly uncertain items are discussed among relevant parties so that the meeting can be better focused on actual decision-making activity.

As for the meeting itself, each processed issue should have a clear beginning and end. If some issues are left open or unsolved in the meeting, a processing schedule should be agreed upon. As part of the meeting, a list of action points common to the entire group should be reviewed and updated. The list should be updated with the state of the tasks agreed upon in the previous meeting. Finished tasks should be marked as completed and taken off the list, whereas for unfinished tasks, the person responsible for each new task, and the schedule of the new tasks, should be added to the list.

At the end of the meeting, the chair should make a concise summary of the conclusions of the discussion and the actual or potential decisions arrived at. After the meeting, the secretary should record in the minutes of the meeting the central subjects of conversation in the meeting, the decisions reached, and the actions agreed. Appropriate minutes are concise, easy to read, and emphasize actions. The minutes, complete with relevant appendices, should be distributed to all participants as quickly as possible after the meeting. The minutes should be stored in a designated place in the project's documentation system: the common folder for the project in the supplier's information network, for instance. The matters on which a decision has been made in the meeting should be communicated to relevant parties as agreed at the meeting, usually by the chair or another designated person, and the status of followup action taken related to the tasks should be presented and discussed at subsequent meetings.

The matters discussed during a meeting and the conduct of the meeting varies according to the type of meeting in question. There may be a need to organize broader workshops, particularly at the beginning, end, and central milestones of the project. In these workshops, many issues related to the project are processed and planned intensively over one or two days. The first and last meetings of a project are discussed in detail in Section 5.3 by way of example, and the content and procedure of steering committee meetings are discussed in Section 5.5.

The management of meetings can be regarded as a so-called hygiene factor, which, when handled well, is an invisible yet critical part of effective project work. When meeting management is handled poorly, however, meetings tend to take too much time, slowing work progress and harming project atmosphere. Typical mistakes made in meetings are poor planning, poor management of the meeting process, lateness and other distractions in starting the meeting, slipping from the agreed schedule, concentrating on little things instead of more relevant matters, indulging in personalities, drowning decision making in arguments or digressive conversation, and too detailed and lengthy documentation of the discussions in the meeting minutes. To minimize these problems, the meeting chair should keep the meeting under control, focusing attention and discussions on the most relevant issues (not on personalities). It is also helpful if, at the outset of the meeting, the chair gets meeting participants to agree to follow clear meeting principles.

4.8.4 Negotiations

In the context of project management, *negotiations* are meetings in which the work between the customer and the supplier, and the price to be paid for it, are agreed upon. Thus negotiations occur in the context of project sales as well as project-related subcontracting. Stricter than normal requirements apply to these negotiations because several stakeholders are present and the task is complex and difficult; it is challenging to arrive at objectives that satisfy all parties.

Typically, negotiations consist of one or several meetings between the customer and supplier. In addition, informal occasions may be arranged for the parties to get to know each other, to exchange thoughts, or to give and receive notifications. A predefined plan is usually prepared to guide the negotiations as a whole, for example, explaining that the negotiations are to be held over a tight time schedule, and providing a list of issues to be prepared and processed. Depending on the scope of the target of negotiations (i.e. the project or subcontracting package), the duration of negotiations can vary from less than an hour to several months.

Negotiation involves bringing out differing points of view, justifying them, and asking, explaining and searching for a common understanding. Experiments have shown that the best negotiation outcome occurs when both parties share project-related information as openly as possible. Typically, in an open negotiating environment, solutions are found together to the benefit of both parties, even in cases in which the negotiating parties value different things.

An agenda should always be prepared and distributed in advance to all participants involved in official negotiation sessions. Both parties should nominate a person responsible for the negotiations; for the supplier it is often the sales manager, and for the customer it is usually the purchasing or investment manager. Depending on the situation, lawyers, potential project managers, and technical and other experts may be present as well. It should be made clear which member of a party's negotiation team will be the lead person responsible for presenting and making decisions on issues, and on which items the other members of the team can comment, at the request of this lead person. Team members should avoid talking simultaneously and should avoid unnecessary correction or dispute of comments made by other members of the team because such comment causes unnecessary confusion in the team’s message and is a sign that the leader is not in control of the situation. In short, internal conflicts should be resolved inside the team outside the negotiation situation, and to maintain a proper negotiating position the team should act consistently and maintain clear roles over the course of the entire negotiations. If the team airs an internal conflict, the other party may take advantage of the situation to drive its own interests.

As mentioned, the leader of a party’s negotiation team should comment on items and make decisions during the negotiations. Special care should be taken to ensure that acceptances and decisions are appropriate; nothing proposed by the other party should be accepted by accident. The negotiating team must be especially cautious when agreeing to terms relating to its responsibilities and the scope of delivery; for example, the supplier should not forget to use contractual terms to legally restrict its financial liability to a certain maximum sum.

Both parties should remember that processing a new matter may require additional investigation; there is no need to make an immediate decision. Either one of the negotiating teams may ask for a break and leave the room to discuss the way to proceed in an uncertain situation. During these breaks, additional information can be requested via telephone or e-mail from people who are not present at the negotiations. If the negotiating team does not have the authority to decide on a matter presented, or if the issue at hand requires substantial additional investigation, the negotiating team can state that it will make the required inquiries and return to the matter in the following negotiation meeting.

At the end of a negotiation meeting (particularly after long meetings), the discussed and agreed-upon matters should be summarized in writing so that they can be communicated in a followup memo. Typical negotiating meeting documentation should include a record of decisions reached, further actions to be taken, and a list of open matters requiring additional investigations or negotiations. Such written documentation helps ensure that the matters raised in negotiations have been understood by each party, and serves to avoid problems that often arise if parties rely on oral agreement; frequently recollections of oral agreements differ, so the central issues related to negotiating and making a contract should be documented in written form.

Further actions, if any, should be included in an end-of-meeting summary, and these may include concrete tasks for both parties, for which responsibilities and scheduling must be agreed upon. Such summaries should also specify the agreed time, objective, and content for the next negotiating meeting, and indicate who is to attend (participants, convener) and what content matters need to be prepared beforehand.

Although negotiations may require several different meetings, their principal result is the contract document that emerges from the entire negotiating process; the contract directs and guides project collaboration and implementation between the parties. However, the value of the negotiating process itself should not be discounted, as it increases mutual familiarity and trust, factors that are as significant for the future collaboration as are the matters stated in the contract.

4.9 Integration management over the course of a project

The project does not necessarily remain unchanged throughout the project lifecycle. Indeed the original project ideas frequently change in some respects, so integration management over the entire course of the project is required to ensure that the project results provide the expected *benefits* and that the project remains feasible to the end. Central tools for integration management during project implementation and control are the project plan (that may be updated during the project), *change management*, and *project reporting*. In this section we discuss project change management and project reporting. As well we discuss the topics of monitoring project progress with the help of earned-value calculations, and assessing project success.

4.9.1 Change management

Many types of changes occur during a project. In this context, a change includes any deviation from the plan that affects project progress or results and requires a response. The deviation may be self-inflicted: the project personnel may invent more features for the product resulting from the project or improve its quality. The deviation may also be inadvertent and caused by an external source: the customer may want new features, the regulations of authorities may change during the project, or availability and capacity problems may arise regarding equipment used in the project. It is often useful to make a distinction between unwanted changes and changes demanded by the customer, as the customer may be willing to pay more for the changes it requests. The purpose of change management is to try to avoid feature, product, or resource-related problems that may threaten the success of the project, or at least to minimize them. In short, c*hange management* involves reacting to an unexpected deviation related to the project.

Needs for change

Many factors in the project's operating environment can precipitate the need for change. A customer may add, specify, or decrease its requirements. New information may be received during the project from or about end users, authorities, or other stakeholders, and these revelations may create change. The market or competitive situation may change and in some ways affect the project. There may be unexpected events in the work of subcontractors – delays, resource changes, or false interpretations – and these should be taken into account. There may be updates in the available technologies that should be considered. The choices of technology made by the customer or the project team can change as the project progresses. Furthermore, issues internal to the project like quality problems, availability of resources, or deficiencies in the product specifications or plans, may cause pressure for change during the project lifecycle.

Changes can be related to the technical, commercial or other features of the product resulting from the project, the progress or methods for project execution, or some other areas of the project plan. If the deviations are so small that fixing them or leaving them unfixed does not affect the results or progress of the project, it may not be advisable to process them as part of change management. Most often the project personnel can fix such small deviations in their own work without affecting the schedule, budget, or other objectives of the project. If, however, the deviation has expected direct or indirect effects on achieving overall project objectives, change management is needed.

Risk management is one way to anticipate and control needs for change. Additionally companies intentionally use certain reviews, acceptances, decision gates, and freezing points to minimize the effects of unanticipated changes. The freezing point refers to a set or fixed time beyond which the details of the plan can no longer be changed. There can be several status levels assigned to plans that are fixed (i.e. in the frozen phase). Perhaps freezing enables subsequent plans to be made, or freezing can signal that the plan can be used as the basis for ordering the required materials and services from subcontractors. In any case, freezing always implies that the frozen plan can no longer be changed without applying separate change management procedures. In product development, for example, the plan for the chosen concept can be frozen (concept freeze) or the product design can be frozen (design freeze) at a certain milestone of product development, at which the concept or design is considered final and the related accepted documentation guides further actions. Freezing requires that all the information and documentation related to the stage of work or intermediary result is in order and can be accepted by the various project parties. After a project plan is frozen, all changes related to the concept or product structure must be processed by the means of change management. The company may have established practices for freezing plan details, and the intermediary reviews they require, and their links to change management must be indicated clearly.

Activities and execution of change management

Changes related to project scope always have an effect on other project objectives. Therefore change management should proceed in a methodical and controlled manner. Change management practice can be agreed upon as part of the project plan, project norms, or other project guidelines. Typically change management proceeds from identifying a need for change to analyzing a change and accepting (or rejecting) the change, as illustrated in Figure 67.

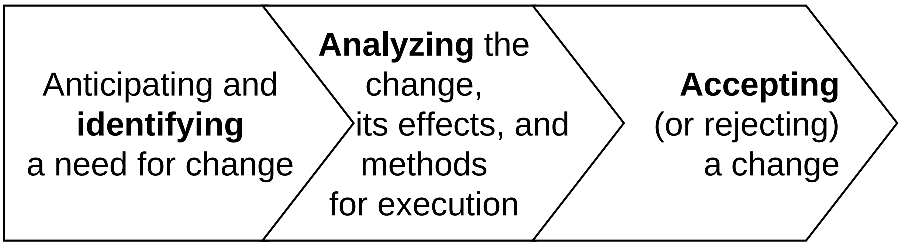


Figure 67. Progress of change management

The purpose of change management is to[28]:

- process *change proposals* directed at the project;
- identify the effect of the proposed change on all the areas of the project;
- identify external and indirect effects caused by the change; too narrow an analysis of the change may ignore significant change effects;
- evaluate the effects of the change on the project plan, particularly the project budget, schedule, and results;
- evaluate the benefits and disadvantages of the change, and compare them with the benefits and disadvantages if the change were not executed;
- identify optional ways to generate the benefits that are to be reached through the change;
- accept or reject change proposals;
- communicate acceptance or rejection decisions, and their justification and consequences, to all affected stakeholders; and
- report changes and their effects in a uniform manner.

Identified needs for change are processed in a project by means of a *change request* (or change proposal). In order to process the changes systematically, change requests must usually be presented in a uniform manner and according to an agreed-upon process. It may be agreed, for example, that change requests implying small and medium effects are to be presented to the project manager, that changes implying large changes are to be submitted to the chair of the project steering committee, and that all changes are to be documented in a common change management database. At a minimum, the following content should be addressed in a change request:

- description and definition of the need for change;
- source or reason for the change (e.g. demand of the customer, error or fault, enhancing a specification);
- implications of the change (benefits and disadvantages of the change, and what would happen if the change were not executed);

[28] Meredith & Mantel (2003)

- target of the change (e.g. specification, contract, project plan, procedures); and
- evaluation and description of the change (direct and indirect effects and implications on project scope, schedule, costs, resources, and benefits).

The change request is presented and recorded in a way agreed upon in the company. It may be necessary to analyze in detail the need for change and its effects, particularly if the effects of the change are long lasting and apply to multiple stakeholders. Figure 22, presented in Section 4.2, depicts the exponential increase in the cost effect of a single change as a function of time. This cost increase is due to the indirect costs of the change that, in turn, cause additional changes to plans and to previously executed parts of the project.

The recorded change is processed in the project in an agreed-upon way. It may be agreed in the project who accepts the changes and what are the general terms and requirements for accepting them. There are three general options for the change decision: the change is not executed at all, it is executed inside the scope of the project (through modifying the project plan), or it is executed later as a separate project or as part of another work package.

A key element of change management is communicating change decisions. Whatever the decision concerning the change, the person who presented the change proposal and the other relevant parties must be informed about the rationale for the change decision, the execution of the change, and other issues related to the change.

The types of responses required by a change can vary among and within companies, and from one decision and the next. A general guideline cannot be provided for the extent to which changes should be taken into account in the project budget or schedule. Are the budget and schedule revised because of a change, are only the required additions made, or is the variation that occurs accepted inside the original plan? The response to change is thus specific to a project or company. It is nevertheless common that change decisions and responses are recorded in the same way as change requests, and a person is designated to be responsible for the responses. The realization of changes can be monitored as part of the normal work of the project team. As the responses required by changes are implemented, agreed-upon followup may still have to occur in order to assess the final effects of the changes. If it has been possible to control the change effectively, the project usually progresses smoothly in spite of the identified deviation.

General principles of change management

In addition to the specific change management procedures we have outlined in this subsection, there are a number of general principles for change management.[29]

- All project contracts between the customer and the supplier should include a description of the way changes related to the project plan, budget, schedule, and results should be requested and processed, and the way the financial and other responsibilities for executing the changes are determined.

[29] Meredith and Mantel (2003)

- After the project plan common to the customer and supplier, and other plans, have been accepted (or officially handed over to the other party as plans equivalent to frozen plans), all matters involving changes to the plans must be processed as change requests.
- Changes shall be accepted in written form. If the changes are related to issues at the project contract level, acceptance of the customer and the contractually responsible people from the executing organization are required. If the changes are internal to the project, the accepting party can be the chair or another member of the steering committee or the project manager, depending on the importance of the change and the person who is authorized to accept changes in the project.
- Change requests should be discussed with the project manager before they are processed officially. (It may be concluded that the change is so small that it does not affect the project plan or the details of the project contract.)
- When a change request has been identified, recorded, and accepted, the project plan should be corrected to reflect the fact that the change has been taken into account. The change must be communicated to the relevant parties.

Change management is in many ways linked to risk management. Change management becomes relevant if anticipated or unanticipated risks are realized, or if other deviations from the plan occur. Risk management can be used to decrease the need for change management, but changes cannot entirely be avoided. Change management relates strongly to document management, as several versions of the technical and project documentation can be created during the progress of the project. It is essential that all relevant people have access to the same version of the documents and that everyone works according to the valid version of the document. In particular, changes made to frozen documents are processed through the means of change management. Additionally change management can be related to problem solving and processing conflicts, which are studied in Chapter 5, Section 5.4. Problems and conflicts can lead to changes and change management.

4.9.2 Project control and reporting

Project reporting and followup are a central part of *project control*. The purpose of *project reporting and followup* is to ensure that the project is proceeding as planned and that the project results fulfill expectations. The project situation and intermediary results describe the progress of the project. Progress can be studied from two different perspectives: from the perspective of the progress made in the product resulting from the project, and from the perspective of the realization of the project plan – the work performed in the project. Full project reporting and followup is conducted in order to serve the interests of the supplier and, targeted reporting and followup occurs to serve the interests of the project customer.

Reporting can include all the areas of project management, or the management team can have other special wishes concerning reporting in the project. It should be noted in reporting and followup that project-specific reporting may be slightly different than reporting in general. Project reports to management may require information other than that needed for project control; for example information on single projects needed for integration management related to the project portfolio may be included. In this section, project control is discussed as a general concept that covers the actions that ensure that the project is moving in the right direction.

Project control

Project control involves procedures used to ensure that the project progresses over its lifecycle according to the project plan and that the expected benefits result from the project. Project control is thus a central part of project management. In practice, project control involves comparing actual progress with planned progress, analyzing identified deviations, identifying and evaluating alternatives, and executing corrective responses when needed. *Followup* is closely related to project control: it involves a constant search for information that provides a picture of the progress of the project and serves to inform decision making on the required responses. *Reporting* is agreed-upon formal followup that is often periodic and tied to project milestones, deviations, or time.

It is vital to the success of project management that some avenue be open to get feedback on the state of the project, its resource usage, and its results, and to compare these progress parameters to the original objectives. On the basis of this feedback information and comparison exercise, corrective responses can be identified, which can be used to get the project back on track. For this purpose, it is necessary to define, develop, and maintain a project control system.

Control systems are not unique to project management; they apply to many types of processes. The following features are characteristic of an effective project control system:

- thorough planning of the work required by the project ;
- accurate estimation of time, workload, and costs;
- clear communication of the activities required to fulfill the project scope;
- disciplined budgeting and acceptance of costs;
- up-to-date accounting of both the progress of the product resulting from the project and the accumulated costs;
- periodic estimation of the time and costs still to be consumed;
- periodic and timely comparison of the actual situation and the planned situation (both at the time of comparison and at the end of the project); and
- level of detail that fits the complexity of the project.

Project control is thus closely related to project planning and to the estimates that are made in a project. Even though project estimates and plans may be accurate, project control is indispensable, and it should be conducted with care. Faults and deficiencies in project control may not cause disturbance momentarily, but control errors are usually reflected in project results. The earlier deviations and faults are detected, the easier it is to affect them.

Project control requires that there be truthful information available on the progress and state of the project, necessitating timely project monitoring and reporting: disclosing the progress of scheduled work, the accumulation of costs, and the state of the product resulting from the project, for instance. Reporting and monitoring information may relate to a single reporting period, but should also include accumulated data and descriptions that reflect the entire project up to the moment of reporting. At its best, monitoring and reporting is regular and appropriate activity that is beneficial to all parties.

In addition to situational information, insight is required about the extent to which the monitoring and reporting information signifies a deviation from the accepted plan. Thus, reporting information must be compared with the plan: Actual costs, resource usage, and results are compared with the progress according to the plan at the moment of reporting. Ideally the comparison reveals that the project has progressed as planned. Nevertheless, deviations are even more significant than simple reporting information, as they reveal a need for further action. Deviation reports are particularly useful for decision making, and should often be reported through such visually clear graphic reports as S-curve-shaped cost and resource reports, or earned-value reports, as presented in Section 4.9.3, or through traffic light reports, in which the reader’s attention is directed to the critical parts by the familiar green, red, and yellow (amber) colors of traffic lights.

In order to arrive at correct decisions and actions based upon reporting information and deviation reports, it is essential to know the source of the reported information and the factors that caused the possible deviations. The earlier the information is available and the more reliable it is, the easier it is to take corrective action. In case of a serious deviation, it is particularly important to prepare an immediate path for bringing the project back to health. The effects of the corrective measures on the future progress of the project should be well thought out because they may require additional planning and significant corrective steps, including such major actions as reorganizing resources, adding assignments, changing the budget; furthermore, change management may be required. Sometimes deviations bring opportunities to the project; corrective actions may replace later phases of the project or bypass a resource bottleneck, for example.

We note that the project control system causes costs for the project. Increasing project control or making it more effective, therefore, should not be an end in itself; rather, the control system should be set in proportion to the uncertainty factors present in the project (risks and opportunities). An optimum should be sought in project control, at which the costs of the control system are used to ensure the least possible amount of risk and greatest possibilities for capturing opportunities.

Reporting systems and practices

Reporting is a central part of project control. Without appropriate monitoring and reporting, project control would remain occasional and vague, and would likely be unsuccessful. Consistent reporting is required in order to understand the state of the project, to provide a solid basis for related decision making, and to justify actions based upon facts, not merely feelings.

An effective reporting system provides truthful, justified, information and makes such information visible to facilitate analyses and actions. We can identify several requirements for a properly functioning reporting system; these requirements relate to the system’s initial data, instructions, content, and use, and to the conclusions and actions made with the help of the system. The requirements for an effective reporting system are presented in Figure 68.

Sufficient initial data and instructions	Right content and efficient execution	Yields information that leads to further action
• Makes skillful use of descriptive and numerical information • Makes information easily available • Provides clear instructions to users, for example, the project parties know the roles of all parties and execute their own role in providing reports	• Is directed at the most relevant matters for the project and the company • Covers all the relevant areas and objectives of the project • Consists of methods and tools that are easy and fast to use • Is regular and appropriately frequent considering the project time span • Has accuracy suitable to the nature of the project • Is transparent and consistent at its various levels	• Provides information that is comparable with the plan • Warns of deviations that require action • Tells about the future and the past • Promotes clear, interactive communication • Leads (when needed) to concrete decisions and actions

Figure 68. Requirements of an efficient reporting system

The reporting system, like project planning and other areas of project management, must be appropriate for the project. For example, reporting in small projects may be informal and frequent as the project team may constantly be in contact with each other; thus no separate reporting information is needed. In large, risky projects there may be a need for systematic, regular, and consistent reporting that helps form a coherent picture of the complex entity. In the case of large projects, reports may require several levels and may need to be linked; thus information gathering should be as automated and as frequent as possible. Typically for large entities, the basic status-of-project progress reports form part of the project information systems, and information about deviations, in particular, should be handled in more detail through face-to-face discussion.

In creating a reporting system, four basic questions should be addressed.

- How is the reporting information collected (from where, and by whom)?
- How is the reporting information processed (by whom)?
- For what needs are reports produced (and what types of reports)?
- How frequently and at what level of detail does reporting occur?

Reporting may require the collection and processing of both descriptive and quantitative (numerical) data. Numerical data are often available through the supplier’s systems for materials management, resource management, schedule planning, and accounting. Project-specific reporting may be possible based upon project accounting codes in the company’s reporting systems, although project resource and cost management has not been developed to this level in all project suppliers’ organizations. All project parties hold qualitative, descriptive information. The project manager may need to ask for it separately, or there may be an established procedure for gathering it, such as regular e-mail communication and personal reporting of deviations. Typically subcontractors, as intermediaries, are asked to provide reports; thereby their activity is monitored and, simultaneously, valuable information is collected for project control.

Often, collected data must be processed prior to its inclusion in reports. Part of the numerical data can be summed up into reports – in the supplier’s monthly reporting, for example, Monthly reporting, however, may not be timely because the project may require a shorter report cycle or a situation-specific report. For example, certain decision-making situations require that the project work completed to date be reported at exactly that time and for that specific purpose. Situational reporting requires manual work on the part of the project managers or their assistants to find the correct information and to combine and illustrate it in a graphical manner. The following reports are based upon things that have occurred during the project (the basic data that are needed to construct them cannot necessarily be found in the company's information systems, so manual work may be required):

- summary reports of quality problems;
- reports about changes in requirements;
- risk reports (actual and anticipated), and the realization of external risks;
- summary reports of change requests; and
- inspection documents and written reports of meeting minutes.

Reports may need to be tailored to suit the various preferences of multiple stakeholders. Although it is generally believed that project communication should be as open and broad as possible, distributing reports too extensively may be a disadvantage because of information overload. It should therefore be agreed upon as part of project planning to whom reports are distributed and what is reported within the scope of the project reporting system. Although different parties may require different types of reports, reporting should always be used as a regular means of project communication.

At their simplest, reports can be divided into internal and external reports. Internal reports on the project are more detailed and they deal with everyday issues, including internal communication matters. The content of the reports may cover, among other items, realization of activities, resource usage, cost accumulation, quality management, procurement status, division of work, and events that are relevant for the project. Reports may be descriptive or comparative, and are most useful when they concentrate on the deviations that precipitate needs for potential further actions. For small-scale projects, reporting may be conducted orally in context of weekly meetings, whereas in large-scale projects, written reporting information may be generated automatically by the information system.

External reports on the project are often directed at the customer, the project steering group, or managers assigned to monitor the project. As the support of both the customer and the steering group is particularly important, reports are used to ensure continuation of the support and foster a common understanding that the project is progressing in a manner desired by all stakeholders. External reporting is not necessarily as frequent and detailed as internal reporting, and its emphasis is on summarizing and clearly presenting the most relevant information. Nevertheless these external reports should be consistent with the detailed information in the internal reports, so that both internal and external project stakeholders have the same type of information on the state of the project.

Instead of or in addition to summaries, the customer may require relatively detailed project-specific reporting, particularly in projects that are billed on the basis of time and material used.

In such cases, detailed hour and cost reporting is required, and is usually presented as part of the invoice or as an appendix to it. The cost report presented as an appendix to the invoice may be highly similar to the project's internal cost report, but it should report costs based upon pricing principles that are contained in the written contract, not based upon actual costs.

Figure 69 illustrates a project reporting system designed to produce reports targeted at various stakeholders. Although the situational data is the same, the form and level of reporting may vary according to the expectations of the stakeholders.

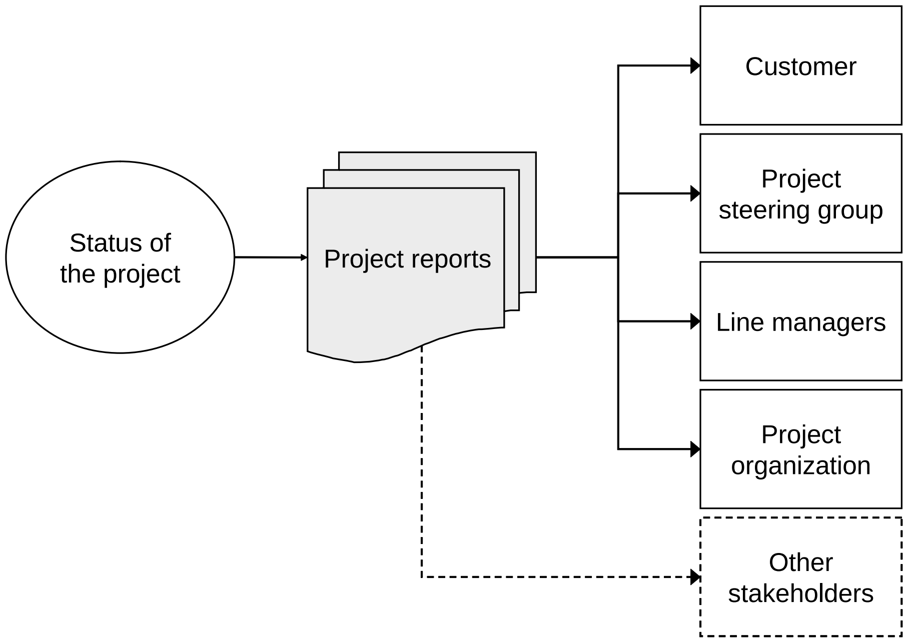


Figure 69. Target groups for project reports; the reporting needs may vary by target group

The accuracy and frequency of project reports depends on the complexity of the project and project organization, the requirements of stakeholders, the details of the project plan, and particular situational needs. In the project plan and the contract between the supplier and customer, an agreement on regular reporting has probably been made. The hierarchy present in the project plan, the work breakdown structure, should be reflected in reporting. The reporting information processed in a subproject is probably more detailed than the summary information that is reported to the project steering group, nevertheless, the information from the subprojects should be utilized in making the summary. There may also be a need to report detailed information to the steering group in a certain situation – to explain the reasons for the most prominent deviations, for example.

A significant feature of reporting is that, as a reporting period closes, it should no longer be possible to report new events that associate new costs to the period. If the reporting cycle is one month, costs and events can be accumulated and summarized only until the end of February, for example, the cut-off time for the reporting period. Costs or events cannot subsequently be allocated to this month even though they concern February's work. If constant changes were accepted to the historical data, it would be difficult to maintain credible reports and summaries from the various phases of the project. Often fixed-cost and event reporting times have been upon within companies, and these must be adhered to in maintaining the project information system.

Report types

Instead of using detailed situation reports, it is beneficial to utilize various *deviation reports* to control projects. Because expected project progress is specified in project plans, only a deviation brings relevant new information from the perspective of project control. Deviation reporting is based upon comparing the planned and actual situations of the project and the deviation between them. In this case, a deviation may relate to the current time of reporting (e.g. costs in a reporting period), previous time of reporting (costs up to the time of reporting), or a future time anticipated from the time of reporting to the end of the project (estimated costs up until the end of the project).

Deviation reporting can concern almost any area of the project plan: schedule, costs, scope, resource usage, quality, risks, among other components. The simplest way is to define the deviations is in a table or spreadsheet in which the contents to be compared are placed in adjacent columns or rows. For example, for a particular deviation item, the first column of a tabular spreadsheet may contain the planned figure, the second the actual figure, and the third the difference between the actual and planned figures. Illustrative, graphic presentation methods can be used and are useful in deviation reporting, of which the tabular form is one useful method. Several optional presentation methods for deviation reports are presented in Figure 70.

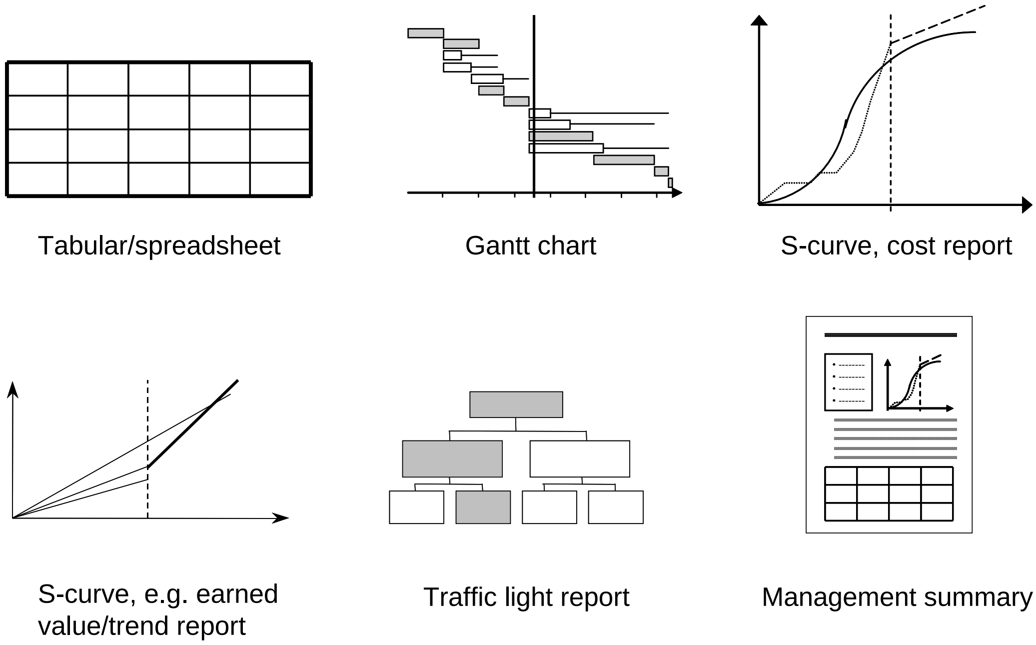


Figure 70. Examples of various deviation report types

Gantt charts and S-curve reporting can be used to compare the actual and planned values, as described earlier in Section 4.3.5 concerning management of project resources, schedule, and costs. The areas on which the reader of the report should concentrate can be highlighted through use of different colors and marking methods.

The traffic light method, presented separately in Figure 70, can be utilized in many ways. In the figure the traffic light idea has been applied to the work breakdown structure to illustrate what parts of the projects are in the expected condition and what parts require control actions. The traffic light format can also be included as part of tabular or management summary reporting, but the meaning of the different colors of the traffic lights must be agreed upon, as well as the way they are applied for the different project objectives. Are time, resources, cost, and scope to be processed separately? Green may signal that actual performance is in line with the plan. Yellow or amber may indicate that actual performance deviates from the plans inside some small range, or that the deviation does not require rapid action (or is already in control). Red may signal that actual performance deviates substantially from the plans, or that the item requires immediate action.

The milestone trend charts portray some factor of the project (e.g. schedule or costs) and its deviations in the various phases of the project. The management summary report may comprise a summary of several different graphs, and it is usually accompanied by qualitative and descriptive notations – the project manager's own explanatory text, for example. Typically project managers prefer that the report be short (one page) and that it concentrate on the relevant issues.

There may be a need for various types of reports at the various stages of the project lifecycle. Usually a distinction is made between intermediary and final reporting. Intermediary reporting may be regular, tied to milestones, or both. Final reporting is usually tied to the closing of the project: the project results are accepted only after the final report is finished and accepted.

The matters to be discussed in an intermediary report (or in the aforementioned management summary report) may include the following:

- project progress and achieved intermediary results;
- possible deviations and changes in the plan (in order to ensure anticipation, the situation at the end of the project should be viewed at every reporting point, noting the deviation between the current forecast concerning the end of the project and the original plan);
- time, money, use of subcontracting, and additional use of experts;
- possible problems and risks, near-future challenges;
- the effects of the project or its results on other activities, and on customers;
- suggestions for solutions (e.g. options for suppliers), and needs for reiterative planning (organization, people, objectives); and
- central actions in the subsequent work stage.

In the intermediary report, the situation can be described as it is. As described earlier, usually the actual values are compared with the planned ones so that further actions can be identified. It is also common to make a more detailed estimate for the actual project situation in the near future and at the end of the project, as compared with the original plan.

The final report presents a survey of project results and the realization of the project plan from the perspective of all stakeholders. As part of the final report, comparisons (of key figures) can be presented, comparing planned figures to actual accomplishments for all the areas of the project plan. In order to evaluate the project, a comparison is made between the actual and the planned values. Matters to be studied include the product resulting from the project, and the utilized human resources, time, and costs. If deviations are evident, the factors that led to the deviations should be analyzed and the lessons learned should be applied in the future.

4.9.3 Monitoring project progress: earned-value calculation

The project manager always has a qualitative feeling about the state of the project. This feeling is not based upon single measures or on attaining a single objective, but on the simultaneous state of various factors, on active monitoring of the project factors, and on discussion with the project stakeholders.

In practice the project manager is not able to get a complete picture of the project status and progress based solely on a schedule report, cost report, or a report describing the level of completeness of the project. Instead, the project manager must combine the information in these three reports to get an overall view of the actual project situation and to estimate the likely situation in the following stages of the project. Many project managers make such a combined judgment in their heads. Another approach, earned-value calculation, may be helpful. It is a monitoring method based upon systematic calculation that is used to study the progress of the project on the level of the entire project and on the level of the elements of the work breakdown structure (WBS). Performing an earned-value calculation combines the monitoring of schedule, costs, and the result achieved to date.

In performing an earned-value calculation, the planned and actual work is monitored as well as the planned and actual schedule and cost for this work. The staring point for an earned-value calculation is the basic information presented in Table 15.

Table 15. Basic information for an earned-value calculation

Concept	Abbreviation
Budgeted Cost of Work Scheduled	BCWS
Actual Cost of Work Performed	ACWP
Earned Value Budgeted Cost of Work Performed	EV BCWP
Budget at Completion	BAC

The numerical information related to schedule and costs is usually available at the various levels of the WBS, provided that the WBS has been laid out properly and a functioning reporting system is in use in the project. Additionally, an estimation of a percentage level of completeness is required, a figure based upon a comparison of results to date against the total plan. Casting concrete could be an element of the WBS, for example. According to plan, 1,000 m^3 of concrete should have been cast (scope), but only 500 m^3 were cast. The level of completeness would be 50%. Although 70% of the budgeted work hours and the budgeted labor and material costs have been expended, the level of completeness is determined on the basis of the results of the work (i.e. 500 m^3/1,000 m^3 = 50%).

In order to get a correct picture of the results achieved in the project and a realistic view of the project situation, it should be possible to determine the differences in the time and cost inputs used to accomplish the earned value of the project. Often, an estimate about when the project results will be finished and how much it will cost to accomplish the results must be determined. We now present the basic principles of earned-value calculation and illustrate them through an example, using as a starting point the project total schedule, a budget divided into reporting periods, the total plan for the project scope, and time now (the current time in the project lifecycle from which data is collected and at which the earned-value calculation is computed).

Basic information for the earned-value calculation

The basic information for the earned-value calculation is determined (at time now) and includes:

- budgeted costs of work scheduled BCWS;
- actual costs of work performed ACWP; and
- earned value EV (i.e. budgeted costs of work performed BCWP) = level of completeness (%) * BAC.

It is not always easy to estimate the level of completeness of work in a project. In mass manufacturing, the number, volume, or other concrete share of finished units (out of the objective total number of units) can be calculated. Sometimes the actual work can be compared with the work that remains and the level of completeness can be estimated. Sometimes, as in a painting job, a visual estimate can be utilized.

In projects a numerical or visual estimate is not necessarily valid (at least for the entire project), but some type of estimate of the level of work completeness should be calculated in order to use the earned-value method. The question is how to compare the partial results of the project and the work in progress to the (ultimately) finished work. Estimating the level of completeness is often made easier by performing estimates at the lower elements of the WBS, then calculating the earned value for the entire project based upon these lower level estimates. When using this procedure it should be noted that the higher-level key figures do not necessarily tell much about the actual situation at the lower levels. The figures describing the level of completeness on the upper level are weighted by the size (costs) of the elements of the WBS. In addition, cost savings in one activity may be balanced by cost overruns in another; thus the deviations and their causes are not necessarily visible in the upper level reporting.

In order to estimate the percentage of work completed, the activities specified in the work breakdown structure should be studied separately. It is not useful to study only completed activities (100% complete) while ignoring nonstarted or unfinished activities (0% finished), because work that has been started but not yet finished is also relevant for the project. In addition, a purely subjective estimate cannot be trusted, as the majority of people would estimate their work to be more complete than it really is. If activities are carefully limited and relatively small, however, it can roughly be estimated that incomplete (but started) activities are, on average, halfway complete according to plan. In this way the estimation should not cause substantial control-related risks. If it is harder to make a more detailed division, it can be decided that an activity that has not been started is 0% complete, an incomplete activity is 50% complete, and a completed activity is 100% complete. A slightly more detailed estimate on the level of completeness could be: not started (0%); started (25%); almost finished (50%); finished (75%); and, received and accepted by the person responsible for the following activity (100%).

The cost variance and cost indexes describing the situation in the project are calculated

- Cost variance (CV) = BCWP – ACWP
- Cost performance index (CPI) = BCWP / ACWP
- Cost variance index (CVI) = 100% * CV / BCWP

The schedule variance and schedule indexes describing the situation in the project are calculated

- Schedule variance (SV) = BCWP – BCWS
- Schedule performance index (SPI) = BCWP / BCWS
- Schedule variance index (SVI) = 100% * SV / BCWS

If the cost performance index (CPI) is 1.0, the performance is according to plan, indicating that, in achieving the actual result (as a share of the total result), the planned amount of money was used. If CPI > 1.0, performance is better than planned, and if CPI < 1, it is worse than planned. The same type of thinking applies to the schedule performance index, but this index tells whether less or more time has been used to achieve the actual result, compared with the plan.

In the cost variance index (CVI), the magnitude of the cost variance is compared with the achieved earned value. If the variance index is positive, performance is better than planned, and achieving the result has been less expensive than planned. If the cost variance index is zero, the performance is according to plan. If the index is less than zero, the performance is worse than planned. The same type of reasoning applies to the schedule variance index, except that it describes the actual schedule-related efficiency as compared with the plan.

Forecasting or estimating the manner in which the entire project will be finished

In order to make forecasts, assumptions must be made about the way the remaining part of the project will progress. Generally one of two alternatives is assumed.

A) The remaining part of the project will progress according to the *original* budget (i.e. the absolute cost variance that has accumulated to date will stay the same until the end of the project); thus cost estimate at completion = ACWP + (BAC-BCWP). This principle is based upon the assumption that the factors that affected cost efficiency to date will not repeat in the future, and that the absolute cost variance that has accumulated to date remains as the only absolute cost variance at the end of the project. With respect to schedule, the same type of assumption can be made to calculate the total duration for the project, or the estimate for total duration can be calculated using some other principle.

B) Cost efficiency continues at the same level at the later stages of the project (i.e. the actual percentage cost variance stays the same through to the end of the project). Thus: Cost estimate at completion = BAC/CPI. This principle is based upon the assumption that cost efficiency compared with the achieved result will continue at the same level. As in the first alternative, regarding the schedule, the same type of assumption can be made to calculate the total duration for the project, or the estimate for total duration can be calculated using some other principle.

Estimation cannot necessarily be based upon the ungrounded linear estimation used in the examples in this subsection. It may be critical to identify the real reasons for schedule and cost variances, perhaps by studying the lower-level elements of the work breakdown structure with the same type of earned-value calculation, through which the central elements for study, further actions, and underlying causes may be found. The causes may also be located through reasoning that is not based upon the earned-value calculation. When the cause has been identified, it can be analyzed by studying the activity network, for example, to determine the way this cause affects the activities on the critical path and what activities must be accomplished faster or moved forward to be started earlier in order to keep the project on schedule.

Analyzing the data reported as a result of the earned-value calculation, and obtaining additional information

As previously mentioned, the earned-value calculation can be performed on the lower levels of the work breakdown structure and, based upon these lower-level elements, values can be calculated for the progress of the higher-level elements. This exercise may be essential to get an overall picture of the project, but the information included in the results of the calculations and the related restrictions should be identified.

Figure 71 provides an example of a hierarchical reporting structure that contains content that can sometimes lead to making the wrong types of assumptions on the upper level. The reporting structure presented in the figure is a two-level work breakdown structure comprising three elements. The starting point for reporting is activity-level data, which are not necessarily visible in the reports. For simplicity's sake, let us assume that there are only two activities: A (construction, which is procured from a subcontractor) and B (planning, which is internal work). The level of completeness of both activities is coincidentally the same: 50%. The information about the activities are written in the lower level reporting structures and they are used to calculate the data used in reporting on the project level.

Now, in reporting for the entire project, the cost performance index shows substantially weaker cost efficiency than was planned: the cost estimate at completion that has been linearly extrapolated under the assumption of similar cost performance during the rest of the project, is $13,060 and this shows a substantial cost overrun compared with the total budget of $10,100. If the project structure or the situation at the lower levels was not known, it could be erroneously interpreted that the project's engineering team has performed below expectations. The reports on the lower level elements (construction and engineering) reveal that the internal engineering team has been highly cost efficient: the cost estimate at completion is 60 and it shows a substantial cost decrease compared with the total budget of 100. Instead, the external construction is the cause of inefficiency in use of costs. This information may support the reasoning that procurement management has failed in some area, lowering cost-efficiency: in organizing the competitive bidding, in formulating a contract, or in managing the subcontractor's work, for instance.

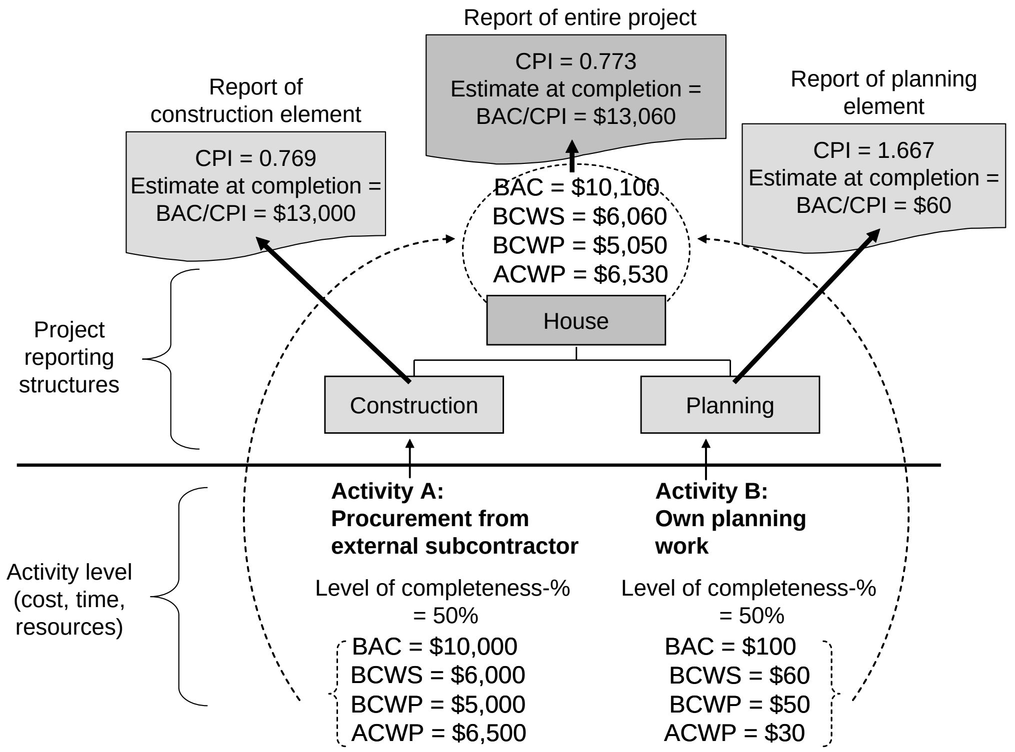


Figure 71. Example of a simple reporting structure and the accumulation of information from the lower-level elements of the work breakdown structure to the upper-level elements

Example: Earned value calculation

Sally and Larry are studying the accumulation of project costs together with LivingHouse’s project manager.[30] At this stage (time now) the budgeted cost of work scheduled (BCWS) is $124,000. The actual cost of work performed (ACWP) is only $110,000. The difference ($14,000) can be seen in Figure 72.

[30] In reality, the accumulation of project costs should be viewed regularly from the project start, as it has been done in the Smiths’ construction project. In practice, cost accumulation is often not linear, that is, it does not progress at the same pace. For simplicity’s sake, only the situation of ”time now” is presented in the example, and the accumulation of costs has been described as a straight line, that is, in linear form instead of in an S-curve form.

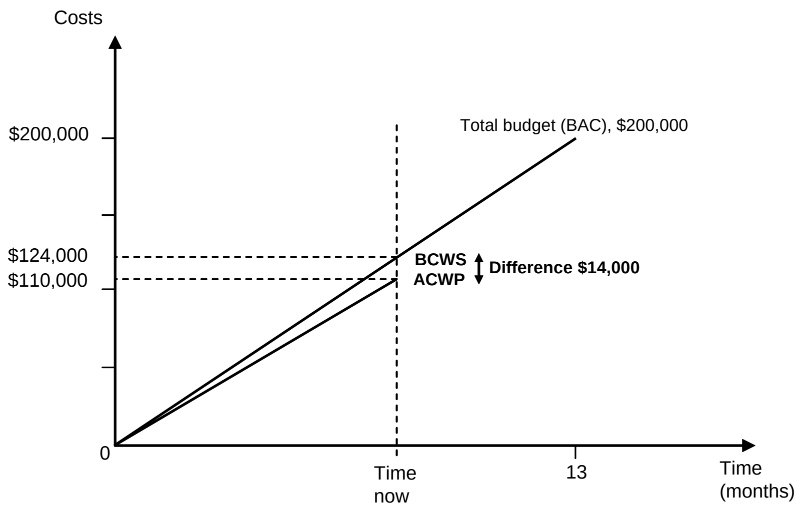


Figure 72. Costs of work scheduled and work performed

This does not necessarily mean that the project is progressing with $14,000 less cost than expected and according to schedule because the figures do not reveal what concretely has been done in the project. For a more detailed evaluation, the project manager presents the work breakdown structure in which the completed work packages have been marked. Additionally, for single uncompleted work packages, the project manager estimated the level of completeness (or percent complete) of each package. This analysis reveals that only 43 % of the entire work of the project has been completed, although according to the plan, at time now, 62 % of the work should have been completed. Earned value or EV (i.e. budgeted costs of work performed BCWP = EV) is $86,000, as presented in Figure 73.

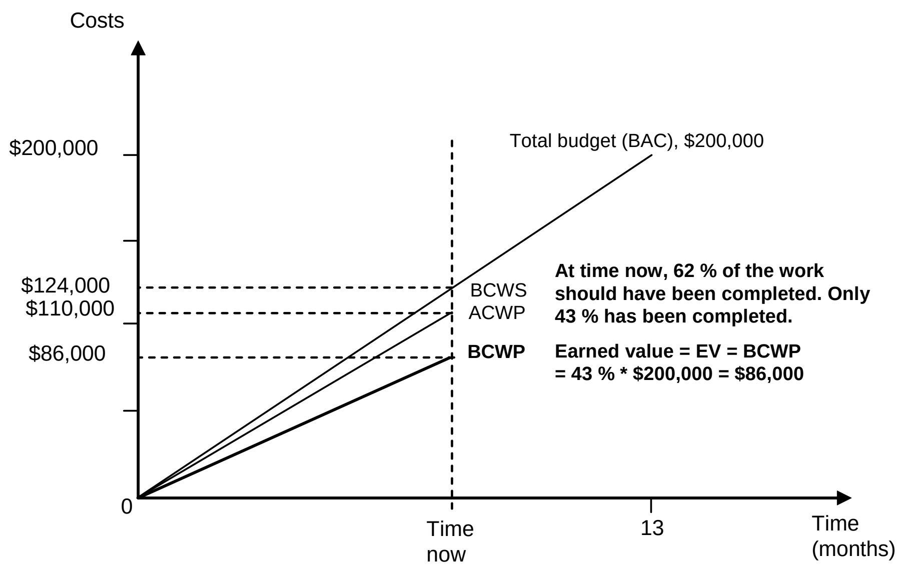


Figure 73. Earned value

Its now possible to describe the cost accumulation and schedule progress of the project at time now by presenting the calculated values, including indexes for cost variance, cost performance, schedule variance, and schedule performance. These indexes are presented in Figure 74.

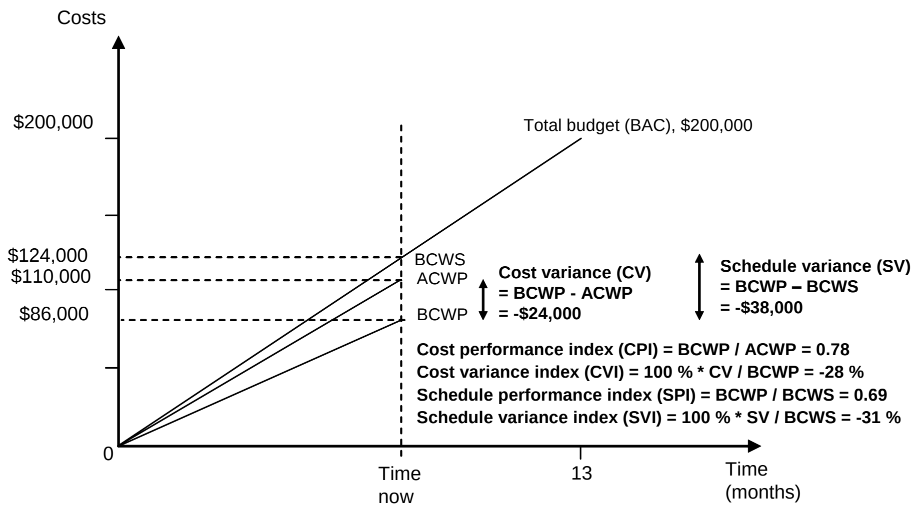


Figure 74. Variances and indexes that describe the state of the construction project

If the remainder of the project progresses according to the original budget, the cost estimate at completion is ACWP + (BAC - BCWP). It is thus assumed that the absolute cost variance that has accumulated in the project will not change for the remainder of the project. The contractor and the Smiths can, to some extent, affect the working pace in the project, so, when estimating the duration of the project, they assume that some schedule catch up can be achieved. The estimate for the remaining phases of the project is presented in Figure 75.

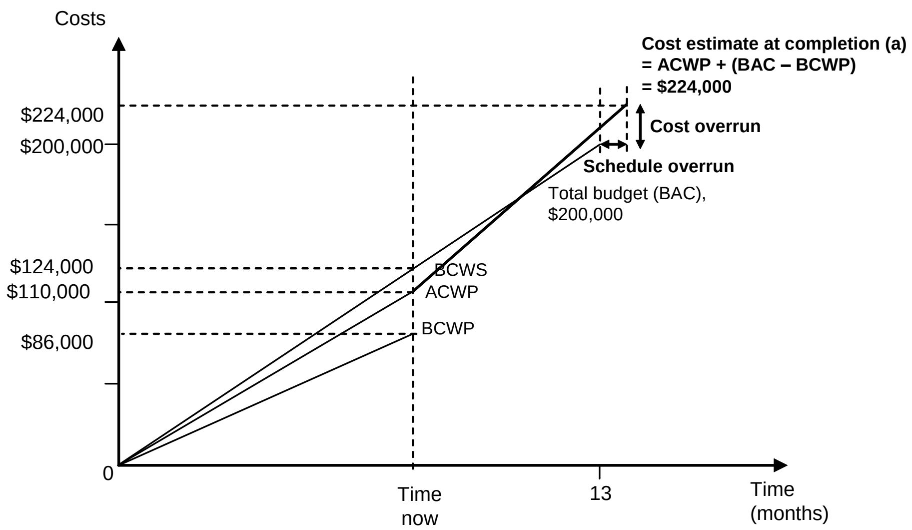


Figure 75. Estimate for total costs assuming that the remaining work progresses according to the original budget

If performance remains the same (i.e. if the overrun of costs and schedule continues as in the past), the cost estimate at completion is BAC/CPI. Furthermore, if the schedule performance remains at the current level until the end of the project, the estimate for project duration is 13 months/SPI. In this case, the cost and schedule overrun in this project would be substantial, as is seen in Figure 76.

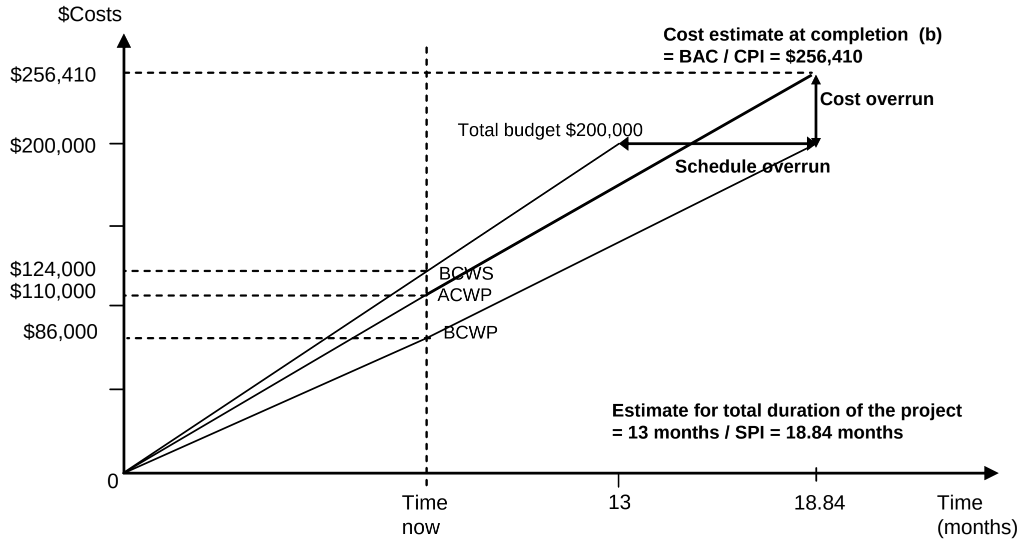


Figure 76. Estimate of total costs, assuming that the cost and schedule overrun will continue in a similar manner as to date

The two alternatives presented above in Figures 75 and 76 are vastly different. In order to estimate the actual results for each project, an estimation of the past and future possible deviations must be made, based on as truthful information as possible. In addition, a qualitative estimate is needed.

To date, the actual cost overruns have been due to three things: 1) In the HVAC system and electricity and electrical works markets, demand currently exceeds supply, and the Smiths ultimately had to pay more than planned for this subcontracted work; 2) The Smiths had not noticed that one specialized supplier had sent in its bid price offer without value added tax (VAT), so the final price increased by the amount of the tax; and 3) The Smiths wanted to change the kitchen package delivered by Livinghouse, and this turned out to be the most expensive single change.

The reasons for the cost overruns have thus been identified. The project is already well underway and all the future material purchases and subcontracting assignments have been agreed upon, therefore, there should be no additional expenses related to these matters. Generally, there should be no cost overruns because the Smiths do not want to make any further changes to their house building project; simply, they do not want to have to apply for additional funding.

The project schedule, on the other hand, has lengthened considerably, an outcome attributable to slower than planned progress of the work that the Smiths performed with help of a group of friends. With the exception of a few subcontracting assignments, the external workforce has kept to its schedule. Larry and Sally will have their winter vacation shortly, but it will be a busy working vacation. They will use it to work fulltime on their construction project, while the grandparents look after their two children.

The estimate on the final result described in Figure 75 can thus be considered realistic. The cost overrun is now certain. On the remaining part of the schedule, the performance can be expected to improve somewhat, but a schedule extension of one month will be insufficient. After talking with the site manager, the Smiths revise the schedule completion objective to the beginning of August. Thus the total project duration will be about 17 months, i.e., about three months longer than the original expectation of 14 months.

4.9.4 Evaluating success

As a project ends, and as various other projects of this supplier are compared to it, a question arises regarding the absolute and relative degree of success of that particular project. The question of success is multifaceted, and is featured as a central part of the research on project management. Whether the project was fully completed or was discontinued at some point, is related to success. Nevertheless, knowing whether or not the project was closed according to plan does not solve the question of project success. Even if a decision is made to discontinue a project, the project may still be judged to be a success; the level of success can perhaps be measured by how quickly the project was discontinued, incurring the least possible damaging effects without needlessly prolonging the project. In addition, a discontinued project can be considered successful if the supplier has benefited from work accomplished on the project up to the point of discontinuation. Likewise, a completed project that did not achieve its objectives may be considered beneficial if something essential to the supplier's business has been learned. On the other hand, a project that is conducted to the end and executed according to plan can still be considered unsuccessful.

The success of projects and project management can be studied from two mutually balancing perspectives: efficiency and effectiveness. Success can mean the *efficiency* of project management: the project may be judged to be successful if the scope, time, and cost objectives have been met and if it has progressed according to the plan and the agreed-upon changes to the plan. In terms of efficiency, the success criteria concerning keeping within the schedule and budget can be verified by using numerical measures, whereas subjectively estimated factors may be used in studying the scope objective. If there are several stakeholders involved in the project, the realization of scope may be studied from several different perspectives; thus the results from evaluations of project success may also differ. Customers' opinions, for example, are affected by their other objectives, which are unrelated to the project. Achieving customer satisfaction can be considered a relevant criterion for success, whether or not the concrete objectives that were set in the plan were achieved. In the long term, the satisfaction and wellbeing of the internal project personnel is critical, as it fosters success on future projects. The internal project personnel should not be worn out in one project in any circumstances. Furthermore, the order of priority of the project objectives differs for the various project stakeholders: for one party, time may be the most important objective, for another it may be costs, and for yet another it may be the functionality of the product resulting from the project. Thus there are mutually contradictory expectations related to project efficiency; therefore, evaluating it is open to interpretation. This variability should be considered at the time of defining the project's original scope objective and other objectives.

Many best practices of project management aim at efficiency of project management. The reporting and monitoring tools that are used over the course of the project are often applicable to evaluating efficiency. These tools may include the use of both numerical information and qualitative estimates.

In recent years, the perception of success based upon efficiency has been viewed as too narrow as it does not cover the benefits and revenue generated in the project. On the other hand, success of a project in terms of efficiency can mean suboptimization, which is not beneficial to the entire business of the company. There is often a delay between closing a project and the time when its indirect results can be verified, but these effects are a relevant part of project success. The reparability of a new factory or automation system cannot be studied until a failure actually occurs, an event that may not occur until months, or possibly years, after project commissioning. Likewise, after a new product has been launched, there is a delay before the profit from the product can be calculated. Furthermore, the size of the profit is affected if such unexpected after-sales actions as competitive responses occur. The perception of project success held by the various parties may change when they observe the product resulting from the project in use and experience the indirect effects of the project. In addition to efficiency, attention must be directed to such events at the final stages of the project lifecycle as learning, realization and management of risks, and development of customer relationships and customer satisfaction.

Increasingly, project success has been studied in terms of project *effectiveness* or *performance* (i.e. total benefits and stakeholder satisfaction). Benefits are particularly related to carrying out the expected change, the benefits experienced by the customer, the business-related benefits for the project supplier, and the realization of the expectations of other stakeholders. The business-related benefits for the customer and project supplier can mean both financial results (i.e. the difference between project revenue and costs: project profit), and the development of competence and collaborative relationships that promote business. From the financial perspective, the payback time on investments, the ratio of revenue to costs, and the sales revenue created by the product resulting from the project can be studied. Additionally, the future benefits from the project may be studied, which may include the effects of the project on the business infrastructure, product portfolio, or technology platform – factors which can be used efficiently in improving the chances for success of future projects. Effectiveness can often be measured as concrete key figures, but it may be useful as well to study customer satisfaction with the project results, and the satisfaction of the project team.

Example: Final review and closing the project

Now that the Smiths' house has been finished, a civic residential building authority makes a visit to conduct a final inspection and review. This step assesses whether or not the work has been completed according to the construction permit and the accepted drawings and designs, and that the building fulfills the requisites for safe and healthy living. The site manager from Livinghouse transfers to the Smiths the maintenance manual package for the house, which has been collected over the course of the project. That manual package includes information on, for example, what materials, products, and systems are used in the construction, and how damage can be prevented and the useful life of the house prolonged through everyday actions. Larry has posted on his webpage, in the form of a diary, his experiences with the project.

In addition to the final review by the civic residential building authority, a handover inspection is held between the contractor and the Smiths, the customer; in this inspection, the construction work is examined in detail. A record is made of the inspection and any visible faults and deviations are listed. Only after these noted items have been corrected should the last part payment to Livinghouse be made. This is also the point at which the contractor's period of guarantee responsibility begins.

The Smiths evaluate the project from their own perspective. The budget was exceeded by $25,000, primarily because changes were made to the kitchen after the project was in progress. That said, the kitchen is now exactly the way the Smiths wanted it. Of course they are disturbed a little by the fact that, had

> the changes been made earlier in the planning phase, project costs could have been lowered. The total result, that is, the scope of the project, meets the Smiths' expectations and they are highly satisfied. In the end, the schedule was exceeded by three months, but the possibility that this could happen was known during the entire length of the project. The construction project would probably have been finished substantially faster if the Smiths had given more work to external parties, but doing own work was the Smiths' conscious choice, based on controlling cost. To celebrate the end of the project and their new home, the Smiths organize a large housewarming party in August before school starts.

Evaluating success after the project has been closed can have many purposes. It can affect the revenue to be received from the project as the project price may be tied to achieving the objectives. There may be bonus or sanction clauses in the contract that are connected to the benefits provided by the project; the project supplier may receive additional revenue from the sales of the product resulting from the project over a certain period after the project has been delivered. Post-closure evaluation acts as a critical starting point for developing future project business. The results of analyzing what project management factors contributed to project success or failure, for example, can be considered in subsequent projects. In other words, these lessons learned can be transported from one project to another to the benefit of the overall company. New business opportunities may also be identified as part of post-project closure evaluations.

Evaluating success of a completed project may serve the interests of future project sales and marketing activities. Customer references from successful projects are valuable sales aids when preparing and selling new projects. The awareness and reputation of the project supplier is enhanced by project success, but may suffer from repeated failures. Evaluation information collected on completed projects may be used in schemes for rewarding personnel involved in the project team. As for evaluations at milestones over the course of the project, results of evaluations conducted after project completion may determine the project manager's and team members' duties, monetary commissions or project compensation, and advancement opportunities. Understandably, the managers and personnel associated with successful projects often comprise a sought-after work force.

4.10 Literature

Cleland, D. I. (1994) Project Management, Strategic Design and Implementation, 2nd Edition. New York, USA: McGraw-Hill.

Eisner, H. (1997) Essentials of project and systems engineering management. USA: John Wiley & Sons Inc.

Frame, J. D. (1995) Managing Projects in Organizations: How to Make the Best Use of Time, Techniques, and People, 2nd Edition. San Francisco, USA: Jossey-Bass Inc.

Kerzner, H. (1995) Project Management - A Systems Approach to Planning, Scheduling, and Controlling, 5th Edition. New York, USA: Van Nostrand Reinhold.

Lewis, J. P. (1995) Fundamentals of Project Management. USA: American Management Association.

Meredith, J. R. and Mantel, S. J. Jr. (2003) Project management: a managerial approach. 5th edition. USA: John Wiley & Sons.

Morris, P. W. G. (1994) The Management of Projects. London, U.K.: Thomas Telford Services Ltd.

Morris, P. W. G. and Hough, G. H. (1988) The Anatomy of Major Projects. Chichester, UK: John Wiley & Sons.

Morris, P. W. G. and Pinto, J. K. (Eds.) (2004) The Wiley Guide to Managing Projects. London, U.K.: John Wiley & Sons Inc.

Turner, J. R. (1999) The Handbook of Project-based Management – Improving the Processes for Achieving Strategic Objectives, Second Edition. London, UK: McGraw-Hill.

Wysocki, R. K., with contributions by McGary, R. (2003) Effective Project Management: Traditional, Adaptive, Extreme, Third Edition. USA: Wiley.

5 PROJECT ORGANIZATION AND LEADERSHIP

In this chapter we examine the organization and leadership of projects from the perspectives of competences, and from the viewpoint of the project parties' behaviors and ways of working. We view the project organization as a temporary structure to which project personnel are assigned and in which they are expected to accomplish the project tasks regardless of the company organizational unit to which they otherwise belong. In particular, we study the roles and work of the project manager, the project team, and the project steering committee.

5.1 The human resources of a project

A central factor in organizing and leading a project is the personnel, in particular, who they are, what they know, and the way they work together. In Chapter 4, human resources were studied primarily from the viewpoint of a number of personnel, but staffing a project is not that simple; in addition to the number of resources, their appropriateness and quality must be considered.

The greatest expectations are usually held for the *project manager*, who should be able to utilize the available resources optimally and to solve potential problems on a timely basis. In the following sections, we discuss the characteristics, tasks, and competences of a project manager. We also touch on the expectations for and requirements of the project team, and reemphasize the point that resources should be allocated to a project with consideration for the situation at hand, as well as the project objectives.

5.1.1 Characteristics of a project manager

Almost without exception, a project is assigned to one person, whom we call a *project manager*, an individual who bears responsibility for assessing the project's consistency with company objectives, for attaining the project goal, and for directing the execution of the project. Being a project manager is not necessarily a permanent task or title, and the incumbent can be assigned the role according to the needs at hand. In industry and the public sector, a project manager's role can exist under various titles: development manager, production manager, technical manager, project coordinator, project director, or may simply be called, the "person in charge".

The project manager is subject to many expectations from various stakeholders. Customers demand results quickly and expect performance according to the contract. The project manager’s bosses – the company management – may require cost efficiency and innovations. The personnel assigned to the project may expect the work to be well managed and that they will receive timely and appropriate feedback. Partners need information on such factors as the state of the project and the particular expectations that are placed on them. The project manager must be able to maintain a balance among these sometimes competing expectations in order to fulfill the objectives of the project, while making compromises and managing multiple needs for change.

Choosing the project manager, therefore, is a significant decision. Several decades of research and practical experiences have helped project management professionals to identify the characteristics, competences, and other qualities that a project manager should possess. In product development environments, upper managers often appoint the most expert employee to become project manager, but this decision often proves to be a mistake; a technical expert often becomes frustrated with the managerial work required of a project manager and, simultaneously, the organization loses the technical input that the expert could be providing. In delivery project environments, on the other hand, the tendency has been to develop professionals in the field of projects – individuals who systematically develop the skills required to undertake the tasks of a project manager.

The specific archetypal characteristics of a project manager have yet to be identified in leadership research. Many types of personalities can play the role well; effective project managers are capable of responding to the situation at hand, and different situations and environments require different types of project management. Nevertheless, the temporary nature of a project, its objective orientation, and the project-related risks require people who are able to tolerate a dynamic operating environment and adapt to its requirements. A variety of expectations placed upon a project manager have been listed in many contexts. In addition to being competent time managers, effective project managers must be able to tolerate uncertainty; be result-, performance-, and future-oriented; be attentive to details; and be flexible, practical, and committed to their work. An effective project manager is optimistic, energetic, empathic, trusting of others, and tolerant of a rapid working pace. Project managers do not work in a vacuum so it is reasonable to ask if these characteristics should be traits that every member of a project team should possess. Independent of the personal traits of project managers, by enhancing their own skills, these managers can modify the team structure and develop common practices that affect the success of their projects.

5.1.2 Competences of a project manager

In addition to possessing the basic skills of project management, the project manager requires technical and content-related information – at least on a general level – to able to discuss matters related to project content. Technical competence is usually related to the technology and processes of the product resulting from the project, which is why the competences needed vary by business and from one project to another. In addition to these basic competences and skills, the competences of leadership and management have often been discussed in the literature, and they include competences in coaching, challenging, negotiating, influencing, enticing, achieving results, participating, showing direction, keeping order, delegating, helping, guiding, holding meetings, managing various groups, and coordinating.

In the role of project manager, a person manages both people and business; a summary of these requirements is presented in Figure 77.

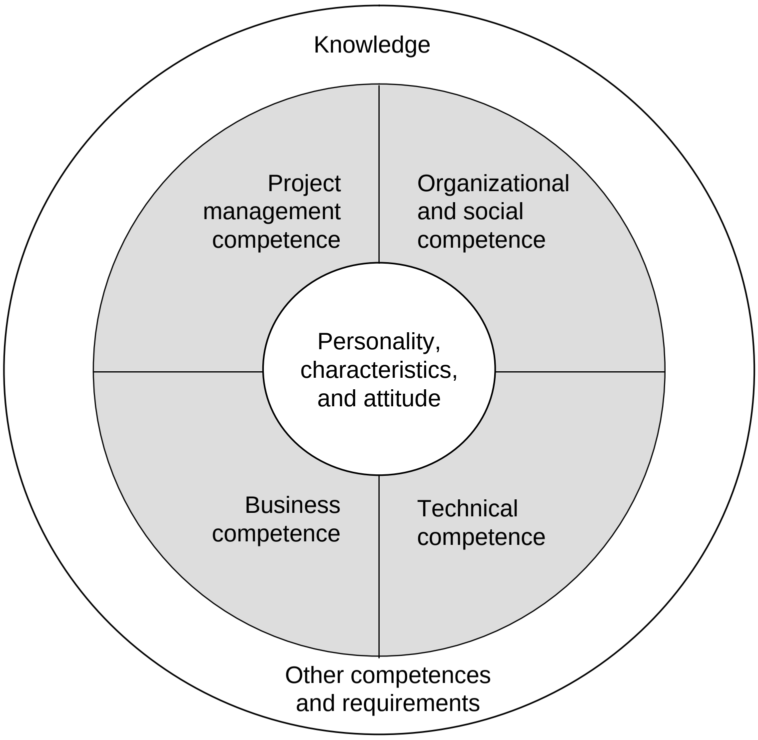


Figure 77. The competence areas of a project manager

In the following section, we briefly describe business competence, as well as social and organizational competence. Although it is impossible to say which of these areas of competence is key, or if they all of them apply in all projects, we believe that these are the types of factors likely to affect any project and its success.

Business competence

For a project manager, business competence refers to the ability to see and implement the objectives that are central to the company. Business competence includes an outlook toward the company's business, an understanding of the customer's business, and knowledge about suppliers' and partners' businesses.

The project manager who has a **business competence**...

- is able to form a connection between the project and the company's strategy, and to fulfill the business objectives through project management.
- is able to keep up to date on developments in industry and technology and to estimate the effects on the project of changes in these factors.
- is able to balance the ideal technical opportunities and the scope of the project with the objectives of the business schedule (best compromise, not perfection).
- is capable of understanding the project's financial effects beyond the costs (e.g. is able to balance project benefits and return on equity vs. expenses).

The project manager who **understands the customer's business**…

- listens to the customer, and is able to consider customer needs when preparing and executing the project.
- understands customer diversity.
- understands the customer's business and its uncertainties in a broader sense than from the perspective of a single project, and is able to see the relevant opportunities for collaboration, including outside projects.
- is able to learn about the customer's business, and has the patience to do so.

The project manager who exhibits **partnership competence**...

- is constantly in contact with business partners, understands their perspective on the project, and is able to consider their expectations for and concerns about the project.
- is able to motivate business owners to participate in the preparation phase of the project.
- builds the project team, creating close and successful interaction with partners.

Social and organizational competence

The social and organizational competences required of a project manager can be grouped into such categories as leadership, communication, negotiation, problem solving, and influencing the organization.

In order to exercising *leadership* properly, a project manager must be able to affect the project results through people. Management and leadership are both required in a project, and as a project increases in complexity and scale, the leadership role of the project manager increases.

Through leadership the project manager…

- establishes the direction of the project for other employees by creating a strategic vision of the future and the changes required to achieve that strategic vision.
- influences employees by words and actions, creating common understanding of and commitment to the vision so that all the parties participating in the change understand the requirements of their actions and willingly collaborate to achieve the project objectives.
- motivates people to direct their activity toward productive work and to overcoming political, bureaucratic, and resource-based obstacles to achieving change.

Communication refers to the exchange and transmission of information. The sender of the message must ensure that the information is clear, understandable, unambiguous, and complete in order for the recipient to interpret it correctly. The recipient also has responsibility in receiving information and verifying its understandability. Communication is thus two sided and it can be studied from different perspectives in a project. Project communication may refer to writing, speaking, or listening, and may be formal or informal, vertical or horizontal, and directed internally or to the external partners. The project manager…

- interacts in the project team to achieve common objectives.

- communicates with the management of the organization to ensure that the desired benefits result from the project.
- communicates with the customer to clarify expectations and requirements, and to discuss progress.
- communicates with partners and subcontractors, to ensure that adequate resources are supplied to the project.
- communicates to the media and other stakeholders, if necessary.

It must be noted that the communication competence requirements expected of the project manager differ slightly from the general communication setting for the overall project. Each company has its own communication practice for a project, and, typically, these practices are set in the project plan and concern people other than the project manager. On the other hand, the project manager, as a communicator and recipient of messages, acts in an environment that is broader than the project. Accordingly, the project manager's communication role concerns things that extend outside the project. Managerial communication as described here is a broad subject, and cannot be limited to the project environment.

Negotiation is a strong means of influencing another party and achieving a contract or another form of unanimity. The project manager may negotiate the contract directly with the other party or with the help of third parties. The ability to negotiate is a rare and highly valued skill – a well prepared contract gives a strong basis for, for example, executing a project.

Many matters can be the subject of negotiations, at any phase of the project, in many steps, and on many different levels. Project negotiations are typically related to:

- project objectives – scope, cost, or schedule;
- the changes needed in the objectives;
- contractual terms;
- activities; and
- resources.

Project managers require **problem solving** skills, particularly the ability to identify problems and make related decisions. Problem solving concerns problems that have already been realized, whereas risk management is related to potential future problems.

Identifying and defining problems requires the project manager to be able to identify the real reasons behind symptoms that appear on the surface. Problems may also be internal to the project – insufficient resources or a need to redirect resources, for instance. They may also be external: a delayed project contract permission, for example.

Problem-related decision making requires that the problem be analyzed with care and that the solution options be identified on the basis of the analysis. Project managers should be able to choose the best solution for the project (or the business) from among the different optional solutions. They can also seek input from the customer's representatives, the project team, and the management or personnel of their own organization in preparing to make the decision. The solution should also be one that will work in practice, and its effects should be understood beforehand. Decision making in a project is, in many ways, a critical, demanding issue, because there is often no single best decision. The project manager must often consider a group of equally advantageous or disadvantageous options and is faced with choosing one that can be realized in a suitable time for the project; solutions that are too late or too early may be detrimental.

Project managers must be able to **influence the organization** to get the work done in the face of the current constraints of the organization and its surrounding network. They should understand the formal and informal structure of their own organization, and that of potential partners, and should identify the right channels of influence to suit the project's purpose. To be able to influence the organization, project managers must understand organizational power games, know the right people to contact, and choose the right actions.

In spite off the negative tone generally attached to power games and politicizing, in the project world these behaviors are seen as positive means of exerting influence. Power involves the ability to affect behavior, change the course of events, avoid objection, and make people do things they may otherwise not do. Politicizing involves affecting the common activity of a group in spite of the fact that the members of the group have different interests; it also involves willingness and skill to use conflicts and disorder in a creative manner.

In order to affect the organization, project managers must…

- find support from the appropriate stakeholders.
- adapt their own style and approach to create the desired effect.
- get management support for their cause.

Other competences and qualifications

In addition to the competences profiled thus far in this subsection, project managers must devote sufficient time to their project. It sometimes happens that one person is appointed to lead up to six projects simultaneously, especially in companies that have a fast pace of project activity. In such a situation, it can be anticipated that the project manager's time devoted to a particular project may not be sufficient and that the quality of project management may suffer. Often in such circumstances, project managers must abandon their technical area of expertise and refrain from or reduce their work input so that their time will be released for management. Project managers will not be successful unless they devote adequate time to matters of resource reservation and review of the work description. In addition, project managers must get along with people and gain the respect and trust of their subordinates. This dimension relates to project managers' credibility as a leader, a capability that they must demonstrate at the outset of a project. If project team members do not have trust in the capability of their project manager, they are unlikely to commit to the project objectives.

The tasks of the project manager may vary depending on the scope of the project and the extent to which the work can be delegated to other personnel.

5.1.3 Competence requirements of the project manager in different phases of the project

At different stages of the project lifecycle, different types of capabilities are needed. This is easily forgotten, and project execution may at some stage suffer from missing or improper competence. A number of the competence requirements are expected of the project manager, some of which can be delegated to or shared with other people. The company may also define separately the persons responsible for the different tasks or stages of the project lifecycle and work toward maintaining the required capabilities.

The strategic importance of projects is created largely at the first and final stages of the project lifecycle. At the beginning of a project, choices are made regarding such matters as the projects to be started or discontinued, new customers, the technological solutions to be applied, the profit expectations for the product, the required partnerships, and the prioritization of stakeholder expectations. At the end of its lifecycle, the project may involve providing maintenance services, engaging in product management, working at maintaining the customer relationship, developing and responding to new project ideas, and spreading the lessons learned to other projects. The situation of the product and the customer must be understood in a broader sense than merely project procurement, because the supplier may have follow-on business opportunities. At the first and final stages of the lifecycle, the emphasis should be on the business perspective of the project and on understanding the customer’s business. At the beginning of a project, negotiation and partnership skills are needed in order to prepare the project appropriately. At the final stages of the project lifecycle, a good technical understanding may be advantageous in finding new business opportunities.

In the starting phase of the project, particularly during the planning work, project management skills are needed. A systematic approach must be emphasized in all the knowledge areas of project management, including estimating and planning of scope, scheduling and costing, planning resource requirements, thoroughly evaluating risks, and making a quality and communication plan. Literary skills are useful in making the project plan, although part of this work can be delegated. Making use of earlier project experience helps in making a realistic project plan. Technical skills are also useful when thinking about the scope of the project. Many social- and organization-related skills are useful at the preparation phase of the project; during the project planning phase there is a need for a lot activity and a number of decisions related to communication, negotiation, influencing the organization and the customer, and persuading a project team to get together.

In the execution phase of the project, relevant activities are controlling the management of work, ensuring that actions are of high quality, and taking care of stakeholder relationships. Among the skills expected of project managers, controlling and monitoring of all the knowledge areas are emphasized. Skills at change management, external and internal briefing, developing the project team, and handling potential conflicts are also needed. Leadership and problem solving are the most emphasized social and organizational skills. As a member of the project team and the project steering committee, the project manager is also expected to have the skills to act effectively in a project team, not only to manage the team.

At the closing phase of the project, followup, reporting, and closing actions are emphasized. A well conducted project finishing stage can fix many problems and faults that occurred during the project, although the expectations for success should not rest entirely on the closing phase. Other relevant closing matters are collecting the accumulated lessons learned and spreading this information to others in the project organization. To increase the performance of future projects, it is essential to identify successes and provide rewards to personnel working on the present project. As well it is necessary to maintain tight collaboration with the customer in order to support the commissioning of the product and to identify new opportunities.

Figure 78 emphasizes the competences required of the project manager during the different phases of the project lifecycle. In particular, it is apparent from this figure that there are many competences required of the project manager during the execution phase of the project. The competences at the beginning and end of the project can be organized in different ways. The division of work between project managers and other actors should be decided upon clearly at the earliest stage of the project, when the project opportunity is identified.

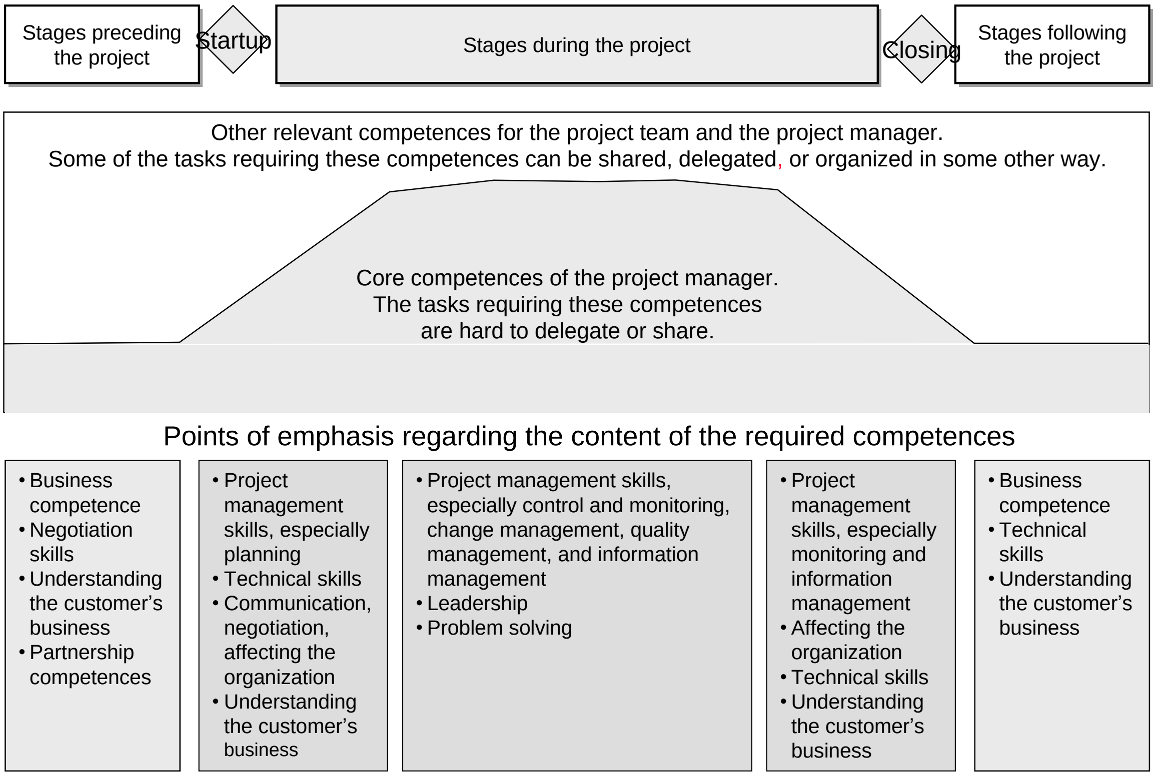


Figure 78. Competence requirements of project managers in the phases of the project lifecycle

A central issue, of particular concern at the starting and final phases of the project, is who should possess competence regarding the broader aspects of project business. Is this burden placed on the project managers or on some other parties? Is it sufficient for a project manager to possess competence in the traditional project management knowledge areas?

It is hard to find an unequivocal answer to these questions, because project management is conducted in different ways in different companies. Still, there is a need for a project manager whose central competence area is the efficient execution of projects according to the prescribed objectives and assigned resources for a project. All project managers do not want to give up the basic project management functions, and in some environments this is a suitable decision. In such a case, the competence requirements related to the broader aspects of project business are directed at other people working on the project team, or otherwise supporting the project.

Business accountability can be directed at the sales organization. When the objectives are set at the sales phase of the project, and project revenue and the development of customer relationships are monitored long into the maintenance phase, the person holding business accountability may be the sales manager who takes part in the project throughout all its stages. In product development projects, this role may be assumed by the product manager or the head of the organization responsible for the product line involved. Furthermore, if a separate project portfolio or product group manager procures the resources in the project and coordinates resource use among various projects, the project manager can concentrate fully on managing the project team and on supervising the technical execution of the project.

It is nevertheless probable that part of the requirements concerning business competence is directed at the project manager. In many project environments, there is a need for "heavyweight" project managers to participate readily in the management of customer relationships and the broader business aspects of the project throughout the entire project lifecycle. These project managers participate actively in project sales and thus can exert influence to ensure that the project is chosen and defined according to broader business goals than those of a single project. Such project managers also bring the required technical expertise and credibility to the project, and they allocate some of their working time to taking care of customer relationships, and to engaging in strategic planning. The project manager may be in a key position to help establish a long-term collaborative relationship with the customer during the final stages of the project lifecycle.

The amount and quality of business competence that is required from a project manager depends on the nature of the project as well as on the way the company has divided the project responsibility among different parties. At a minimum, the project manager should be able to discuss the achievement of the company's business-related goals with the customer, product managers, and other middle managers. The project manager has power and freedom of action, so is able to affect and the achievement of customer and company goals.

The project manager also has the opportunity to renew the company's business by bringing it new ideas and methods that have been identified and learned in prior projects. In order to understand the importance of new business opportunities, the project manager requires knowledge of business logic and strategic objectives, as well the boldness to look substantially further into the future than the current project.[31]

Because competence requirements vary during the project, it would sometimes appear attractive to change the personnel so that the competent and effective planners can concentrate on the planning phase and the knowledgeable and effective executors can concentrate on the execution phase. It is typical in a product development environment that concept development is conducted in a separate organization from the actual product development, and the intermediary

[31] Martinsuo and Kujala (2005)

result is transferred to a different team. Nevertheless, these situations have their challenges. Communication is always inadequate and the executing group may not be satisfied with the communication plans. Documenting the project related information does may not provide a sufficient means of transferring project information: someone must maintain the overall idea for the project, and most often the person taking this role should be the project manager, even though some of the project workers may change over the course of the project. In order to devise a practical and effective plan, the project manager should also learn about the actual work requirements involved in project execution.

5.1.4 Project team and its membership

The *project team* is a group of people chosen to execute the project, the team's work is lead by the project manager. For small projects, the project team may comprise one or two people working part time to help the project manager. For large projects, there may be a *core team* consisting of subproject managers or other appointed people. The members of the core team work close together during the project and are typically assigned to the project full time. There is also the *extended project team*, which consists of the core team as well as all the other people working on the project. Large projects may also be divided into subprojects, each of which has a project team. In the largest projects or programs, there may be hundreds or even thousands of employees involved; in this case the term "project personnel" can be used in the same sense as the term "company personnel". In a project organization of this scale, a multi-level and multi-unit team and organizational structure may be applied.

A common factor for the members of the core project team is that they know they are members of the project team, and they are conscious of their own role (at least, in order for the project to succeed, they should know this). The obligations and responsibilities of core project team members toward the project form part of their work description; in contrast, other stakeholders are involved in setting expectations and requirements for the project. As compensation for their work, project team members earn a salary. Because of the temporary and unexpected nature of the work, the compensation system may differ from the systems that are in use for other types of work assignments.

The right combination of people that possess the right type of competences and knowledge for the project are collected in the project team from within the company and, possibly, from subcontractors. Membership in the team requires that the person work to achieve the agreed-upon project objectives. The basic requirement is that a member of the project team is able to devote time to project work, alongside other work assignments, and, of course, the member must be willing to do project work.

The assignments of project team members are always determined case by case. Team members may participate in preparing and planning the project. They commit to executing the project according to plan, with each member performing the appropriate work according to the workload estimate. Sometimes members of the project team also work with the product resulting from the project and may be involved with service or maintenance tasks after the project is finished. Each member of the project team agrees with the project manager and the line manager on the assignments and workload estimates made in the context of project planning.

The general activities of project team members include:

- timing the project work in their personal work calendar, according to the agreed-upon project plan and schedule;
- executing project work under the direction of the project manager according to the project plan and agreed-upon workplan;
- anticipating and managing risks related to achieving project objectives;
- actively communicating the progress and state of work to other project team members and the project manager;
- reporting deviations to the project manager immediately;
- reporting project related issues to the project manager; and
- continuously developing their personal project competences.

The project, as an organizational entity, is in a sense like a temporary employer for project team members (at least the representatives of the employer). As with any employer, the project entity assigns activities to the team members, expects a proper execution of the work, and pays a salary as compensation for the work. A project employee should take project activities as seriously as any other activities assigned by the employer.

In some companies, projects are started without proper preparations, and employees are simply assigned to work on the project in addition to their regular work assignments. If a company has no established practice for properly planning resources, the project team members should ensure that they really are able to execute their role as part of the project team. Each team member should be able to agree that they have the required time, competence, and motivation or willingness to participate in the project, even if their participation may involve personal sacrifices, including needs to decrease participation in other activities, reorganize activities, and obtain additional resources to take care of other assignments; otherwise the project work may easily stretch workdays to intolerable levels.

The project may be only one part of a team member’s assignment; half of a member’s work may consist of routine customer service activities and half project activities. Such a team member is able to put in only 2.5 days of project work per week, perhaps all the afternoons in a week. If this project-available time is divided among five projects, the person has limited time to devote to any one project, perhaps as little as one meeting and one simple, short assignment per week. Such an arrangement is usually disadvantageous because devoting only a few hours of work to a project per week makes it difficult for a person to be highly committed to the project and to act with full force to achieving project objectives and benefits. It is also destructive to projects if the urgency of team members’ other work interferes with project assignments. If a company is deficient in its organizing and planning of project work, it will likely suffer in the eyes of the customer – customers may be unsympathetic toward a supplier’s project planning and organizing difficulties, customer relations may deteriorate, and, consequently, the supplier’s reputation and future earning potential may be threatened.

A significant part of project planning is ensuring that the work of the people taking part in the project is efficient and productive. Typically an individual's participation in projects may occur in parallel with other daily work assignments, but as mentioned previously, other work often takes priority, relegating project work to be done as evening work.

In the worst case, the workload of personnel assigned in part to a project may be planned at a utilization of as much as 150 to 200% of normal working hours, which means that people will perform uncompensated extra work or will perform weakly in all areas of their work. In working on established project activity, the setting is different; a clear and sufficiently large workload input for each project is defined in the person's work description. This input includes the common project meetings, the individual's particular work on the project, planned and informal interaction with the other team members, and time for learning. Other tasks do not supersede these project activities, and executing project work is as important as performing any other work. Only in exceptional situations is it sensible to plan for a member to participate for less than 20% normal work time on a project; such instances may occur for personnel assigned to project support functions.

5.2 Project organization

Project planning includes determining the responsibilities for executing work, the roles of different parties, and the division of work among the parties. The project should be organized like any other goal-oriented group activity; everyone does not do everything, and each person has particular tasks. In determining roles and responsibilities, it should be ensured that all the tasks relevant for the project have been allocated as the responsibility of some project member.

5.2.1 Structure of the project organization

As part of organizing the project, the central responsible people and working groups are identified and the division of work among them is determined. At least the following parts can be identified in typical projects: the project manager, the project team, the project steering committee, and the customer. It must be noted, that the project team may include people from many units or even organizations – from the customer, supplier or subcontractor. The *project organization*, as a temporary organization, differs from the more stable structure of the organization, although both organizations are connected to each other through resource allocation. The relationship between organizing a project and the line organization is discussed further in Chapter 7.

An extensive project may include various types of steering committees, all of which become part of the project organization. Subprojects can be determined and defined in many different ways. Subprojects may be directly related to the activities identified in the project plan. Steering committees can be internal to the organization or they may include representatives of the customer. A project core team, which consists of subproject managers and other appointed people, can also be marked in the organization structure. An extended project team may also be defined, which includes the personnel of all subprojects.

Slightly different organization methods can be applied to different types of projects. The key difference is often related to drawing the lines between the project and its management and the external organization, customers, and suppliers. The rough organization structure of a large power plant project is presented in Figure 79. Defining the subprojects has in this case been based upon the product structure. Multilevel project management, close collaboration with the suppliers and the customer, and the role of top management in supervising the project are emphasized in the organization structure. In this example, the large project has been assigned a separate supervisor, who follows its progress more closely than the steering committee does.

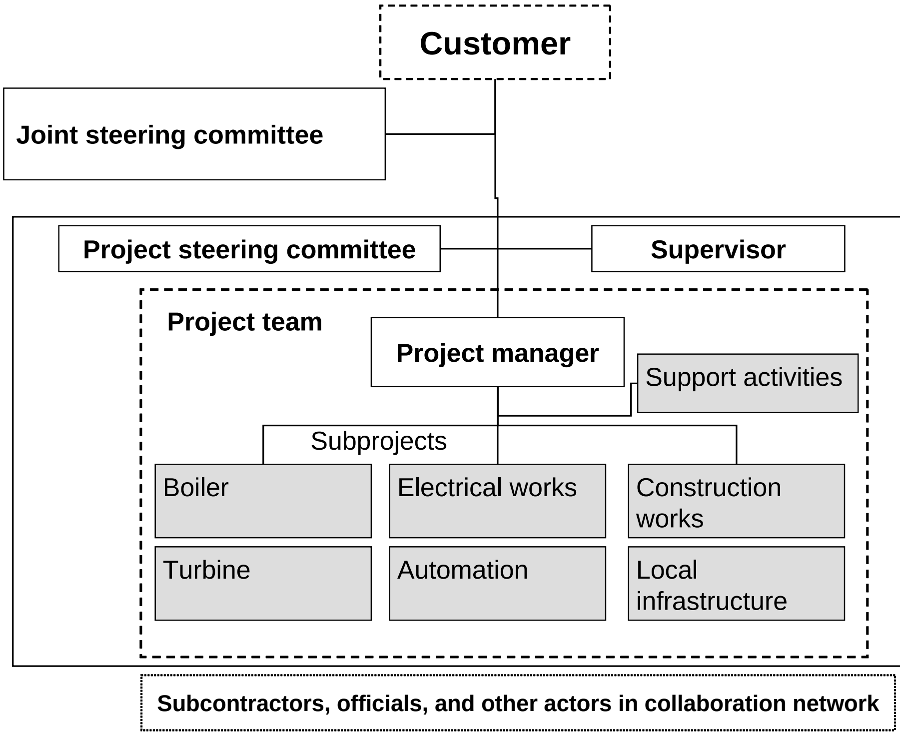


Figure 79. An example of the organization structure of a power plant project, from the perspective of the project supplier

Figure 80 illustrates an example of the organization structure of a medium-sized product development project. The structure is based upon the activity packages identified in the work breakdown, which have been organized into subprojects. The support functions and subcontractors that are relevant for the project are also visible in the organization structure. As there is no direct external customer, a sponsor has been designated for the project and represents the internal user or customer of the project result. The sponsor acts as the chair of the steering committee or as another key person on it.

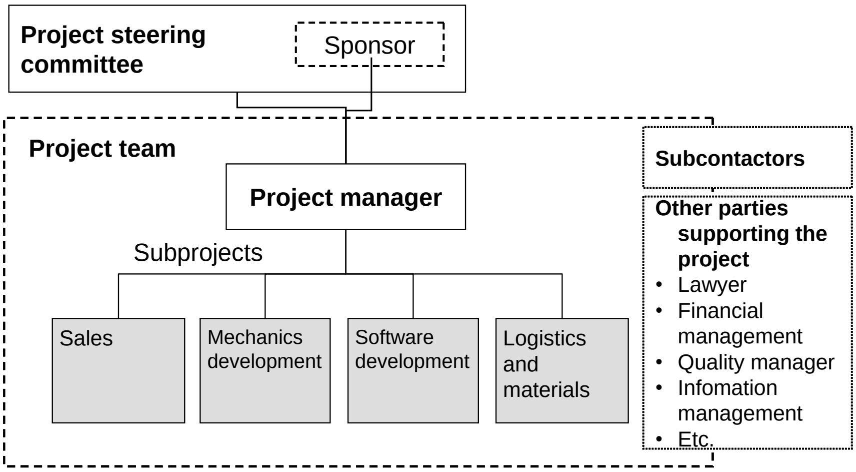


Figure 80. An example of the organization structure for a product development project

Figure 81 depicts an example of the structure of an internal development project. This type of structure could fit a strategically important project or an operative development project that has no fixed resources and is executed by people from different operational units as needed. In order to ensure efficient execution, the project is supervised by a sponsor who is appointed by company management. The steering committee is called together only at key points of the project. As the project may have extensive effects on the practices of the organization, a pilot team is typically created to take care of piloting subprojects. The pilot team tests and ensures the suitability of the project results. In particular, large infrastructure projects should be divided into smaller subprojects. In the example in Figure 81, subprojects are based upon the stages of the project.

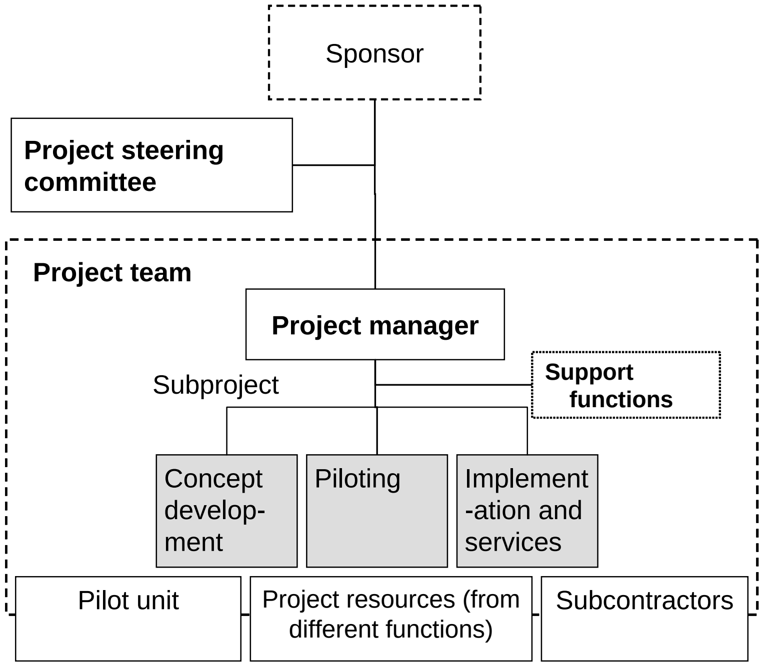


Figure 81. Example of the organization structure for a company's internal development project

The internal organization of the project (its reporting structures, roles, and division of work) should be described in more detail at the operational level, especially in large projects. Projects have their own formal internal structure as do any other organization. The purpose of the project organization structure is to ensure that all work has been assigned to the project team in the proper way and that the division of work is made clear to project personnel and, if needed, to their line organization. The project structure is often described at the level of individuals so that each actor in the project is mentioned.

Many significant factors should be considered when designing the project organization structure. Project size and type have been discussed previously. Other such factors are whether project personnel work full time or part time, the content of the project, the type of people that comprise the project team, how well they know each other, how well they get along, the organization culture, and the dominant way of working. There strong, established subcultures in the organization should be considered as well. The project structure should be one that supports communication among members of the project team and links together the project parts; it should be suitably flexible, able to tolerate potential changes in personnel, and designed to promote people's commitment to the project even though the project manager may not control all the work of the team members.

The following general principles should be considered in planning the organization structure.

Principle of uniformity. The project organization structure may follow the product structure or the structure of the surrounding organization. The benefits from uniformity are related to ease of communication, clarity of responsibilities, possibilities for concurrent engineering, and the logical structure of the project plan. Uniformity requires strong integration and avoidance of overlapping or conflicting work. The project manager has a critical role to play in achieving integration and in promoting interaction.

Principle of expertise. The project organization structure may also be dynamic and people may be allocated to perform many different tasks across work package boundaries so that their expertise is used in many different places during the project. The benefit of using the principle of expertise is the efficient use of resources and flexibility. Challenges may be posed by many problems typical associated with matrix organizations, such as use of power, overlapping work, and uneven division of work. The role of the project manager may be related to coordinating activities and solving conflict situations.

Principle of equality. The organization structure of a project may be diffuse, even lacking a structure. Responsibilities are determined as the work progresses, according to the situation and without specific preassigned leadership role. This approach is typical in research projects. The development of Linux is a good example of the principle of equality. The advantage of this approach is greater creativity, increased commitment of project team members to the project work, and improved efficiency resulting from collaboration. Its challenges, however, are losing focus as the work progresses and the tendency for people to seek leadership either by taking on too much of the role themselves or by expecting others to do so.

Principle of strong leadership. A strong ideological or technical leader may emerge in a project; this person has a dominating role, determining the specialized roles and tasks of the other members of the project team. This approach is suitable for planning and product development projects in which the head designer may have a dominant role. The advantage of the approach is that subprojects have been integrated in the organization structure and in the daily interactions among experts. The challenge may be to find a suitable ideological leader or to cope with the existence of several competing visionaries.

It is necessary to design an organization structure that fits each project individually regardless of the surrounding organization or the project customer. Nevertheless, the existing restrictions on the project should be considered. If the project operates in a hierarchical organizational environment in which the freedom to manage an individual project is limited, a diffuse structure that follows the principle of equality will not necessarily work. Similarly, if it is difficult to find a credible head designer, a project structure built according to the principle of strong leadership should not be chosen.

5.2.2 Roles and responsibilities in a project organization

The execution of every project is different, and thus the roles and responsibilities of the project team members differ. The responsibilities of the project manager and the steering committee may have been decided upon at a general level in the company, but they may also have project-specific characteristics. When forming the project structure, the division of responsibility must be agreed upon both within the project team and between the project team and various stakeholders. The clearer the division of responsibility is at the start of the project, the less probable it is that misunderstandings will occur.

The division of responsibility in the project is related, for example, to the person who is responsible for the activities in the project, who makes decisions and supervises project progress, and who in the project communicates with whom. At the very least, the division of responsibility can and should be executed at two levels.

It is useful to agree on the division of responsibility among project parties (project team, project manager, steering committee, and customer) in a general way. At the same time, the share and role of the different parties in project decision making should be made visible. The division of responsibility can be illustrated and documented in many ways, such as part of the description of the project organization structure, as a flowchart, or in the manner presented in Figure 82 – through the decision-making points in the project. In the example provided in Figure 83, there are business decisions related to each milestone that require the opinion and commitment of the management team.

	Milestone 1	Milestone 2	Milestone 3	Milestone 4
Introducer	Developer of idea	Project manager	Project manager	Project manager
Review - quality - processes	Project office	Project office	Project office	Project office
Review - technical - resources - competences	Team leader	Business unit management team	Business unit management team	Business unit management team
Acceptor	Business unit management team	Project steering committee	Project steering committee	Project steering committee

Figure 82. An example of a general-level division of responsibility in the central decision-making points of a project

Additionally, it is usually necessary to specify a more detailed division of work so that the tasks are allocated at a subproject and even at an individual level. The work breakdown structure can be used as a starting point for dividing responsibility. An example of a division of responsibility on the individual level by the detailed activities of the project is presented in Table 16.

Sometimes it is necessary to proceed to an even more specific level, to list all the project activities and parties and determine the role of each party in each activity. Roles can be grouped and assigned simple abbreviations or color codes in order to condense the matrix.

Project organization roles and responsibilities include:

- executing role;
- role with responsibility for decisions;
- role that takes part in decision making;
- commenting role;
- role that is responsible for progress;
- role that supervises progress;
- directing or guiding role; and
- role of target of communication.

Table 16. Example of a responsibility matrix (R = responsible, E = executes, A = accepts)

Persons Work packages, and activities	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9
Work package 1	R	E	A	E	-	-	-	E	E
Task 1.1	A	R	-	E	-	-	-	E	E
Task 1.2	A	-	R	R	-	-	-	-	E
Work package 2	-	-	A	-	R	E	E	-	-
Tasks 2.1, 2.2, …									
Work package N	E	-	A	-	R	E	-	-	-
Tasks N.1, N.2, …									

Roles other than that of project manager can be assigned in the project. In addition to their assigned tasks, specific project team members may be assigned project management-related tasks; in such cases, other project team members should be aware of such augmented role assignments. For example, the project may have an administrative assistant who helps in documenting and recording project information and in performing like tasks. The project may have a quality manager who is responsible for such tasks as evaluation and documentation that are required to monitor success in achieving the project quality objectives. In a project there may be a specific person responsible for managing the customer relationship; often this role is assumed by a sales manager who works cooperatively with the project manager. For large projects, in particular, there may also be a financial manager who takes care of reporting and financial planning. These roles do not necessarily require full-time work in the project; indeed they may form a small portion of the responsible person's work.

5.2.3 Allocating resources to projects

When a project organization is prepared, one should always consider the source from which the project resources will be obtained, and the project leader needs to negotiate on the use of the resources. The resource allocation activity is organized in different ways in different companies. The use of human resources in a project, in particular, requires interaction with the other parts of the company organization. The planning, procurement, and allocation of material resources may be more straightforward as it is more likely that they can be procured externally without constraints.

Most often there are units or departments in a company that own, use, and develop resources for different purposes. These units may be called competence centers, resource units, or resource pools. Projects need resources suited to executing the work that has been defined for the project. Projects may produce results that provide monetary benefits to contributing units of the company or such other forms of benefit as new competence, new products and solutions, or new customer relationships. Allocating resources to a project may be problematic for units of the company, as the units may have other activities to which they need to assign their personnel.

The project's resource need is determined, at the latest, during the planning stage of the project. On the basis of this need, project leaders can initiate discussions with the heads of units that house the needed resources. Among the matters to be investigated are the extent of available resources, the available competence, the need to release resources during the later stages of the project, and the resource reservations that have been made for other work. If an adequate amount of the suitable resources can be found in the resource units, the units may offer them to be used in the project according to commonly agreed terms and principles, as presented in Figure 83.

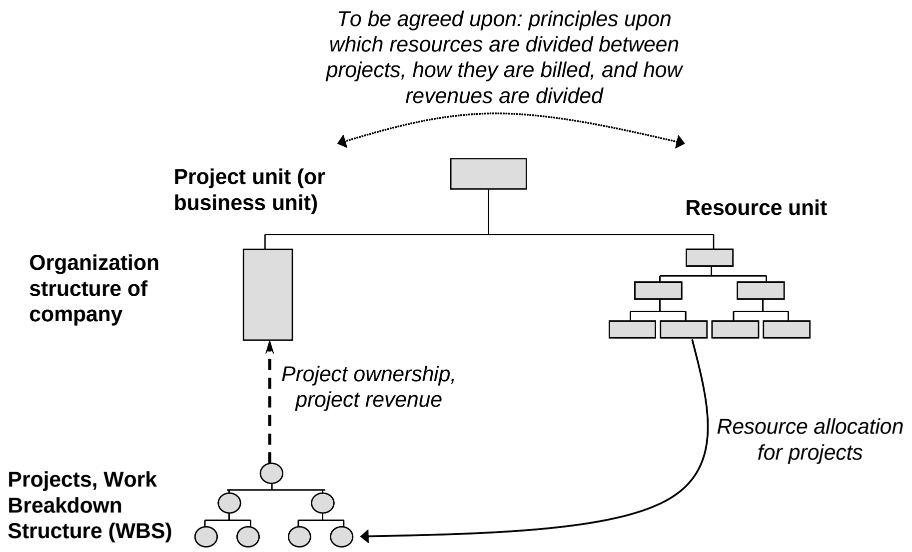


Figure 83. The interaction between resource and project units in allocating resources and sharing revenue

As noted in discussing resource management issues in Chapter 4, fitting resources to the project schedule may affect the cost and duration of the entire project. Thus, negotiating with the resource units is critical for the execution of the whole project. The company should agree on common resource management practices in a broader sense than just concerning a single project, so that negotiations do not end up being fights among competing projects.

In addition to agreeing on the source and allocation of resources, the internal billing principles should be agreed upon in the company to ensure that the costs of resources are directed to the right projects. The project cannot be considered an independent result unit, so it cannot be assigned real costs. The billing principle does not need to consider the exact salary of each person; usually it is a calculated estimate or average sum. A multiplier, similar to a payment on overhead costs, can be applied to facilities and materials, although it is possible to assign their exact values to the project with the help of modern financial information systems.

The heads of projects and resource units should also agree on the way the project benefits are divided among the units. Sometimes, the results are connected to project ownership: the unit that owns the project may also own its results. If two units share the project, project ownership, and thus project results, can be divided between the units. Sometimes projects are coordinated by a single unit that owns all the project results, and the share of results that belongs to each resource unit is estimated indirectly through their resource contribution or some other principle. The ways of dividing results and benefits depend on the organization structure and the framework that has proved to be the most effective in the operating environment of each company.

The division of responsibility between the organization's resource pool and the project pool should be taken care of as discreetly as possible, and it should be kept an internal matter. From the perspective of the customer, it is essential that the project seems like a well coordinated and executed entity instead of as a group of miscellaneous competing subprojects.

5.3 The work of a project team

In addition to the capability and competence of its individual members, the work of the project team is affected by factors related to group dynamics, and these should be taken into account in choosing team members and in forming the team into an effective group. There are many types of interactions and collaborations during projects. The project is not a rational machine that works as programmed; it is affected by several human factors. The efficiency of a team is influenced by how well team members get along with one another, how well the division of work is assigned to members, and whether or not members are able to agree with one another on matters and remain flexible at times of change.

The greater the people skills, sensitivity, and anticipation of the project manager, the more likely the team is to exhibit positive human factors. There are certain rules of thumb that can be used to increase the probability for project team success. It is of utmost importance that the project manager has access to sufficient information on the project personnel and their competences and resources. Often project managers get to know people during projects. Compatibility should be aimed for when forming the project team so that the team members complement each other and their personalities and competences fit the content of the project. The formation of the project team is easier if the organization has good practices for developing other personnel than just project managers, and if it has an adequate number of suitable people available for projects. In the following subsections we discuss further the characteristics of a good project team as well as the topic of general project competence.

The project team is often formed in a hurry and in a situation in which the amount and quality of available resources are limited. The project manager may need to be satisfied with what resources are available. In such a case, the functioning of the project team can and should be affected by making project procedures more effective, and, fortunately, there are good practices available to improve efficiency.

5.3.1 What makes a good project team?

The quality and functionality of a project team can be studied from two perspectives.

- An external perspective – to what extent is the project team capable of accomplishing its assigned task, and what is its perceived reputation among stakeholders?
- An internal perspective – to what extent does the project team experience team spirit and how willing is it to work for the project objectives?

These perspectives are related to each other and support each other in many ways. Although a project may fail externally, the project team members may still hold a good image of it, thus the project is a success from an internal perspective. In such a case, project team members will probably talk to others about the project in a positive tone and attract positive attention. If, on the other hand, the project succeeds externally but the team members are left with a negative perception of the project team and its working methods, the achievements may not feel as significant and they are likely to be forgotten quickly. If the project succeeds from both internal and external perspectives, the same project team will probably continue to work together on new projects. The reputation of the team spreads and the team members seek to establish within the organization the successful procedures they used. There are, however, always risks in doing so; the success of one project cannot necessarily be repeated as the circumstances and the specification of projects change, and important things may be forgotten in subsequent projects.

External perspective

From the external perspective, a good project team is recognized for its performance: good project teams are effective and they are able to accomplish the agreed upon and planned work. Effectiveness can be defined as the group doing the right things and doing things right – directing the resources of the project correctly and considering their effective use toward achieving the objectives of the project, for instance. Effectiveness may mean different things in different projects, depending on the goals, conditions, and characteristics of the project team.

There is, therefore, no one and only recipe for a good project team. Instead, research has recognized general factors that are related to team efficiency and are connected with the performance of the project team. The various factors related to the operating environment of the project, the project assignment, people, leadership, and organization, are presented in Figure 84.

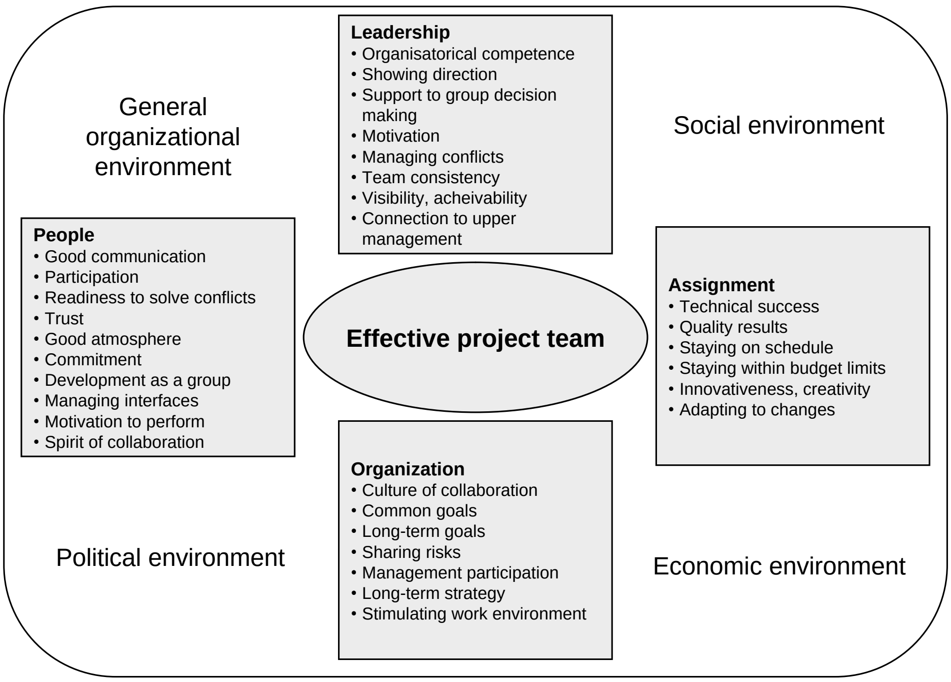


Figure 84. Factors related to the performance of the project team

Factors related to the **task** indicate that the work done in a good project yields results as the project progresses. Technical progress, quality, being up-to-date, following the budget, and renewal are not single matters that can be noted only after the project has been completed – they can be verified during the course of the project. The best project teams are also flexible in their work, adapting to the required changes.

Factors related to **people** concern the functioning of the team: communication, participation, commitment, trust, and problem solving. A good project team is more than the sum of its parts. Even if all the most competent and successful people worked on a project, it would not succeed without common commitment to objectives, good team spirit, and adequate team member interaction.

Factors related to **leadership** highlight the fact that leadership in the project team is not only the responsibility of the project manager but of the entire team. Although the project manager does a substantial part of the leadership work, other team members may have tasks related to leadership (e.g. delegating work, making use of expertise, affecting others). There is some type of leadership connected with all types of work, and leadership must be seen as an interaction of the team members. Thus formal leadership and informal leadership are both relevant for the successful performance of the project. Showing direction, organizing the work, supporting decision making, managing conflict, and the other factors presented in Figure 84 form a vital part of the performance of a good project team.

The factors related to **organization** concern the structure, operating culture, strategy, and working environment in which the project is executed. Forming project teams is a frequently used method of organizing a company's activities, and is a particularly effective organizational format for company management to support and promote the execution of single projects to reach the company's objectives. A project is not a detached, isolated entity; it is a meaningful part of broader company aspirations and goals. In addition to the management and coordination of the project team, the entire company business is influenced by the project.

Many types of common social, political, and economic forces are influential in the external **operating environment** of the project. The most relevant point for efficiency is how well these factors are considered (i.e. the way the activities of the project team can be timed correctly according to the external factors). The people involved in projects during times of recession undergo a different type of external pressure than do those operating during a time of economic upturn. Political decision making can be more favorable for an infrastructure project at one time than at others.

Many factors influence the effectiveness that the project team develops over time and through working together. Examples of such factors include trust, team spirit, ability to change, and conformity. Still, there is not necessarily any actual time for learning in a temporary project, as quick results are expected from the team members. The uniqueness of a project and the part-time nature of some resources also signify that there is not much time for group members to practice or train on procedures; the work of the project team may include a lot of improvisation. In an efficient project team, successful improvisation may be established quickly. In addition, the project manager may positively affect the development of a project team from the early phases of the project by providing feedback and useful tips, and through acting in an integrative role.

Internal perspective of the project team

From an internal perspective, an effective project team can be recognized through its smooth work activity and good atmosphere. Every person that has worked on a specific project develops a feeling about how well the project team functioned. The project team members also talk about their project and their team outside the project, and their perception of the functionality and atmosphere of the team is transmitted in their communication with others. The characteristics and functionality of the project team can be studied on three levels, as presented in the iceberg shaped graphic in Figure 85.

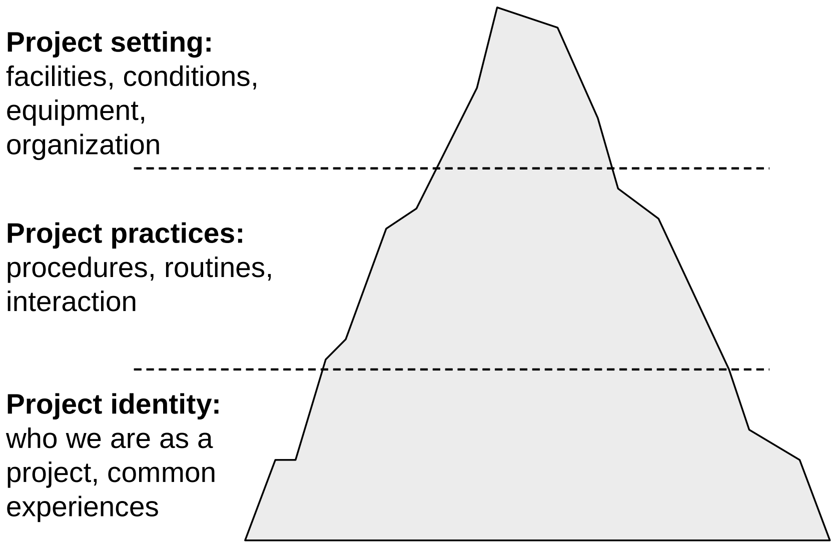


Figure 85. Factors affecting a good project team – an internal perspective

At the top of the iceberg in Figure 85 is the project setting – the project artifacts – which can be seen and experienced by all. This part is thus related to whether the practical matters are in order in the project. Does the project team have the tools needed to execute the work? Are the project conditions (e.g. the project's position among other projects in the project portfolio and in the surrounding organization) conducive to the project team members working undisturbed? Is the work organized in a suitable manner, and are the physical facilities appropriate? It is often easy to affect these visible aspects of the project setting, and many methods of project management and project planning are targeted at this level. Nevertheless, their effects on the functionality and atmosphere of the project are only partial.

At the middle of the "iceberg" in Figure 85 are the project procedures and practices, some of which are readily apparent and others virtually invisible. Project practices concern the form that the work takes in a project, the way interaction occurs among the parties, and what types of routines are developed. These practices and procedures can also be called project culture. Some of the practices can be created through interactions with the surrounding organizations or the customer. The project personnel may learn practices from the organizations around them; the practices for reporting working hours and recording costs, for example, may be adopted from the company to which the project belongs. Some of the practices, nevertheless, are created as part of the project, and these practices may differentiate the project from the surrounding organizations and make it unique. The practice of weekly meetings, the compensation method, or a seminar practice that is tied to project milestones may be project specific. The practices can be affected, at least in part, when planning the project and as the project progresses through organization and management. Some components of the practices are created inadvertently, and they can afterwards be experienced as successful or unsuccessful.

At the bottom of the iceberg is a strong layer that may not be visible but which is reflected into practice: the project identity. The question is what type of an identity is formed for the project and whether the project team members relate to this identity or to some other identity. The identity of the project team develops over time through the experiences that the team members gain from working on the project. The identity cannot be forced or shaped consciously; it is created from experience. Identity can be reflected in the way project team members describe the project among themselves or to external stakeholders. If team members' experience suggests that the project is "just work that needs to be done", the project identity seems much weaker than if they feel that "we are revolutionizing our business". At its best, project identity is relatively stable and unique; it differs suitably from its environment and can be differentiated from that of other projects and teams. It also motivates the team members in hard times to act positively toward the project, and it is remembered long after the project has ended. The downside of a strong identity is that people external to the project team may find it too different or strong and may defend themselves against it, or attack it.

The development of project identity can be affected in many ways, including coincidence (e.g. what types of people are put on the same team). The development of project identity can be affected through concrete, external, instrumental factors listed at the top of the iceberg in Figure 85. A name can be chosen for the team or for the project that differentiates it from other teams and projects. The project team may have its own room or other commonly used spaces at which the critical decisions are made together. In project work, there may be better or unique tools available to the team than are accessible to other personnel. The project team members may be located physically close to each other or they may use the same electronic communication methods. It is often beneficial for the project manager to require that project-related documents be created and managed in a restricted manner; typically an electronic project-specific folder is created and is accessible to project personnel only.

The development of the project identity can also be affected through incentives and sanctions, or via some other practices related to the factors at the middle of the iceberg. Incentives include monetary compensation and other forms of feedback and incentives. In scheduling work on the project there may be flexibility in working hours. A fast-paced feedback channel may be established between the project manager and the team through regular meeting practices, or by arranging parties and other social activities. A project-specific compensation system can also be used, as can project bonuses – a financial incentive that has become more common in recent years. In such a bonus system, part of the salary for project personnel is tied to the results or partial results of the project. And forms of self sanctioning may occur in a project; if a member of the project team acts against the group's set values and norms, other team members may (perhaps by use of humor) punish the dissenting member for this breach.

In addition, the development of the identity can be strongly affected by the actions of the project manager. Each project manager has particular personal characteristics that can be used to create a unique project identity. The project manager may be seen to be an easily approachable and encouraging person, one whose actions create an environment in which the team members want to do their utmost in order to achieve the project objectives. The project manager may also be seen to be disciplined, systematic, and trustworthy and to create a safe project environment through actions by which everyone knows their role and task and in which acting according to plan is rewarded.

5.3.2 Starting a project

Starting a project is a crucial moment, because the state of readiness at this initial point has an effect on the success of the entire project. The starting phase of the project presents the best opportunity to affect the attitude of work in the project and the type of project atmosphere that prevails. At this phase, it can also best be ensured that the people connected to the project understand what the project is about. Creating commitment both within the team and with the customer is characteristic of the starting phase. Without a clear start, the entire project may be left unclear and vague. If the project does not have a proper start, can it have a clear and successful ending?

Considerable pressure and many expectations prevail at the beginning of a project, and these forces often lead to mistakes being made. The customer may demand a quick start for the project, but if resources are not available, there is no use in starting it. The executing organization may be full of excitement about starting the project, but if the customer has not accepted the plan, a premature start may result in a waste of resources. The market can signal an urgent need for the project results, but if the direct customer or the commitment of the project organization is missing, it may be pointless to start the project.

The project should be started when it has been found adequately feasible, the project plan has been accepted, the project contract has been signed, and the project has the required planned resources available in the manner required for project execution. Starting the project means that costs start to accumulate to the project, implies that the project should progress as planned, and that the participating people are conscious of their role in the project. A kickoff meeting can be used to start the project. The details affecting the execution of the project can be discussed in this meeting, and the project spirit may be raised to promote a dynamic start for the project. More specifically, the following range of matters may be discussed in a kickoff meeting.

The matters to be discussed in the kickoff meeting can be itemized as follows.

1. Introducing the project team and getting to know each other

2. Reviewing project objectives:

- project goal

- objectives, metrics for results, success factors

- project stakeholders

- potential bid and contract

3. Reviewing the project plan:

- phases, activities, and work packages

- decision-making points, responsibilities for decision making, and central contents of decisions

- project personnel and organization, division of responsibility

- ways of working, including work methods, tools, and techniques for the project team

4. Reviewing schedule, resource plan, and budget

5. Reviewing instructions and standards:

- reporting working hours

- followup practices for time, resources, and results

- documentation tools and practices

- meeting practices

6. Reviewing the training plan for the project team

7. Starting the actual work and agreeing on next steps.

5.3.3 Lifecycle of the project team

As projects are temporary and sometimes of short duration, time-related pressures may settle on the project team and its work. In all management and teamwork settings, benefit derives from knowing the people involved and taking advantage of the strengths of different parties, but in a project there may be little time to get acquainted and to determine individual team members' strengths; therefore the team should start working immediately. Nevertheless, research on the formation of project teams shows that the path to achieving effective teamwork usually progresses through five stages.

Forming a team. When the project team is formed, everyone attaches expectations to it. At the start, motivation of the team members is likely to be high because starting a new task is enticing and full of possibilities. Nevertheless, efficiency is still low as results are not achieved in an instant and many things are still unclear at the beginning. Team members function more as individuals than as a team.

Storming: testing the boundaries. Early on in the project, team members may notice that, among them, there are different perceptions of the way the team should work, what the project objectives are, and the way the project objectives will be reached. Disputes, even conflicts, may arise from these situations, so motivation and efficiency are likely to decrease temporarily. Team members may test each other's limits and the position and limits of the project with respect to the operating environment. This phase of the project is risky – at worst it may happen that the team does not find a common spirit and remains a chaotic field of battle throughout all project stages.

Norming: Creating common rules. If, and hopefully when, discussion can be formed on the matters causing conflict and challenges, the team can employ negotiation, compromise, and planning to find common ways of working. A common identity and set of norms starts to form, and hopefully efficiency is built on top of these. By creating rules, team member motivation is likely to be restored and team performance level normalized. Nevertheless, there should be a limit to norm setting as too many norms may isolate the project from the external environment and teams may focus on the wrong things.

Performing. Team performance may at some point reach the optimal level, the point at which expected results are achieved with reasonable efforts, the team works efficiently, and the project manager ensures the prerequisites for a good performance in the project. However, in a long-term project, it is probable that the team will experience a period of saturation or satisfaction in which it no longer does its best for the project. The project manager should ensure that suitable changes (e.g. structural or content-related changes) are made at this stage that will challenge the team to achieve a better performance.

Adjourning. At the end of the project the efficiency of the project team may decrease or increase, depending on what is expected to occur in the period following project completion. Efficiency may decrease if the well integrated project team believes that it has nothing to expect from the post-project completion stage and the team members must dissolve a good project team. In an ideal situation, efficiency may increase near the end of a project as the team members want to exhibit their best performance in order to get further tasks and meaningful projects in the future. The project manager can also influence the experiences and feelings that team members have at the final stages of the project.

This five-step type of progress is often repeated from one project to the next, as it is seldom that the team is able to work on many projects in a row with exactly the same team members. The kickoff meeting described earlier can be helpful in speeding up the first phases of team development. When an intensive and adequately long initial meeting is booked for forming the project team, the project norms can be agreed upon while members are getting to know each other and are discussing common objectives. In extensive, long-term projects, the meetings that occur after the kickoff meeting can be extended if there is further need to specify or modify the project norms.

5.3.4 The project team’s way of working

The project management procedures can be agreed upon at the company level, on a project level, or both. Project norms are used to create and establish common understandings and good practices. In some organizations, a project handbook or instruction booklet is created and it includes guidelines for project planning and management, and for good management practice. In other organizations, the team determines its own procedures and practices. The document that outlines the team’s way of working may be referred to as *project norms* (see example in the next paragraph) or code of conduct. The norms can also be agreed to in the form of a *project team contract,* whereby the parties of the project (i.e. the project manager, the project team members, and the project steering committee) negotiate the terms for a social contract and formally sign it as declaration of their mutual commitment. It has been found to be useful to discuss teamwork procedures and practices at the starting phase of the project so that differing opinions surface quickly and the project team becomes unified.

Example of the content of project norms

1. Tasks and responsibilities of the project participants

- division of work (if not visible in the project plan)
- acceptance criteria and phasing of project results
- practices for recording working hours and costs, cost accounts, and the related responsibilities
- approval of invoices
- quality assurance and reviews
- handling deviations and conflicts

2. Tasks and responsibilities of the subcontractor

3. Working practices and operating environment

- use of tools
- use of facilities
- archiving (who, what, in what form, using what names, where)

4. Project decision making, change management, and monitoring risks

- responsibilities of the steering committee, the customer, and the project manager
- the key decisions, decision-making points, and activities in these points
- activities used to manage risks
- change management principles

5. Practices for reporting and information sharing

- what is reported, when, and to whom
- steering committee meetings and their content
- project team meetings and their content
- internal followup meetings, what they are
- public relations and communications inside the organization, what, when, and to whom

One way of implementing the project norms is through use of a project team contract.[32] A common understanding and agreement within the team on the procedures to be applied in the project is one way of ensuring that interactions team members' interactions support the project. The values, norms, and procedures to be used in the project are agreed to in the team contract. When defining the contract, it is useful to discuss the meaning of the suggested values and norms in practice and the way they promote the success of the project. If equality among team members is stated as a critical value in the project, for instance, the contract wording should include statements about equality and the way it can be achieved. The project norms discussed earlier can be presented as part of the project team's contract. The team contract is often written in a narrative form, and it is signed by all project team members. The project team contract is not necessarily completely finished during one project; it can develop and improve from one project to the next as the team members learn about best practices. At its best, the project team contract is enhanced and simplified with experience and as the project team members come to know the key issues by heart and do not need to think about them separately.

During the project, the team works according to plan and hopefully according to the defined project norms. Often the entire team meets to discuss the progress of the project. Typically, the project team will have weekly or monthly project meetings, according to common agreement. In addition to situational reviews, project challenges are discussed and action points are decided upon in the meetings. A record is kept of the other decisions affecting the project. Other issues that may arise in the meetings include change proposals, external issues that affect the project, matters happening in the company, and other matters any team member wants to discuss or be informed about. It is customary that a recording by memo or minutes is kept of the project meetings, and such recording is sent to the steering committee. At a project's central milestones, there may be a need to organize more extensive workshops, in which partial results are finalized for decision making.

5.3.5 Closing the project

The project may be closed when the results have been completed, the customer has accepted the results, and the final report has been completed. The responsibilities and authorities related to closing the project should be defined clearly. At the simplest, it is a question of who has the authority to close the project. The starting point is usually that the project manager who carries operative responsibility for the project cannot alone confirm the closing of the project. The common practice is that the project steering committee holds the final meeting at which the project is found to be completed. There are many things to be considered when closing a project: deciding on the responsibility for maintaining the product, for instance, releasing resources for other work, and closing the project cost account. Closing the project should be as clear as starting it. Sometimes the mistake is made that the end of the project is left up in the air or that the project is ended too abruptly, without thorough closing work. If the project closing is not arranged appropriately, it may occur that the project personnel must take care of the project product long after the planned closing of the project. This in turn causes resource management problems in subsequent projects.

[32] Vartiainen et al. (2003)

In order to close the project it is necessary that the project results and the final project report be handled officially in the steering committee and (most probably separately) with the customer. The task of the steering committee is to accept the results of the project and to solve potential open questions concerning future responsibilities. Uncompleted work should not be accepted as completed. The project can nevertheless be closed even if there are items on the list of deficiencies. In this situation, the work on the list of deficiencies is organized as additional work that does not necessarily require the existence of the project or the related organization and responsibilities. The project results, together with all documents, are handed over to the customer. The customer should accept the results formally and a record is often made of the handover. If further deficiencies arise at the point of handover, a list of deficiencies should be made including the work that should still be completed as part of the project. The official final reporting emphasizes project success, and this outcome tends to provide a welcome lift to the spirits of project personnel. Frequently, the customer wants to celebrate a successfully completed project with the project supplier, as well.

In addition to emphasizing success, the project team should study the entire project realistically from all viewpoints with the objective of learning. At the end of the project, the project team should form a common understanding of how well or poorly the project progressed and what was learned for the future. It is also essential for the satisfaction of the personnel that project closing is taken care of in an intact and controlled manner. If the project started with a kickoff meeting, at the end it is good to celebrate the project achievements (or if a project has failed, to discuss the real reasons for failure) in the final internal meeting or feedback session of the project team. This internal meeting is separate from the meeting held with the steering committee and the customer, and the idea is to discuss internal matters that the customer does not need to know about. The purpose of this internal meeting is not to find culprits or to dwell on past mistakes, but to **learn**. The feedback discussion should be held in a positive, future-oriented spirit. Lately, organizations have increasingly adopted the practice of collecting lessons by employing satisfaction surveys of all project personnel and stakeholders. In order for it to be possible to learn from the project, the company’s development needs and good practices must be identified. An agreement should also be reached about the manner in which the lessons learned and the needs for development are communicated more broadly in the company, and to the right parties. The following list presents the themes that should be covered in an internal project-closing meeting.

Matters to be discussed at the closing meeting of the project

1. Review of project deliverables

2. Review of the realization of the project plan

3. Analyzing the results of the customer satisfaction survey

4. Analyzing information regarding the degree of satisfaction of project personnel

5. Steering committee’s final review of the project: its deliverables and progress

6. Collecting lessons learned

7. Conclusions and contributions to other projects

8. Freeing the project team of its duties.

5.3.6 Obstacles to efficiency

Efficiency refers to the portion of the project team's potential performance that it achieves in practice. The project team often has the opportunity to produce much better results than what it actually achieved. Practice has shown that only part of the ideal efficiency is realized. If the performance of the team nears its upper limits, the team operates at high efficiency. If only part of the practically possible results is achieved, efficiency is low.

The way efficiency is defined in more detail depends on the circumstances and objectives. Furthermore, achieving efficiency depends on many types of situational factors which are discussed at various points in this book. On the other hand, the factors preventing and reducing efficiency seem to be generally similar. The most common obstacles to efficiency are related to organizational tension, poor communications, and weak coordination among actions.

Organizational tension is related to procuring resources for the project from the (line) organization and, more generally, from the matrix organization as a structural form. There are sources of internal inefficiency in organizing temporary resources, one of which is the lack of continuity. In starting new activities, it always takes time for personnel to familiarize themselves with the task, make changes between tasks, and get to know the other team members. Furthermore, the temporary personnel assigned for a partial role in a project may sometimes have difficulties in committing to their work and in doing it with full force; if they do not feel that the project is their own and do not understand the effect of their own work, they will not necessarily work as hard as they could. Inefficiency may also be caused if the cross-functional project team and the other project resources are not fully controlled by the project manager. People's responsibilities for their normal work, their commitment to other groups, and projects that use the capacity of equipment and the routines of the line organization, may compete for the actual time that is supposed to be available for project work. Furthermore, the project manager does not necessarily have an excusive right to the resources needed, the project must progress in the midst of other requirements, and there is often tension caused by the line or matrix organization.

Perhaps the largest single reason for complaints and inefficiency in a project is deficient communication. Adequate and effective communication is part of the vitality and efficiency of the project. Typically, mistakes in communications are made in three areas. 1) Communication is sometimes erroneously thought to be an output rather than a means or tool of the project. The project team may believe that making a communications plan part of the project plan is all that is required for project communication. In reality, however, the communication in the project plan most often refers only to communicating the (partial) results of the project, and does not address the communication related to executing the project. Difficulties are especially related to communication during project execution, not the least because an excessive number of communication channels exist. The number of communication channels increases rapidly as the size of the project team increases. If there are n members in the team, there are $N = n*(n-1)/2$ channels that are internal to the project team. In a team of three people, there are three communication channels. In a medium-sized team of 20 people there are 190 possible communication channels. 2) Communication can be prevented, slowed, or distorted because of bureaucratic requirements and power issues. If several different middlemen are required in communicating significant issues, information arrives slowly to its recipient and sometimes it is outdated. In addition to bureaucracy, an excessive load of unnecessary information may prevent finding the right required information. 3) Communication is open to interpretation, which may cause distortion. As the message travels through different middlemen, its content can be changed and something can be left out and something may be added. The sent message does not always reach the recipient unchanged. The greater the number of middlemen, the greater the risk of distorting the information and creating misunderstanding as the information is communicated. Communication cannot be packaged beforehand; rather, it is created in the everyday interaction and communication situations in the project.

The third reason for inefficiency is related to the coordination of activities. The project can be seen as a system consisting of interrelated parts, in which the parts must form a coherent entity to enable the entire system to function properly. In software development projects, for example, the term “systems integration” is used, and it is critical to the success of the entire project. Even if programmers work separately and part of the work is done by external subcontractors, the compatibility of the different parts must be ensured through systems integration. This is not necessarily easy. In programming work, for example, a great deal of time and effort goes into testing, finding faults, and integration. There are many other methods for fitting the parts of the project together, configuration management being one. Matters concerning coordination are introduced during project planning and are discussed further in connection with the activities of change management, but the time that goes into fitting parts together has often not been properly considered, or unpredictable difficulties may arise in the integration process.

All of these challenges to achieving efficiency are matters that the project manager and the project personnel can affect through their actions. The organization can also develop in its project practices by learning from earlier mistakes.

5.4 Leading the project team

When the project team has been formed and it has started the project work, the job of the project manager, in addition to project management, is to lead the project team and its work. If project management is focused on implementing a well formed project plan and on change management, leading the project team is more a matter of interpreting single situations and choosing and executing the suitable implementation methods. In a complex environment of people and things, the project manager must work continuously at the limits of personal competences, and often through instinct. Everyone can develop and learn in the role of project manager.

The project manager, as for any other manager, can take care of management work in many different ways. In this section, we discuss what project leadership actually is, the ways different leadership styles can be applied, the ways the project manager can affect the project team and its work process, and the actions of other stakeholders. Problem solving and conflict situations arise, at least to some extent, in most projects and we study them separately.

5.4.1 Management and leadership styles

Management means affecting results through people and things. A distinction is often made between management (managing things) and leadership (managing people), although, in the end, it is a question of two sides of the same influencing coin. In a project, management is primarily the project manager's task, although other members of the project team or other parties can assume management-related tasks. In expert organizations, for example, it is typical for people other than the official manager to act as the initiators of such activities as counseling, servicing, monitoring, coordinating, auditing, and giving instructions. The central difference between these two roles – management and leadership – is that the project manager is also accountable for the project result; in leadership roles delegated to project team members this is not necessarily the case.

Project managers have five central tasks in managing things that are related their responsibilities for fulfilling project objectives. The nature and content of the project manager's tasks, as described in the earlier chapters, include:

- planning the work so that project objectives can be attained;
- organizing the project team to realize the work;
- assigning the activities to people to ensure that all activities are executed;
- monitoring progress; and
- coordinating stakeholder collaboration (e.g. interactions with management, collaborations with customers and suppliers, relations with authorities).

In leading people, a useful division can be made between leading individuals and leading groups. Although the primary leadership task of the project manager is to lead the project team, individuals must also be attended to. The project manager should understand the diversity within the team and know how to make use of it for the benefit of the project. When problem situations arise during a project, it may be wise to assemble people with suitable competences to generate ideas for solving the problem. The project manager should also be able to cater to the various needs of individuals to some extent by choosing appropriate management practices and modes of working. The project manager should, for example, learn to identify which team members tend to work in a self-controlling manner and which members require more regular feedback on their work. The project manager must sometimes solve conflicts and resolve problem situations in the project and may have to act as a conciliatory or balancing party. Whether leading individuals or groups, the project manager has a number of leadership tasks.

Showing direction and maintaining balance in the project team. The project manager takes care to insure that all team members have a common perception of the purpose of the project, the big picture. In addition, the project manager sees to it that team members do not engage in unnecessary actions, reclusion, or mutual conflicts.

Managing work. The project manager coordinates and manages the work of the project team, assigns tasks, and promotes teamwork. In addition this manager balances the benefits and disadvantages of individual work versus teamwork, and searches for an optimal way of working within the project, all the while aiming to avoid or minimize reclusion related to individual work and the disagreements and inefficiency related to teamwork.

Motivating the team's decision making. The project manager ensures that necessary decisions are made during the project, both in terms of content and execution methods. Sometimes an authoritative and individual level decision can benefit a project, and at other times it is beneficial to strive for unanimity and the commitment of all parties. The project manager should know which avenue of action is the best in each situation, taking differing opinions into account and knowing the way to justify decisions to different parties.

Feedback, recognition, and rewards. The project manager is a motivator who gets people to do the right things for the project. Providing feedback, recognition and rewards to team members are ways of doing this; however, punishment, orders, and forbiddance is sometimes necessary. The project manager should be the first and the direct party that communicates the successes and achievements of the project, takes note of good performance, and mentions it outside of the project. This manager should also know the types of feedback and rewards most suited to different situations, such as the best ways to provide negative feedback.

Ensuring overall benefits. The project manager ensures that the project is beneficial to all parties. The basis for the benefits of the different parties is created in the preparation phase of the project, so the project manager should remember the perspective of the project team. When the project succeeds well, it should be perceived as such by the customer and the members of the project team.

The success factors for project management, and more generally for management, are dependent on the situation. Objectives, circumstances, the requirements of the customer, and the needs of the project team, should be considered when choosing the leadership style. According to the model of situational leadership, leadership styles differ based upon the extent to which the project manager's behavior shows direction and gives support to subordinates.[33] In practice, four different leadership styles can be identified, depending on the type of situation (Figure 86).

[33] Blanchard et al. (1985), Blanchard et al. (1999)

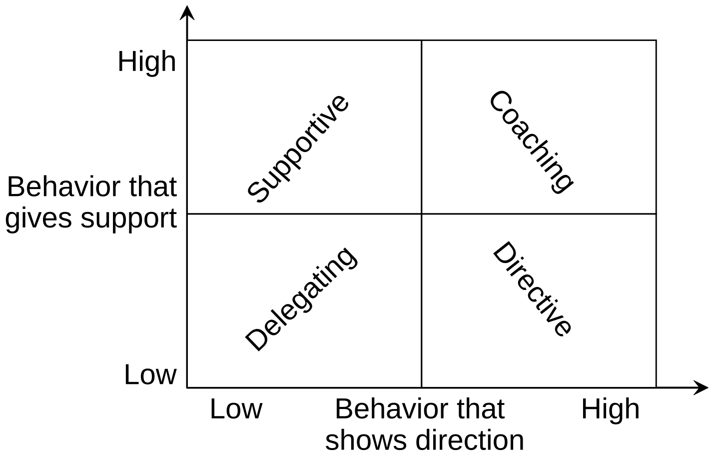


Figure 86. Four leadership styles

The directive leadership style means that the project manager communicates the project objectives, shows through actions what direction should be followed in the project, and assigns activities to people, but does not provide support during the execution of the activities. A directive style assumes and requires that the project team is committed to following the direction shown by the project manager. It is most applicable to situations in which the competence level of the project team is not high and no substantial risk or uncertainty factors are present. A directive style may also be appropriate in the clear starting and finishing stages of the project, and in crisis situations requiring quick action. Mere guidance is not necessarily applicable to uncertain, changing environments, as the project manager alone is not necessarily capable of handling all the uncertainties. Some examples of the directive style are the ordering, authoritative, and bureaucratic styles in which the manager creates rules and procedures.

The coaching style means that, in addition to showing direction and assigning tasks, the project manager gives support to the project team as the work progresses. The support may include, among others, feedback, motivation, tips, counseling, and negotiation. The coaching style means agreeing on matters interactively and together. In this style, both goal orientation and support of the project manager and the project group's teamwork have their place. The coaching style considers the commitment and competences of the project team and is applicable to many situations. It may be extremely flexible regarding risks and uncertainty factors and it may be most applicable in the preparation and planning phases of the project and in creating change, which is a point at which the commitment of people to common objectives is especially needed. A coaching style does not necessarily function well if the project team members are highly independent and feel they can do well without constant support and guidance from the project manager. In practice, the coaching style can also be called democratic leadership: the project manager makes use of the competence and activity of the team as a basis for choosing direction and making decisions.

The supportive style means that the project manager gives support to the project team members as the work progresses but does not instruct or show the direction that should be taken in the project. In using a supportive style, goals and directing activities are to be concluded by the project members. The supportive style fits situations in which the team members clearly have the competences required for the project, and perhaps have greater insight into the needs of the project than the project manager has, but team member commitment may be lacking. The supportive style may motivate team members to collaborate and to find common interests. It is not necessarily applicable to change situations requiring quick solutions or to people whose competence level is extremely low or extremely high regarding the objectives of the project. When taken to an extreme, the supportive style may be too protective and aimless and may lead to dispersed or unproductive work.

The delegating style means that the project manager does not really show direction nor give support to the project team members. The project manager delegates the responsibility for interpreting objectives and for coordinating the practical work to the team members. The delegating style is particularly applicable to situations in which the competence level of the team members is high and they are committed to common goals. Independent, experienced professionals do not necessarily need support or direction. The delegating style can mean that the project manager trusts that the team members will ask for advice if they need it. The style also fits situations in which uncertainty, creative solutions, and initiative are especially useful: in the preparation and development phases of the project, for instance, and for product development projects. The extreme form of the delegating style is the indifferent, laissez-faire type of leadership in which the project manager leaves the project team on its own, practically abandoning it.

Project managers often assume roles in projects other than the management roles. They may assume the role of an expert, a role in technical assignments, or a role in sales, for instance. The way in which the project manager implements these work roles presents a separate challenge. The project manager may stray into adopting a management style that in fact is not management, perhaps becoming an extreme technocrat, salesman, or bureaucrat.

The project manager may become a technocrat who concentrates on technical details and tries to find an ideal technical solution rather than one that would fit the project objectives. By becoming submerged in technology, the project manager may attempt to do the work alone, perhaps focusing unduly on minor or irrelevant matters, signaling distrust of the project team's ability to produce the expected project results.

In some instances, the project manager may become a salesman and public relations (PR) person, dedicated to selling the project and taking care of the customer relationship so entirely that the execution and results of the project are forgotten. An excessive concentration on the customer relationship may mean that the project scope extends and changes along the way but that other objectives, resources, and execution methods do not keep up with the change. In such a situation the success of the project may be compromised.

In other situations, the project manager may become a bureaucrat or a bookkeeper who abides by the project instructions and procedures with care, perhaps even slavishly, and expects the same from the project team members. In such cases, the project manager concentrates energy on the official requirements of the project and their fulfillment. At the same time this manager can become blind to the changes occurring in the project environment, to the priority of issues, and, particularly, to the importance of achieving project objectives. Even if the project documentation was done correctly to the n^{th} degree, the benefits expected from the project may not be achieved through it.

5.4.2 Affecting the work and results of the project team

What causes the project team members to act in the right way regarding the project objectives and results? Can the project manager affect the work and results of the team, and how? Affecting the work and results of the team is discussed in this section from the perspectives of behavioral motives, content of the project work, and work motivation.

Three central motives direct the behavior of people: power, performance, and affiliation (connection with other people). In their basic nature, projects serve the performance and affiliation motives: they involve goal-oriented activity and, at least the majority of projects, emphasize working in groups. In particular, projects serve the performance motive: they include result-based incentives and feedback; visible intermediary results; deliverables; and broad, common overall objectives. Although positive effects accrue from teamwork, there is also a disadvantage related to the motive of affiliation: a project always means temporariness and, to some extent, a separation from the line organization and the person’s potential long term field of activity. The power motive is realized in projects only secondarily and in exceptional situations, as projects are most often created to avoid or bypass the traditional power hierarchy. Projects tend to have little hierarchical structure and to emphasize power related to results and (temporary) roles, not long-term positions. Projects do not promote hierarchical career progress; rather, they foster horizontal career progression through challenges and objectives. It is common that individuals who are directed more by the performance motive than by the power motive partake in project work, but this does not mean that the other motives are not at play in projects. Sometimes it is possible to see which of the three motives – power, performance, or affiliation – drives team member’s actions by observing the behavior of the project manager and the project team members in different situations.

When discussing work motivation, a distinction is often made between intrinsic and extrinsic motivation. Intrinsic motivation refers to the person’s own will and need to do something without receiving a special reward or feedback from it. Extrinsic motivation means that doing something is attractive because of receiving external rewards, avoiding sanctions, or some other effect. Internal motivation in a working environment is often created by the work that the individual does. The content of project work is often diverse, challenging, unpredictable, and development oriented. As previously mentioned, some individuals fit this type of work better than others. As projects are unique and the activities they include can be specified individually, there is a good opportunity for creating meaningful work content. Team members can affect the content of their work by communicating their wishes and objectives at the outset of the project. The temporary nature of the work content and the lack of continuity and development opportunities may weaken motivation.

In addition to being affected by the work content, work motivation in projects is affected by many factors closely related to the performance motive and to self actualization. According to the well known Maslow hierarchy, these self-actualization motives belong to the highest category of needs, because in expert work the basic needs for upkeep and safety are usually already fulfilled. The work motivation of the project team is promoted by the work being meaningful, having a purpose and offering experiences of progress and success. It is typical of expert work that it offers the opportunity to control one’s own work. Money is rarely the source of motivation in such cases; rather, project personnel appear to seek and respect professional recognition and such incentives as a share in the project results and achievements.

Motivation can vary in the different phases of the project lifecycle. It is well known that the excitement of the starting phase subsides quickly when the execution phase is started. Sometimes the project motivation can fade away unnoticed, but in practice at the end of the project when results begin to show, there is a large potential to raise project members' motivation and spirit.

5.4.3 Affecting the results of the project through stakeholders

The means available to the project manager to affect the project setting, practices, and work of the project team have been described in many ways earlier in this book. The project manager, who has a critical role as the intersection point of all stakeholders (and the other project personnel) can also affect the project results through the stakeholders. Often, the project manager acts as a gatekeeper: information flowing between various stakeholders and the project travels through this manager and promotes interaction among parties taking part in the project and the external stakeholders. In the following paragraphs, we discuss some ways in which project results can be affected through customers, subcontractors, and the steering committee. These phenomena also apply to other stakeholders, although the probability of affecting authorities, end users, and the media is often smaller than are the chances of affecting the stakeholders that actively collaborate with the project.

In collaborating with the customer, the project results can be affected in a number of ways throughout the project lifecycle. Marketing actions prior to the start of the project may affect customers' expectations and wishes. The project supplier should make its product offering visible so that customers can define their requirements and needs in the correct manner. In the project preparation and sales phase, the project opportunities and execution methods can be stated in a more detailed manner than in the marketing phase, and these are related to the project results.

As the project progresses, the results can be affected through the entire project work as well as through collaboration between the customer and supplier. In particular, in change situations, some solution suggestions or alternatives may need to be resold, and they may have different effects on the project results. There may be a situation during the progress of the project at which decisions must be made and some explanation provided – if the project does not progress as planned, for example. Customers form perceptions of the project during its entire duration, and all these actions have an effect on the project results.

The project results can be further affected in many ways during the final stages of the project. Implementing a customer satisfaction survey may be regarded as a positive step that improves the results of the project. Contacting the customer personally after closing the project helps create a positive perception.

In collaborating with subcontractors, the project manager can apply a similar method to that used in the project team to show direction, offer encouragement, give feedback, and manage the work. But in such interactions, the project manager may have a more controlling, and perhaps even a sanctioning, role. A contractual subcontractor relationship means that that the project supplier is the customer of the subcontractor and can thus, through its requirements (and contractual terms), direct the work of the subcontractor. The management and control of the subcontractor can be executed in different ways: through weak, medium, or strong control. The depth of the subcontractor relationship should also be considered: is it a question of a single purchase, repeated collaboration, or perhaps even a strategic, long-term partnership. The form of collaboration as well as the imposed controls and sanctions may have a large impact on the work of the subcontractor.

It is also possible to affect the steering committee, although the steering committee is often seen as the appointer and a decision maker of the project. The target of influence can be a single decision-making situation of the steering committee or, more broadly, the project results and their evaluation. Matters can be promoted through the external stakeholders of the project. By being persuasive, the project manager should be able to justify and present the suggestions so that the steering committee is able to make justifiable decisions based upon them. Perhaps the decision outcome is what the project manager had hoped it would be. Sometimes an effect on the steering committee occurs inadvertently. If the steering committee is presented with only one option, it is easier for them to accept the suggestion than to think of other options, even if it is not the best possible solution. On the other hand, if the steering committee is given three different options with analyzed and justified benefits and disadvantages, the steering committee will most probably choose the best and right solution with stronger justifications. By affecting the decisions and choices of the steering committee in this manner, the project results can be affected.

5.4.4 Problem solving, and conflict and crisis management

Project management can usually be taken care of through the means of ordinary management, as described in Chapters 4 and the current chapter. Managers of projects are continuously faced with problems to which planned actions do not provide solutions, and the solution must be sought through use of creativity or with the help of various systematic methods. A *problem* can be any project situation in which a procedure or solution is not readily known or in which there are many options. *Problem solving* involves the actions directed at solving this situation, eliminating the problem, and minimizing its negative effects. In fact, a project can be seen as an entity consisting of numerous problems and solutions to them, as all the project activities and phases can be considered to be different types of problems. Problem solving may be part of change management, but it is not always required.

Problem solving usually proceeds through the following stages:

- identification of the problem;
- analysis of the situation (e.g. what is the level of severity of the problem);
- creation and evaluation of alternative solutions;
- decision making and preparation for execution;
- execution; and
- followup, if needed.

Problem situations arise up during all stages of the project lifecycle, concerning all project parties and on different levels of project management. Three different levels of problem severity can be identified.

Solving (small) problems can be attempted by using the appropriate fixes. A mistake may occur in the technical execution of the project, for instance and there may be several ways of fixing it. One could attempt to solve conflicts through such means as negotiation and prioritization. Two stakeholders of a project may have differing views on the realization of part of the project, for example, and a solution can be sought through negotiation.

The project's survival may be threatened in a crisis situation, and the project supplier must try to recover from it. The project customer may go bankrupt, requiring the project supplier to find other customers or the most inexpensive way of discontinuing the project.

Problems of different magnitude and with differing effects must be handled in different ways. Different problem solving methods and tools are presented in Figure 87. There are many ideation, problem-solving, and teamwork techniques that can be applied in analyzing and solving problems.

Problems	**Conflicts**	**Crisis situations**
• creating ideas and alternatives with the help of various ideation methods • analysis of the problem with various problem-solving techniques • prototyping • systems thinking • scenario techniques • coincidence	• prevention e.g. by agreeing in advance • justification, argumentation, debate • negotiation, collaboration • reconciliation, using an external intermediary • outsourcing (e.g. activity transferred to another project or another actor) • use of power • casting a die	• corrective measures • minimizing negative effects (e.g. communication, maintenance, replacing solutions) • replanning • alternative plans (plan B) • crisis counselling, perhaps therapy

Figure 87. Examples of methods and tools that the project manager can use in solving problems of different levels of severity

Conflicts are caused, for example, by the project stakeholders having their own goals and expectations, the parties drawing their own conclusions on matters, and all parties not receiving the same type of information on all matters concerning the project. When two or more parties meet regarding some detail of the project, differences in opinion may surface and may force the parties to solve the conflict before progress can be made in the project. Although the intention is to agree on many details in the project planning phase, some differences in opinion may surface only as the project progresses. It is necessary to bring out the differences in opinion and their justifications in solving conflicts, to discuss them as constructively as possible, and to seek either the best possible solution or a compromise, or to partition the matter that is causing the conflict completely outside of the project. Use of power is also an option: in some conflict situations, the chair of the project steering committee or the project manager may have or be assigned the power to decide the way to deal with the matter that is causing the conflict.

Crises are extreme cases of problems, for which a solution cannot or is unlikely to be found, risking the realization of the project's benefits. A crisis could be a conflict for which no exit can be found. It may be a catastrophe caused by the environment or something that has occurred in the environment that stalls the progress of the project or otherwise disrupts implementation of its results. A substantial change in the goal or conditions of the project may bring into question the usefulness of the project, make the project obsolete, or render the project harmful to execute as planned. The resignation of the project manager or some other central resource of the project may also create a crisis and require crisis management. Although a real solution is not to be found for a crisis, it is possible to survive and heal after a crisis. Crisis management involves minimizing the detrimental effects and revisiting the planning of the project so that the period following the crisis proceeds as well as possible. In addition to many types of fixes and redesign, there may be a need to provide personal counseling to the people affected by the crisis, and perhaps crisis therapy.

At the start of the project, all parties expect that the project could be conducted with the least possible amount of conflicts and crises. With the help of contracts, plans, and discussion, the incidence of problems can be decreased and the progress of matters facilitated. Nevertheless, at least some problems are encountered in most projects, and there needs to be sufficient competence and readiness to solve them. Readiness is also significant because problem and crisis situations reveal real potential. Sometimes there is a positive side to conflicts – a chance to find new business opportunities, new project ideas, or even ways to broaden the project. Because of these potential upsides, problem solving and conflict handling should be conducted with care. The best projects survive their crises and are strengthened based upon the lessons learned from handling the crisis. It may not be possible to rehearse for crises or problems, but they can be prevented and they can be prepared for or mitigated in many ways.

5.5 The work of the project steering committee

A project is usually assigned a steering committee that controls and supports the project to ensure that the expected results and benefits occur, and that makes the central decisions related to the project. Some companies may prefer to talk about a project management team or board rather than a steering committee. Delivery projects may use a somewhat different terminology than product development projects, for instance. Our use of the term "steering committee" highlights the unique nature of projects and differentiates this temporary committee from the management teams and boards that permanently lead the functional line organization. We consistently use the term "project steering committee" by which we refer to a group of managers controlling and supporting the project and linking to higher decision-making authorities.

For small projects, in particular, it may be more practical to appoint a single supervisor instead of a full steering committee. This supervisor may be either a member of the company or unit management team, or another person with expertise on the project content. If there are few projects, the company or unit management team may act as a common steering committee for projects or it may delegate the management work concerning projects to a separate project steering committee. Four different ways to appoint and empower the project steering committee are presented in Figure 88.

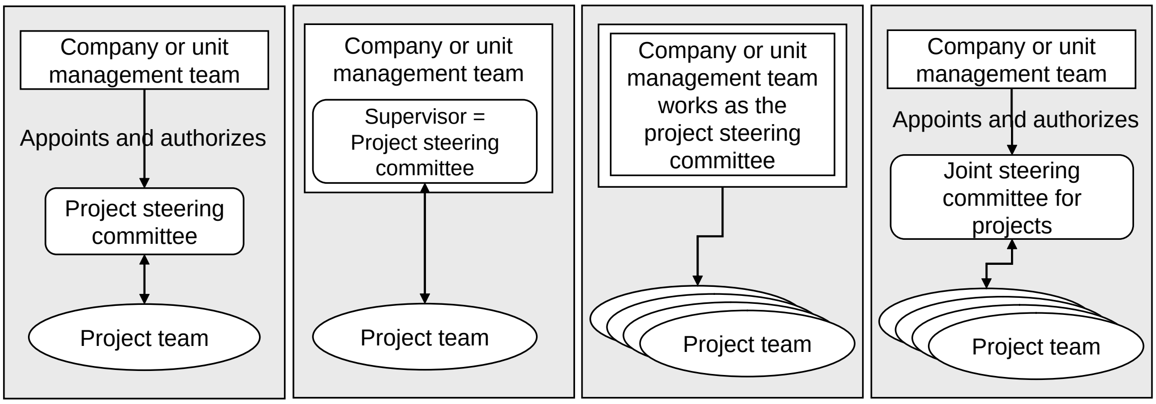


Figure 88. Different ways to appoint and empower the project steering committee

Because the management team of the functional line organization may have a role in steering the entire project portfolio of a business unit, we refer to it as the (company or unit) management team. Although the remainder of this chapter mainly focuses on the activities of project steering committees, some of the issues may apply to the work of company management teams as well.

5.5.1 Purpose and activities of the steering committee

The project team concentrates on executing the plan according to the objectives set for the project, and this feature provides rationale constituting a professional party such as a steering committee. Members of a steering committee are typically close to the project and are well aware of the needs of the stakeholders, enabling the committee to ensure that there are proper operating conditions for the project and to supervise and control project activity in a sufficiently objective manner, hence increasing the chances that the expected benefits will result from the project. The project steering committee makes the central (business-related) decisions in a project, supervises the progress of the project, solves the substantial problems in the project, and bears responsibility through its members for ensuring that the project benefits are received by the customer and the executing organization. The tasks of the project steering committee may also include a discussion of broader project matters, such as part of management's evaluation of its entire project portfolio.

The steering committee is the nearest support for and the active partner of the project manager. A variety of responsibilities may be allotted to the project steering committee, but they are usually related to project supervision, control, support, and decision making. Such examples are:

- ensuring the operational preconditions of the project;
- accepting the project plan and granting the authority to execute it;
- ensuring the relevance of the project benefits and considering the risks related to the expected benefits;
- making the critical content- and business-related decisions of the project, nominating the project team, and closing the project;
- supervising, monitoring, and supporting the execution of the project plan, as needed;

- accepting the intermediary and final results of the project and ensuring that the expected results are reached;
- processing the significant changes to the project plan (for the parts on which the project manager cannot decide); and
- presenting matters to the company or unit management if needed, such as suggesting the disruption or discontinuation of the project, deciding on changes to the project's resources, and ensuring that the project portfolio is kept balanced in change situations.

5.5.2 Membership in the steering committee and nomination

Members of the steering committee represent the decision makers regarding the content and effects of the project. This membership may include management from the project supplier, representatives of the customer, representatives of a potential subcontractor or financer, and, when needed, other stakeholders that are relevant for project decision making. For large delivery projects, in particular, there may be two steering committees: one functions at the interface with the customer and solves the related issues, and the other is internal to the project supplier and concentrates on the technical and commercial decision making in the project. Likewise, in large product development projects, a commercial steering committee may be appointed to handle business-related issues and a technical steering committee to make technical and other operating choices. The practice for appointing or selecting a steering committee varies from one company to another, and it is imperative to find a practice that fits the company's objectives, structure, and management principles.

The steering committee is appointed to its task in a way agreed upon in the company or together with the customer as part of the preparation phase of the project. A suitable project steering committee may be suggested in the project plan, and it is assigned to the task by the company or unit management team. A steering committee that includes customer's representatives can be formed during initial project negotiations, the composition of which is chosen from the people taking part in the strategic discussions.

Not everyone can become a member of the steering committee. Before the steering committee is determined, the people suggested as members should be investigated to determine whether they are suited to and available for the task. Criteria for membership on the steering committee should include that the person have the time, competence, and interest in taking part in the work of the steering committee and, in other ways, demonstrate capability to influence the requisites and progress of the project.

In order for a steering committee to be effective and to function smoothly, it should be relatively small in size, comprising about four to eight people. For small projects, a smaller committee or a single supervisor may be sufficient. The larger the steering committee, the greater the danger that conflicts and inefficiencies occur. The member structure and size of the committee should be suited to the scale of the project. The steering committee has a chair (e.g. the person that has ordered the project), and other functional roles can be added in the committee, if needed. The project manager often functions as the main presenter and discussant at steering committee meetings, and may also serve as the committee's recording secretary.

There are dangers to be avoided in appointing members to the steering committee and in outlining its functions, and they should be considered when initializing the work of the committee. The aim should not be to construct a fully representative steering committee, as a broad steering committee is prone to ineffectiveness and internal conflicts. Furthermore, the company's entire management team should not be included on the steering committee, as every member of top management does not necessarily possess the relevant competence or time required for such large participation in the project. If there are several project steering committees in a company, they should differ from each other. All projects should not be assigned the same steering committee, as the steering committee work requires time. If the company or unit is small and there are only a few projects, it may be useful to use one common steering committee or to take care of the steering committee work as part of the work of the company or unit management team. The steering committee should not interfere with the details of the project, nor should it attempt to do the work of the project team. It must be remembered that the project manager is the CEO of the project and should keep the primary responsibility for project execution and results.

5.5.3 Tasks and practices of the steering committee

The work of the project steering committee often starts as soon as the project starts, or at the time of signing the project contract. It is not uncommon that the steering committee may have met informally in the preparation phase of the project. The steering committee continues working for the duration of the project.

The work of the steering committee typically includes regular meetings, studying intermediary or situational reports, monitoring project events and progress, and engaging in other collaboration activities with the project manager, the customer, other stakeholders, and the project team. Thus the work of the steering committee involves much more than simply attending meetings, and this should be taken into account when planning the schedule of the steering group members. The work of the steering committee runs smoothly when it progresses according to schedule and along the lines of a clear framework. Nevertheless, change management in a project may involve the steering committee; changes in the project schedule, for example, may affect the activity of the steering committee.

The meetings of the steering committee are often related to project milestones or other central review phases. It is essential to obtain the steering committee's opinion on the central intermediary results of the project before they are presented to the customer. In its meetings, the steering committee also executes its tasks of supervising and monitoring project execution and it may make decisions as a group. As it may be difficult to assemble the members of the steering committee other than for agreed-upon meetings, the agreed schedule should be kept and the meetings should concentrate on the most central issues. If the project has not progressed in the planned manner, the meeting should be used to find a way to ensure planned progress during the remainder of the project. If needed, extra meetings can be arranged to go through unfinished items.

The meetings of the steering committee should be well prepared and concise. Although the meeting schedule may have been fixed into the project plan, the steering committee is invited separately to each meeting, at least one or two weeks before the time of the meeting. The invitation to the meeting is usually prepared by the project manager together with the chair of the steering committee. The matters to be discussed in the meeting are fixed at the latest when the invitation is sent. An agenda is made and the participants of the meeting are sent relevant material to be studied before the meeting; such material may consist of intermediary reports, suggestions, and additional information related to decisions, as well as other background and contextual documentation. The additional material should be of good quality, clear, and unambiguous so that the meeting can be kept concise. Concrete comparisons, analytical inferences, and clear, justified suggestions prepared and distributed beforehand ease the work and flow of the steering committee meetings. If there is a large amount of material, a concise summary of the items requiring decisions and actions should be made with references to the additional material.

An example of an invitation to a steering committee meeting and content of the agenda is presented below. The agenda should contain a clear indication of the matters that require the steering committee's opinion and decision, who will present the issues, and the amount of time reserved for the discussion. If the technical review required for a milestone has not been completed on schedule, for example, the following text could be included in the agenda section concerning intermediary results: "A suggestion to complete the technical review by [date], [name of person responsible], 10 min". The project manager (or another person appointed by the project manager) typically sends the members of the steering committee a letter or e-mail invitation to the upcoming meeting, according to the procedure agreed upon in the project or the company. This invitation accompanies the distribution of the package of meeting material. If there is a need to invite such external parties as the subcontractor's representatives to the meeting, they may receive only the part of the invitation that concerns the subcontractor.

PROJECT XX STEERING GROUP MEETING 1/20xx

Time:

Location:

Participants:

AGENDA

1. Opening the meeting, and matters to be discussed

2. Intermediary results:

- Central results so far, and the required decisions (specified)

- Deviations from the plan and required actions

- Other matters requiring the steering committee's attention, for instance, milestone approvals, and matters and deliverables to be presented to the customer

3. Next phase: A review of tasks, decisions, and actions required in the forthcoming phase

4. Action plan: Summary of the actions for correcting deviations and other activities in the next phase, responsibilities, schedule, and followup

5. Miscellaneous items.

6. Next meeting: Time and matters to be discussed (especially if the meeting differs from the plan)

APPENDICES:

- Intermediary reports

- Relevant documents related to decisions or deviations

- Other topical project documentation that requires the comments of the steering committee

Typically, steering committee meetings are led by the chair of the committee, if not agreed otherwise. Matters are usually introduced in the meeting by the project manager, who may also invite other people to present and discuss intermediary results. A well prepared meeting proceeds according to the prepared agenda and schedule. The time reserved in the meeting for the presentation of a single matter may be short - 15 minutes - highlighting the fact that the matters cannot be discussed in much detail during the meeting. Instead, the person presenting the matter should be prepared to hold a concise and informative briefing and trust that the steering committee has familiarized itself with the material that was provided in advance. Thus, the meeting can concentrate on discussing the most central matters and the ones for which a decision is required. If it appears that insufficient time has been reserved for the matter, an experienced chair knows when to discontinue a lengthened briefing or discussion and can refocus committee members on the most central issue quickly, suggest additional time for discussing the matter, or suggest a new meeting or some other way of continuing the discussion. If the matter at hand is of great urgency, the meeting can sometimes be lengthened if the schedule of the members of the committee allows it. Lengthening the meeting schedule should not become a repeated practice. At the end of each matter on the agenda, the chair should present conclusions on the opinions and decisions of the steering committee, which are then recorded in the minutes of the meeting.

The minutes of the meeting are recorded, and they become a key part of project documentation. The minutes can be kept by the project manager, by an assistant assigned to the project, or by some other person designated by the project manager. The minutes should not be an exact record of the discussion during the meeting, but should include the central decisions, potential conflicts or differences in opinion, the agreed actions and responsibilities, and the matters that are transferred to later discussion. The minutes of a meeting lasting a few hours should not exceed two typed pages. When the minutes have been drafted after the meeting, the chair and the project manager should check their content, after which the minutes are stored in the documentation of the project and distributed to the participants. There is little need to make changes to the content of the minutes afterwards, if common conclusions on the discussed matters have been reached during the meeting and if no mistakes have been made in the writing or checking phases.

A running action item list can be kept as part of the minutes, and monitoring the progress of activities may be an integral part of the meeting practices. An example of this type of steering committee activity list is presented in Table 17. When the need for a new activity is noted in the meeting, it is marked in the chart and the project manager assigns the activity to someone's responsibility. When the steering committee finds that an activity has been completed, this is marked in the list, and the activity can be deleted from the list before the following meeting.

Table 17. Example of an action point list in the record of a steering committee meeting

Activity (and what subproject or work package it concerns)	Date of completion (expected)	Person responsible	Completed
1.			
2.			
3.			
4.			
5.			
6.			

Meetings may also be a feature of the project team, the negotiation process between the customer and supplier, and other collaborative work. The same good practices of holding meetings apply to these meetings, although each meeting type has its own characteristics. Meetings of the project team concentrate on operational issues. In meetings with the customer, the customer's requirements and the rules concerning negotiations discussed in Chapter 4 are emphasized.

In addition to the methodical project work that the steering committee is responsible for, the steering committee may be under other types of pressure. Sometimes the committee must work in crisis situations – if an unsolved conflict has emerged with the customer, for instance. In such a situation, the members of the steering committee may need to negotiate, provide ideas, and analyze alternative solutions, and thus they engage in activities that exceed the scope of the steering committee member's role.

In practice the working methods of project steering committees may differ substantially from one another as do the ways of working of project teams. Some steering committees are formal and official, others are flexible and informal. Some steering committees remain distant from the project team, whereas others work in close collaboration with the team. Various working methods may be effective, providing that the work of the steering committee serves the objectives of the project and the company. The work of the steering committee is an integral part of the entire project culture.

5.6 Projects as part of a company's organization structure

At the beginning of this book, we note that projects are not necessarily a company's only form of business. We also point out that project business can have different roles as part of the company's activity. In all cases, the company must decide the way in which project business and other forms of business are organized. It must, for example, be understood what work would be profitable to execute as projects and what work is better managed in some other way.

Central issues in project management are the way projects are organized on the company level and the way they are realized as part of the *company's organizational structure*.

In practice, three different types of organizational solutions can be identified: *functional organization, projectized* (i.e. project-based) *organization, and matrix organization*.[34] These differing solutions vary in regard to coordinating activities, decision making, and division of responsibility. In each organizational solution, the importance and position of a project is different. There may be many variations within each structural type, and we discuss, in particular, the different versions of the matrix organization. In addition, we discuss the importance of the organizational structure for project management.

5.6.1 Functional organization

Traditional organizational structures have been created as hierarchies in which efficiency is pursued by grouping people with similar competences into functions, and by separating the executive, planning, and visionary work into their own hierarchy levels. Typical functions (units) are production, marketing, planning, and financial management, all of which can be divided further into smaller groups. Each employee has a line manager.

There may be projects in a *functional (line) organization*, but they are usually limited to projects inside a single function. As each group and unit only has power concerning resources in its own area, it must concentrate on working within this area. If a project in a functional organization requires competent resources from another unit, the matter must be referred to higher levels in the organizational hierarchy to be processed. A product development project may be an internal assignment of the product development unit, but regarding production-related matters, the manager of the product development unit must negotiate with the production manager and return to the project team with the answer. The project itself has no negotiating power, and the actual coordination is conducted according to the organization's hierarchical structure by the managers of the line units. There are usually no project managers in a functional organization, and if there are, they have no special power compared with the role of the unit manager.

In some cases, projects such as the implementation of an organization-wide information system common to the entire company can be conducted in a functional organization. In this case the project is coordinated by the management of the company or units. The functional organization is presented in Figure 89.

[34] E.g. PMBOK (2004), Turner (1999)

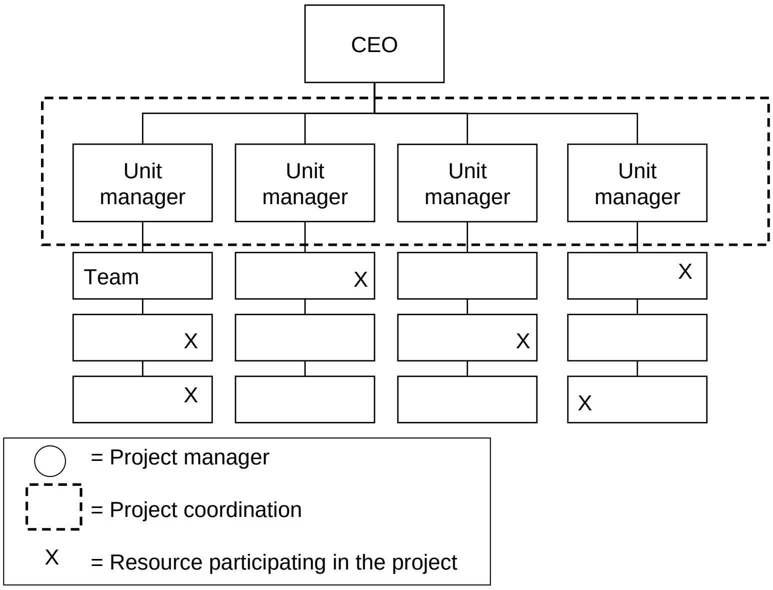


Figure 89. The functional organization and the coordination of inter-unit projects at the level of unit managers

In a functional organization projects have no special position or acknowledged identity. Rather, they are part of the normal functioning of the unit; they are started and finished, and their results are transferred, when needed, from one unit to be processed in another according to the hierarchy. The coordination among units is the responsibility of management, so the role of the project manager may be minimal. From the perspective of managing projects, the functional organization is cumbersome and inflexible, and makes it difficult to achieve the expected efficiency in project management. Some characteristics of the functional organization presented from the perspective of projects are summarized in Figure 90.

Characteristics from the prespective of a project	
• Projects do not have their own identity • The project manager does not work as an integrator, as the hierarchical structure determines responsibilitites and the transfer of results • Does not support effective project control	
Advantages • Possibility to develop speacialized skills and effectiveness • Clear task specifications • Stable, long lasting • Stable procedures internal to the function are made possible • Fits a stable business with slow change	**Disadvantages** • Difficulties in cross-functional collaboration, difficulties in communication • Slowness to develop the business as a whole • High risk of project failure (application of results difficult) • Inflexibility

Figure 90. Characteristics, benefits, and disadvantages of the functional organization, from the perspective of project business

5.6.2 Projectized organization

An option to the functional organization is the purely project-based organization, or what we refer to as the *projectized organization,* which is built primarily on projects. Its structure is based upon temporary projects (or programs) that are independent and whose project managers have available all the required resources for the project, and the power to manage them. Projects may consist of subprojects, units, or groups, which report directly to the project manager. There may also be departments or support units in the projectized organization that serve several projects simultaneously.

In a projectized organization, projects have their own resources and the project personnel report only to the project manager. The projects also take care of competence development, long term planning, and other line responsibilities, and the project manager is able to execute CEO-type roles. The project has cost and profit accountability, so planning and monitoring project management forms the major part of the company’s planning and monitoring. There is no need to negotiate for resources, as the project may procure all the resources it needs in the preferred way. Ideally, everyone working on the project should be conscious of their assigned project responsibilities, as it is their primary work. A simple projectized organization is presented in Figure 91.

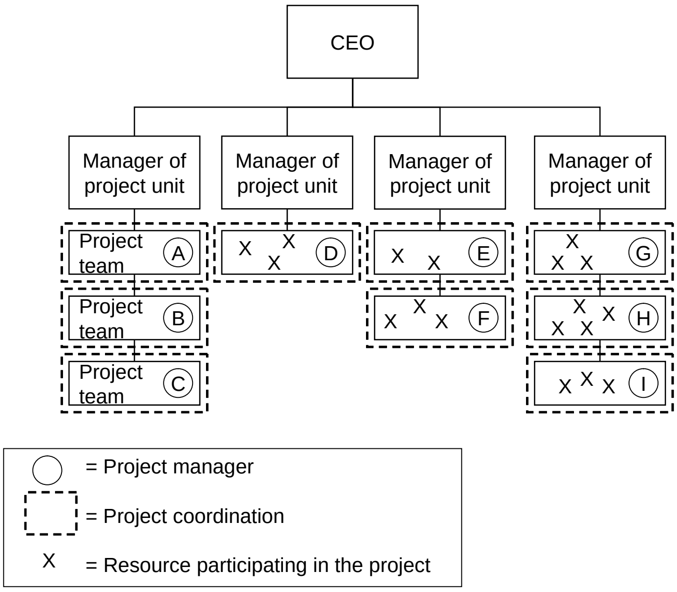


Figure 91. In a projectized organization project managers coordinate projects that have their own resources

In a purely projectized organization, projects are the primary way of doing business. As projects are temporary, the downside of a projectized organization may be instability and unpredictability. Finishing projects and starting new ones may become a turbulent time, as the resources must be fit to the needs of the new projects. There is a danger of inefficiency in allocating project-specific resources if projects are incapable of sharing resources. A projectized organization is perhaps the most supportive of effective project management, but it has disadvantages concerning business in general. The characteristics, benefits, and disadvantages of the projectized organization are presented in Figure 92.

<table>
<tr><td colspan="2">Characteristics from the prespective of a project
• Projects are the main way of doing business
• Project-specific resources
• Projects hold financial and profit responsibility
• Supports effective project control</td></tr>
<tr><td>Advantages
• Project manager has a clear managing role and financial responsibility
• Project goal and boundaries visible to everyone
• Adaptability, flexibility
• Possibility for new ideas and bold choices
• Supports proper project planning and followup</td><td>Disadvantages
• Risk of inefficient resource usage
• Challenges to manage inter-project collaboration and coordination
• May be too dynamic
• Demanding for management: requires attention
• Weak opportunities for specialization
• Unanticipated career paths</td></tr>
</table>

Figure 92. Characteristics, benefits, and disadvantages of the projectized organization, from the perspective of project business

5.6.3 Matrix organizations

As we have noted, functional and projectized organizations have their own benefits and disadvantages. In order to make use of the dynamics related to projects, and at the same time preserve the sustainability and possibilities for specialization of a functional organization, many companies have aimed at a structural intermediary form of the two extreme solutions. Nowadays, *matrix organizations* have become a common way to combine the best features of the projectized and functional organizations. There are many types of matrix organizations, depending on the relative emphasis placed on functional versus projectized features in the structures.

The closest form to the functional organization is the **weak matrix organization** (or functional matrix organization). In a weak matrix organization the functional organization with its units, hierarchy levels, and competence groups determines the organizational structure; as well cross-functional projects are identified. Projects are coordinated beneath unit management. The project personnel that are assigned to the project by the line organization coordinate the work that is done in the project. The resources have been sourced from the different functional units. Some of the people may work in the project part time, and some work full time and have their full-time roles described in their work description. When the project is completed, the people continue their regular work at their functional places and their work description may be slightly different. The person coordinating the project is not necessarily called a project manager so does not have extensive authority in utilizing resources and may merely coordinate the cross-functional work. The weak matrix organization is illustrated in Figure 93.

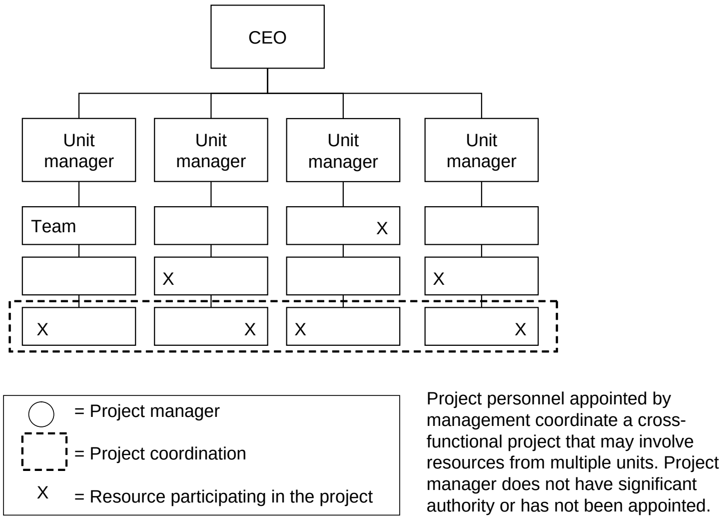


Figure 93. Weak matrix organization (or functional matrix)

In the balanced matrix organization (Figure 94), the project manager manages the project and shares responsibility with the line managers. The project manager may be responsible for the schedule and cost objectives of the project, whereas each of the line managers may be responsible for the content and quality of the work belonging to their particular area (project scope). Resource usage is agreed upon between line managers and the project manager.

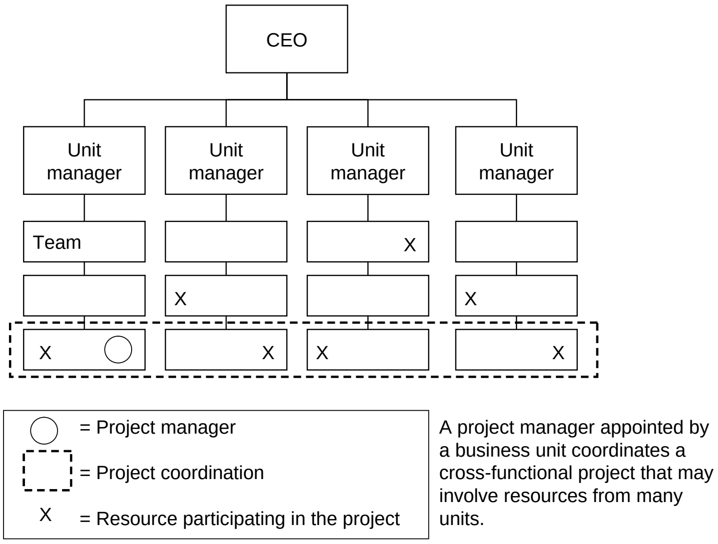


Figure 94. Balanced matrix organization

The type of matrix organization closest to the projectized organization is the **strong matrix organization** (or project matrix organization), in which the business accountability rests within the projects instead of within the functional units (Figure 95). Thus, in the strong matrix organization, the project manager has considerable power, projects may have permanent personnel, and the work description of project managers is regulated principally by projects. The power of the project manager is strengthened in that the superior to whom this manager reports is in at least as strong a position in the line organization as are the unit managers that own the resources. The entity formed by the projects is coordinated at the same level as functional units, so instead of being focused on the needs of single projects, decisions may be directed by the common strategic goals of the projects as a whole.

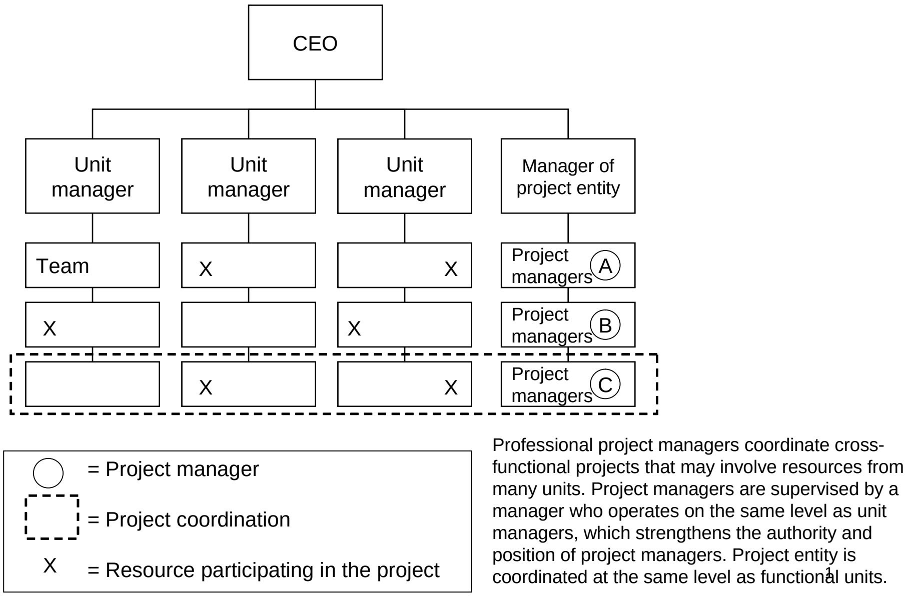


Figure 95. Strong matrix organization (i.e. project matrix)

It is common for all matrix structures that the project manager negotiates and agrees upon resources and project results together with the managers of the functional organization. Resource pools (units of the functional organization – resource maintenance and development) and project pools (projects – requirements for and borrowing of resources) can be identified in matrix organizations. If there are several parallel projects underway in the company, the same people may work on several projects, in addition to performing their functional tasks. Matrix structures differ from one another, especially regarding responsibility for work management and accountability. The more the organization is inclined toward a projectized organization, the larger the responsibility transferred from line management to project managers.

The positive opportunities of a matrix organization are related to its offering sustainability and development opportunities typical to functional organizations and balancing these with the flexibility of project work. The largest challenges are related to fitting together the goals of the functions and projects. In a matrix organization, the unit managers must negotiate with the project managers about the correct allocation of resources. Relevant questions include: How is the development of long-term capability versus catering to more immediate situational project needs prioritized? To what degree are urgent customer service and product development activities, that will not provide benefits until the following year, emphasized? If the functional unit is responsible for funds and people, the project manager may have a difficult time negotiating for a sufficient allocation of these resources to be assigned to the project. It may also be challenging from an employee's perspective to work for two managing superiors.

The matrix organization may work well if the company's strategy is clear, if the matrix responsibilities have been determined unambiguously, and if everyone has a common understanding of the way resources should be directed in order to implement the strategy. Some general characteristics, benefits, and disadvantages of a matrix organization are presented in Figure 96.

Characteristics from the prespective of a project	
• Aims at combining the strengths of both the fuctional and projectized organization • Currently the most common organizational form • Managers of the function and the project negotiate on resource allocation – controversy is typical	
Advantages	**Disadvantages**
• Flexible use of skills • Allows specialization • Adapts to changes in the envitonment • Dual reporting – communication is emphasized • The objective of projects is clear • Development oriented – many career possibilities • The reallocation of resources is smooth	• Challenges in division of responsibility, difficult position of project manager • Two managers, two sets of objectives: does everyone know what is important? • Politics and power conflicts • Difficulties in prioritizing work activities and resource usage • Battle for resources

Figure 96. Characteristics, benefits, and disadvantages of a matrix organization

5.6.4 The importance of organizational structure in project management

As described above, there are some differences in the way the organizational structure is reflected in the work and roles of the project manager and the members of the project team. In practice, the organizational structure has a significant effect in the success of projects. Therefore the tasks, position, use of time, and many other requirements of the project manager differ from one company to another. Some differences among organizational solutions are illustrated in Figure 97.[35]

It must be remembered that other internal and external factors of the company, not just the project organizational structure, are reflected in the work of the project manager and the project team.

[35] PMBOK (2004)

Organization structure / Project characteristics	Functional	Matrix			Projectized
		Weak	Balanced	Strong	
Power of project manager	Low or none	Limited	Low to moderate	Moderate to high	High to almost total
Percentage of personnel fully employed in projects	Virtually none	0-25%	15-60%	50-95%	85-100%
Role of project manager	Part time	Part time	Full time	Full time	Full time
Titles under which project manager's work is done	Project coordinator, team leader	Project coordinator, team leader	Project manager	Project or program manager or director	Project or program manager or director
Administrative personnel required in project control	On a need basis	On a need basis or part time	Part time	Full time	Full time

Figure 97. The organizational structure affects the project manager and the work of the project team in many ways

This chapter has concentrated on the organizational structure, which has obvious effects on projects. It can also be deduced from the discussion on structure that the project, as part of a company, is impacted by phenomena other than the requirements presented by stakeholders and project management. In the activity of the company, the project is not a detached unit; rather, it is attached to the higher goals and other projects of the company, as well as to the functional (line) organization.

5.7 Literature

Boyatzis, R. E. (1982) The Competent Manager: A Model for Effective Performance. USA: John Wiley & Sons.

Frame, J. D. (1995) Managing Projects in Organizations: How to Make the Best Use of Time, Techniques, and People, 2nd Edition. San Francisco, USA: Jossey-Bass Inc.

Galbraith, J. R. (1977) Organization design. USA: Addison-Wesley Publishing Company.

Handy, C. B. (1982) Understanding Organisations. USA: Penguin.

Katzenbach, J. R. and Smith, D. K. (1994) The Wisdom of Teams. Creating a High-Performance Organization. USA: HarperBusiness.

Kotter, J. P. (1990) A Force for Change: How Leadership Differs from Management. New York, USA: The Free Press.

Pinto, J. K. and Kharbanda, O. P. (1995) Successful project managers. Leading your team to success. Van Nostrand Reinhold: USA.

Vartiainen, M., Ruuska, I. ja Kasvi, J.J.J. (2003, in Finnish) Project competence – resource for dynamic organizations. Tampere: Teknologiainfo Teknova Oy.

6 PROJECT-RELATED SERVICES

In this chapter, we discuss the commissioning of project deliverables, the phases of project management that begin once the project supplier's product is handed over to the customer for business or personal use. In particular, we emphasize project-related *services* – offerings that complement the product, and which the supplier attempts to sell to customers to ensure that customers achieve full benefit from the project deliverable.

Project customers use the primary product resulting from a project in their normal daily business or private lives and they typically expect long-term benefits from the product. In our case example focusing on the Smiths' house construction project, the product is used as the family's home; in an airplane development project, the use of a new airplane model enables the air transport customer to execute new passenger or cargo delivery projects; and by investing in a new paper manufacturing machine, the industrial customer gains new capacity to manufacture and sell paper. But project-related services are secondary items, complementary to the primary product. Such complementary items may include nonphysical services (such as managing the product during its use or providing maintenance, repair, development, or evaluation work) or physical products (such as spare parts or tools).

6.1 Purpose of services

Services include all the phases from project handover to the disposal, reuse, or replacement of the product. The purpose of services is to stabilize the future state that was defined as the goal of the project as a productive way of working. With the help of services, the effectiveness and reliability of the product can be ensured and its usefulness improved by such means as developing additional services or new ways of product use.

In an extreme case, the project supplier does not sell the customer the project and the resulting product, but rather enhances the customer's capacity or performance. In this case, the right of ownership is not transferred to the customer and the supplier retains part or full ownership of the product. Thus the supplier no longer supports the use of the product by selling the customer separate services, but is itself responsible for product use and for providing supporting functions. In this situation, the customer either pays rent or a comparable usage or lease fee for the use of the product, or the customer buys, as a total service, the capacity or benefit it gets from using the product.

As the supplier's activity is related in this way to the customer's value chain, special forms of collaboration and contract models are required between the customer and supplier. For example, the following types of terms are used to describe the optional collaboration forms: lifecycle contract model, private-public-partnership model, and build-own-operate model. The customer must ensure the prerequisites for the economic profitability of the investment so the supplier can take the responsibility and risk for the fixed assets it has constructed. In practice the customer must be ready to enter into a usage or capacity purchase contract with the supplier for an extended period, perhaps as long as several decades. The supplier may need to enter into other contracts to procure such items as services, materials, or equipment related to executing the investment or to supporting its use. The project supplier often forms a separate company (a project company) to carry responsibility for executing the investment as well as its ownership and use. Separate funding is secured for this separate company and its investment, and external financers who offer such a loan base their investment decision on the economic strength of the borrower's ensured future business, as evidenced by signed contracts with the customer. The supplier can also sell part-ownership of this separate company to the financers who may want to participate in the investment by taking an equity position. The customer can also own stock in the separate company, in which case the company is jointly owned by the customer and supplier.

The lifecycle contract model is a special case of project business, but it highlights the importance of project-related services in business. Because the use of products depends strongly on the particular type of product and business in question, in this chapter we focus on general services, offered by the executor of the project, that complement the project; the term "after-market services" is sometimes used to describe these services.

At the final stage of the project lifecycle, the efficiency and reliability of the product requires *product management*. If the deliverable is a tangible fixed-asset device, such as piece of major equipment, a system involving major tangible components, or if it is a factory building structure or facility, product management may involve preventive, corrective, or modernizing maintenance. If the deliverable is a nonphysical (intangible) product, however, such as a mobile phone service package or a change in the organization's way of working, then pricing, division of responsibility, or service package version management may be emphasized in product management instead of maintenance. Additionally, it may be necessary to complement the product with services. Improving the usefulness of the product may require different types of additional services, including, perhaps, product development and, at the end of the lifecycle, product disposal and product replacement (with another solution). The development and maintenance of these supporting services occur during the entire lifecycle of the project, and such support can deal with just one project or a broader part of the firm's business.

In Figure 98, the typical phases of project-related services are presented for the post-handover phases of the project lifecycle. The time phases after handover can be divided into the guarantee period and the post-guarantee period, and these time phases are typically defined in the project contract.

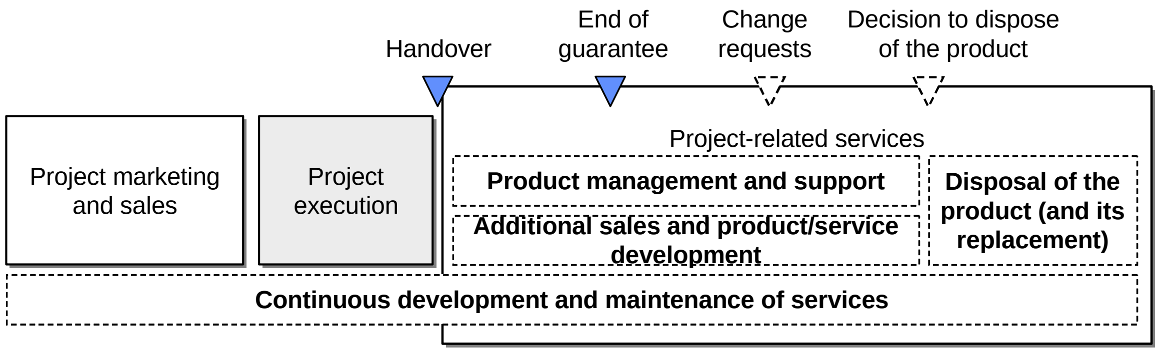


Figure 98. Support services during the product use phases of the project lifecycle (from the executor's perspective)

The product realized in the project – be it an airplane, an automation system for a paper manufacturing machine, a house, or a phone – once placed into use by the customer is assumed to begin providing the benefits that were expected from it. Companies have many means for maintaining these benefits and for providing support during product use. Sometimes the customer itself takes care of product management and support, and further development and eventual disposal of the product. Nevertheless, the project supplier often has an attractive opportunity to participate in providing support during product use, particularly if the supplier has established a strong trust relationship with the customer. The division of responsibility for product use support can be agreed upon in the initial project contract, in a separate service agreement (a general contract specifying the service offering from a supplier to a customer), or in a service level agreement (a specific contract detailing both the service offering and the level of service guaranteed by a supplier to a customer).

6.2 Commissioning the product

Project execution ends once the project supplier hands over the resultant product to the customer, a point that is referred to as commissioning the product (i.e. when the customer receives the completed product resulting from the project). At this juncture, a closing meeting is held between the project supplier and the customer; at this meeting the cost account for the project is closed, and the project itself is officially closed. The division of responsibility related to commissioning the product is determined in the project contract. Many products resulting from a project – a new house, a mobile phone model, a computer system, a factory – require close collaboration between the project executor and the customer as the product is put into use.

As part of its project delivery, the project supplier often undertakes to participate in the test usage phase and in supporting the commissioning and initial use of the product that resulted from the project. In the case of large factory projects, the suppliers of the main equipment for the project participate in factory start-up operations, which may take months. Furthermore, on large project deliveries, training of customer's personnel is often a relevant part of a supplier's service offering. Guarantees relating to mechanical equipment and product performance value guarantees are valid after project handover and transfer of ownership occurs, and they ensure that the project supplier is accountable for project delivery and for possible product defects during a specified period after handover.

If the entire work of a large project is handed over at one time at the end of the project, the project supplier is in danger of getting stuck dealing with deficiencies and other potential disputes with the customer concerning the entire project, and thus the project supplier risks possible fracturing of collaborative relationships with the customer. To avoid such situations, project handover often occurs in parts and project payments are tied to these partial handovers and receipts. If project handover is conducted in parts, the last parts are handed over as the project is closed. In this final phase, mutual claims can still be presented, an agreement can be made to solve them, and a memo can be exchanged in the context of the final review. The supplier, as project executor, must be careful in reviewing the customer's list of deficiencies and requests for change work at the end of the project; the supplier should ensure that the deficiencies and change requests legitimately belong to the scope of the project and that acceptance and billing of possible changes proceeds correctly. The project executor does not need to perform work that does not belong to the project without charging an extra fee, but on the other hand, the customer should not need to ask for extra project completion work to be performed; all contractually agreed work must be performed, but not extra work.

In commissioning the product, the actual operational use of the product begins, and the responsibility is transferred from the project supplier to the customer (in particular, to the unit or department that operates and maintains the product), and the responsibility for the project shifts from the supplier's project manager to, for example, the customer's business manager or production manager. At the same time, the provision of support services for the product begins.

The customer experiences benefit from the product after the project execution phase ends, and the customer's degree of satisfaction can depend equally on how well the product performs and on how well product maintenance is conducted during product use. The customer is interested, for example, in how quickly the use of the product generates business and profits, how low operating expenses can be achieved, and how long product use will remain profitable (i.e. how long revenue exceeds operating and maintenance expenses).

For the project supplier, the final or use phase of the project lifecycle is a possible source of costs but, as previously mentioned, it presents possibilities for generating new business from the sale of support services, and this business has become attractive to suppliers of both product development and delivery projects. As described in Chapter 2, a product can be formed of a combination of tangible (physical) product features and intangible services, the combination of which comprise a total product concept whereby the project supplier's work continues in the form of services. In short, the supplier often engages in what we refer to as service business.

Guarantee period and product liability

Products have a predetermined guarantee period during which the project supplier agrees to correct all or a restricted list of defects that may be detected in the product. During the guarantee period, the supplier ensures that the performance and usability of the product fulfills the requirements expected from the project. The guarantee may be a full guarantee, under which the supplier is responsible for fixing, at no cost to the customer, all the product defects and problems that have arisen during the guarantee period, or it may be a restricted guarantee, under which the supplier bears responsibility for only those defects or problems that are within the limited scope and cost specifications detailed beforehand in the guarantee document. The scope, duration, and division of responsibility of the guarantee period form a crucial part of the project contract.

In its official definition, the guarantee period typically applies to projects executed by an external supplier. For a company's internal projects, however, such a guarantee period is not usually defined; the people from the internal unit that executed the project, or the personnel in the internal unit that use the product, usually take care of the work that is required after project execution, depending on which unit has the most suitable resources available to it. It is common in cases of internal organizational development and product development projects, that personnel involved in executing a project must perform unanticipated and unplanned finishing work related to the project after the project has been closed. Such finishing work can disrupt new project implementation and commitments of company personnel, and may distort the company's internal cost structure. In order to help direct or allocate the costs, it would be useful if the internal parties agreed upon a guarantee period for internal projects, after which the internal unit or party that ordered the repairs or extra work would pay for any expenses associated with this work.

For external projects, the length of the guarantee period is often based upon the maturity of the technology, the state of the competitive situation, or the particular standard that has been agreed to within the industry. If the project is large scale, the various parts of the project may have particular lengths of guarantee period; typical guarantee periods range from a few months to several years. Instead of a guarantee period, the supplier can offer the customer an extensive maintenance contract that is free of charge and lasts for a specified period – one year, for example. The latter arrangement may encourage the customer to purchase, upon the expiry of the free maintenance period, an extended maintenance services contract from this same supplier.

Although, the division of work during the guarantee period is ultimately determined on the basis of negotiations between the contractual parties, it may have been afforded weight at the sales phase of the project; the terms of the guarantee period may have been one of the choice criteria that the customer used to evaluate suppliers' competitive bids.

During the guarantee period, both parties should take an active interest in monitoring the use of the product. For its part, the customer may want evidence that the product fulfils the original requirements, functions as expected, and produces results. If faults or problems are detected, it is cheaper for the customer to detect them and have them fixed during the guarantee period than to be unaware of faults and problems until after the guarantee period has expired. From its perspective, the supplier may want to avoid and anticipate potential product use issues and minimize any costs resulting from product faults and problems. Thus the supplier may become active in monitoring product use, including studying the way the desired capacity or fault level is achieved and the way the customer actually uses the product. The more severe the problems become, the more expensive it will be for the project supplier to fix them. If the project parties are close partners, the monitoring efforts conducted at the beginning of the product usage phase may provide an effective means for the project supplier to gather information that will help it to further develop its product.

The project supplier may prepare for the possible expenses of the guarantee period by creating a guarantee contingency fund at project closing. The monetary size of this contingency can be estimated on the basis of earlier comparable deliveries or on other reliable and valid investigations, and it may be set at a percentage of the worth of the entire project delivery – 1%, for example.

The customer must be able to trust the product supplier's ability to produce a safe product that fits its purpose in use, especially during the guarantee, but also after it. Under the particular country's product liability legislation, the project supplier has product liability for the solution it has executed. This regulatory liability provision is valid regardless of the supplier's guarantee period; if the product causes damage that it should not cause in a normal operating situation and environment, the party that has experienced the damage has the right to demand and get remuneration for the damage from the supplier on the basis of product liability legislation. In addition to covering the product, this remuneration may extend to such indirect effects experienced by the customer as loss of productivity, disruptions to production, and resulting loss of sales. When claiming for product liability, there must always be proof that the customer has experienced damage, that the product has proven unsafe to use, and that there is a cause-effect relationship between the performance of the product and the damage.

To cover anticipated and unanticipated product use problems, the project supplier can purchase insurance from a third party, thus transferring part of the risk included in using the product to an insurance company. Insurance companies offer various types of product liability insurance and they tailor their insurance packages on the basis of risk analyses to suit the needs of the project supplier. The insurance contracts typically contain precise definitions of the risks that are covered or not covered and, if covered, to what amount. Faults and accidents caused by improper product use are typically not covered by insurance. Although it is highly unlikely that an insured risk actually occurs, the expenses associated with such an occurrence may be severe.

6.3 Developing and maintaining services

In order for the project related services to be of use to both the customer and the supplier, they should be prepared and planned in a timely manner. Some of the required services may be fully independent of the project and instead form an integral part of the supplier's standard, modular service offering. The supplier's marketing and sales personnel can use the service offering as support for their work, and the customer may use service factors as a decisive criterion in choosing among competing project suppliers. Part of the supplier's service offering may be project specific and thus require either creating a completely new service concept or tailoring an existing service to suit the product involved in a particular project. In practice, new and tailored services are developed as the project progresses and these services form part of the total product outcome from the project.

Because of the importance of product services, the supplier and customer typically discuss them at the ideation and preparation phase of the project and revisit them periodically throughout the project lifecycle. During project scope specification, the required and possible alternative maintenance and auxiliary services are identified and their feasibility and requirements evaluated. Typically only part of the services discussed at the ideation phase of the project are realized during the project. Some services from a more permanent service portfolio can also be modified and selected as part of a customer-specific service concept. Customer-specific maintenance services are described and conceptualized and the service processes are planned, executed, and tested during project execution. In this phase, the division of responsibility for executing the services and a possible subcontracting network are planned. At the final stage of project execution, the supplier's service package for this particular product is finalized and is marketed at the same time the product is commissioned. Any new services developed are fitted together with the supplier's existing service offering and specific supplier personnel are assigned clear maintenance and execution responsibilities for the agreed service package.

As applies to the physical product, support services must be maintained. In order for the services to be executed efficiently and effectively, there should be clear descriptions and guidelines for at least the most common services. Furthermore, the execution responsibilities for the services should be clearly defined and allocated to the parties, and the earning logic of the services should be profitable in one way or the other. A typical mistake in project business is to fail to assign a price to each service or to allow a free service period to extend for a long time after the project is commissioned. It would also be a mistake if the service responsibilities were ambiguous; it is essential that the parties agree on which of the specific service supports needed during product use are the responsibility of the customer and which are the responsibility of the supplier. By agreeing on these matters in advance of project commissioning, service responsibility conflicts and unanticipated repair and maintenance work can be avoided.

6.4 Product management and support

The task of product management and support is to ensure the product's performance and reliability after project execution. Performance objectives typically have been defined previously in context with the project scope, or, possibly, at the time of setting the project goal. The product performance objectives can be related to technical performance (capacity) and to efficiency of use. Performance objectives can be changed on the basis of preliminary product use experiences, and performance expectations may be raised during use. Performance can be affected in many ways through product management activities. Comprehensive product use instructions can be prepared and product use training provided, for example, especially at the start of product use. In addition, guidance can be offered on means to improve the product's technical performance by making the right technical adjustments, by changing components, or by using other suitable implementation methods. Face-to-face or call-center consultation-based customer support, and other supports, can be offered to assist in changing the product if the customer wants to use the product in new and more effective ways. Furthermore, the customer's experience with the product can be affected if the supplier changes the pricing principles for product components or spare parts (e.g. from unit-based pricing to performance-based pricing), rearranges responsibilities for product or service maintenance, or tailors the entire offering to better suit that client's specific needs.

Regarding the achievement of performance objectives, product management can be studied from a technical, lifecycle, commercial, or organizational perspective, as illustrated in Figure 99. Under the technical product management column of Figure 99, we refer, in particular, to support during the use of investments in fixed assets, a situation that involves operational reliability of fixed assets and offers the project executor a natural opportunity for enhancing its service business.

Figure 99. Four components of product management

Operational reliability refers to both the availability and maintainability of the product. Reliability can be affected anticipatorily or reactively with many types of procedures, most often referred to as maintenance procedures, which should be studied in a broader context, including technical and managerial perspectives for treating fixed assets.

6.4.1 Technical product management

Product management and support may take many different forms. Often, however, a division is made into preventive product management supports, the goal of which is to maintain or ensure high reliability and performance of the fixed assets, and corrective product management supports, in which realized product faults and performance problems are fixed. The extent to which product management is the responsibility of the project supplier or another external party is also determined separately in each situation. Examples of different services that project suppliers can offer to their customers as part of project business or as its complement are presented in Table 18.

Table 18. Examples of service opportunities in project business in the fields of anticipative and corrective product maintenance

Anticipative product management	**Corrective product management**
Preventive maintenance	Diagnostics, fault investigation
Control and adjustment services	Repair, reinstallation
Modernizing	Spare parts business
Training, guidance, documentation	Equipment leasing services
Certification	Consultation
Monitoring, followup, evaluation of performance, inspections	
Auditing	
Consultation	
Capacity or usability	

As described earlier, in an extreme case, project management could refer to selling capacity as a service. In lifecycle contract models, the customer expects high delivery accuracy and high quality product performance, and has transferred the responsibility of product management to the supplier. The supplier, in turn, invests in capacity, tries to utilize it as effectively as possible, maintains it carefully, and tries to get the cost level as low as possible compared with the price paid by the customer. As well, the project supplier aims at a high utilization rate and high predictability. If the competitive environment is such that it would be easy for the customer to change suppliers, capacity problems may turn out to be a risk factor for the original supplier. Typically, however, the large size of the fixed asset facilities, their physical nature, and their weak transportability decrease the customer's inclination to change suppliers, especially in the case of large project deliveries.

6.4.2 Maintenance as an example of services

Product maintenance is a service that supports the product and its use after project execution. Performing product maintenance does not necessarily belong to the core activities of the project customer, but it is necessary in order to achieve and stabilize the change that was the objective of the project; if maintenance is not performed, the project benefits are not realized, or they are short-lived. Deficiencies in maintenance appear as faults, delays, unanticipated repairing costs, weak profits from the business, and even as accidents. In many industries, maintenance has been outsourced to a subcontractor or to the project supplier because performing it is not considered to be part of the customer's core business. Regardless of which party performs the maintenance, however, strict quality requirements must be applied to it.

Maintenance consists of all the technical, administrative, and managerial procedures applied during the product lifecycle that aim at maintaining or improving the product's performance level to ensure that the product fulfills the requirements that have been set for it. A product failure is an event in which the product's ability to execute the required function or activity ceases entirely or its performance is not acceptable in quantity or quality. Maintenance services can be divided into three areas – preventive, corrective, and improvement – according to the nature of the activities performed; all these activities are required in product management.

Preventive maintenance identifies and decreases possible sources of failure, prevents breakage and emergency situations, and lengthens the lifecycle of the fixed asset. It is based upon a plan and a predetermined time – regular maintenance, for example. Additionally, maintenance requirements are anticipated through monitoring and checking the condition of the fixed asset, by timing maintenance based upon its condition, and by making condition-based anticipative repairs. By practicing extensive preventative maintenance, product failure involving equipment that has been in use for a long time is avoided and a high level of reliable product performance is maintained.

Corrective maintenance refers to unanticipated repairs that are needed, as failure occurs, in order to restore the functionality of the product. Failure can be caused by erosion, misuse, false estimates, inadequate working conditions, and many other factors. Conditions that may cause product failures may be latent, and they may cause such symptoms as weakened performance. There may be observable disturbances or damage in the performance activity, which causes the activity to cease or otherwise to be disturbed. In corrective maintenance, the cause of the failure is located so that it can be removed. Disturbances can be fixed, for example, by cleaning, adjusting, or restarting the equipment, whereas damage requires repairs. During repair activity, some components, equipment, or parts may require replacement or improvements. Additionally, corrective maintenance may require testing the repaired equipment, disposing of and replacing faulty outputs from production, leasing a temporary solution for the time that the fixed asset is out of order, and giving guidance to the users to avoid comparable disturbance situations.

Through **improvement maintenance**, the use of the product can be made more effective; improving maintainability, reliability, and modernization are considered improvements. By making various adjustments and changes to equipment settings, or by acquiring complementary products, services, or materials, the product's performance can be improved regardless of the original performance objectives set for it. Additionally, training and other competence development services can serve as a basis for improvements.

It is usually recommended that the major part of maintenance would be planned and scheduled preventive maintenance aimed at avoiding failure. The costs of corrective maintenance are unpredictable and can grow into large sums, whereas the costs of preventive maintenance can be anticipated and may remain at a stable and acceptable level. Improvements in product performance can be considered a development investment and a boost to profit expectations, just like any other investment.

Example: Maintenance services of a house supplier

Livinghouse's business has its primary emphasis on house package deliveries. Because customers have made inquiries about the availability of maintenance services to complement the projects, however, Livinghouse has been considering adding certain post-house construction services to its business offerings and selling them to customers. Although, marketing such services is not yet very common for house package suppliers, Livinghouse would like to differentiate itself by doing so, and believes that it is wise to analyze the business opportunities in this area.

In its preliminary analyses, it identifies business opportunities in several areas of maintenance. **Preventive maintenance** could be offered in the form of an annual customer visit, during which a general inspection checklist would be used to help identify potential problems. As well, the functionality of the technology installed in the house would be checked, with the help of a separate checklist. This service could be priced to be affordable and attractive for the customer, but at a price point that would at least cover Livinghouse's direct expenses. By providing preventive maintenance, Livinghouse could maintain the customer relationship and perhaps later gain opportunity to sell more profitable additional services. In the long term, the objective would be to create opportunities to generate new business from the same customer, for example, contracts for significant house expansions and renovations.

For the purpose of **corrective maintenance,** Livinghouse has planned to start a professional call service, establish a service center, and offer year-long service contracts. The pricing of the service contracts could be based on a fixed monthly price plus a variable charge, depending on the extent of service utilized by the customer. With long-term and continuous contracts, the loyalty of the customers could be increased, and Livinghouse could employ adequate and skillful resources to serve customers' constant and stable maintenance work demand. Corrective maintenance requires the recruitment and training of some new service personnel, but Livinghouse already has an annual service contract with a few good customers and this start would provide work and a good training setting for the new personnel. The same personnel could also be trained and assigned to perform preventive maintenance tasks and to manage the customer relationships as they executed their corrective maintenance duties.

Modernizing maintenance presents an attractive opportunity for Livinghouse to get new projects. The company could complement its product offerings by offering repair, renovation, and house expansion services that could be priced according to the normal project pricing methods: either entirely or partly at a fixed price, or according to a cost plus contract. Because it would be engaged in a long-term customer relationship with homeowners, Livinghouse would likely be viewed as a known, reliable supplier and would therefore have an advantage over competitors who would likely be regarded by these customers as completely unknown and, therefore, risky suppliers. In short, providing post-sale services helps generate customer loyalty and continued sales, and it is an effective way for Livinghouse to market its products and capabilities.

According to Livinghouse's estimates, the maintenance services during the life cycle of a house can generate sales revenue (turnover) of up to 50 % of the initial project's selling price. In particular, Livinghouse sees a great revenue opportunity in providing maintenance services to not just their own house projects, but also to houses of their competitors' "installed base" (i.e., complete houses that are already in use). In addition to this service revenue, selling and delivering maintenance services for competitors' installed base of houses would provide Livinghouse with an opportunity to generate new customers. In the future, Livinghouse's share of services may increase to the point at which its profits from service revenue exceed that of providing house package deliveries, a market that is highly competitive.

6.5 Additional sales, and product and service development

Product management is closely related to the collaboration of the project supplier and customer in other than project-related areas. As the collaboration continues, the parties may identify new project areas in which they could collaborate. The goal may be to replace, add to, or extensively renew an existing solution. Additionally, collaboration can be broadened to areas that are not related to the project. The possibilities for collaboration may be opened either through the actions of the customer or through the project supplier's own development work.

The customer's degree of satisfaction with the project and with the collaboration during product use, affects the new collaboration possibilities that can be created after the project is closed. In particular, if the collaboration goes well, the customer may offer the project supplier better access to new project opportunities than it gives competing suppliers. This can happen in at least three ways.

The customer may make direct requests and talk openly about its future procurement to a project supplier that it considers trustworthy. Because of the supplier's compatibility with the technology and knowledge of the customer's working procedures, for example, and as a result of experiencing the benefits of the supplier's maintenance services, the least expensive option for the customer may be to order extensions and additional entities from the same supplier.

During the project, and in commissioning the project, the supplier may be able to **observe and discuss the product in use in a broader context at the customer's facility** and thereby identify opportunities to satisfy other needs related to the customer's activities or operating environment. The project supplier should also pay attention to the customer's customers and be vigilant for additional business opportunities related to these supply chain settings.

The customer may tell of its future plans and the uncertainty factors related with the future. The customer may communicate about its strategy or alternative views of the future, which may suggest new product development opportunities for the supplier. The development opportunities may be related to new content areas, the management of different versions of the product, or to attempts to extend or increase the effectiveness of the product throughout its lifecycle. The customer may have made a more detailed roadmap of its strategy, which signals the direction for the development of a certain area in the following years, or it may outline extension, update, or version management plans, all of which may present opportunities for the supplier to gain new business.

The project supplier can also approach the customer anticipatively and proactively; in short, the supplier may develop opportunities for additional sales, not only through responding to the wishes of the customer, but by offering suggestions to the customer.

The project supplier may, on its own initiative, follow the market for and development of the customer's business. Through understanding the market situation and the new challenges involved in the customer's business (and the entire value chain), the project supplier can anticipate and develop new services that the customer will need. In addition, a project supplier may be wise to draw on the knowledge accumulated by a third party company that studies different industries and markets in a broader sense than from the perspective of a single project or customer. Purchasing intelligence reports from such specialist companies may provide project suppliers with ideas that, through conversation with customers, may convert into project opportunities.

The project supplier may follow the technological developments in its field and implement new technical solutions quickly. As one source of product and service development ideas, a project supplier may use technology and material suppliers actively engaged in new product and service development, particularly those known to be at the forefront of innovation in their respective areas. By drawing upon the technology procurement and technology intelligence activities of such companies, a project supplier gains access to new technological ideas and information that it can apply in its own business, for example, in its communications with customers as it attempts to generate new project opportunities.

The project supplier may actively standardize and renew the offering of its own solutions. In addition to focusing on obtaining business in the near future, a project supplier should look further into the future and define a development strategy, which is used to direct development investments in the medium and long term. The project supplier should organize its own service and development activities in such a manner that the ideas inside the company can be put to use across a number of project settings, thereby increasing the effectiveness of the supplier's development work. Solutions that are standardized with skill can assist in bringing new project and new business opportunities to the supplier.

Project and business opportunities that are created from a customer perspective or through the supplier's own development work are handled through the project supplier's normal marketing and sales efforts. As collaboration with the customer is deepened, the project supplier may commit to developing products, services, and total solutions together with the customer in joint development projects.

6.6 Product disposal and replacement

Projects often involve massive investments that produce a product expected to last years, if not decades. Through preventive maintenance and product improvement, the product's lifecycle can be lengthened or its product life may be extended if new productive solutions are invented for its use. As equipment designed for mass production ages, for example, it can be adjusted and possibly transferred to produce a lower volume product, and old buildings can be transformed through repairs to serve in new uses. Durables are often dismantled at the end of their lifecycle and recycled into new uses, used as parts, or handled as energy waste.

The wear and tear and aging of old technology, the development of new technology, and the development of market requirements sometimes necessitate disposing of a well functioning old technology. Paper-making machines may be in use for decades, but because they embody the technology of the 1950s they may not be as efficient as more modern solutions are. Matters related to this final or end stage of the product lifecycle should have been taken into account in the earlier phases of the project lifecycle as safe, environmentally friendly, and inexpensive disposal of the product is in the interests of all stakeholders.

Sometimes premature product disposal or removing a product from the market, perhaps in the middle of its lifecycle, is called for because of legal, moral, ethical, or financial considerations. Products that are faulty may clearly cause injury or put human life in danger, therefore, they must be taken off the market. New legislation and regulations related to the environment and trade often include transition periods during which emissions or some other feature of a factory must be decreased to a certain maximum or threshold level. As a fixed asset gets older, its maintenance costs may increase to a point that continued maintenance and operation of the facility becomes unprofitable and the need to purchase a new solution (facility) rises to the forefront. Thus it is necessary to monitor product performance and profitability from an ethical, legislative, and financial perspective during the various stages of product use.

The decision to dispose of a product or, potentially, to reuse it and to replace it with a new product, often involves as important an investment decision as was the case at the start of the initial project. Although the costs of taking apart, moving, and disposing of the product are not necessarily substantial, the fact that the process or equipment is removed means that capacity is also removed. A new investment is required to replace this capacity unless an investment in capacity has been made before or the business goals have changed and no new investment in this same area of operation is warranted.

The use of the product and its disposal at the end of its lifecycle can and should be considered at the earlier (planning and executing) stages of the project. The opportunities for reusing or selling the product should be considered carefully. Products differ from each other in the way they preserve their value during their lifecycle. It may also be possible and valuable to disassemble, recycle, and reuse components. Although the resale price of the used solution might not be high, and there may be a fee for product disposal, minimizing waste that ends up at the garbage dump is valued.

Full reuse or recycling is not always possible. Security and environmental regulations have become stricter in recent decades; there may, therefore, be materials in use in the old technology that would not currently be accepted, and it may be difficult to dispose of them.

Replacing a fixed asset with a new solution may create new project opportunities for the supplier. When executing the project and its related after-market services, the project supplier should keep in mind the customer's willingness to collaborate on new solutions.

6.7 Organizing and managing services

The project supplier's choices determine to what extent it offers services to its customers outside the project. Furthermore the business expectations associated with incorporating services as part of the company's business may vary, as is often the case with the initial project objectives.

A project company's choices concerning services can be guided by a conscious *service strategy* that determines the importance of the services, what they are, in what entities they are offered, the target groups for the services, and the type of business the company is targeting with its services. The importance of services can range from a support function for projects to the basis for a lucrative independent business. The *service mix* limits the services or areas in which the company will concentrate. Target groups can be chosen, for example, services can be offered only to the company's own project customers, or they can be marketed more broadly to the customers of other project suppliers. The business objectives of services can range from aiming at high profits to under pricing in support of enhancing customer relationship management, a strategy that may eventually result in project or production work that provides significant profits. The project supplier may have a general *service proposition*, in which it describes the type of service experience it wants to offer its customers. The decision to offer services to the customer requires the supplier to devote suitable resources, competences, and procedures to ensure quality services are provided.

Many choices relevant to services are based upon the supplier's service strategy and competences; however, customer needs often require situation-specific tailoring of services. It is characteristic of services that they are created in a process in which the customer is an active party; the service cannot be performed separate from the customer. The supplier can, however, make long-term commitments to each customer regarding what services it will provide and on what terms. In the following section, the service earning logic and service level agreement are discussed. At the end of the chapter, the management of services is described in general.

6.7.1 Earning logic of project related services

The earning logic of project-related services relates to the way the project supplier collects revenue from the services it executes. The contract types used for project-related services differ by pricing principle, and the chosen principle may vary from project to project. Some companies have made a strategic choice to concentrate on certain types of projects, which may also constrain their earning logic concerning services. The following five types of earning logic are widely used; the list progresses from service-based earnings to benefit-based earnings.

- **Direct earnings** (service-based earnings): payment for the service provided – for the time and spare parts used in performing maintenance work, for example.
- **Indirect earnings**: there is no payment, or only a small payment, for the service provided, but the real payment is received from selling such items as raw materials and spare parts and from charges associated with the use of products. A service is free to a customer, for example, but the customer pays costs of spare parts consumed or used in performing the service.
- **Participative earnings**: a third party pays and the user pays nothing or a substantially reduced fee. The advertisers displayed on a web page finance the development and maintenance of the web page, for instance, and access to the web page is either free to users or costs them significantly less than it would otherwise.
- **Earnings based upon promise**: for example, a monthly fee that covers an option to consume a certain service during a certain time period. A case in point would be having access to maintenance service following an agreed lead time; there may also be an additional fee for using the service.
- **Earnings based upon output**: the customer pays only for the value it receives from consuming the service. The price for improving maintenance may be fixed to increased capacity or the resulting benefits during a certain time phase.

Direct earnings require a thorough service description, cost estimate, and service-based pricing. When priced well, direct earning is virtually free of risk, and revenue from the service can be anticipated based upon the service provided. In cases involving earnings based upon output, the project supplier can sell its expertise instead of labor hours. If choosing earnings based upon output, the supplier must have extensive information on the customer’s business and processes. Earnings based upon output may be a highly profitable way of providing services, but this approach also includes the risk that the customer will not benefit from the service in the expected way.

For projects in which the costs that have been negotiated are low, the actual revenue may be related to the services offered after the execution of the project. Projects may be executed with low profit if the pricing of post-project commissioning and support services indicates a clear profit. Alternately, services can be offered at a low price if their costs are covered by the profit from some other activity. Nevertheless, no service is entirely free to its supplier or customer.

6.7.2 Service level agreement

The project customer and supplier (or a third party) can enter into a *service level agreement* for the support services provided during product use. This is a documented agreement detailing the responsibilities of the supplier and customer during maintenance of the product. The document must contain a description of the service output, the expected results, implementation methods, measures, and objectives. The required service level is often described in detail, at least in terms of quality, availability, and price. For cases in which the partners come from different organizations and are involved in an exchange between two units or companies, service level agreements may be highly specific and unambiguous. Typically, deviations and disturbances, and the related requirements, are described in detail, and delivery and payment terms, as well as the bonuses and sanctions related to the service level, form a significant part of the agreement.

In contrast to service level agreements, the concept of *service agreement* does not include the supplier committing to a specific service level requirement; rather, the supplier is committed to offering certain services when requested, according to the agreed-upon cost terms. A service agreement involving maintenance services, for example, can commit the supplier to be available when needed, but it does not state the any required level of services to be provided; instead the supplier simply commits to maintaining the competences needed to provide services if the customer at a future time requires the specific service. In contrast, a maintenance service level agreement can include the requirement to provide the highest possible availability of equipment (the supplier commits to monitoring the state of the machines used by the customer and to performing anticipative maintenance). Nowadays, especially in connection with long-term project business, service level agreements are a more attractive option to both supplier and customer parties than are the more modest service agreements.

In Table 19 the content of the service level agreement is presented at a general level.

Table 19. (Rough) content of a service level agreement

Area	Specification
Service definition	To what services does the agreement apply, where and when are the services executed, and what is created as the result? What is the agreed service level? What is the point of handover and transfer of responsibility?
Executing the service	How is the service executed, and who starts the service and executes it? What are the performance measures, frequency of measures, and performance levels?
Terms of the service	On what terms and with what exceptions does the supplier commit to executing the service? (Upper and lower limits can be stated, as well as exception situations: for example, an hour’s reaction time during on-duty time; two hours at other times; or solving the problem in 24 hours, otherwise there will be a sanction.)
Price of the service	How much does the service level cost, and what are the prices for separate additional services? Such service level costs can be based upon cost or benefit to the customer.
Contract and service contact people	The contact people for the contract go through the complaints and needs for change. Both parties have their contact person. The service contact people take care of service level issues. Both the customer and the supplier typically have their own responsible person.
Appendices	Additionally, the agreement may include specified service descriptions. What does the maintenance of equipment include, for example, and in what situations is it required?

The service level agreement forces customers to express the factors through which they will measure the quality of the service supplied and to indicate which factors they consider critical for their expected service experience. As long as the contract is valid, the customer should maintain the type of conditions whereby the service level that is to be attained can be reached. For the project supplier, the service level agreement provides a useful means to develop and standardize services and competences, as well as to take care of the maintenance in a professional manner. The service level that has been set through a contract thus challenges both parties to work for the common goal. The contract is often regulated with monetary sanctions or bonuses that serve to make the service process more efficient. Efficiency is beneficial for the entire customer and collaborative network of the project supplier, not only the project supplier and one customer.

Example: Livinghouse's service agreement

The Smiths are satisfied because their house construction project went well. Now they are interested in exploring what kinds of additional services Livinghouse could provide in the post-project completion phase. After the house is finished, Livinghouse presents the Smiths with a service agreement which includes several main points.

1. The agreement covers preventive maintenance, which includes inspecting the building technology annually, performing the required regular maintenance as outlined in an appendix to the agreement, and discussing the problems the customer may detect. A fixed monthly price has been specified for the basic service.
2. If problems or repair needs are detected in the inspection, Livinghouse offers the customer a solution. The final solution and the possible costs of the repairs are left to the customer, who may choose either Livinghouse or some other supplier to perform the repair work.
3. In the event of an emergency, a representative of Livinghouse can be reached through a telephone service 24 hours a day, seven days a week. A telephone guidance service is included in the fixed monthly fee. If the contact made by the customer leads to a maintenance visit, this will be charged for according to the price list that is presented in the appendix to the agreement.

As can be seen from the description above, the service agreement is meant for customers who do not have the time or competence to maintain the house. Although Larry could take care of the maintenance himself, the service agreement has been priced low enough and the Smiths decide to accept it.

The Smiths' project was finished successfully, although there were some inefficiencies related to project management. The Smiths will continue to evaluate the success of the project for many years; as they reside in the house, they will evaluate many of its aspects, including the functionality of the choices they made, the quality of the contractors' work, the implications of the financial arrangements on the family's standard of living, the wear and tear (depreciation) of the structure and furnishings, and the needs for modifications and additions that accompany the family's use of the house.

6.7.3 Organizing and managing services

The project supplier should organize its execution of services in the proper way. The contact person for the contract may be the project manager, and the service contact people may be the product or maintenance managers for the various services, or some other service people familiar with the customer's activity. A customer specific service team (or one team for several similar customers) can be formed from the managers and service personnel and other parties taking part in executing the service; typically the service team is led by the service manager. It may be necessary to set up a call center, especially for substantial customers, in which customers' service requests are collected, sorted to be executed, controlled, and monitored. In project business, it is common to keep the customer specific service team relatively stable, because the project product is usually unique and only a select group of people in the supplier's organization have the required competences to be involved in service delivery. Flexibility and reliability of service activity can be enhanced by keeping good documentation during project execution and by engaging in open communication with internal employees and the customer's personnel about of the things that have been learned during the project.

The service team and manager work in close cooperation with the corresponding parties of the customer, as the customer always participates in the service process in one way or the other. The role of the customer may range from reactive task assignments and monitoring to active participation. In corrective maintenance of a machine, for example, the customer may only make a repair request and examine the repaired machinery after the project supplier has made the actual corrective work. Alternatively, the person using the machine in the customer's organization may participate in the corrective work together with the project supplier's designated person even though the supplier bears responsibility for the entire maintenance activity from dismantling the machine to diagnostics, repairs, test use, and start up. Although the general division of work would be defined in the service level agreement, roles and participation must always be checked in each situation.

The service team executes the assignments stated in the service level agreement, often according to a monthly or weekly plan, and on the basis of single service requests or damage claims. The service manager ensures that the agreement and plans are up to date and, furthermore, is responsible for strategic customer collaboration, and for managing, controlling, and monitoring the work of the service team. The service manager and the other members of the team often participate in planning and developing services as part of projects and in efforts to create a new service assortment. The people who have been assigned product responsibility are responsible for managing their own service; as well they prepare change opportunities and version management proposals for the service over the long term. Sometimes service managers may participate in acquiring new customers and in marketing and selling services to customers beyond existing project customers.

As applies to the project sales and execution phases of the product lifecycle, the performance of services should also be monitored and estimated. The factors to be monitored and measured are nevertheless different than those that apply to project sales or execution stages. Issues that are significant to both contractual parties are often determined in the service level agreement. Such issues include service availability, reaction time in failure situations, availability of capacity (running time in relation to full capacity), setup times, number of interruptions or other deviations in use, and customer satisfaction. Many of the typical measures in the service level contract are related to the **reliability** of the product resulting from the project. The **benefits** of the product resulting from the project are further followed and estimated from the customer perspective: sales revenue, payback time for the investment, lifecycle of the investment, capacity, yield, increase in operating profit, and profitability of the overall business. These factors are not directly related to the service level agreement but tell indirectly of the success of the project related services. In addition to these factors, the service executing party should study the **profitability** of the service: the ratio of revenue to costs in relation to the service strategy. Furthermore, the **quality of the service process** should be monitored in order to ensure that the desired levels of service and customer satisfaction are achieved. Changes in the profitability or quality of the service may require a change in activity.

Services are monitored and evaluated repeatedly and regularly. Many measures that belong to the service level agreement can be tied to the compensation system of the service personnel so that personnel are motivated to followup on or monitor the current level and adequacy of service provision and take the initiative to seek opportunities to develop additional service business. The use of services could also lead to the customer making service level reviews or overall audits of the performance of the service provider's activity. The customer may want to find out, especially if the service level agreement is to expire shortly, whether it is profitable for the customer to continue service collaboration with the project supplier or whether the service level agreement should again be subject to a competitive bidding process. The project supplier may make a complete self-assessment, conduct an audit, or calculate a comparative benchmark estimate, in which the service activity of the supplier is compared with the offering of other service providers.

6.8 Literature

Artto, K., Wikström, K., Hellström, M. & Kujala, J. (2008) Impact of services on project business. International Journal of Project Management 26 (5) 497–508.

Gorchels, L. (2000) The Product Manager's Handbook. The complete product management resource. USA: NTC Business Books.

Grönroos, C. (2000) Service management and marketing: a customer relationship management approach. USA: John Wiley & Sons.

Wikström, K., Hellström, M., Artto, K., Kujala, J. & Kujala, S. (2009) Services in project-based firms - four types of business logics. International Journal of Project Management 27 (2) 113-122.

7 MANAGING PROJECT BUSINESS

Although the primary focus of this book is management of individual projects, we recognize a broader company perspective: Management of a company's entire project business. When many projects are being conducted in a company simultaneously, only a few individual projects can have a major effect at the level of the entire company. Although managing an individual project to attain its particular objectives is essential, this focus alone does not ensure the success of the entity formed by a company's multiple projects. In managing individual projects, project managers need to understand the position of a single project within the business entity, and this requires managing project business from the perspective of the entire company, including understanding technology and the business processes involved in achieving project deliverables. Overall, in managing project business, managers must take into account the strategic direction of the company, its management practices, the entity formed by the company's portfolio of projects, the entire resource assortment of the company, the characteristics of the company's operating environment, and other internal and external factors affecting the activity of the company.

In this chapter we discuss project business success factors and their connection to a single project. These success factors are context dependent, therefore, management practices and modes of operation must be applied appropriately for each operating environment in order to achieve the goals of the company. The success of project business is realized in the form of achieving competitive advantage in line with the company's overall strategy, and its growth, profitability, and renewal objectives, all cast within its operating environment.

7.1 Strategic management

7.1.1 Project business success factors

Literature and practical experience reveal four areas of project business in which companies make decisions affecting their success: management system, financial management, project portfolio management, and managing customer and supplier networks. Figure 100 presents these project business success factors and their connection to strategic management and projects.

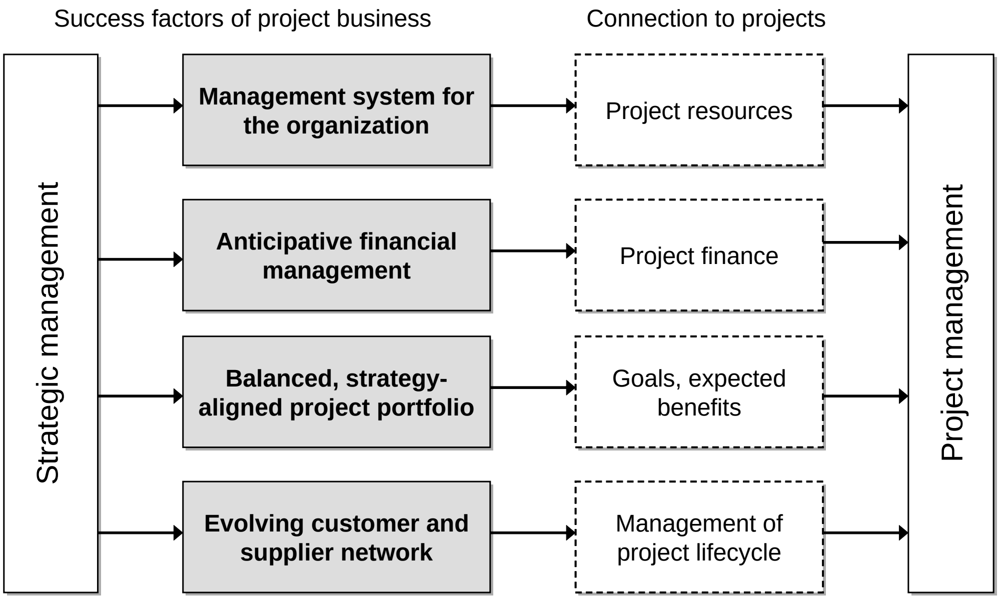


Figure 100. Project business success factors and their connection to the management of single projects

A project is related to its broader operating environment through at least four factors: resources, financial matters, goals, and lifecycle. Projects compete with each other for the company's available scarce human and other resources. A well functioning management system ensures that resources are directed correctly, that good practices are applied in managing the project, and that each project receives sufficient support. A company should view its delivery projects as a means of production and business, but its development projects as an investment in the company's future. In both cases, it is important to anticipate the financial results of projects and their overall effects on the results of the company. A company's strategic objectives can only be realized if the goals and expectations for the benefits of individual projects are in balance, and if each project has been allocated resources in alignment with the company's strategy. Achieving this outcome requires project portfolio management, a process in which projects are evaluated and compared with each other in order to realize the strategy. Customers, subcontractors, and other stakeholders are significant sources of change and new business at the various phases of the project lifecycle; therefore a company's evolving external network plays a key role in its project business success.

7.1.2 Strategy

Strategy involves choosing the business objectives and the means to achieve them. Strategic management is related to the management of the company to achieve success in its future operating environment with its current and potentially new resources.

Strategy can be seen in two reinforcing yet slightly different ways. A company's overall strategy forms a common basis for its substrategies – for its business and development substrategies used in separate units, for example. *Business strategy* is best visualized as choices concerning business content and execution. In the case of the Smiths' house construction project described throughout this book, the kitchen supplier ProKitchen may have its own business strategies for its businesses concerning standardized kitchen solutions, tailored kitchen solutions, and deliveries of partial solutions. Business strategy directs delivery projects (and other ways of doing business) and its execution may require various development and change projects. Typically, early in the project lifecycle decisions are made to ensure that projects realize the chosen business strategy, particularly in the phase of project marketing and sales. A *development strategy* involves choosing the means to affect future business in an indirect manner and to create readiness for future business strategies. In our ongoing case example, ProKitchen's development strategy may be visualized as a materials development substrategy and an acquisition strategy, which define the long-term renewal in kitchen materials and business. Development strategies are implemented mainly as projects. Figure 101 illustrates the relationships among company strategy, business strategies, and development strategies, as well as actions.

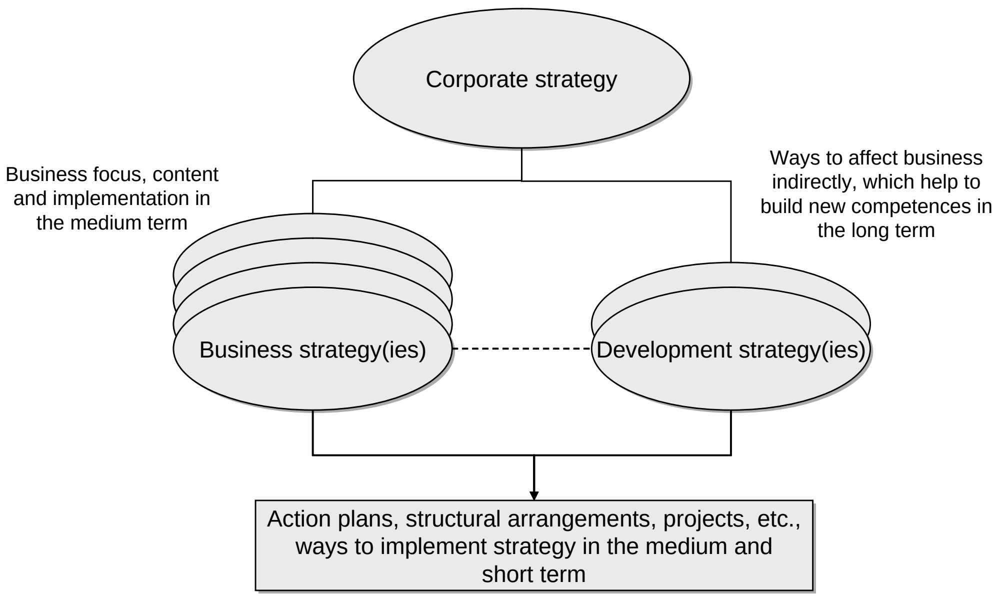


Figure 101. Business and development strategies as part of the company's strategy

To some people, strategy is a clear plan, a guideline and a roadmap, whereas to others it is an unpredictable development path that gains its form in practice – in a project, for example. We can talk about an intended strategy (or strategic plan), and an emergent strategy that is created during the course of a project. As a sum of the implemented parts of intended strategy and emergent strategy, we get the realized strategy. Strategy lives and changes, although at intervals long-term decisions are made and they direct the emphases of the company's activity. The constant renewal of strategy is typical in project business because of the temporary and renewing nature of projects. In choosing and executing projects, a new emergent strategy can often be detected, and thus the realized strategy of a company can be traced to the projects. Projects also provide an impulse to renew the company's strategic plan, and they may change the course of a company.

Project managers and project sales managers play a key role in implementing and renewing the overall company strategy. When planning and executing projects, project managers must frequently estimate whether or not the project fulfils the company's strategic objectives. Furthermore, through the projects they manage, project managers may provide valuable information to the company's higher-level managers concerning the direction in which the overall company strategy should be developed in order to renew the company's business or make it more effective. Conversely, higher-level company managers play a central role when choosing among project opportunities, when starting projects, and at other critical decision-making points in the project lifecycle. Because they are involved in the work of the project steering committee and because they must make business-related decisions, these members of upper management communicate the company's strategic goals and help to keep a big-picture focus on the broader effects of an individual project at the overall company level.

7.1.3 Projects as part of business strategy

Business strategy affects the decisions concerning the business in which the company engages and the way its business is executed during the strategy period. Business strategy is limited by its target and the operating environment. Business unit strategies are limited to the operating or geographical environment of each unit, whereas group strategy concerns the actions and operating field of the entire company. The decisions and choices made as part of the business strategy concern four central issues: positioning in the market, business model, content of the strategy, and direction of the strategy.

Positioning a company in the market involves many types of choices, which we can phrase as questions: In what market will the company operate? What market share will the company seek in each market area? In which direction should the market be developed? What resources and competences will be utilized when striving for competitive advantage? What role will the company strive for with respect to stakeholders? In project business, decisions concerning the market involve global, regional, and local considerations and activity, as well as what positioning the company takes in the value chain that delivers added value to the customer. As for resource utilization, project suppliers may emphasize either the effective use of the company's own resources or the skillful management of a subcontracting network.

Business model refers to the earning logic with which a company (or unit) tries to attain the best possible financial result. In project business, the earning logic may be based upon selling resources, products, or solutions. When selling resources, the project supplier does not take responsibility for the product; rather, it offers resources only for the customer's use in a particular project. In the case of a project that involves sales based upon products, the project supplier is responsible for ensuring that the project is executed according to the technical specifications of the project contract. The project supplier should in this case package its competences into product-like entities. When selling solutions, the project supplier takes responsibility for the entire project according to the contract and the stated objectives for performance and functionality. The earning logic is affected by whether the company offers services as part of projects, or in parallel with projects.

The content of company strategy regulates the ways in which it creates and attains added value in its business. The project supplier can compete in its chosen position and business model by concentrating on cost leadership, differentiation, or specialization. In pursuing a cost leadership strategy, a company seeks efficiency and savings in all areas. Cost leadership is common in project business, and if the services and products are similar among competitors, cost leaders do well. In implementing a differentiation strategy, a company concentrates on offering the customer something unique, such as unique technology, product and service characteristics, implementation methods, or distribution channels. If pursuing a specialization strategy, a company may implement either cost leadership or differentiation in some restricted market or customer group.

Strategic direction is related to what type of change strategy the business pursues. Typical strategies strive for growth or profitability. Growth may require procuring new resources, engaging in strong innovation activity, pursuing acquisitions, and embarking on reorganization. A growth strategy is an attractive strategic direction, especially in a quick-paced and evolving operating environment. A profitability strategy concentrates on ensuring that better results are achieved with the current resources. Actions consistent with a profitability strategy include: rationalizing and increasing the efficiency of operations, perhaps including elimination of some functions and parts of the operation; continuous quality improvement; and restructuring.

Business strategies are related to and affect projects in a number of ways.

- The analyses related to the business strategy can be implemented as a (development) project.
- The development of a business strategy can be implemented as a (strategic) project.
- The content of the strategy may affect projects, particularly when choosing among projects and addressing such central questions as what projects will be implemented and what projects will receive investment. In particular, delivery projects, product enhancement projects, and other maintenance projects become visible in the business strategy if projects are the company's central way of doing business.
- The strategy can be used to create criteria that form the basis upon which projects are chosen, evaluated, and, if needed, eliminated as part of everyday business.
- The implementation of strategy may require change and development projects.
- A development strategy that outlines the emphases and content of the development investments, may be presented as part of or parallel with the business strategy

7.1.4 Projects in the development strategy

Development projects are used to develop a company's competences. The competences of a company include the organization's ability to implement activity that leads to attaining company objectives with the help of the organization's resources. The competences of an organization are used in creating, developing, producing, and offering products and services to the market. Competences provide the central underpinnings upon which the company's business model and value creation logic are built.

Development strategy is related to the company's direction of renewal and the means that it uses to develop possibilities for future business. The term "development strategy" is not use in all companies, but such synonymous terms as investment, technology, or acquisition strategy may be used, or development strategy may be referred to as a directed plan for renewal. The time span involved in the development strategy may depend on the industry's pace of change and the state of the company's business. In referring to development strategy, a difference is often made between medium-term (2-5 years) and long-term (5-15 years) development, and both should be prepared for in the company’s activity. The relative emphases to be placed on medium-term versus long-term development investments is one of the central strategic questions to be addressed at the corporate level, because, in time, the balance, mix, or ratio of these two time horizons significantly affects the realization of business strategies.

Under a development strategy, choices are made on the future businesses, products, and services; their emphases and timing; and the extent of investments deployed in developing activities and systems. When determining a company’s development strategy, it is necessary to study the company’s development history, the future trends and uncertainty factors in the market, and optional future scenarios. As part of a development strategy, investments as well as their emphases can be determined, and road maps can be created to illuminate the relationship of projects to time. On the basis of these strategic choices, the projects and programs that implement a company’s development strategy can be chosen, and action and resource allocation plans can be made.

Many activities can be regarded as part of a development strategy, including product development, venturing, restructuring, large equipment and systems investments, organizational development, and human resources development. A substantial part of a company’s development strategy is implemented as projects. Development strategy can also be implemented as part of delivery projects; for example, new products or procedures can be tested in delivery projects.

7.2 The organization’s management system

Projects are not necessarily the only form of business in a company, and project business may have different roles as part of the company’s activity. Company management must decide what part of its activity is to be implemented in form of projects and what priority is to be assigned to its project business. Only if the activity has characteristics that require the use of project management methods should it be implemented in project form. Part of the project activities are simple and occur in a similar form in different projects, and the company must maintain these required basic competences over the long term. The matrix organization, which was presented in Chapter 5, Section 5.6, is a well founded method for organizing business situations in which projects have been chosen as the means to achieve business objectives and, simultaneously, to develop needed long-term competences.

7.2.1 Dividing responsibility in a matrix organization

In project business, the most likely functions to require long-term competence development are project sales and marketing, production (i.e. technical execution), customer service, and development (e.g. product and technology development). In a pure line organization, personnel working within these single functions may concentrate on optimizing their own activity, in which case collaboration over functional boundaries and integration management become more difficult. Various functions have their own objectives on the basis of which their activity is planned and evaluated. Sales and marketing managers may be interested in sales volume and sales profit, whereas their counterparts in the production function may view efficiency, schedule, and cost matters to be more relevant. Nevertheless, in project business the optimization of business must be studied as a whole, not restricted to one function. In a matrix organization, this perspective can be represented by the project manager who carries responsibility for coordinating the work over functional boundaries, and for achieving the benefits the project may bring for the overall company's business, not just for a single function. Figure 102 presents a simplified division of work in a matrix organization between the resource units (e.g. sales, production, and customer service) and the project.

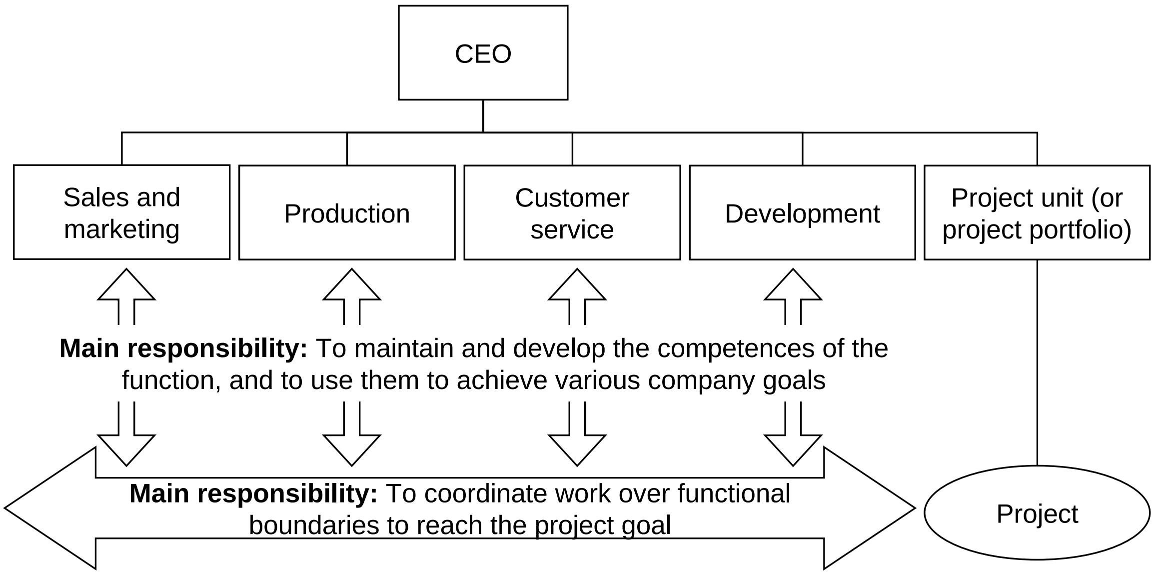


Figure 102. The main activities of resource units and projects as part of a matrix organization structure

A central question in matrix organizations is who is responsible for the business: Is it the heads of the resource units, or the managers of the projects? Being responsible for business includes being responsible for goals, resources, costs, and realizing strategy. In a strong matrix organization, these responsibilities tend to be assumed by project personnel, and in a weak matrix organization they tend to be assumed by personnel within the resource units. In both cases, it is useful to ensure that, in setting the functional targets and in defining the measures, the emphasis of study is on the entire project lifecycle and its success, not on suboptimization. Rather than following the cost of project execution, for instance, a better measure to be followed from the perspective of the entire company may be project profit, which has a direct connection to gross profit in the company's income statement (in a pure project delivery business, the gross profit in the income statement is the sum of project profits). If the perspective is further widened to include customer service, a particularly interesting target for followup could be the formation of a customer-specific profit account that would reflect the profits resulting from the projects delivered to that customer. In this case, the monitored measure is customer profitability.

7.2.2 Sharing resources

Resource units within a project supplier company direct their resources simultaneously to multiple projects, each of which may have a different goal. Project managers must therefore compete for the same scarce company resources. A functioning management system takes into account the adequacy of resources and directs them to the right projects. Figure 103 illustrates the challenge of dividing scarce resources among multiple company projects that are being executed simultaneously.

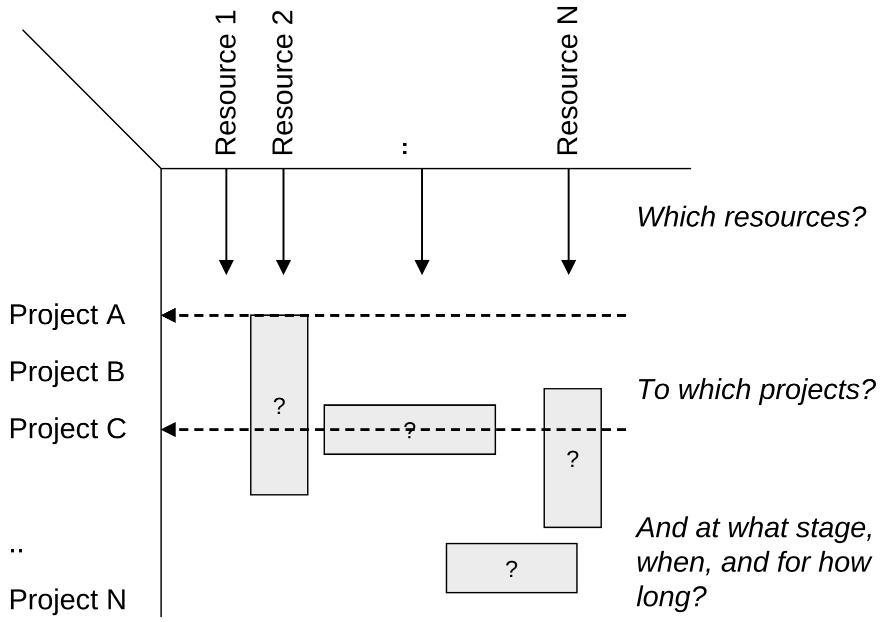


Figure 103. Challenge of dividing resources within an entity formed by several projects

For example, in product development, the same production personnel and prototype equipment may be used by several projects. If several projects enter the prototype phase simultaneously, the same personnel and production capacity cannot fulfill the needs of all projects. There are many optional solutions for this problem. The float of some project activities can be used to solve the resource conflict, for example, some projects can be delayed, and more prototype production capacity can be procured or rented. For some projects, the physical prototype can be replaced by using a computer simulation of the product that can be developed by project personnel, and the physical prototype phase can be postponed to a later stage in the project lifecycle.

The starting point for ensuring the sufficiency of resources is the ability to plan and anticipate the resource needs in every project and to negotiate on their use over functional and project boundaries. Examining the approximate resources needed, and their timing and probability of realization is studied earlier, at the beginning of the sales phase of the project lifecycle. Such anticipative planning is essential, as it is difficult to increase or decrease the amount of resources needed for the execution of a project on short notice. Although some resource peaks can be leveled by subcontracting, it is hard to locate and contract with particularly critical or rare competences and to put them into use quickly.

Resources, particularly those that are critical or rare and are needed for multiple projects simultaneously, should not be tied up in a single project. Before making a binding allocation of resources to projects, the relative importance of the various projects should be assessed, particularly the relative benefits that they offer toward achieving overall company strategy. In other words, in an entity formed by several projects, resources should be divided among projects so that the company derives the most benefit from the entity. To maximize overall company benefit, it may be necessary to change the schedule, the cost, and perhaps the scope of individual projects. These changes may be required later in the projects' lifecycle, and when they do occur, the division of resources among the various projects must be readdressed.

To ensure that sufficient competences and resources are available, company leaders must understand and estimate the competence profiles that will be needed for future projects, and work toward systematically developing these competences. In planning competences, it is critical for company leaders to ensure that the competences fit the dynamics of single projects **and** the overall project business. Continuous learning, flexibility, and the constant restructuring of resources according to changing conditions are emphasized, for example, in the competences of the executing organization. In a dynamic project business, development should not be left to chance; the competences of an organization are created only through active and long-term development. Development can be organized in various ways: through training, learning on the job, common project frameworks, job rotation, and recruiting people with the right competence profile.

7.2.3 Project management framework

Managing project business gives rise to the need to direct and execute good practice in projects, at a more general level than in managing a single project. This involves using common practices and directions in all areas of project management. Common practices may include checklists and directions on the way to plan a project, a procedure to reserve resources from resource units, and reporting practices. Common guidelines for managing the project team and for the process used to choose and approve subcontractors can also be agreed upon. The company's quality system, a separate project management framework, or a project management handbook, may include the recommended actions for all areas of project management.

Every project is a unique entity; therefore, situational factors, not just common guidelines, must be taken into account in managing projects. The execution of a small, simple project does not necessarily require a perfect, detailed project plan or extensive risk identification and evaluation, although these would be recommended in the project management framework. It is the project manager's responsibility to achieve, simultaneously, the project objectives and to ensure that the chosen management practices suit the situation. If the project fails, the project manager cannot avoid responsibility simply by claiming that actions taken were according to the general guidelines.

Project management may be supported in a company by a common or unit-specific project office. The project office (or project management office) may include one or several people whose task is to develop and offer various types of tools, practices, and project management training to the projects. Personnel in the project office can act as links between projects and the units of the line organization, and they can take care of tasks related to procuring and dividing resources. They may also be assigned supervisory tasks designed to ensure that consistent practices are used and minimum requirements are fulfilled – in project reporting, risk management, and customer relationship management, for instance. The project office may also have information collection and reporting tasks such as collecting and reporting information from projects and project groups that is used at project portfolio decision-making sessions for choosing and prioritizing projects.

These project office tasks involve administrative support functions related to project management. The project office may have yet another role: It can act as the organizational home base for project managers, an organizational unit to which project managers belong. Project managers are hired or assigned to lead specific projects, and they return to their organizational base between projects. In the time between projects, more experienced project managers can guide their younger colleagues as they handle the practical problems in their projects. This type of activity promotes exchange of information among, and the learning and professional development of, project managers.

Using common and proven-to-be-effective project management practices helps to disseminate knowledge in the organization and fosters development of the company's long-term project business. Years of experience can be incorporated into a common project management framework, and sharing its standardized, modular procedures with the personnel executing the projects prevents the recurrence of problems. The maturity or quality of project business cannot, however, be measured directly on the basis of how well the procedures are followed. At times, in order to bring benefit to the company, it is imperative to deviate from the project guidelines. Because of their experience, project managers bear responsibility for detecting and understanding that the situation at hand requires actions that may differ from the guidelines. These justified deviations may lead to individual and organizational learning and to developing the project activity in a broader sense.

The company's compensation system too plays a key role in directing the behavior of project personnel. Compensation is a direct way of indicating how greatly the company values project work compared to other work, risk taking compared to safe solutions, situation-specific problem solving compared to following the guidelines, and the results of a single project compared to the success of the entity formed by the company's many projects.

7.2.4 Learning from projects

One vital characteristic of the management system used in project business is that new information, accumulated through experience, is put to use quickly. Individual and organizational learning occurs both inside a project and in the period between projects.

In a single project, deviations from the plan, changes made earlier, and experiences from these events promote learning. If new problems or deviations from the plan are noted in the project, information and experience from the earlier phases of the project must be used in defining the changes, and the changes must be put into practice quickly. The project team members also learn to work together. In some situations the best way to ensure that learning is leveraged is to assign the same project team to subsequent projects. Learning in a project setting can, on the other hand, mean sharing information and collaborating among the various functions and stakeholders. People taking part in the project may have different types of information about the customer, for example, and sharing of this information should help to fulfill the expectations of the customer to the greatest extent possible.

There are many mechanisms for transferring or sharing knowledge among projects other than by keeping the project team the same. There may be project areas that can be easily transferred over project boundaries. One well proven execution method or technical solution may be of use in several projects. Some projects may have information on the same technology or customer that can be applied usefully in other projects. New ideas created in one project may not be worth implementing in the project in question, but they may be usefully applied later in other projects. Project management or product-related experience may accumulate throughout project execution, and sharing these experiences may make the execution of other projects faster or more efficient. Project lessons learned can be collected to promote learning over project boundaries, and these lessons can be documented and shared for use in later projects, or perhaps incorporated into the company's project management framework. In some companies, entire information systems have been developed in which project lessons learned are shared. It should nevertheless be remembered that only part of the lessons learned are general and common; some lessons may be due to the characteristics of a unique project or to situational factors, or they may simply be pure coincidence. Thus, the repeatability of the lessons should be evaluated before they are extensively developed or distributed.

Project personnel gain unique experience during their work on projects and these experiences may not be easily transferred through training, by reading, or by working in single projects. Therefore, in many companies, common forums for project managers or project personnel are held, at which people share their experiences gained from working on various types of projects. Such fora can also be used to develop a common project management framework, and they may eventually lead to developing activity within a broad collaboration network.

The most effective learning mechanisms are learning from practice and learning from personal interaction among people. Examples of effective learning from practice are small probes and learning from mistakes. Small probes include small-scale projects, developing project opportunities, or piloting. In the probes, new information and experience is created, which may help decide whether or not to execute the project on a large scale. If the probe fails, losses are small, and the new information collected in the probe is more valuable than the investment consumed by the failed probe. Learning from mistakes is often the most effective means of learning, thus unfavorable matters should be analyzed and discussed in project group settings. Discussing these difficult matters requires a constructive atmosphere, in which project personnel are assured that their positions are secured and that they will not be blamed or disciplined in any way.

There are many fora that can be utilized to ensure that the company benefits from learning that involves personal interaction among people. Project managers from other projects can be invited to project review meetings to bring new insights, which may help to ensure successful execution of the project in question. Learning about the future can occur in meetings by discussing weak signals or alternative scenarios for the future, for example. People learn from each other through mutually processing opportunities related to the optional scenarios. In particular, at the start of a project when the suitable execution and management methods are still under discussion, it is useful to study optional scenarios. The project manager should ensure that people present in the start-of-project discussion and planning meetings are experienced and represent a variety of viewpoints or perspectives.

7.3 Anticipative financial management

In addition to the profitability of a single project, successful project business calls for understanding the way the result of the entire company is formed from the entity of various projects and other work. If one part of project business aims at profit and another part comprises development work that represents an investment in future business that causes costs, the entity formed by the two should be kept profitable at the overall company level. Anticipative financial management can be used to help attain company level profitability targets. This can be achieved if, at any project lifecycle stage, development of the project's financial result can be evaluated anticipatively in a precise and timely manner. By using an anticipative approach, problems can be foreseen and solved in a timely manner and the probability of occurrence of events that may bring success and larger profits to the company can be strengthened. Many problems and success factors associated with a single project may reflect on other projects and the entire business of the company, therefore, financial management should be studied in the entity formed by several projects instead of a single project.

7.3.1 Formation of the income statement

Projects cause the same types of revenue and cost items in the company's income statement as do any other company activity. In this section, we present a simplified description of revenues and costs by assuming that the part of a company's business activity that creates sales revenue is formed only of projects delivered to external customers. Thus the sales revenue in the company's income statement consists only of project revenue. This situation is illustrated by Figure 104, in which sales revenue for the project structure has been marked with a T. Direct project costs are caused by such items as project procurement and payments to project personnel, which comprise salaries and related social security and insurance payments. In Figure 104, direct costs recorded to the project structure are marked with an A. When the project sales revenue (T) and direct costs (A) are recorded to a project, they are accumulated to the higher levels of project structure and company organization structure, as indicated by the thick arrow in Figure 104. In the figure, the hierarchy formed by the project structure (work breakdown structure) and the organization structure has been turned upside down. Shown alongside this inverted hierarchy is the company income statement formula, in which the revenue and costs that have been recorded in the hierarchy are accumulated, as indicated by the thin arrows in the figure. The difference between the project sales revenue (T) and the direct costs (A) is called project profit when referring to results of a single project. The sum of all project profits comprises the gross profit of the company's income statement.

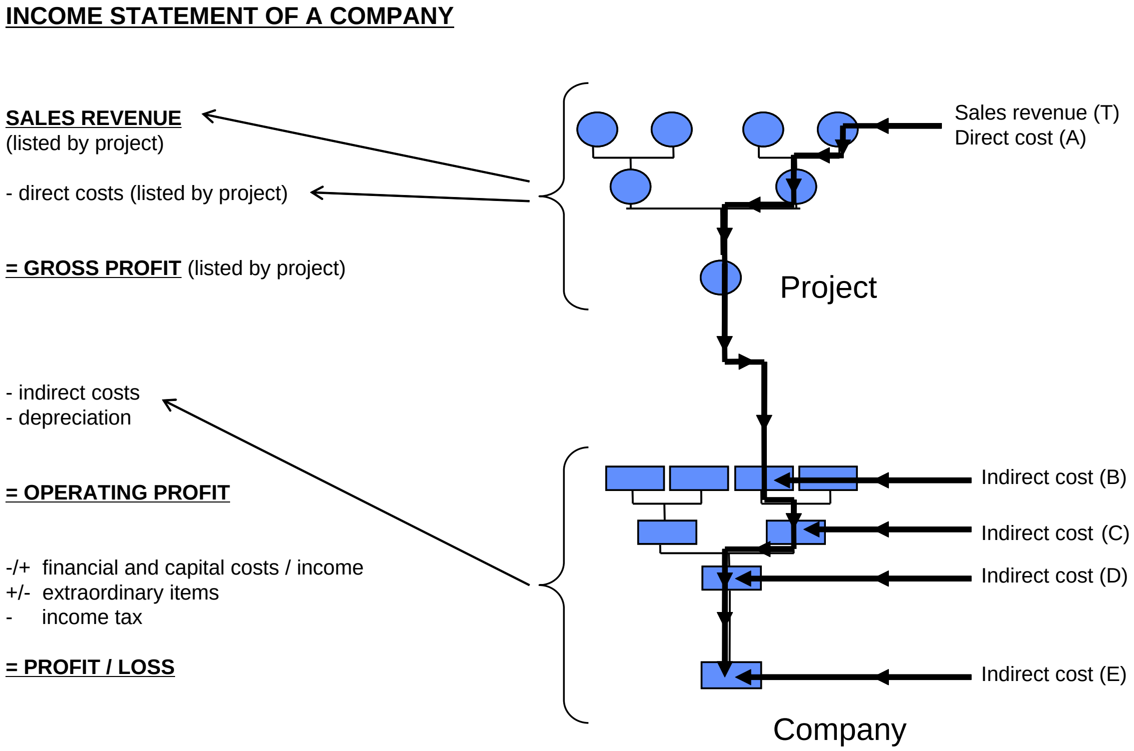


Figure 104. The formula for the company income statement (complete with illustrative direct project revenue and costs, and indirect company costs from various parts of the organization structure)

Direct costs are incurred within units situated at various levels of the company's organizational hierarchy (e.g., units can be delineated by customer group, product group, business unit, resource unit, and at the top by the management of the entire company). Figure 104 illustrates the way indirect costs (B, C, D, and E) are recorded to organization units on different levels. The indirect costs of the resource units include unit employees' labor hours that have not been marked through recording the hours from hour cards (and the respective direct costs) to the direct costs of the project structure. The indirect costs recorded to organization units may be facilities, equipment, and related costs, as well as the costs for the unit's marketing and sales activities, its process and product development costs, and its training and administration costs.

Project revenue should cover direct costs and an appropriate project profit. Gross profit, which is calculated as a sum of all project profits, should be large enough to cover indirect costs (B, C, D, and E), as well as other items of the income statement. We can say that *overall sales revenue targets* are set on the basis of the project profit. Covering direct and indirect costs is not sufficient, however, as the magnitude of overall sales revenue should be large enough to ensure that sufficient company-level *operating profit* is generated to cover debt expenses, financial income, and income taxes, shown at the bottom of the income statement. After completing all these calculations, the company should achieve the profit (or earnings) as recorded in the final row of Figure 104.

Concerning the capital costs at the bottom of the income statement, if the capital required is financed through additional external debt equity, interest expenses and other financial expenses (e.g., transaction costs) are incurred on the debt capital raised for and committed to the project. The risk on internal equity financing, on the other hand, is reflected in a company's internal rate of return, which management sets for internally funded investments; and, indeed, a company's internal rate of return for investment calculations is often higher than the interest rate on external debt equity. The combined cost resulting from the company's internal rate of return and from its use of external equity may be substantial across all the firm's projects. The capital cost or income from each project can, in principle, be calculated separately. The capital costs caused by a project can be kept in control if the installment payment schedule is balanced with work progress, whereby, in the agreed project payments, the customer is billed for the performed work as it is actualized. If payments are not balanced with the progress of work, either the project is funding the customer's activity or the customer is funding the supplier's project.

In income statements and intermediate financial reporting, costs and revenues are recorded according to the accrual principle. It is essential to understand the meaning of the accrual principle and the central concepts related to applying it, so that the construction of the income statement and balance sheet from the project information can be understood. The accrual principle involves recording a cost when the input has been received (and recording a revenue when the output has been delivered), even if the monetary flow occurs at another time. The difference between items recorded on an accrual basis versus the actual monetary flow, can be seen in the balance sheet of the company, whereby the invoices that have not yet been paid by the customer are shown in the sales receivables, and the invoices that the company has not yet paid to the subcontractors are shown in the payables.

If the cost and revenue items are recorded in the accounting system on an accrual basis, the project records should use corresponding cost and revenue accounts and codes, so that project costs and revenues can be summed directly to the accounts of the company's income statement and balance sheet. The recording of accrual-based revenues is called the *recognition of accrued revenue (or revenue recognition, or matching revenue with cost)*, and it involves recording revenues in the income statement for the accounting period (or allocating or dividing the revenues to the appropriate accounting periods). If the accounting system is not fully based upon the accrual principle, some recordings must be made prior to preparing the income statement or the intermediate financial reports; in this process, the recorded project items are corrected to follow the accrual principle. In accounting terminology, the term *recognition of accrued revenue and cost* is used to describe the allocation or division of revenue into the revenue account of the accounting period's income statement, according to the level of completeness of the project. In this procedure, the part of costs corresponding to the completed part of the project is recorded as a cost for the accounting period, and the result is the share of the project profit attributable to the completed part, indicated as the difference between revenues and costs. If there is work in progress in the project, which is yet to be completed or delivered to the customer, the costs for this work are recorded to the inventories of the balance sheet when making the income statement.

If the customer is making a large investment for its own use through the project, it will eventually record the investment as fixed assets in its balance sheet; this recording is referred to as *capitalization*, that is, the customer *capitalizes* the costs as fixed assets in its balance sheet. In a situation in which a project is incomplete, the customer can capitalize part of the fixed costs (appropriate to the level or degree of project completeness) in its balance sheet. In addition, the customer can include in its income statement depreciation costs related to this portion of asset capitalization.

7.3.2 Anticipating financial returns

Although a company cannot be managed merely based upon financial figures, only financially profitable business can be planned and developed in the long term. Companies that find themselves in a financial crisis often make the mistake of cutting project costs and, thus, central parts of the project content. In turn, such cuts may make it more difficult to implement long-term strategy, may deteriorate or slow down the results of the project, and may lower workplace morale. These problems can be avoided by acting anticipatively. As is done for project cost management, the company's financial management should be studied anticipatively, for example, and financial results should be estimated through the whole or entity formed by projects. On the basis of anticipative study, the required fixes can be executed.

Regarding anticipative evaluation on the project level, we note that, earlier in the book (Chapter 4, Section 4.4.4), we discussed recording project revenue and costs. This topic should not be understood as merely recording actual revenues and costs, but as recording an estimate, a budget, or committed costs. If the revenue and cost estimates for the project have been recorded in a timely manner using project accounts in the company's accounting system, they can be used as a basis for estimating company-level revenue, long in advance of completing the entire project in question.

A useful overall picture of the company's financial development can be formed by studying simultaneously all its projects and the financial information related to them. The project opportunities recorded in the list of bids, and the probability estimates for their realization, provide the company with key anticipative information. When the information concerning the list of bids is combined with projects already on the order book, the financial development of the company in the near future can be estimated in a highly reliable manner. If the average duration of the company's projects is 12 months, the financial result of the company can be reliably estimated about six months beforehand, based upon the information available about projects already in the order book. On the basis of the list of bids, and taking into account the probability of winning each contract, the financial result can be calculated even further into the future, perhaps as much as a year forward.

Table 20 illustrates the way a forecast (expected value) for the development of project profit in the upcoming years is formed from the list of bids, and from projects currently on the order book. When assigning projects to years, the project schedule and the estimates of the degree of completion of the projects at the end of each year should be considered. The projects already in the order book are certain, but the projects in the list of bids are uncertain, hence, an estimated probability for the actualization of the contract must be assigned to each bid. Table 20 presents the estimated project profit annually as an expected value, in which the probability for actualization has been taken into account. A similar type of table can be used as a starting point when making anticipative resource planning decisions.

Table 20. An estimate for the development of project profit in the upcoming years, based upon the list of bids and the order book

Project	Order / Bid	Estimated probability that project will be realized	Sales revenue (estimate)			Project profit (estimate)			Expected value of project profit (= project profit * probability that project will be realized)		
			Project total	Year X	Year X+1	Project total	Year X	Year X+1	Project total	Year X	Year X+1
Order book:											
Project 1	Order	100 %	200	200	0	25	25	0	25	25	0
Project 2	Order	100 %	120	80	40	24	16	8	24	16	8
List of bids:											
Project 3	Bid	50 %	100	40	60	30	12	18	15	6	9
Project 4	Bid	10 %	160	40	120	40	10	30	4	1	3
Total									**68**	**48**	**20**

In order for a company to perform these anticipative calculations, it needs information on the project profit estimates made by sales, the exact cost estimates for the execution phase, and the realization of planned costs and schedule. By monitoring project profit, the company's activities can be guided toward projects that are financially profitable. Profit objectives cannot, however, act as the only basis for choosing and prioritizing projects, as projects also fulfill nonfinancial objectives.

7.3.3 Internal resource trading

By using internal transfer prices and internal resource trading, matrix organizations can bind resource usage in projects to the company's financial management system. The organization structure, consisting of projects and resource units, has been described earlier (Sections 5.6 and 7.2.1). A central issue in this structure is ownership: project units own the projects and resource units own the resources. As a result, a project unit purchases the resources it needs from a resource unit at an internal transfer price, and the resource unit receives internal revenue equivalent to the transfer price. For simplicity's sake, we concentrate here on the financial management of a strong matrix organization. Figure 105 presents a simplified principle for dividing cost and revenue between a project and a resource unit.

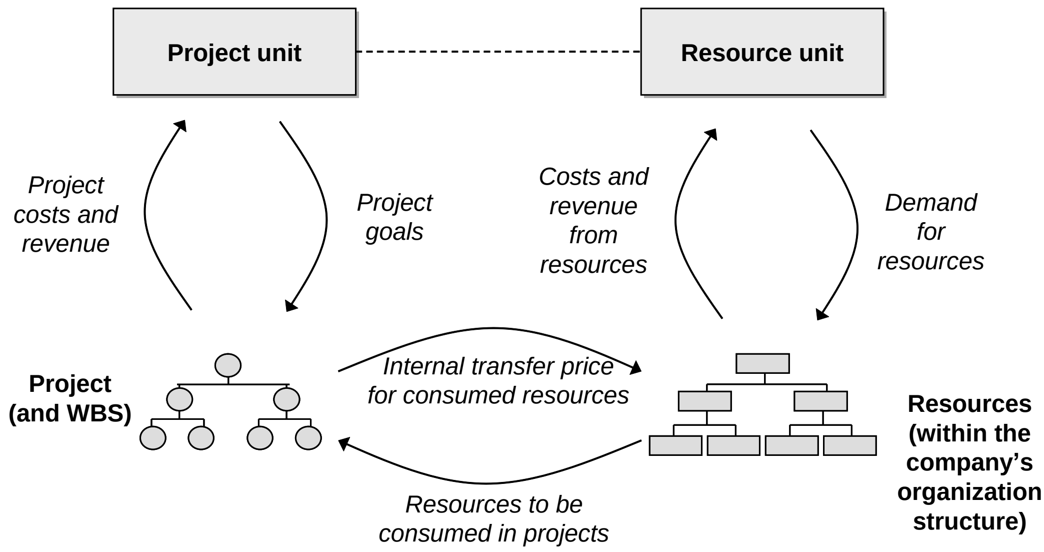


Figure 105 . Costs, revenue, and collaboration between a project and a resource unit regarding use of company resources

If the company delivers projects to an external customer, the sales revenue received from the external customer is recorded to projects and, thus, to the project unit that owns the projects. The project units procure the needed resources from the company's resource units and pay them according to the internal transfer price procedure. Such exchange of resources and recording of revenues and costs are displayed in Figure 105: The project unit purchases the resources it needs from the resource unit at an internal transfer price, and the resource unit receives internal revenue corresponding to the transfer price. In practice, this process can happen by workers in the resource unit using a weekly hour card to mark their working hours for the unique project number. Simultaneously, the project incurs a cost corresponding to the transfer price, and the resource unit receives internal revenue corresponding to the internal transfer price (hourly price). The resource unit uses this internal revenue to cover the cost of its activity and strives to develop its internal business so that it can function well in the internal market. Internal trade may also be based upon a formal internal contract, whereby the internal resource unit sends the internal customer project bills, as specified in the contract.

Determining the transfer price – pricing – and the effect of the price on the company's internal activity, is a multifaceted matter. At its simplest, the transfer price (e.g. an internal hourly price) includes the direct and indirect costs the resource unit must cover in order to reach zero profit. Although all the company's indirect costs would be allocated to the hours of productive project work to determine the transfer price, this hourly cost cannot be considered the *absorption cost* of the hour because, in covering direct and indirect costs, costs are covered only up to the level of the *operating profit* (see formula for the income statement in Figure 104). The financing costs and income tax at the bottom of the income statement formula should also be included in the absorption costs.

It is essential to ensure that the price of resources procured internally is competitive. Because there is usually no competition in internal trade, internal resource prices, which include indirect expenses, may seem overpriced from the perspective of the organizational unit that bears financial responsibility for the project. This project unit may be able to purchase the same service at a lower price from an external subcontractor, who may be able to keep costs low because of its efficient management structure and low overhead costs. Nevertheless, in applying internal trade and the transfer price procedures, the perspective of the company's broader and longer-term revenue objectives must be kept in mind. The cost of the internal resource may be justified if the resources bring synergistic effects, decrease risks, create new competences in the company, or ensure that the company acquires or maintains a leading position in a desired competence area. Project managers may also be assigned the opportunity to use external resources, which, in addition to being flexible, encourage the company's own resource units to keep their activity competitive.

When transfer prices are used to calculate the internal result for organizational units, a lower level of information is combined with a higher level in making the income statement, so that internal trade between entities at the lower levels in the hierarchy are deducted from the higher level revenue calculations. If the income statements of two units are combined as one higher-level income statement, for instance, the sales revenue created by the units selling to each other cannot be summed to the higher level, and it must be deleted from the calculations. This accounting procedure is known as an *aggregation*, whereas combining the information concerning companies in a group is called *consolidation*.

7.4 Strategy-aligned project portfolio

In the previous sections of this chapter, we emphasized the need to manage the entity formed by projects from the perspectives of management systems, and resource and financial management. A central question from the management perspective is the way in which the combination of parallel and consecutive projects is coordinated to realize and renew the company's strategy. Realization of strategy is most affected when new project opportunities are created, projects are chosen and started, major project-related business issues are decided upon, and decisions are made regarding prioritizing and balancing the projects with respect to one another. Managing projects as a whole portfolio of projects can bring new tools, methods, and practices into the company that are related both to project management and to managing a company in general.

The entity formed by projects can be studied in two slightly differing ways: as project portfolios and as programs. In both approaches, a project portfolio and a program consist of several projects. A project portfolio is a group of projects with a permanent nature that lives and changes as the company's activity is renewed. At any time, a cross-sectional or overall description of the simultaneous projects in the portfolio can be constructed. A program, on the other hand, is founded to attain a certain objective; thus it is a temporary organization. A program is restricted in content and is formed of a continuum of projects, and it has a beginning and an end. Because the initial objective of the program often is only defined at the level of a *mission statement*, and not as detailed requirements, it is not necessarily known at the start of the program the exact way in which the objective will be reached. In such a situation, the projects to be executed as part of the program are not known either, and must be founded along the way.

In practice, there may be several programs in a project portfolio, but the relationship between project portfolio and program is not necessarily purely hierarchical. Sometimes programs are founded to include existing projects that are progressing well, and the purpose of the program is to coordinate and manage their execution in order to get synergistic benefits; in such a case, program management resembles project portfolio management. Additionally, some programs may be such large entities and may last so long (e.g. decades) that it is necessary to create project portfolios and to use project portfolio management methods in managing them.

It is a common feature of a project portfolio and a program that both of them treat projects as an entity (a group), and that the project group has common strategic objectives. The emphasis, especially in project portfolio management, is on allocating existing resources through project choice and prioritization, so that the project group fulfills the company's strategic objectives under the constraint of scarce resources. A program, on the other hand, aims at attaining the strategic objective set for it. In contrast to managers involved in project portfolio management, program managers do not assume management responsibility for the projects of a certain company or a unit.

Nevertheless, the approaches used in managing several projects simultaneously are highly company-specific. In short, each company has its own practices for managing the entity formed by projects.

7.4.1 Project portfolio management

A *project portfolio* refers to a group of simultaneous projects and project opportunities that have common strategic objectives and that compete for the same resources. A company always has some project portfolio, and its content, borders, and management practices may change over time.

Projects belonging to the same project portfolio usually have at least one common decision-making body that makes decisions on starting, executing, and closing projects. As well, this body monitors or follows up on decision outcomes. Such a body may be a management team, consisting of the CEO and all the business unit managers – a team that studies the projects as a whole and ensures with its cross-functional structure that the group of projects to be executed is in line with the company's strategy. Studying projects as a portfolio is an effective means to avoid suboptimization of units and to eliminate purposeless and overlapping development projects. A project portfolio perspective facilitates focus on the common benefit of the company (or unit), not the benefit of a single project. To support its decision making, the management team needs information on the project portfolio, which may be collected by the project office on the basis of the documentation it has received on single projects.

Project portfolio management involves directing a group of projects using various portfolio management methods and techniques, the overall purpose of which is to achieve the company's business strategy. Strategic decision making is emphasized in project portfolio management as it includes consideration of what projects to undertake, what projects should be left out, and the way in which the company's scarce resources should be divided among projects. In parallel with project portfolio management, the feasibility of the company's project portfolio needs to be considered from a technical, commercial, and project management perspective; hence choosing and prioritizing projects plays a central role in project portfolio management.

At least as important as the decision on which projects to choose is the decision on what projects will *not* be undertaken. When handling project ideas and project opportunities, it may be easier to turn down a project or to postpone it, whereas making a decision to discontinue a project in progress is difficult. When studying the project portfolio, the basis for rejecting or discontinuing a project is nevertheless not necessarily that the project is a poor one, but it may simply be that it does not fit the project portfolio (any longer). The rationale for rejecting a particular project candidate may include, among others, a belief that the project is a poor fit or creates an imbalance with respect to company strategy, has a poor risk-to-expected-benefit ratio, demands special and scarce resources, or that information has been received about an unfavorable change in the external business environment that directly affects this particular project. Predefined evaluation criteria are often used as support in choice and prioritization decisions, and they are used to study both single projects and the project group.

The objective of project portfolio management is to maximize the value of the entire portfolio, and to keep the portfolio balanced and aligned with strategy. In attempting to maximize value, the entire project portfolio is used to achieve business-related benefits and efficiency by taking risks that are commensurate with the benefits. A balanced portfolio can mean many things depending on the company, but usually it is tightly connected with strategic choices. If the objective is a balance between high-risk and low-risk projects in a portfolio that is aligned with strategy, for example, the resources in the project portfolio are allocated correctly and the set of projects comprising the portfolio effectively implement the company's strategy.

It is essential to understand the activities of project portfolio management both in theory and in a company's particular operating environment. Figure 106 illustrates the way various activity stages of project portfolio management get their input from the company's strategy in the form of goals, methods, and resources, and the way in which the decisions related to the project portfolio reflect back to the strategy, and on the projects and their decisions.

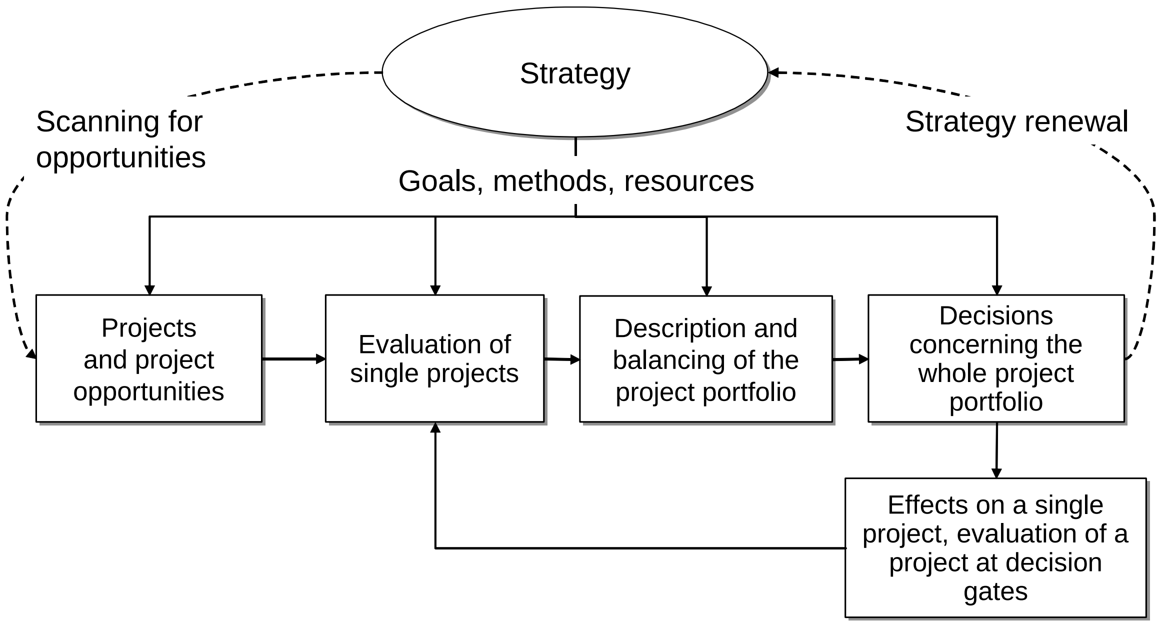


Figure 106. The stages of project portfolio management, and the links to strategy and projects

In the execution of a single project, relevant decisions are made in the reviews that are conducted at various project phases (i.e. at milestones or gates in the project lifecycle), so it is natural to include portfolio management considerations at these decision-making points. Upper management may review a single project to assess its relevance to the project portfolio – its alignment with the company's overall portfolio strategy, for example, its particular contribution to portfolio balance targets, and its degree of fit with other defined evaluation criteria. Evaluating fit with various evaluation criteria can be aided by use of checklists, various quantitative and qualitative measures (e.g. anchored scales), or graphs. The results of applying evaluation criteria to an individual project are also communicated to the meetings and reviews of the decision making body that studies the portfolio of the company's projects. Such reviews concern the study of the entire portfolio and are separate from the actual execution of the project; they may be conducted as part of strategic planning work. In order to attain the company's future strategic objectives, decision making related to the project portfolio is guided by various roadmaps that describe the requirements set for project content and the dependencies among projects in addition to the evaluation criteria.

From the perspective of the project portfolio, some of the critical estimates and choices concerning a single project are made at the beginning and at the end of a project. In these phases, project decision making is not necessarily formal or planned. In product development, for example, the term "fuzzy front end" is used, which refers to an early stage at which product ideas and execution options are only being investigated tentatively. The intuition, vision, beliefs, and contacts of an individual may guide choices more strongly than a formal set of decision making criteria. It is particularly important for project portfolio management and strategy that insignificant and unprofitable ideas are eliminated as soon as possible. Nevertheless, potential ideas should be carefully prepared at the earliest possible phase and considered, if they seem to contain substantial potential. The ideas then either ripen to the execution phase in a timely manner or new information is received to justify a quick decision to reject or redevelop them.

7.4.2 Program management

A program is an entity formed by several projects, and the program has a predefined goal, a beginning, end, and resources. A program is often founded in order to implement a certain strategy – starting a new business and launching the related products, for instance. A program may take several years to be implemented. Because of the program's complexity and duration, the objective may be defined only at the level of a general *mission*, and not as detailed requirements. The projects to be included in a program are not necessarily started or even known at the outset of the program.

A program is thus a temporary organization that has been founded to act as a tool to manage a complex and large project entity. A program may consist of simultaneous and consecutive projects and other complementary activities, the goals of which fulfill the common objectives of the program. *Program management* refers to the coordination of projects to realize strategic objectives. In a common program, the coordination of projects brings benefits that would not be achieved by executing the projects separately. Program management requires, in particular, management of dependencies between the program and the external environment and the dependencies the various projects in the program, including related coordination, communication, information management, and decision-making activities.

The projects that are executed as part of a program do not necessarily use the same resources. The dependencies among projects may result from the program level strategic goal in a technical, functional, or content-related manner. Thus the program-level strategic objectives require that projects are set in line with each other and that the program is managed through effective coordination. Additionally, project managers and project personnel must have sufficient information on the other projects in the program. This requires them to manage time, information, and collaboration activities, depending on the need and situation.

7.5 An evolving customer and supplier network

In project business, customer and supplier collaboration should be studied in a broader context than that of a single project. Many projects can be delivered to the same customer and several orders can be made to the same subcontractor. Competence and trust can be developed in the customer and supplier relationships, and these conditions bring opportunities for strategic specialization and competitive advantage. Customer and supplier relationships can be seen as a network that renews the entire business, not only the activities of a single company. There are many opportunities to benefit from the transition from a single purchase to a long-term partnership, but there are also risks.

7.5.1 Effects of a customer relationship on new business opportunities

From a business perspective, taking care of the customer relationship in the starting and closing phases of the project may be seen to be even more important than during the execution of the project. The most substantial benefit from a customer relationship is created when new products and other services can be sold to the same customer with small additional sales effort; the company saves the time and effort that goes into finding a customer and developing a customer relationship (marketing). In a trust-based relationship in which both parties are satisfied, the customer will probably use the same supplier in several projects and may tell other potential customers about its positive experiences with this supplier. Both parties benefit from a strong and smooth relationship; knowing the other party’s way of working keeps the resources and costs needed for coordination low for both parties. Additionally, the customer may be willing to pay more for the benefits brought by the known flexibility of the supplier and the knowledge that the right product will be delivered. The effects of customer relationships at various stages of the project lifecycle are presented in Figure 107.

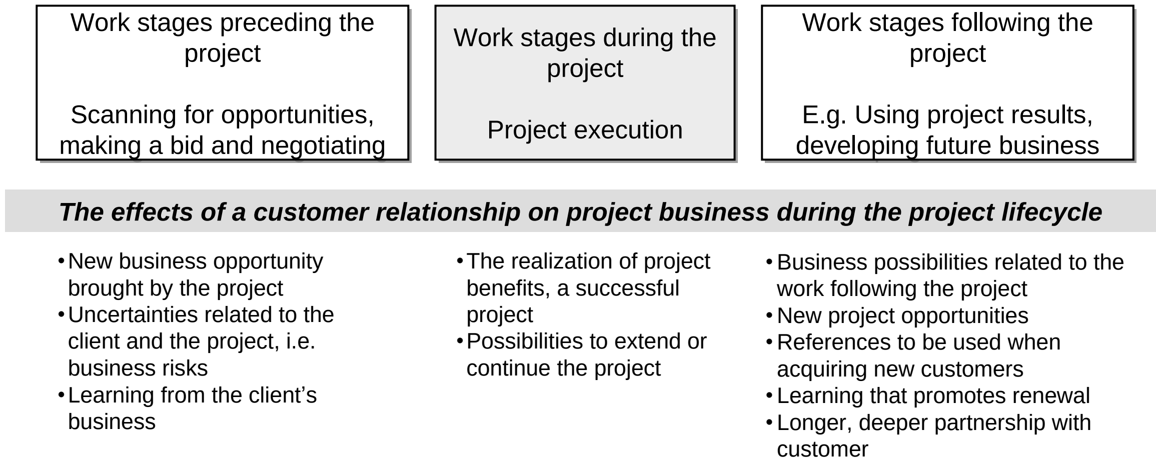


Figure 107. Effects of a customer relationship during the project lifecycle

A strong customer relationship may reveal new business opportunities at any stage of the project lifecycle. Working with the customer at the initial stages of a project, or merely studying the customer's operating environment, may bring out problems and project opportunities, which are new business opportunities. During project execution, possibilities may arise for new projects or for extending the project contract. The supplier-customer relationship is strengthened especially during project execution, and this creates a foundation for collaboration on future business. At the end of the project lifecycle, the product has been taken into use and the project supplier may offer services that support the use of or renew the product. The services are not necessarily implemented as projects, but they can be added into the service assortment and developed into profitable business. In the business model of some project suppliers, services have become a more important source of revenue than projects are.

7.5.2 Learning through a customer relationship

When considering the scope of the project, it is necessary to familiarize oneself with the customer's business in a broader sense than simply the project's usage environment. The project supplier should find out about the customer's customers, end users, technologies, and systems; as well, the customer's business, structure, processes, and activity models should be studied. In order to execute the project effectively, it is useful to know the right people and the informal networks in the customer's organization. In short, it is essential that the supplier develop into an expert on the customer's business. This ensures that the supplier is able to join the customer's value chain and thus create value to the customer's business (and, at the same time, to its own business).

At the end of the project lifecycle, it is useful to consider what was learned from the collaboration with the customer that could be used by the company's to improve the effectiveness of its activities, or to promote renewal. The starting point for learning could be the following questions: Is there something in the customer's business that must be taken into account in project execution? How can we help the customer succeed in its own business? Can the information collected on the customer be applied to generate new project opportunities? What other new business opportunities does the customer's operating environment reveal for our business? Can something be learned from the customer that can be used to make our own activity more effective? What does the customer's operating environment tell us about the general market situation, and what types of opportunities does it reveal?

7.5.3 Strategic subcontracting

Making cost efficient purchases may be attractive from the perspective of single projects. Nevertheless, from the perspective of the entire company, subcontracting may take on greater strategic importance. Cost efficiency is not the only basis for subcontracting; rather, subcontracting decisions may be heavily influenced by overall company strategy regarding the types of business the company will engage in, what things the company itself makes, and what things are procured from outside sources. The motivation for subcontracting may be the company's strategic need to concentrate on its core competence and to procure, in the most beneficial way, complementary competences from outside the company. Decisions regarding company strategy also affect what types of competences are maintained in the company.

In addition to choosing the content of the subcontracted items, a strategic question should be asked regarding what other subcontracting firms the company wants to collaborate with. All possible subcontractors are not necessarily equally interesting to the company, and the choice of subcontractor is typically affected by the competences, resources, reputation, financial standing, and reliability of the possible subcontractors. The company may, for example, concentrate its subcontracting only to the most well known or most successful firms in the business, or to specialists or local firms. When qualifying potential subcontractors and choosing among them for each project, it is necessary to ensure that the chosen supplier represents a party that brings added value to the company and, at the same time, fulfils the criteria for a suitable supplier.

When starting the subcontracting relationship, the nature of the relationship can and should be addressed: Is it a question of a single-natured collaboration, or is there a possibility for longer-term benefits for both parties? Initializing a subcontracting relationship consumes time and money in a similar manner to the case of creating a new customer relationship. It may be beneficial, therefore, for both parties to view the business opportunities in a broader sense than just concerning a single purchasing transaction. One factor affecting the success of the project supplier is how well it succeeds in forming a relationship with the network of subcontractors that support its activity. The network can be used in the project sales phase to prepare a competitively priced bid and, in the execution phase, it can be used to ensure the availability of resources. Various types of annual company-level contracts can be entered into with the more significant subcontractors, in which the forms of collaboration, and often prices, are determined. A well functioning supplier network makes the entire company's business flexible to the changes in customer needs and the market situation.

In determining the content and executing parties of the subcontracted parts, the company also needs to consider perspectives in addition to the financial and project-specific benefits. Supplier collaboration may have indirect effects on projects and business; such effects include publicity, enhanced supplier's reputation, greater new project opportunities, and new information. Alternatively, the supplier may turn out to be at a disadvantage regarding reputation and financials. A poor subcontractor may endanger the success of the project and give the market an incorrect signal of the project supplier's quality of work.

Subcontracting activity is established in many companies and is managed with effective methods. When the creation and maintenance of single subcontracting contracts has developed to a high level, the company will most probably start to pay greater attention to the broader network formed by subcontractors. Thus, the company operates in a long-term supplier network from which it picks suitable subcontractors for projects, when needed. New subcontractors are qualified into the network, when needed, and poor performing subcontractors are entered onto a blacklist so that they will not be used in future projects. Effective management of the entire supplier network may bring substantial added value when competing with other project suppliers.

7.5.4 Toward partnerships with customers and suppliers

Every new project presents a chance to strengthen relationships between the customer and the supplier. Strengthening this relationship has many advantages in project-based activity, both from the perspective of the customer and the supplier. When the supplier increases its knowledge of the customer and its business, it is better able to direct the product it offers to the needs of the customer. The customer gets better and more diverse information on alternative solutions. When the partnering supplier is able to define the real needs and problems of the customer better, the price level may be affected positively. The supplier gets a broader view of the customer's field of operation and can find new business opportunities. It gets specific and confidential information on the customer's needs and expectations, and it can direct its solution in the right way. A trusted supplier may have better chances to affect the content and execution methods of a joint project, which is often to the benefit of both parties. The same benefits are valid in strengthening the relationship between the supplier and its subcontractors: working with known subcontractors with whom it is easy to collaborate, is often of benefit to the business of all parties.

Although there are numerous benefits to supplier-customer collaboration, there are always risks and costs related to partnerships. In a partnership that is stronger than usual, the customer may lose the possibility to create competition between different suppliers, and it may become overly dependent on a single supplier. Maintaining a tight customer relationship requires resources from the company and the partnership may include requirements for a lower price level or a better than normal service level. The parties should carefully consider the strength of partnership in which they want to engage. Additionally, all project suppliers should recognize the fact that the relationship may be different in two simultaneous projects: in one project suppliers A and B may compete for a contract, in another B may be A's subcontractor, and in a third A and B may be allied forming a common partnership consortium. There are many other options in between single purchases and partnership; these options are presented in Figure 108. Repeated subcontracting creates a more binding relationship than a single purchase, and some customers may certify certain suppliers and engage well performing suppliers into repeated collaboration. Several partnership options can be identified in long-term collaboration situations, and the terms "operative partnership", "tactical partnership", and "strategic partnership" can be used to describe them. The strongest form of collaboration may be an alliance, in which the companies may have common business interests and common long-term objectives.

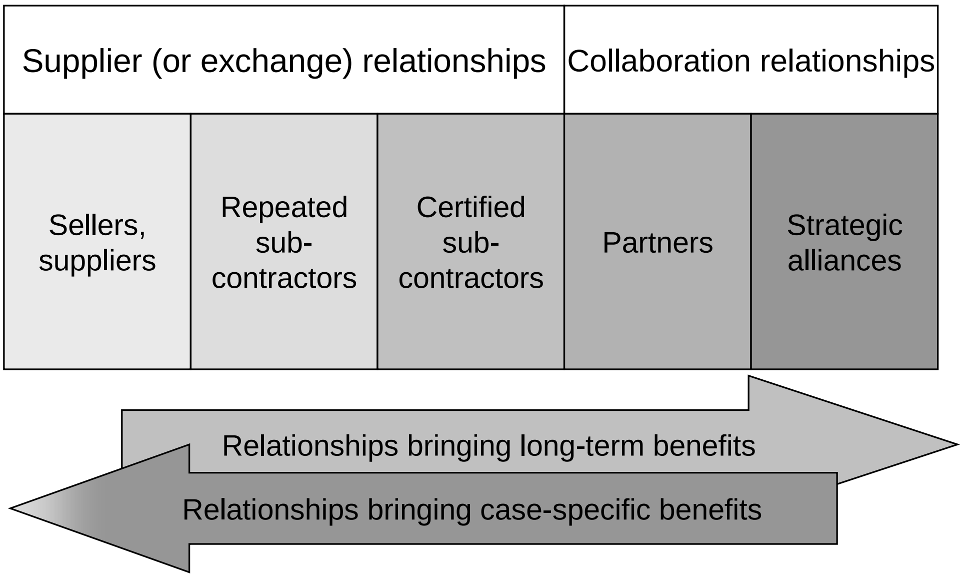


Figure 108. Different types of supplier and collaboration relationships

The opportunities and importance of a partnership must be considered from a strategic perspective that is broader than merely considering a single project. It must be possible to estimate, whether or not the time and work put into the partnership will generate the expected benefits in the long term. In an operative partnership, both parties aim at making their own activity more effective and, in that way, achieve lower costs. In a tactical partnership, the goal is to develop common practices that, from the perspective of both parties, are judged to be more effective than the earlier ones. In a strategic partnership, the objective is to achieve common product and business innovations that provide both parties with a strategic competitive advantage.

7.6 Project business in the future

In this book we have discussed various areas of project management and project business and have emphasized good practices. Throughout this book our objective has been to offer the reader the central or core methods for managing both a single project and the entire project business; the latter highlights the importance of projects for business in a broader sense.

Knowledge concerning project business is renewed constantly through research and active and diverse development conducted in companies. As we look to the future, we find it useful to divide project business knowledge areas into four perspectives: lifecycle, project business in a company, company in its business environment, and individuals and groups in project-based work. We now turn our attention to the future of project business from these perspectives. A summary of the project management areas in which we believe the management of project business will mostly develop in the future is presented in Figure 109.

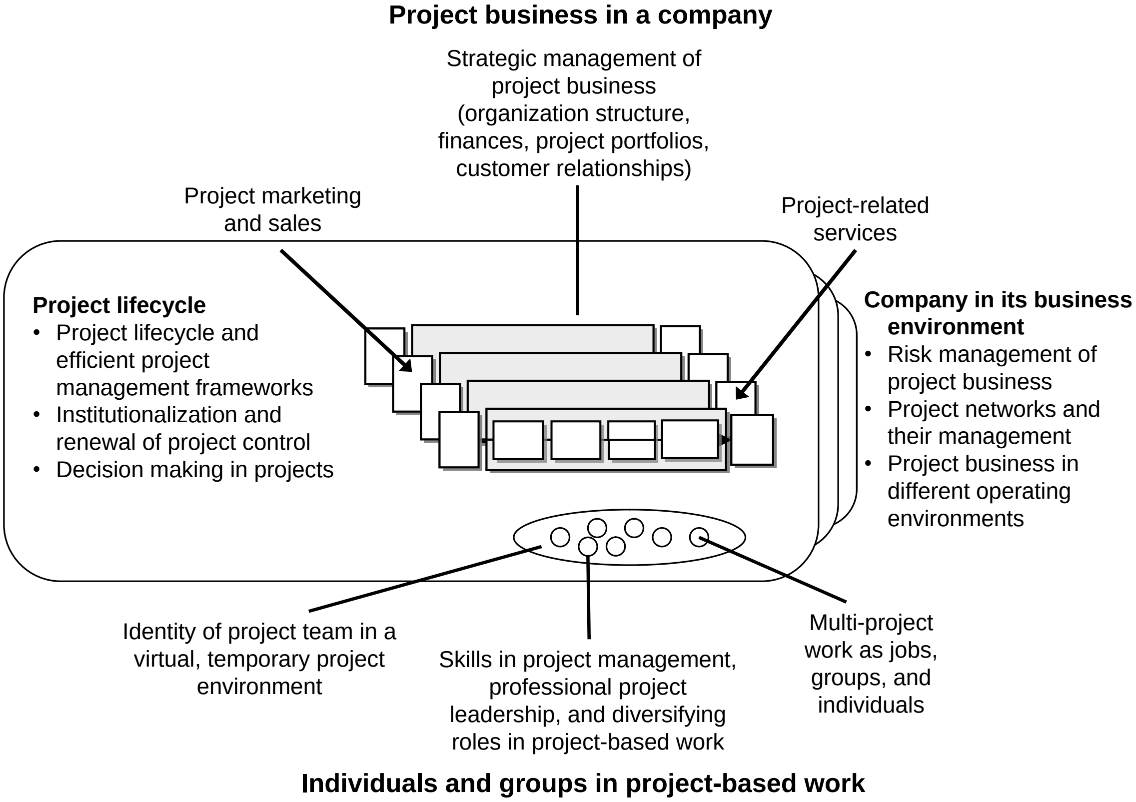


Figure 109. Future research and development areas in project business

7.6.1 Project lifecycle

This book has benefited from the results of research and development on project management methods, tools and practices carried out in recent decades. We believe that the research on single methods will continue, although the most substantial possibilities for new knowledge can be found in the broad study of the project lifecycle. The perspective of study has already shifted from the execution of a single project to the entire lifecycle, in which the preparatory work for the project and the complementary services are included. Customers and suppliers and the network formed by these actors are also included in the scope of this perspective. Strongly related to the lifecycle is the decision making concerning projects, which also ties project management to the management of the company's business. Project marketing and sales, and project-related services, are key to creating new business opportunities. The potential profitability of service business related to projects has recently precipitated a large degree of interest, discussion, and research activity among project management researchers in various parts of the world.

From the perspectives of research and the development activities in companies, it is beneficial to study effective project frameworks as a whole (not only as single tools or methods), the creation and development of project management frameworks, and the changes in project management practice over time.

7.6.2 Project business in a company

As the importance of project business increases, the strategic management of single projects will receive increased emphasis. Technology companies that are radically renewing their business need a strategic perspective to managing their product development projects: investments and resources must be allocated correctly in terms of risk and revenues. Strategy can be studied both from the perspective of the entire project business of the company and that of a single project. Both perspectives provide new opportunities for developing project business.

The management of a company's entire project business requires further concrete improvements in organizational solutions, in management of project portfolios and large development programs, and in long-term development of customer relationships. In a single project, the strategic perspective involves applying company-level solutions, but it also includes a broader perspective on the benefits expected from the project. There is still a need for companies to develop their potential for analyzing the indirect effects of projects, particularly the way the customer, future, and infrastructure benefits from the project are taken into account in the project scope; these benefits are realized only as a joint result of several projects. A transition must happen from project-level suboptimization to company-level optimization, which may require many changes in planning, followup, compensation, and other aspects of project business. In addition to joining the customer value chain, a significant element of project business is complete and efficient internal value creation.

7.6.3 A company in its operating environment

Managing the entire delivery chain and stakeholder network is closely connected with the project lifecycle and project marketing. There is increasing research into project networks and their ways of working within project business. In a network, a project is executed by a tightly collaborating but temporary organization formed by several companies and their own subprojects. In the background is a loose network of companies that can be stable or slowly changing. The management of project networks is a relevant part of innovation and product development projects but, in our view, future research and the application of new practices will focus on production and delivery networks. Theoretical background and practical solutions for network management can be found in supply chain management applications (project supply chains), network research in industry, organization theory (temporary and stable organizations and networks), and business performance measurement. There is great potential in project network research for developing new practical procedures and frameworks.

If project business is studied in general as part of a company's operating environment, the perceived challenges in every business are risk and uncertainty. Thus risk management will remain a central area of project management research, but the content of systematically executed risk management will change substantially. Researchers have already noted that different sources of uncertainty are emphasized in different environments. These may include deficiency or excess of information, the unpredictability of information or the environment, or the speed of change of the environment or situation. Future risk management research will seek new risk management solutions for each area of uncertainty. In complex project networks, for example, research will likely be focused on various types of risk management solutions that are applicable to dynamic, fast-paced product development projects. Additionally, research perspectives will explore the various levels of risk for a company and its stakeholder network, and the various ways of managing project, company, and network risks.

In this book we have emphasized that different contexts and different types of projects require different management methods. One future area for research and development is related to project management and project business in various operating environments. There are already clues from existing research that suggest there are clear differences in objectives and approaches among delivery, investment, product development, and organization development projects. Applying project business in different cultures requires new frameworks for managing international projects. In order to understand this point, it must be accepted that projects have their own strategy: the project strategy.

7.6.4 Individuals and teams in project work

At an individual and team level, projects may be only one way of executing and controlling work. There is a growing importance of temporary project work in the activities of private companies and public organizations. Simultaneously, because a project-based way of working has changed the processes and procedures in companies, it affects the roles of personnel, the organization of work, the competences required, and working conditions.

When studying project work in a team, the special nature of networked, geographically dispersed, and multicultural project work becomes relevant. Having a temporary organization as the context of work brings forth several new possibilities for research in the fields of work and organizational psychology. The formation of organizational identity, learning, trust, conformance, and commitment in a temporary organization, for example, present interesting topics for further research.

As temporary organizations, projects offer a unique, challenging research environment. It is now time to come back to people as the executors of projects. In today's project business, the importance of an individual is emphasized: each person working in a project is an expert that may know more about a specific field and have a clearer perception of the related issues than does the project superior. Today's project work requires expertise, quick situational sense, and fast-paced decisions. Every project worker is a decision maker and a risk taker: projects cannot be conducted successfully by meticulously following predefined instructions. One challenge concerning human resources management is often caused by people doing other things simultaneous to executing their responsibilities in the project to which they have been assigned. The term "multi-project" work can be used to describe the situation in which individuals need to prioritize and manage their time according to the priorities they attach to their varied, and sometimes competing, work demands and responsibilities. The understanding of multi-project work and its justifications and effects should be further explored through research. In particular, concrete answers are needed to questions about the way to manage multi-project work better, and, simultaneously, the way to improve the wellbeing of individuals working on projects.

In addition to the perspective of organizing work, competences and professional project leadership become critical issues. The competence needed for project management has the same content from one business to the other, but the needs for deepening and distributing the competences vary among companies. Creating a suitable level of project management competence is a crucial development task for virtually all companies. Modern certification and training programs offer good solutions. The new, broad challenges of research and development concern the need to emphasize the business perspective in assigning various project roles and in dividing work among the various actors in a project.

7.7 Literature

Artto, K.A., Martinsuo, M. and Aalto, T. (Eds.) (2001) Project Portfolio Management. Strategic Business Management through Projects. Helsinki, Finland: Project Management Association Finland.

Artto, K. A. and Wikström, K. (2005) What is Project Business? International Journal of Project Management 23 (5) 343-353.

Dye, L. D. and Pennypacker, J. S. (Eds.) (1999) Project portfolio management. Selecting and Prioritizing Projects for Competitive Advantage. USA: Center for Business Practices.

Ford, D., Håkanson, H. and Gadde, L. (2003) Managing Business Relationships. USA: John Wiley.

Kaplan, R. S. and Norton, D. P. (1996) The Balanced Scorecard: Translating Strategy into Action. Boston, MA, USA: Harvard Business School Press.

Kim, W. C. and Mauborgne, R. (2005) Blue Ocean Strategy. How to create uncontested market space and make the competition irrelevant. USA: Harvard Business School Press.

Martinsuo, M. and Lehtonen, P. (2007) Role of single-project management in achieving portfolio management efficiency. International Journal of Project Management 25 (1) 56-65.

Mintzberg, H., Lampel, J. and Ahlstrand, B. (1998) Strategy Safari: A Guided Tour Through The Wilds of Strategic Management. USA: The Free Press.

Morris, P. W. G. and Pinto, J. K. (Eds.) (2004) The Wiley Guide to Managing Projects. London, U.K.: John Wiley & Sons Inc.

Porter, M. (1998) Competitive Advantage: Creating and Sustaining Superior Performance. USA: The Free Press.

Slevin, D.P., Cleland, D.I. and Pinto, J.K. (Eds.) (2004) Innovations: Project Management Research 2004. Project Management Institute: Newtown Square, Pennsylvania.

REFERENCES

Aalto, T., Martinsuo, M. & Artto, K.A. (2003) Project Portfolio Management in Telecommunications R&D: Aligning Projects with Business Objectives. In T. O. Korhonen and A. Ainamo (Eds.) Handbook of Product and Service Development in Communication and Information Technology, pp. 99-147. Kluwer Academic Publishers, Boston, USA.

Aaltonen, K. & Kujala, J. (2010) Stakeholder influence strategies in global projects. Scandinavian Journal of Management 26 (4) 381-397.

Aaltonen, K., Kujala, J. & Oijala, T. (2008) Stakeholder Salience in Global Projects. International Journal of Project Management 25 (6) 509-516.

Aaltonen, K., Kujala, J., Lehtonen, P. & Ruuska, I. (2010) A stakeholder network perspective on unexpected events and their management in international projects. International Journal of Projects in Business 3 (4) 564-588.

Ahmed, M. (1993) International Marketing and Purchasing of Projects: Interactions and Paradoxes, Helsinki: Swedish School of Economics and Business Administration.

Ahola, T., Laitinen, E., Kujala, J. & Wikström, K. (2008) Purchasing strategies and value creation in industrial turn-key deliveries. International Journal of Project Management 26: 87-94.

Ainamo, A., Artto, K., Levitt, R. E., Orr, R. J., Scott, W. R. and Tainio, R. (2010) Global projects: Strategic perspectives. Editorial, Scandinavian Journal of Management 26: 343-351.

Anttila, V., Artto, K. A. and Wallén, G. (1998) Project Management by Results. Project Management 4 (1) 40-45.

APM, Association for Project Management (1996, 2000, 2006) APM Body of Knowledge. 3rd Edition 1996, 4th Edition 2000, 5th Edition 2006. U.K: Association for Project Management. http://www.apm.org.uk/

Archer, N. and Ghasemzadeh, F. (1999) An Integrated Framework for Project Portfolio Selection. International Journal of Project Management 17 (4) 207-216.

Archibald, R. D. (1976) Managing High-Technology Programs and Projects. New York, USA: John Wiley.

Arenius, M., Artto, K. A., Lahti, M., Meklin, J. (2002) Poject Companies and the Multi-Project Paradigm: A New Management Approach. In: D. P.Slevin, D. I. Cleland and J. K. Pinto (Eds.) The Frontiers of Project Management Research, pp. 289-307. USA: Project Management Institute, PMI.

Artto, K. A. (1986) Risk Management in Cost Engineering. Part 1: Abstract, Introduction and Risk Management. The Cost Engineer 24 (3).

Artto, K. A. (1986) Risk Management in Cost Engineering. Part 2: Risk Analysis Methodology and its Advantages, Conclusions. The Cost Engineer 24 (4).

Artto, K. A. (1994) Life Cycle Cost Concepts and Methodologies. Journal of Cost Management 8 (3) 28-32.

Artto, K. A. (1999) Development of World-Class Practices in Project Companies. In The Future of Project Management, pp. 127-137. Project Management Institute Research Series, PMI, USA.

Artto, K. (2002, 2003, 2004) Managing Business by Projects – The Basics of Project Management from a New Perspective. Course material for Introduction to Project Management. Espoo, Finland Helsinki University of Technology, Department of Industrial Engineering and Management.

Artto, K., Davies, A., Kujala, J. & Prencipe, A. (2011) The project business: analytical framework and research opportunities. Chapter 5 in: P. W. G. Morris, J. Pinto & J. Söderlund (Eds.) Oxford Handbook of Project Management, pp. 133-153. Oxford University Press, Oxford, UK.

Artto, K. A. & Dietrich, P. H. (2004) Strategic Business Management through Multiple Projects. In P. W. G. Morris and J. K. Pinto (Eds.) The Wiley Guide to Managing Projects, pp. 144-176. John Wiley & Sons Inc, London.

Artto, K. A., Dietrich, P. H. & Nurminen, M. I. (2004) Strategy Implementation by Projects, In D.P. Slevin, D.I. Cleland and J.K. Pinto (Eds.) Innovations: Project Management Research 2004, pp. 103-122. Newtown Square, Pennsylvania, Project Management Institute.

Artto, K., Eloranta, K. & Kujala, J. (2008) Subcontractors' business relationships as risk sources in project networks. International Journal of Managing Projects in Business 1 (1) 88-105.

Artto, K., Heinonen, R., Arenius, M., Kovanen, V. and Nyberg, T. (1998) Global Project Business and the Dynamics of Change. Helsinki, Finland: Technology Development Centre Finland and Project Management Association Finland.

Artto, K. & Kujala, J. (2008) Project business as a research field. International Journal of Managing Projects in Business 1 (4) 469-497.

Artto, K., Kujala, J., Dietrich, P. & Martinsuo, M. (2008) What is project strategy? International Journal of Project Management 26 (1) 4-12.

Artto, K., Kähkönen, K. and Koskinen, K. (Eds.) (1999) Managing Business by Projects, Vol. 1 & Vol. 2. Helsinki, Finland: Project Management Association Finland and Nordnet.

Artto, K., Kähkönen, K. and Pitkänen, P. (2000) Unknown Soldier Revisited: A Story of Risk Management. Helsinki, Finland: Project Management Association Finland.

Artto, K. A., Lehtonen, J-M. and Saranen J. (2001) Managing Projects Front-End – Incorporating a Strategic Early View to Project Management with Simulation. International Journal of Project Management 19 (5) 255-264.

Artto, K., Martinsuo, M. and Aalto, T. (Eds.) (2001) Project Portfolio Management. Strategic Business Management through Projects. Helsinki, Finland: Project Management Association Finland.

Artto, K., Martinsuo, M., Dietrich, P. & Kujala, J. (2008) Project strategy – strategy types and their contents in innovation projects. International Journal of Managing Projects in Business 1 (1) 49-70.

Artto, K., Martinsuo, M., Gemünden, H. G. & Murtoaro J. (2009) Foundations of program management: a bibliometric view. International Journal of Project Management 27 (1) 1-18.

Artto, K. & Wikström, K. (2005) What is Project Business? International Journal of Project Management 23 (5) 343-353.

Artto, K., Wikström, K., Hellström, M. & Kujala, J. (2008) Impact of services on project business. International Journal of Project Management 26 (5) 497–508.

Bentley, C. (2001) Prince2: a practical handbook, 2nd Edition. Great Britain: Butterworth – Heinemann.

Blanchard, K., Carlos, J. P. and Randolph, A. (1999) The 3 keys to empowerment. Release the power within people for astonishing results. USA: Berrett-Koehler Publishers, Inc.

Blanchard, K., Zigarmi, P. and Zigarmi, D. (1985) Leadership and the one minute manager. New York, USA: William Morrow & Co, Inc.

Block T. R. (1999) The Seven Secrets of a Successful Project Office. PM Network (April) 43-48.

Chapman, C. (1997) Project Risk Analysis and Management - PRAM the Generic Process. International Journal of Project Management 15 (5) 273-281.

Cleland, D. I. (1994) Project Management, Starategic Design and Implementation, 2nd Edition. USA: McGraw-Hill.

Cleland, D. I. and King, W. R. (Eds.) (1988) Project management handbook. New York: Van Nostrand Reinhold.

Cooper, R. (2001) Winning at New Products – Accelerating the Process from Idea to Launch, Third Edition. Perseus Publishing, Cambridge Massachusetts, USA.

Cooper, R. G. (1999) The invisible success factors in product innovation. Journal of Product Innovation Management (16) 115 – 133.

Cooper, R., Edgett, S. and Kleinschmidt, E. (1997a) Portfolio management in new product development: Lessons from the leaders I. Research Technology Management 40 (5) 16-28.

Cooper, R., Edgett, S. and Kleinschmidt, E. (1997b) Portfolio management in new product development: Lessons from the leaders II. Research Technology Management 40 (6) 43-52.

Cooper, R., Edgett, S. and Kleinschmidt, E. (2000) New Problems, New Solutions: Making Portfolio Management More Effective. Research Technology Management 43 (2) 18-33.

Cova, B., Ghauri, P. and Salle, R. (2002) Project Marketing: Beyond Competitive Bidding. Great Britain: John Wiley & Sons.

Cova, B., Mazet, F. and Salle, R. (1993) Towards Flexible Anticipation: The Challenge of Project Marketing. Perspectives on Marketing Management 3: 375-400.

Dobler, D. W. and Burt, D. N. (1996) Purchasing and Supply Management. USA: McGraw-Hill.

Dobson M. S. (1999) The Juggler's Guide to Managing Multiple Projects. Pennsylvania, USA: Project Management Institute.

Dye, L. D. and Pennypacker, J. S. (Eds.)(1999) Project portfolio management. Selecting and Prioritizing Projects for Competitive Advantage. USA: Center for Business Practices.

Eccles, R., Nohria, N. and Berkley, J. D. (1992) Beyond the Hype. Rediscovering the Essence of Management. Cambridge, MA, USA: Harvard University Press.

Eisner, H. (1997) Essentials of project and systems engineering management. USA: John Wiley & Sons Inc.

Elonen, S. & Artto, K. A. (2003) Problems in Managing Internal Development Projects in Multi-Project Environments. International Journal of Project Management 21 (6) 395-402.

Engwall, M. (1995) Jakten på det effektiva projektet. Stockholm, Sweden: Nerenius & Santérus förlag.

Fangel, M. (1991) To Start or to Start Up? That is the Key Question of Project Initiation. International Journal of Project Management 9 (1) 5-9.

Ford, D., Håkanson, H. and Gadde, L. (2003) Managing Business Relationships. USA: John Wiley.

Frame, J. D. (1995) Managing Projects in Organizations: How to Make the Best Use of Time, Techniques, and People, 2nd Edition. San Francisco, USA: Jossey-Bass Inc.

Gaddis, P. O. (1959) The Project Manager, Harvard Business Review (May-June) 89-97.

Galbraith, J. R. (1977) Organization design. USA: Addison-Wesley Publishing Company.

Gareis, R. (1994) Management by Projects: Specific Strategies, Structures, and Cultures of Project-Oriented Companies. in: Cleland, D. I. and Gareis, R. (Eds.) Global Project Management Handbook. New York, USA: McGraw-Hill.

Gareis, R. (1996) The Application of the "New Management Paradigm" in the Project Oriented Company. Proceedings of IPMA International Project Management Association '96 World Congress, Vol. 2. pp. 687-689, Paris, June 24-26, 1996.

Goldratt, E. M. (1997) Critical Chain. MA, USA: The North River Press.

Gorchels, L. (2000) The Product Manager's Handbook. The complete product management resource. USA: NTC Business Books.

Grönroos, C. (2000) Service management and marketing: a customer relationship management approach. USA: John Wiley & Sons.

Gunter, B. and Bonacorsi, A. (1996) Project Marketing and Systems Selling - In search of Frameworks and Insights. International Business Review 5 (6) 531 536.

Handy, C. B. (1982) Understanding Organisations. USA: Penguin.

Hawk, D. L. and Artto, K. A. (1999) Factors Impeding Project Management Learning. Project Management 5 (1) 56-67.

Hobbs, B., Ménard, P., Laliberté, M. and Coulombe, R. (1999) A Project Office Maturity Model. Proceedings of Project Management Institute Annual Seminars and Symposium, Philadelphia, PA, USA.

Holstius, K. (1989) Project Business as a Strategic Choice - A Theoretical and Empirical Study of Project Marketing. Lappeenranta University of Technology, Research Papers No 12.

Horwitch, M. and Pralahad, C. K. (1981) Managing Multi-Organization Enterprises: The Emerging Strategic Frontier. Sloan Management Review (Winter) 3-16.

IPMA, International Project Management Association (1999, 2001), Caupin, G., Knöpfel, H., Morris, P. W. G., Motzel, E. and Pannenbäcker, O. (Eds.) ICB – IPMA Competence Baseline. 1999-Version 2.0, 2001-Version 2.0b.Monmouth, UK: International Project Management Association IPMA. http://ipma.kingsquare.nl/

IPMA, International Project Management Association (2006), Caupin, G., Knöpfel, H., Koch, Pérez-Polo, F., and Seabury, C. (Eds.) ICB – IPMA Competence Baseline. 2006-Version 3.0, 2001-Version 2b.Monmouth, UK: International Project Management Association IPMA. http://ipma.kingsquare.nl/

ISO 10006 (1996) Guidelines to Quality in Project Management. ISO/DIS 10006, Document 176-2-8-N160.

ISO 10006 (1997) Quality Management — Guidelines to Quality in Project Management, ISO 10006:1997(E), International Organization for Standardization ISO, Switzerland.

Jaques, E. and Clement, S.D. (1991) Executive leadership. A practical guide to managing complexity. UK: Blackwell Publishing.

Järvinen, P., Artto, K. A. and Aalto, P. (2000) Explorations on the Integration of Fractured Process Improvement: The 3A-Workshop Procedure. Project Management 6 (1) 77-83.

Juran, J. M. (Ed.) (1974) Quality Control Handbook. McGraw-Hill.

Kähkönen, K. and Artto K. A. (Eds.) (1997) Managing Risks in Projects. London, UK: E & FN Spon, an Imprint of Thomson Professional ITP.

Kaplan, R. S. and Norton, D. P. (1996) The Balanced Scorecard: Translating Strategy into Action. Boston, MA, USA: Harvard Business School Press.

Kärkkäinen, M., Holmström, J., Främling, K. and Artto, K. (2002) Intelligent Products – A Step Towards a More Effective Project Delivery Chain. Computers in Industry 50 (2) 141-151.

Kerzner, H. (1995) Project Management - A Systems Approach to Planning, Scheduling, and Controlling, 5th Edition. New York, USA: Van Nostrand Reinhold.

Kharbanda, O. P. and Stallworthy E. A. (1983) How to Learn from Project Disasters -True-life Stories with a Moral for Management. Hampshire, UK: Gower Publishing Company.

Kharbanda, O. P. and Pinto J. K. (1996) What Made Gertie Gallop? Lessons from Project Failures. New York, USA: Van Nostrand Reinhold.

Kim, W. C. and Mauborgne, R. (2005) Blue ocean strategy. How to create uncontested market space and make the competition irrelevant. USA: Harvard Business School Press.

Kimmons, R. L. (1990) Project Management Basics: A Step by Step Approach. New York, USA: Marcel Dekker Inc.

Knutson J. (1999) Project Office: An Evolutionary Implementation Plan. Proceedings of Project Management Institute Annual Seminars and Symposium, Philadelphia, PA, USA.

Kotter, J. P. (1990) A Force for Change: How Leadership Differs from Management. New York, USA: The Free Press.

Kouzes, J. M. and Posner, B. Z. (1993) Credibility: how leaders gain and lose it, why people demand it. USA: Jossey-Bass Publishers.

Kouzes, J. M. and Posner, B. Z. (1995) The leadership challenge. How to keep getting extraordinary things done in organizations. USA: Jossey-Bass Publishers.

Kujala. J. & Ahola, T. (2005) The value of customer satisfaction survey for project-based organization: symbolic, technical or none. International Journal of Project Management 23: 404-409.

Kujala, J., Murtoaro, J. & Artto, K. (2007) A Negotiation approach to project sales and implementation. Project Management Journal 38 (4) 33-44.

Kujala, S., Artto, K., Aaltonen, P. & Turkulainen, V. (2010) Business models in project-based firms – Towards a typology of solution-specific business models. International Journal of Project Management 28 (2) 96-106.

Lawrence, P. R. and Lorsch, J. W. (1967) Differentiation and Integration in Complex Organizations. Administrative Science Quaterly 12 (1) 1-47.

Lehtonen, P. and Martinsuo, M. (2008) Change program initiation: defining and managing the program - organization boundary. International Journal of Project Management 26 (1) 21-29.

Lehtonen, P. and Martinsuo, M. (2009) Integrating the change program with the parent organization. International Journal of Project Management 27 (2) 154-165.

Lewis, J. P. (1995) Fundamentals of Project Management. USA: American Management Association.

Lullen, J. J. and Sylvia R. (1999) Getting Organized: Implementing the Project Office. PM Network (April) 51-55.

Lynch, R. L. and Cross, K. F. (1991) Measure Up! Yardsticks for Continuous Improvement. MA, USA: Blackwell Publishers.

Martinsuo, M. (Ed.) (2009) Recipes for success in project-based management. Espoo: Project Management Association Finland. 220 p.

Martinsuo, M. and Ahola, T. (2010) Supplier integration in complex delivery projects: comparison between different buyer-supplier relationships. International Journal of Project Management 28 (2) 107-116.

Martinsuo, M. and Blomqvist, M. (2010) Process modeling for improved performance. Aalto University School of Science and Technology, Department of Industrial Engineering and Management Teaching Material 2010/1, Espoo, Finland: Aalto University.

Martinsuo, M. and Kantolahti, T. (2009) Knowledge integration between the change program and the parent organization. International Journal of Knowledge Management Studies 3 (3-4) 241-258.

Martinsuo, M. and Lehtonen, P. (2007) Program initiation in practice: Development program initiation in a public consortium. International Journal of Project Management 25 (4) 337-345.

Martinsuo, M. and Lehtonen, P. (2007) Role of single-project management in achieving portfolio management efficiency. International Journal of Project Management 25 (1) 56-65.

Martinsuo, M. and Lehtonen, P. (2009) Project autonomy in complex service development networks. International Journal of Managing Projects in Business 2 (2) 261-281.

Martinsuo, M., Aaltonen, K. and Lehtonen, P. (2010) Project autonomy in complex delivery projects: Taking and withdrawing autonomy in system and turnkey deliveries. In: Gleich, R., Mayer, T-L., Wagner, R. & Wald, A. (Eds.) Advanced Project Management (Vol. 2), pp. 95-118. Germany: GPM Deutsche Gesellschaft für Projektmanagement.

Martinsuo, M., Hensman, N., Artto, K., Kujala, J. & Jaafari, A. (2006) Project-based management as an organizational innovation: Drivers, changes, and benefits of adopting project-based management. Project Management Journal 37 (3) 87-97.

McClelland, D.C. (1971) Assessing human motivation. New York: General Learning Press.

McClelland, D.C. (1975) A guide to job competency assessment. Boston: McBer and Company.

Meklin, J., Lahti, M., Kovanen, V., Arenius, M. and Artto, K. (1999) FIT-PRO - A Product-oriented Approach to Industrial Project Management. Helsinki, Finland: Project Management Association Finland.

Meredith, J. R. and Mantel S. J. (1995) Project Management: A Managerial Approach. New York, USA: John Wiley & Sons.

Meredith, J. R. and Mantel, S. J. Jr. (2003) Project management: a managerial approach. 5th edition. USA: John Wiley & Sons.

Mintzberg, H., Lampel, J. and Ahlstrand, B. (1998) Strategy Safari: A Guided Tour Through The Wilds of Strategic Management. USA: The Free Press.

Morris, P. W. G. (1994) The Management of Projects. London, G.B.: Thomas Telford Services Ltd.

Morris, P. W. G. (1981) Managing Project Interfaces: Key Points for Project Success. in: Cleland, D. I. and King, W.R. (Eds.) Project Management Handbook, 2nd Edition. Englewood Cliffs, N. J., USA: Prentice-Hall.

Morris, P. W. G. and Hough, G. H. (1988) The Anatomy of Major Projects. Chichester, UK: John Wiley & Sons.

Müller, R., Martinsuo, M. and Blomquist, T. (2008) Project portfolio control and portfolio management performance in different contexts. Project Management Journal 39 (3) 28-42.

Murtoaro, J. & Kujala J. (2007) Project Negotiation Analysis. International Journal of Project Management 25: 722-733.

Murtoaro, J., Kujala, J. and Artto, K. (2005) Negotiations in project sales and delivery processes: An application of negotiation analysis. Helsinki University of Technology Industrial Engineering and Management Report 2005/3. Espoo: Helsinki University of Technology. Department of Industrial Engineering and Management.

Orr, R.J., Scott, W.R., Levitt, R.E., Artto, K. & Kujala, J. (2011) Global projects: Distinguishing features, drivers, and challenges. Chapter 1 in: W.R. Scott, R.E. Levitt & R.J. Orr (Eds.) Global projects: Instututional and political challenges. Cambridge University Press.

Peltokorpi, A., Alho, A., Kujala, J., Aitamurto, J. & Parvinen P. (2008) Stakeholder approach for analyzing organizational change project. International Journal of Healthcare Quality Assurance 21 (5) 418-434.

Pfeffer J. (1992) Managing with Power: Politics and Influence in Organizations. USA: HBS Press.

Pinto, J. K. (1997a) Twelve Ways to Get the Least from Yourself and Your Project. PM Network 11 (5) 29-31.

Pinto, J. K. (1997b) Understanding Project Risk: Lessons from Past Failures. In: Kähkönen, K., Artto, K. A. (Eds.) Managing Risks in Projects, pp. 41-48. London, UK: E & FN Spon.

Pinto, J. K. and Kharbanda, O. P. (1995) Successful project managers. Leading your team to success. Van Nostrand Reinhold: USA.

Pinto, J.K. and Covin, J.G. (1992) Project Marketing: Detailing the Project Manager's Hidden Responsibility. Project Management Journal 22 (3) 29-34.

Porter, M. (1998) Competitive Advantage: Creating and Sustaining Superior Performance. USA: The Free Press.

Poskela, J., Dietrich, P., Berg, P., Artto, K. A. and Lehtonen, T. (2005) Integration of Strategic Level and Operative Level Front-End Innovation Activities. In: T. Anderson, T.U. Daim, D.F. Kocaoglu (Eds.), D.Z. Milosevic and C.M.Weber (Co-eds.) Technology Management: A Unifying Discipline for Melting the Boundaries. Portland State University, USA: Portland International Conference on Management of Engineering and Technology.

Prince2 Guidance (2002) Managing Successful Projects with PRINCE2. Stationery Office Books.

Project Management Institute PMI (2003, 2008) Organizational Project Management Maturity Model OPM3, 1st Edition 2003, 2nd Edition 2008. USA, Project Management Institute PMI. http://www.pmi.org/

Project Management Institute PMI (1996, 2000, 2004, 2008) PMBoK, A Guide to the Project Management Body of Knowledge (PMBOK Guide). 1st Edition 1996, 2nd Edition 2000, 3rd Edition 2004, 4th Edition 2008. USA: Project Management Institute PMI. http://www.pmi.org/

Project Management Institute PMI (2006, 2008) The Standard for Portfolio Management, 1st Edition 2006, 2nd Edition 2008. USA, Project Management Institute PMI. http://www.pmi.org/

Project Management Institute PMI (2006, 2008) The Standard for Program Management, 1st Edition 2006, 2nd Edition 2008. USA, Project Management Institute PMI. http://www.pmi.org/

PRY (2004) Project Management Association Finland, The Finnish IPMA-ICB-based Project Management Body of Knowledge. Helsinki, Finland: Projektiyhdistys PRY. http://www.pry.fi/ (in Finnish)

PRY, Projektiyhdistys ry. (2004) Projektijohdon pätevyys. Helsinki: Projektiyhdistys. http://www.pry.fi/

Rintala, K., Poskela, J., Artto, K. A. and Korpi-Filppula, M. (2004) Information System Development for Project Portfolio Management, In: Yasser A. Hosni and Tarek M. Khalil (Eds.) Management of Technology – Internet Economy: Opportunities and Challenges for Developed and Developing Regions of the World, pp. 265-280. U.K.: Elsevier Ltd.

Ruuska, I., Artto, K., Aaltonen, K. & Lehtonen, P. (2009) Dimensions of distance in a project network: exploring Olkiluoto 3 nuclear power plant project. International Journal of Project Management 27 (2) 142-153.

Sayles, L. R. (1989) Managing in Real Organizations (McGraw-Hill Series in Management). USA: McGraw-Hill.

Simon, P., Hillson, D. and Newland, K. (1997) Project Risk Analysis and Management Guide. UK: Association for Project Management.

Skaates, M. A. and Tikkanen, H (2003) International project marketing: an introduction to the IMP approach. International Journal of Project Management 21 (7) 503-510.

Söderholm, A. (1997) A Notion on Project and Company Cost Accounting. Project Management 3 (1) 12-13.

Steffens, W., Martinsuo, M. & Artto, K. (2007) Change decisions in product development projects. International Journal of Project Management 25: 702–713.

Thamhain, H. J. and Nurick, A. J. (1994) Project Team Development in Multinational Environments. in: Cleland, D. I. and Gareis, R. (Eds.) Global Project Management Handbook. NY, USA: McGraw-Hill.

Thamhain, H. J. and Wilemon D. L. (1975) Conflict Management in Project Life Cycles. Sloan Management Review (Summer).

Tikkanen, H., Kujala, J. & Artto, K. (2007) The marketing strategy of a project-based firm: The four portfolios framework. Industrial Marketing Management 36 (2) 194-205.

Törmä, S. (1997) A Model for the Dynamic Planning of Industrial Projects. Acta Polytechnica Scandinavica, Mathematics, Computing and Management in Engineering Series No. 85. Espoo, Finland: The Finnish Academy of Technology.

Turner, J. R. (1993) The Handbook of Project-based Management – Improving the Processes for Achieving Strategic Objectives, First Edition. London, UK: McGraw-Hill.

Turner, J. R. (1999) The Handbook of Project-based Management – Improving the Processes for Achieving Strategic Objectives, Second Edition. London, UK: McGraw-Hill.

Turner, J. R. and Keegan A. (1999) The Management of Operations in the Project-based Organization. in: Artto, K. A., Kähkönen, K. and Koskinen, K. (Eds.) Managing Business by Projects, Vol. 1., pp. 57-85. Project Management Association Finland and Nordnet.

Turner, J. R. and Payne J. H. (1997) The Problem of Projects of Differing Size and Skill Mix. Project Management 3 (1) 14-17.

Tushman, M.L. and Katz, R. (1980) External communication and project performance: an investigation into the role of gatekeepers. Management Science 26 (11) 1071 – 1085.

Vartiainen, M., Ruuska, I. ja Kasvi, J.J.J. (2003, in Finnish) Project competence – resource for dynamic organizations. Tampere: Teknologiainfo Teknova Oy.

Ward, J. L. (1997) Project Management Terms – A Working Glossary. Arlington, Virginia, USA: ESI International.

Weiss, J. W. and Wysocki, R. K. (1991) 5-Phase Project Management: A Practical Planning and Implemention Guide. Reading, MA, USA: Addison-Wesley.

Wikström, K. and Artto, K. (Eds.) (2004) IRNOP VI Project Research Conference Proceedings. Finland: International Research Network on Organizing by Projects IRNOP, Åbo Akademi University and Helsinki University of Technology.

Wikström, K., Artto, K., Kujala, J. & Söderlund, J. (2010) Business models in project business. International Journal of Project Management 28: 832–841.

Wikström, K., Hellström, M., Artto, K., Kujala, J. & Kujala, S. (2009) Services in project-based firms - four types of business logics, International Journal of Project Management 27 (2) 113-122.

Wilemon, D. L. and Gemmill, G. R. (1971) Interpersonal Power in Temporary Management Systems. Journal of Management Studies 8 (Oct.) 315-328.

Wysocki, R. K., Beck, R. Jr. and Crane, D. B. (1995) Effective Project Management: How to Plan, Manage, and Deliver Projects on Time and within Budget. New York, USA: John Wiley & Sons Inc.

Wysocki, R. K., with contributions by McGary, R. (2003) Effective Project Management: Traditional, Adaptive, Extreme, Third Edition. USA: Wiley.