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"Best Practice in Managing Distributed Projects"

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A Benchmarking Report from
the CoDisCo Project

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SINTEF REPORT

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Best Practice in Managing Distributed Projects

-A Benchmarking Report from the CoDisCo Project

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ABSTRACT

The results described in this report are based on a benchmarking study carried out during the CoDisCo project, Connecting Distributed Competencies. The project was a joint Nordic collaboration with participants from all the Nordic countries, and the Nordic Industrial Fund has funded the project through its nearly two and a half years duration, from September 1998 to January 2001.

The objective of the benchmarking study was to identify and describe best practice in managing distributed projects, by focusing on four project management knowledge areas; time, cost, quality and risk management.

The best practice in managing distributed projects is identified, described and structured in perspective of five project phases, initiation, planning, execution, control and closure.

The benchmarking study indicated that facilitating communication and team processes are vital for distributed projects. In order to make the results more operational and give project managers some practical guidelines on how to manage distributed projects, ten critical success factors were identified and described on three levels, depending on which level in the project organisation they are intended for; individual, team or organisational level.

KEYWORDS	ENGLISH	NORWEGIAN
GROUP 1	Research	Forskning
GROUP 2	Project Management	Prosjektledelse
SELECTED BY AUTHOR	Distributed projects	Distribuerte prosjekter
	Virtual projects	Virutelle prosjekter
	Best practice in project management	Beste praksis i prosjektledelse

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Preface

This report describes the results of a benchmarking study performed as a part of the Nordic project called CoDisCo, Connecting Distributed Competencies. CoDisCo is a joint Nordic collaboration with participants from all the Nordic countries, as well as CERN in Switzerland. Nordic Industrial Fund has funded the project through its two and a half years duration.

We would like to thank all the organisations that willingly gave us access to the projects benchmarked and their project management professionals, thus giving us an opportunity to find and to describe elements in what we would like to describe as "good practice" in distributed projects. The interaction with these organisations and individuals were interesting and instructive in all senses.

We would also like to express our gratitude to the partners in the CoDisCo project. They have contributed to the benchmarking process in a very constructive manner, and we have, hopefully, given a positive contribution to their knowledge of project management in distributed projects.

Trondheim, February 28, 2001

Jan Alexander Langlo
Project Manager, SINTEF Industrial Management

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Abstract

The results described in this report are based on a benchmarking study carried out during the CoDisCo project, Connecting Distributed Competencies. The project was a joint Nordic collaboration with participants from all the Nordic countries, and the Nordic Industrial Fund has funded the project through its nearly two and a half years duration, from September 1998 to January 2001.

The objective of the benchmarking study was to identify and describe best practice in managing distributed projects. A definition of a distributed project was required, and we have in our study defined it to be a geographically and/or organisationally distributed project, and it displays some characteristics like scattered project resources and it relies extensively no use of communication technology like telephone, videoconference, e-mail, project-web, etc., to carry out its activity.

Five organisations were benchmarked, and these results, together with the results of an international benchmarking study by IMEC, should describe the best practice in distributed projects. In order to constrict our study and make it more manageable, four project management knowledge areas were chosen as main objects in our study; Time Management, Cost Management, Quality Management, and Risk Management.

Best practice in managing distributed projects is identified, described, and structured in perspective of five project phases; initiation, planning, execution, control, and closure. In addition, the best practice is described related to the four initial project management knowledge areas.

The benchmarking study indicated that facilitating communication and team processes are vital for distributed projects. Hence, they were subject for further investigation and description in this study. The result is described in form of critical success factors.

Ten Critical Success Factors are identified and described for distributed projects on three levels:

Individual level	**Team** level	**Organisational** level
1. Single source of information	6. Education and training of project personnel	9. Review board
2. Common workplace independent of time and place	7. Shared reference and commitment to the project	10. Management of external relations
3. Data discipline	8. Periodically teambuilding	
4. Overcome “Sign-on-fear”		
5. Change in method of work; retrieving vs. receiving information		

The limited number of subjects in our benchmarking study, and the nature of the IMEC study, legitimate only for us to call our results for "good practice identified", rather than "best practice". However, the results will apply to most distributed projects, and give project managers some practical guiding principles on how to ensure success in their distributed projects.

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1 Introduction and background

Decentralised operations are a reality nowadays. No major achievement requiring multiple technological disciplines and significant design work can be materialised without geographically distributed operations. The networked operations are becoming normal routines even for industries producing conventional products. Development focus has been turned on human interaction and especially on how documents and information in these networked collaborations are managed. Companies that manage best the activities related to the creation, distribution and management of knowledge in distributed environment are likely to the future winners. This was the background for the CoDisCo project to arise.

CoDisCo, an acronym for the title Connecting Distributed Competencies, was a research project aimed at seeking methods and tools to better integrate and exploit available resources, by collecting distributed competencies into one logical networked entity. CoDisCo aimed to identify and describe methods and tools to connect distributed competencies in such a way that the end-product is delivered on time, with the right quality, with reliable documentation, and within the planned budget frame. The task is apparently immense as one American study reported after studying 8.000 project deliveries that only 16% met the cost, quality and schedule objectives.

1.1 A joint Nordic commitment

CoDisCo was a joint Nordic project with world-leading companies as participants. The consortium of the project consisted of small and medium-sized companies, plus one major company, all of them focusing on one-of-a-kind and project driven businesses. Project partners were: IGP/NSP (N), Aker Finnyards (FIN), Logimatic AS (DK), Hönnun og Ráðgjöf (IS), Kockums Computer Systems (SWE), Helsinki Institute of Physics-HIP (FIN), CERN European Laboratory for Particle Physics (CH) and SINTEF Industrial Management (N). The CoDisCo project was financed by the Nordic Industrial Fund and by the respective contributions of the participants, throughout the 2 years duration of the project (September 1998 - December 2000).

1.2 Objectives of the CoDisCo project

The CoDisCo project had the following main goals:

- Benchmarking best practices of distributed design processes and project management.
- Establishing managerial guidelines and documenting the configuration management processes needed to manage distributed projects, with special emphasis on the specification of the user requirements for distributed product data management.
- Testing of the Internet and WWW based applications in industrial pilot projects to fulfil communication and information sharing needs in distributed projects.
- Industrial follow-up to redefine the processes and to document the feedback from companies, together with the dissemination of the project result to other Nordic companies.

The first item on the list above served as the basis for this report. The goal was to benchmark best practices of distributed design process and project management.

1.3 The Benchmarking Study

Benchmarking is an effective tool in the process of learning from other organizations and by that knowledge improves own processes. By studying some distributed projects organizational structure, operational procedures and information technology support one is able to draw a general state-of-the-art understanding on how companies are performing and managing their distributed processes. Thus one can learn from others how to adapt to the new challenges in a distributed environment. Further information on benchmarking is given in chapter 3.

Projects that are geographically and/or organizationally distributed are particularly challenging to manage. At the same time, it is in the geographically and/or organizationally distributed environments where the know-how to manage these projects exists and where new project management approaches are appearing. A benchmarking study was carried out to identify and describe project management practices displaying good performance in these distributed environments. Benchmarked companies represent various skills and procedures from different business environments. Existing tools and procedures used by the industrial partners in CoDisCo and other world-leading companies were studied and documented in order to set the state-of-the-art, and to identify best practices in project management processes.

In addition, results from the international project "Benchmarking study of large projects", under the research programme IMEC, International Programme on the Management of Construction projects, where 60 major projects were benchmarked, have been used to draw the results.

1.4 The Research Design

Benchmarking as a research method was from the start of vital interest for the project. However, benchmarking was just one part of the research design used to plan and carry out the research activities in the CoDisCo project. A research design forms the strategy and guidelines on how to perform the research, and it is used throughout the project to ensure that all activities are aligned with the project objectives and goals. The research design is also presented in both Chapter 3 and Appendix C.

The starting point in our research design was to prepare some hypotheses to reflect the project goals and the different research topics of interest for the project. In the CoDisCo project, the research design was based on three hypotheses:

- Best practice in managing distributed projects can be identified by benchmarking organisations in different professions using distributed projects, and thus prove that the benchmarking methodology is suited for identifying best practice in managing distributed projects.
- Best practice in distributed projects can be identified by focusing on four project management knowledge areas; time, cost, quality and risk management, as they most likely are the first knowledge areas an organisation will introduce and implement in a distributed environment.
- Special attention should be paid to communication and teamwork in distributed projects due to the impact from specific distributional factors, like stretched communication lines, cultural differences and co-ordination of distributed partners.

It was of vital interest for the project to prove that benchmarking is a well-suited method for establishing best practice in distributed projects. The method has already proven its qualities and suitability on a large number of areas, but not yet tested on distributed projects. This is why the first hypothesis was formed.

The second hypothesis is based on the general knowledge of managing projects, where we know that these four knowledge areas are vital for project success, as they form the foundation of any project carried out. By identifying best practice in these areas, we should also be able to identify the general best practice in managing distributed projects.

Thirdly, we knew that a distributed project would make it difficult to manage and facilitate team processes and communication, due to the separation of the resources and the tools or technology provided to overcome the separation. We wanted to identify certain elements or critical success factors that would help guiding a project manager in a distributed project.

These hypotheses served as the basis for developing an interview guide, choosing suitable organisations and interviewees in the organisation. They were also used as a constant reminder of our goal and as a guiding tool in the different phases and processes of gathering information and analysing it.

Initially, we wanted six to eight benchmarking partners in order to reach our objective of describing best practice in managing distributed projects. Chapter 3 describes the research method in more detail. As the project progressed, we understood that it would be hard to reach this number of partners, mostly due to the fact that we had underestimated the amount of time and effort we had to put into benchmarking each partner and analysing the results. Hence, we had to alter to our original plan slightly, and incorporate the results of the IMEC study with the results from benchmarking only five partners.

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2 Introduction to distributed projects

Let us start by defining what we mean with distributed projects. Distributed projects are those that are geographically and/or organizationally distributed. They display some characteristics as for instance:

- Project resources are dispersed, often in different countries.
- Project resources come from different departments in a company or from different companies.
- Just a few face-to-face meetings take place.
- Communication occurs almost exclusively with help of telephone, videoconference, e-mail, project-web, etc.

Nowadays, distributed projects are not just a reality in industrial and business environments, but also the tendency to become more and more distributed has done nothing but accelerating.

For some companies, working distributed is something they have chosen, for instance in order to benefit from the advantages of working distributed. A remarkable advantage is that working distributed across several organisations and countries, facilitates access to and allocation of the right human resources when faced competence shortage and outsourcing. Other advantages of international production can include: producing on low-cost production sites, by-passing certain political and juridical requirements, advantages of favourable infrastructure and market conditions and new markets.

However, for other companies, working distributed is not something that they have chosen but something they are forced to do. This could have happened as a result of companies focusing on their core businesses to gain know-how, which increases the specialisation degree of them and therefore the needed number of parts involved in a product delivery process. Or perhaps as simple as having close relations to a customer that force the organisation to become part of distributed networks.

Whatever the reason for working distributed is, some challenges are linked to a successful project accomplishment in a distributed environment, such as cooperation with people with other language and culture, and factors due to social, juridical and political conditions. The following subsection will address this issue.

2.1 Challenges in working distributed: be aware!

This subsection is meant to act as sensitizer by making the reader sensitive to the challenges of working distributed, and hopefully make him/her proactive in this respect. The challenges mentioned here are, yet pretty obvious, of interest to the reader, which should bear them in mind when pursuing excellent performance in distributed environments. It is vital to be aware of some challenges in order to be able to face them with the help of new or existing technologies and management practices. These challenges can be classified in two major groups:

1. Challenges for the distributed project team or virtual team
2. Challenges for the organisation

1. Challenges for the virtual team
The project team has to face several challenges when working distributed:

- *Obtaining good communication:* To obtain good communication as not speaking face to face is perhaps the most important challenge when working distributed. Small misunderstandings in the exchange of information are rather likely to arise and the communication has a tendency to become poorer with the distance.
- *Creating a team:* To create a project team when the members are distributed is quite of challenge too. The team building becomes a bit more difficult, since it relies heavily on social relations between the team members, which are not so easy to get in distributed environments.
- *Different working methods and tools:* Working distributed requires the use of working methods and IT-tools that differ in many ways from the ones used when working face to face. Therefore, strong self-discipline is needed from all the members so that the project team can perform well.

2. Challenges for the organisation
Organisations working with distributed projects have to be aware of challenges regarding project management. Some of them are as follows:

- Establishing an incentive policy and mechanisms that assure optimal co-operation.
- Providing needed project information to all project participants.
- Choosing the technology required to overcome geographical distances and supporting team processes.
- Managing projects when partners with different business processes, different company cultures, and perhaps different national cultures and languages are involved.
- Managing conflicts between the project organisation and the basis organisation due to the nature of a distributed Project and the distribution itself, that makes it more difficult to handle and prevent the conflicts.
- The distributed nature of the project may expose the need for developing new contract standards and co-operation models.

Some of the challenges previously outlined, mainly the ones related with communication, will be addressed profoundly in this report, in chapters 4, 5 and 6, in order to provide the reader with some ways of facing them, helping him/her to make the most of working distributed. But first let us know more about distributed projects and ways of classifying them.

2.2 Classifying distributed projects

One important tool in order to understand distributed projects, and to make it possible to form a common goal for discussing related topics, is to find a way to classify them. Humans often use this approach, bringing order to chaos, and then trying to discuss what caused the chaos, how to manage it, and subsequently, how to live with it. Hence, we have to find some way to classify distributed projects.

In the following, we will describe dimensions or factors for classifying distributed projects found in our study:

- Distributional degree ("virtuality degree")
- Economical volume (budget)
- Organisational magnitude
- Project complexity
- Project character or class

We tried to find a simple way of describing what we called "**the distributional degree**". In our study, we found that difference in culture, the number of partners and the geographical distribution of the participants had a strong influence on the distributional degree. We also came upon other research initiatives trying to do the same. According to Riis [Riis, 2000], distribution or virtuality degree is a function of the following factors:

- Geographical dispersion of the project participants
- Cultural differences among the project participants
- Number of independent units represented in the project group
- Degree of co-operation and co-ordination required among the different tasks and the participants

Distributional degree is a continuous scale with two end points, high degree of distribution and no distribution. Each factor contributes to the distributional degree; i.e. the greater geographical distance, the higher degree; the stronger cultural differences, the higher degree; the higher number of independent units, the higher degree; and the more co-ordination required, the higher degree. The distributional degree also experience additional growth when two or more of the factors contribute. Thus, the highest degree is achieved when all factors are at their highest or most complex. A high distributional degree expresses that the distributional complexity of the project is strong, and special attention has to be paid to these elements by project management. It is in many ways an expression of the risk connected to the distribution of the project. Hence, projects with different distributional degrees have to be managed in different ways and by different means.

The economical volume of a project also has a strong impact on distributed projects. High volume normally gives the project management the freedom to act and to make stronger relations to resources and partners, and even bring them closer to the project through co-location or co-operational agreements. This will reduce the distributional degree. On the other hand, low volume forces the partners to find other ways to co-operate, resulting in higher distributional degree. Thus, the economical volume will indicate how a distributed project will be organised and carried out. In our benchmarking study, we found that at least one of our benchmarking partners carried out projects with a considerable economical volume. This gave them a strong and leading position, and although they gave contractors freedom to operate within their scope of the project, they would easily enforce their requirements throughout the project. Co-location at the closing phases of the project is one example.

The difference in **organisational magnitude** also plays an important role, as we discovered in our study. Big organisations carried out their distributed projects in a totally different way than smaller organisations. Of course, some of this is a result of the financial resources available to the project, as described above. However, organisational issues also motivate the difference in project execution. Normally, a large organisation has a strong focus on functional departments and matrix organisation, and has in fact good processes also supporting distributed projects. The organisation

is more likely to undertake a distributed project since it in many ways has an internal distribution, and the organisational learning processes will quickly help mastering external distribution. Smaller organisations do not have these organisational resources available, just as little as the well-developed processes of organisational learning and internal distribution.

Project complexity refers to other issues than those described under distributional degree. In this respect, project complexity describes the technical complexity of the task undertaken by the project, and whether the organisation has any experience by previously undertaking a similar task. The higher complexity, the greater is the need for special competence, and this competence is often not available within the organisation itself. Hence, increasing number of specialists from different organisations will result in an increasingly distributed environment with increasing complexity.

Project character or class is closely connected to project complexity, but it deals with other aspects due to the nature or profession of the project. For instance, a construction project is traditionally carried out in a totally different way than an offshore project, an IT development project, or a product development project for that matter. There are several reasons for this, i.e. governmental regulations, professional procedures, health and safety issues and other constraints due to the nature of the projects. For example, in offshore projects safety issues are very important, in fact so important that a faulty welding could jeopardise the completion of a whole platform, while safety in most civil engineering project does not depend on a single welding. Hence, due to the differences in i.e. safety and risk aspects, projects with different character or classes will not be undertaken nor managed in the same manner.

2.3 Classifying Distributed Projects by Radar Diagrams

All these factors in this chapter can be combined to give a better view of the project. As an example, we have prepared three radar diagrams for three different and fictive projects. They are shown below.

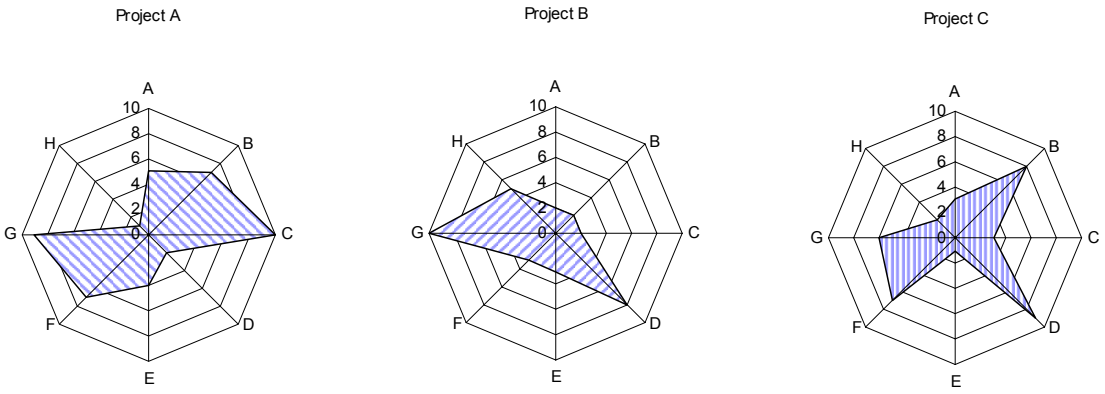

Figure 1 Radar diagrams displaying distributional characters of project A, B and C

In Figure 1, the eight factors described in this chapter are named from A to H. These diagrams describe the total distributional characteristic of each project. A diagram with an extensive area is more likely to be affected by the distributed nature of the project than a diagram with a smaller area. The risk level will increase according to the size of the area, and the diagram will give a clue

to which distributional factor(s) attention should be paid. The idea of these diagrams was conceived in the analysing phase of the CoDisCo project; hence we did not prepare such diagrams for each benchmarking partner during the benchmarking study itself.

We have chosen to scale the radar diagrams in Figure 1 from 1 to 10. Other scales are applicable as well. Each factor is given a number depending on how it contributes to increasing the distributional degree. 1 is low contribution, 10 is high contribution. Note that factor E (economical volume) and F (organisational magnitude) by our definition has a scale where the contribution to distributional degree is inverted compared to the size or volume. A high economical volume and a high organisational magnitude contribute little to the distributional degree, since the project is better prepared and more likely to manage distributed projects; and vice versa for low values.

By using the factors in this chapter to classify projects and bearing their impact in mind, we are better prepared to understand and discuss different issues further on in this report. And, hopefully, we will be more capable of finding practical use for the conclusions and findings from the CoDisCo project.

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3 Benchmarking project management in distributed projects

As previously mentioned, projects that are geographically and/or organizationally distributed display some inherited special characteristics that make them particularly challenging to plan, manage, and execute. At the same time, it is in the geographically and/or organizationally distributed environments where the know-how to manage these projects exists and where some new project management approaches are appearing. In order to find them, a benchmarking study of project management practices in some of these distributed environments was carried out. The results of the benchmarking study, here called "best practices" identified in distributed-project management, will be presented in chapter 4.

But first let us know more about the benchmarking study. This chapter provides an overview of the benchmarking study of distributed project management processes carried out in the CoDisCo project. The chapter starts with a short introduction in benchmarking, followed by a description of the study carried out and its limitations, including a short presentation of the companies involved and a summary review of the benchmarked project management processes.

3.1 Introduction to the benchmarking concept and process

The following operational definition of benchmarking can briefly enlighten the concept: "Benchmarking is the process of continuously measuring and comparing one's business processes against comparable processes in leading organizations to obtain information that will help the organization identify and implement improvements" (Andersen and Pettersen, 1995). In other words, benchmarking is about learning from others in order to improve the results of one's own company. However, in this case, the purpose was to identify overall best practices in managing distributed projects and make them available by publishing them.

There exist a number of different benchmarking models, most of which are quite similar in approach. The Benchmarking Wheel was selected as the benchmarking model to be used in CoDisCo, see Fig. 1 (Andersen, 1995). This figure describes the five phases to be performed in a standard benchmarking study.

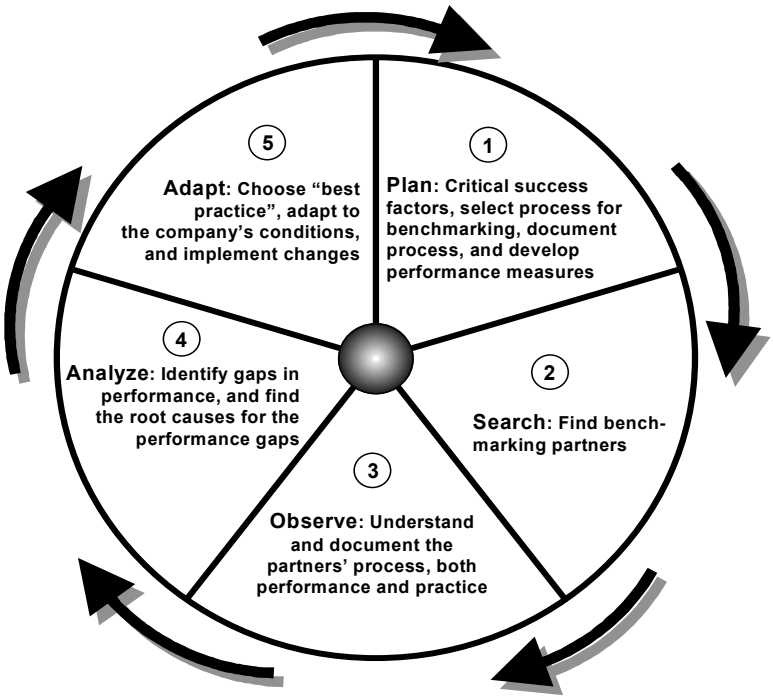

Figure 2 The benchmarking wheel

Benchmarking is an improvement tool with core features that can be summarized as:

- Benchmarking is not just about finding the better performer, it is more importantly about identifying the reasons for this better performance, i.e. what in the business processes, the organization and the project environment that makes the performance possible.
- Benchmarking is improving by learning from others.
- The external focus is meant to highlight that benchmarking can be performed not only towards competitors, but by measuring against all sorts of best performing companies regardless of industry.
- The purpose of benchmarking is to gain improvements, not to evaluate how other organizations perform their processes.
- Benchmarking should be a structured and systematic process

3.2 Benchmarking applied to project management processes

The benchmarking study was carried out according to the aforementioned method and can be summarized as follows:

The first phase: planning

Four project management areas that determine much of the project's performance and success are project time management, project cost management, project risk management and project quality management. These areas also require a strong degree of co-ordination among involved project participants and across geographic locations. They are perhaps even more important in distributed projects than in uni-locational or uni-organizational projects and therefore they were the project management areas where the benchmarking study focused on.

The scope of these project management areas is done according to the PMI Book of knowledge. Section 3.5 provides a short review of selected project management areas: project time management, project cost management, project risk management and project quality management.

In the light of the achieved results, it can be said that other important processes in project management such as integration management, human resource management, and communications management are as important as the ones selected and could have be chosen in addition to them.

The second phase: searching for benchmarking partners
The identification of relevant and suitable benchmarking partners was carried out through the connections of the consortium and general literature search. In this way, best practice projects and companies have been identified. Five companies in different countries in Europe and in USA with distributed projects have been involved.

The companies represent different sectors and operate in partly different market conditions. They are also different in size, grade of distribution and projects size. Section 3.4 gives a short description of the companies involved.

The third phase: observing
The purpose of the observation phase was to study and understand the practices of the benchmarking partners when performing the four project management processes. For this purpose, a benchmarking methodology (Dragsund, 1998) based on the benchmarking wheel has been developed. The methodology consists of methods for data acquisition and analysis techniques that have also been adapted to each of the four selected processes.

Following the guidelines from the benchmarking methodology, face-to-face interviews were performed as the main method to collect the information. Each interview has been conducted with the help of a questionnaire designed for this purpose (see Appendix D). The benchmarking partners received an advance a copy of this questionnaire together with relevant information on benchmarking. During the interviews, additional questions that arose were asked.

The interviewed persons were professionals in project management, some of them were the persons responsible for the different project management areas in their respective companies and some of them were projects managers. All of them had a senior level.

The fourth phase: analyzing
The analysis of the collected information to identify gaps in performance among the projects, in addition to the practices that contribute to the gaps, was executed and good practices were identified.

Even though in the beginning of the project it was meant to have both a quantitative and a qualitative approach, the practical problems to obtain the quantitative data together with our increasing scepticism regarding the validity of the quantitative model has led us to disregard the quantitative questions. The findings, that is to say, the best practices have been identified on the basis of qualitative expert judgement.

As mentioned before, these practices are described further on in chapter 4.

The fifth phase: adapting
In a standard benchmarking study, the fifth phase embraces adapting the identified best practice to the company conditions. However, in this case the benchmarking study's output is this benchmarking report describing the identified good practices and it is on the reader's hands to adapt these best practice to his/her own reality.

In addition to identifying best practice in managing distributed projects, the CoDisCo project had an objective to test and improve a web-based application developed at CERN called TuoviWDM. It was of great interest to see if this application could be of any help in a distributed project, and if it could assist managing distributed projects in any way. Some of the experiences from using this application, good or bad, were adapted and used in the description of best practice.

3.3 Limitations of benchmarking

Benchmarking is not a panacea for improvement. It is a tool, a mean of assistance, which provides a better foundation and more elaborate prerequisites for improvement. It is not a cookbook or a trick that, if instructions are followed, guarantees success or improvement. The following subsections are explicit statements about the major limitations of the benchmarking study. Therefore they are intended to help the reader in the interpretation of the results.

Small sample, only five organisations
The sample of companies that were visited and interviewed to collect information on distributed operations management was limited to a number of five.

Four project management areas
Four major project management knowledge areas (project time management, project cost management, project risk management and project quality management) were studied in the benchmarking study. Other potentially relevant areas were not considered in the study, which limits the extent of the achieved results. On the other hand, it was thought that the areas studied would give some general guiding principles also valid for the remaining knowledge areas.

Qualitative methods
Qualitative methods have been chosen in the benchmarking study. The qualitative methods present weak points and advantages that will be discussed in terms of research profile, research design, data acquisition and data interpretation.

Research profile
Qualitative data and methods describe and conform the system perspective of any situation. Holistic presentations open for better understanding of social processes and relation in a system. This is often the core element in creating a foundation for building and justifying new theories. This implies an intensive intimate study of every research object, thus reducing the number of objects to a minimum due to economical and capacitive constraints. The chosen research objects do not have to be "mid stream" examples. If fact, it is an advantage that the objects are atypical. The problem is to justify that the results from the research study have general validity.

The CoDisCo project chose a qualitative method once it was mentioned that benchmarking should be tested as a tool for identifying best practice in distributed projects. Its research profile

corresponded with our objectives, as we tried to justify or build new theories. We chose a few and very different research objects, which also corresponded with the suggested profile.

Research design
Qualitative methods are characterised by flexibility, rather than structuring. During a qualitative study it is possible to change the research design and adapt the study to emerging elements. A quantitative method is used to structure a huge amount of information, and there is not much flexibility as is would be difficult to compare all this information on an individual basis. The qualitative benchmarking method is also distinguished by little or no guidance by the research scientist, and openness to new knowledge and understanding. The research scientist will guide the interviewee in clarifying the questionnaire, but he will not offer any no guidance as to which answer he wants. A quantitative questionnaire will in most cases point out several possible choices preset by the scientist. The weakness of the qualitative method is that the flexibility makes it harder to compare the results from two or more surveys, as the results may be based on totally different conditions due to the lack of guidance.

The benchmarking questionnaire in appendix C corresponds to the elements mentioned above. The method gave us the necessary flexibility to benchmark the different partners, yet it also proved that the analysis and processing of the gathered information were no easy task. More effort than planned had to be put into this process.

Data acquisition
The objective for qualitative methods is to capture the distinctive character of the object under survey and its context during study. The data then depends heavily on the source and the context. The object or source will describe the situation at own will, and base the description on his or her understanding and knowledge of the context. The data then becomes credible, but will it be valid for other situations and other objects? This is a definite weakness to a qualitative method.

The IMEC study proved to be valuable when it came to data acquisition. It was a study of more than 60 large projects worldwide, thus giving us the required quantitative information to reduce or eliminate the weakness of the qualitative benchmarking method.

Data interpretation
A qualitative approximation with a flexible research design and close relations to the source or object opens for relevant and alternative interpretations. This would help to find a better understanding of the results from the research study. However, the data could easily become ambiguous and unreliable if it is difficult to compare the results from different objects. The dilemma is that while qualitative methods represent validity, quantitative methods will represent reliability.

Here again, the IMEC study gave the benchmarking study the highly needed reliability to give results with general validity. The combination of the two surveys are vital to the benchmarking results.

3.4 Short presentation of the companies involved

Company A represent the small and medium sized enterprises. The company is an engineering and consulting company with 20 employees. One thing that makes the company special, is that they do not only work distributed, but the company is distributed itself. Besides the head-office, they have three other offices located in different parts of the region.
It is characterised by:

- small organisation
- small projects

Based on the factors in chapter 2.2, we have tried to classify the projects typically undertaken by company A. The result is presented in Figure 3, and we have used a scale from 1 to 10, where 10 is the highest contribution to the distributional degree.

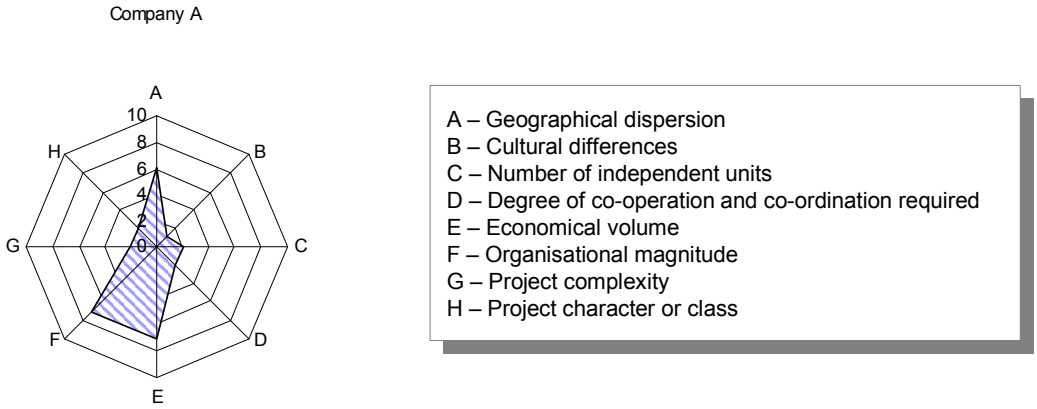

Figure 3 Classification of typical projects for Company A

This figure visualise that company A has to pay special attention distributional effects due to the geographical dispersion. In addition, this is a small organisation carrying out mostly small projects, which implies two things; the organisation lacks the financial freedom and freedom of action to get the required competence at any given time, and given its size, there is not enough competence throughout the organisation to carry out distributed projects. However, the organisation is distributed itself, and has experience in carrying out small, distributed projects. Such normal sized projects should not cause any trouble. In normal projects, the rest of the factors do not have any significant impact on project execution.

Example:
A combined team of engineers, lawyers and social scientist carries out a normal project in Company A, and sometimes they are situated at different locations. There is no formal education in managing projects or project as a working method; the projects are managed as lean as possible using as little resources as possible.

Company B is a large healthcare company; it invents, develops, manufactures and markets pharmaceuticals, vaccines, over-the-counter medicines and health-related consumer products. Markets over 400 branded products and pioneering R&D, including cutting-edge biomedical

research and molecular diagnostics programmes. Employs 47,300 people worldwide with operations in 160 countries.
It is characterised by:

- medium sized projects
- big organisation

Figure 4 tries to describe a typical project undertaken by company B.

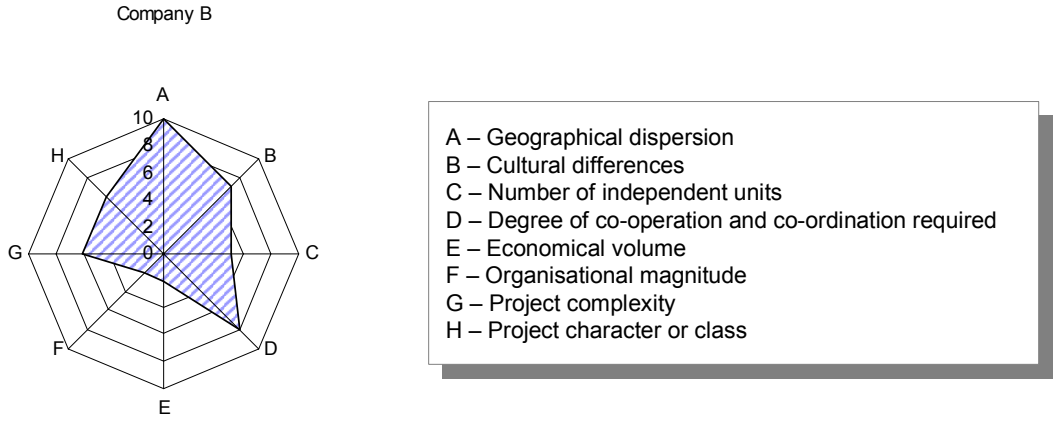

Figure 4 Classification of typical projects in Company B

This is a multinational company with high geographical dispersion and multi-national workforce. The projects normally have a high distributional degree, and this is reflected in the risk management effort in the company. There is a strong centralised control of the projects and their strategic importance for the company is emphasised throughout project execution.

Example:
The organisation has offices worldwide, and subsequently there are multiple languages and cultures involved in the projects. Education of project personnel is mandatory, and there is a strong degree of co-ordination provided by management in the mother organisation. Being in the pharmaceutical market, the organisation has to provide a documented history of all project results and testing at any time. Discipline, training and experience based learning is essential in succeeding in this market.

Company C is a supplier of technology, systems and equipment for the pulp, paper, converting and panel board industries. The company's net sales were EUR 1.7 billion and it had personnel of 10,600.
It is characterised by:

- medium sized projects
- medium sized organisation

Figure 5 describes the distributional degree of the typical projects in company C.

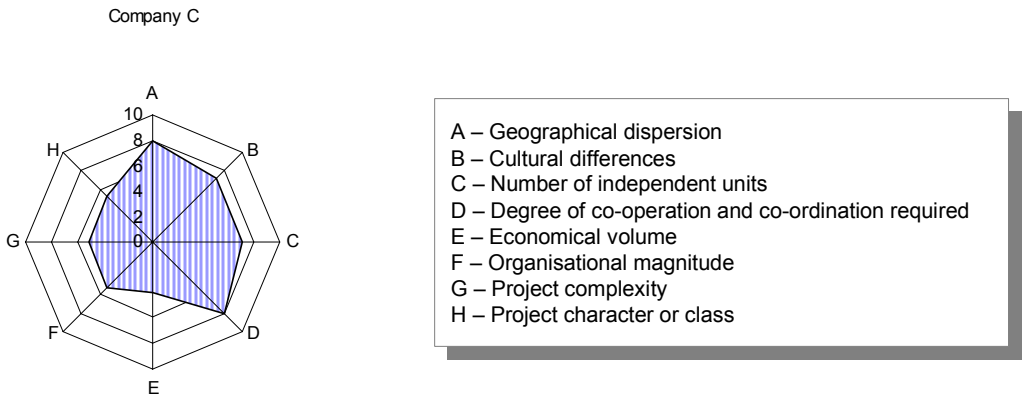

Figure 5 Classification of typical projects in Company C

Company C has a slightly lower geographical dispersion, and the organisational magnitude is some less than in company B. However, the number of suppliers and other independent units and the need for co-ordination are the most vital factors contributing to the distributional degree in company C. These factors also correspond with the concurrent risk management activities in the company.

Example:
Providing a paper mill to a customer is a complex task, mainly due to the size of the mill and the logistic problems of assembling, disassembling and transporting the mill to different corners of the world. And the final tuning of the mill is of course no easy task. There is not much room for error when the paper is produced with a speed of over 100 km/h (1600 meters/min). This involves front edge technology and a competitive organisation. Required competence is developed in-house or acquired from other companies. Parts are produced in different locations all over the world, and the mills are delivered almost anywhere as well. Managing a distributed project is vital for this organisation.

Company D is a global group with core activities in oil and energy, light metals, agriculture and petrochemicals. It has almost 39.000 employees in 70 countries.
It is characterised by:

- big projects
- big organisation
- Co-ordinating role in project

Figure 6 tries to describe a typical project carried out in Company D.

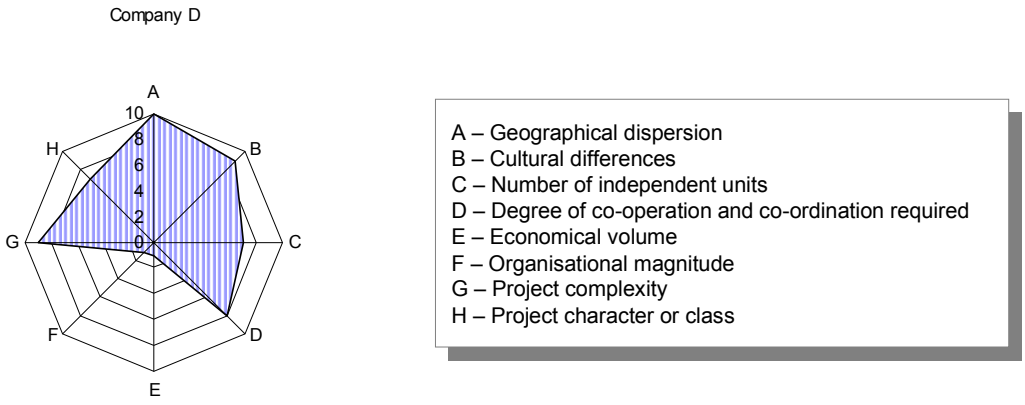

Figure 6 Classification of typical projects in Company D

The nature of the business in Company D makes it multinational, and it has offices on all continents. The distributional degree can vary, as projects are carried out both on the international market and national market. Either way, all the factors contribute to give a high degree of distribution, and good risk management has always been vital for the company.

Example:
The range of projects and products in this company is vast. The company itself works distributed, assigning required resources to any project from different departments and offices throughout the world. The internal educational level is very high, and the organisation has good experience in working distributed. However, expansion to new markets in other parts of the world has proven to be a difficult task. Cultural conflicts have prematurely stopped several initiatives. The organisation is also known for undertaking one-of-a-kind challenges resulting in developing and using new technology.

Company E main activities are construction of specialised tailor made ships, vessels for oil and gas production and heavy offshore structures. The own personnel amount to some 11.000 employees. In addition there are several co-operation companies and subcontractors working on the yard area.
It is characterised by:

- medium sized projects
- medium sized organisation

Figure 7 shows the distributional degree in typical projects in Company E.

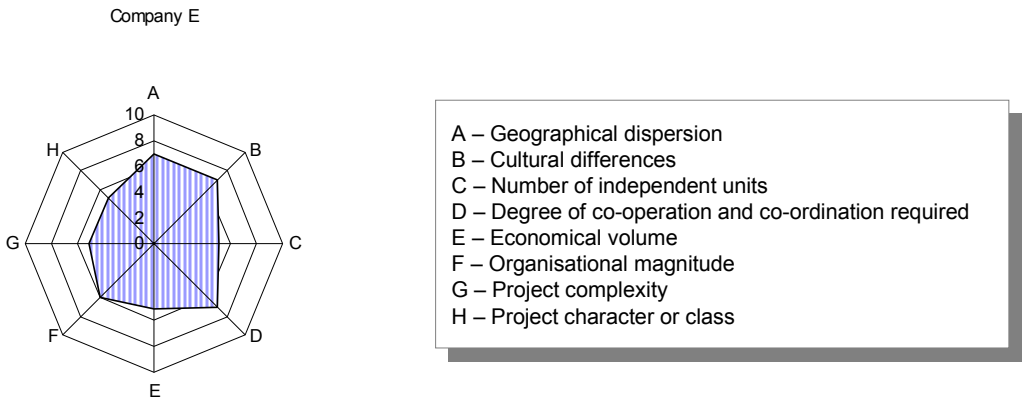

Figure 7 Classification of typical projects in Company E

The distributional degree is slightly less than Company B and D, but Company E has to pay special attention to the geographical dispersion, and the cultural differences, since the national cultures involved are quite different. This results in the need for a strong degree of co-ordination and control. The company already has a strong focus on these elements in their risk management.

Example:
Company E is also a part of a large multi-national organisation. This organisation is seeking new markets and new methods for improving their competitiveness in the existing markets. Distributed projects have been one solution, as specialisation improves the competence of each distributed partner. However, this also require better skills in managing distributed projects.

To summarise, the figure below use two axes, project size and project complexity. In addition company size is visualised by the size of the "bubbles". This is just an example, as all the eight factors can be combined in different ways to describe certain facets and give special view points to distributed projects.

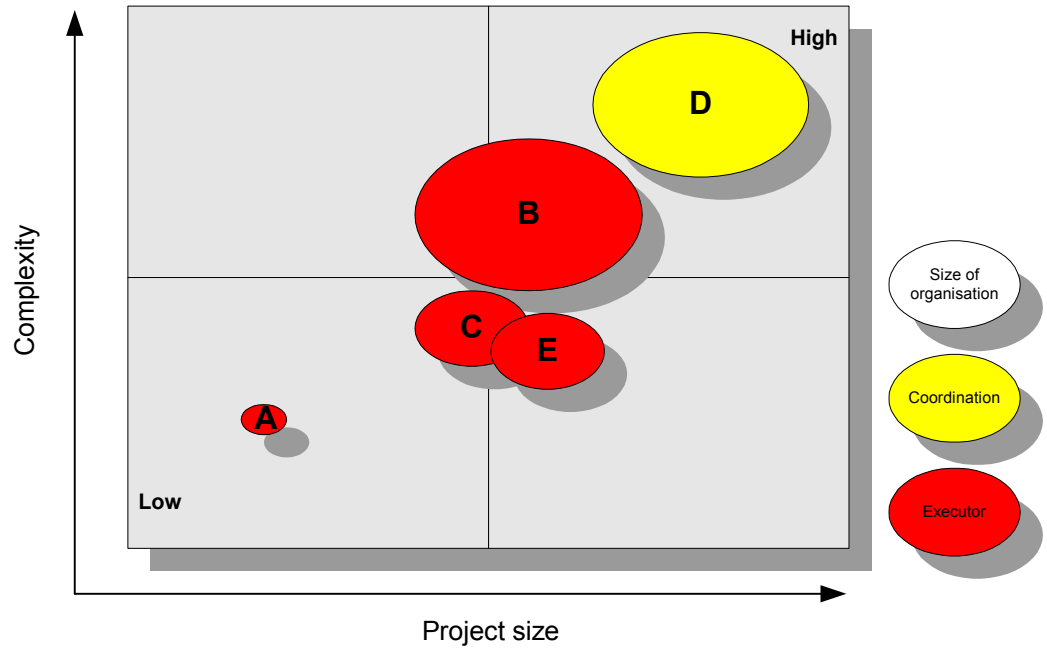

Figure 8 Figurative distribution of the benchmarked organisations

In more detail, Figure 8 gives a figuratively distribution of the organisations benchmarked in our study. The size of the "bubbles" represents the size of the organisation, while the two axes respectively represent project size (economical volume) and project complexity, which are two of the classifying factors described in chapter 2.2. The red colour indicates that the organisation carries out the project as an executor, that is, the organisation is in charge of constructing the project result and use its internal work force to do so, together with external work force from partners and suppliers. The yellow colour indicates that the organisation carries out the project as a co-ordinator, that is, all parts of the project are put out on contract to partners and suppliers. They then report their status and progress to the co-ordinating organisation, but it has no influence on project execution other than through formal channels and through the management of the contractors.

3.5 Introduction to the studied project management process

The task of identifying and describing best practice in distributed projects is immense and overwhelming if your objective is to identify all processes and elements involved. Neither could our budget allow this approach. A selection that would give a general representation of the entire project management knowledge areas had to be made. As mention before, time management, cost management, risk management and quality management were the project processes selected to benchmark in CoDisCo, given the strong degree of co-ordination required to manage them. In addition, these areas (Time, Cost, Risk and Quality Management) are the most common and well-developed areas of today.

The following sections describe in short each of knowledge areas, according to Project Management Body of Knowledge [PMI, 1996].

3.5.1 Project cost management processes

Project cost management includes the processes required to ensure that the project is completed within the approved budget. The major processes included are resource planning, cost estimating, cost budgeting and cost control.

Resource planning involves determining what physical resources (people, equipment, and materials) and what quantities of each should be used to perform project activities. Cost estimating includes developing an approximation of the costs of the resources needed to complete project activities. Cost budgeting comprises allocating the overall cost estimates to individual work items to establish a cost baseline for measuring project performance. Cost control includes monitoring cost performance to detect variances from the plan, ensuring that all appropriate changes are recorded in the cost baseline, preventing incorrect changes from being included in the cost baseline, informing appropriate stakeholders of authorised changes and searching out the "whys" and "hows".

Contractual agreements contain important constraints to the cost management processes. Special attention should be paid at these issues.

A schedule will contain resources tied to each activity. These resources must be allocated and leveled to ensure an efficient usage. The development of a resource pool and the distribution of resources throughout the project life cycle will tie the project schedule to the budget and cost management of the project.

Cost estimating is the process of approximating the cost of the different resources needed to complete the project. Based on factors like the work breakdown structure (WBS), resource requirements, activity duration estimates and historical cost information, the future cost of the different resources will be estimated. Included in this process is the identification of different cost alternatives. For example, additional work during the design phase may decrease the cost during production.

After defining the cost estimates, these are combined with the WBS and schedule to compute the cost baseline for the project. It will be used to measure cost performance later in the project.

Cost budgeting is an ongoing process which will be controlled and reviewed during the project life cycle. To have follow up routines both to the past and the future is emphasized. As other control process, the main cost control features is to influence the factors that may influence the cost baseline to ensure that changes are beneficial, determining changes to the baseline and managing the actual changes as they occur.

In a distributed project the budgeting personnel will have to take into consideration the extra costs, but also the potential benefits of a distributed project. Extra cost can be factors such as: crossing of toll barriers and the cost effects due to communication, distribution and coordination between distributed project participants. Positive effects may include: cheap labour, more beneficial tax systems and less safety and environmental requirements. Exploiting new technology such as IT-systems can optimise some of these benefits and extra cost.

3.5.2 Project time management processes

Project time management includes the processes required ensuring timely completion of the project. The major processes included in project time management are activity definition, activity sequencing, activity duration estimating, schedule development and schedule control.

Activity definition involves identifying and documenting the specific activities that must be performed in order to produce the deliverables and sub-deliverables identified in the work breakdown structure. Activity sequencing includes identifying and documenting interactivity dependencies. Activity duration estimating comprises assessing the number of work periods likely to be needed to complete each identified activity. Schedule development embraces determining start and finish dates for project activities. Schedule control involves influencing the factors, which create schedule changes to ensure that changes are beneficial, determining that the schedule has changed and managing the actual changes when and as they occur.

In a distributed environment, especial consideration should be made to effective communication, coordination and distribution of scheduling information.

Before a schedule is developed, both the different activities and their interdependencies has to be defined and the duration of the different activities must be estimated. These estimates can be based on expert knowledge, historical data, calculation made by computer software or other appropriate tools. To define the different activities accurately is important in order to meet the project objectives. Normally the defining of activities will be sustained by a work breakdown structure (WBS), which displays the activities in different project work packages. The sequencing and the duration of the activities must be accurate in order to support a later development of a realistic and reliable schedule. Actually, the lack of an accurate definition of the work to be done was found to be one of the most common reasons for failure in projects in an American survey in 1988 (Rolstadås, 1997).

In the process of developing a project schedule, the project schedule must be complied with the limitations on the project resources and other project constraints. The scheduling development process will be iterated as the project proceeds and changes appear in the project constraints and estimates.

In order for the schedule to be reliable it must be updated and controlled according to new knowledge and changes in the project. Scheduling control is processes such as having a change control system, defining performance measurements and reacting to lack of conformance to these and the continuous updating process of the project schedules. In this environment the presence of regularly conducted progress meetings, distribution routines for updated schedules and approaches to monitor progress are important.

Applying IT-tools can especially in a distributed project, facilitate these scheduling processes. For instance the following IT-tools can be applied: databases and statistical packages in the estimating process, software for developing, controlling and updating project schedules and software for communication and distribution of schedule information.

3.5.3 Project risk management processes

Project risk management is a subset of project management that includes the processes concerned with identifying, analysing, and responding to project risk. It consists of:

- Risk identification: determining which risks are likely to affect the project and documenting the characteristics and impact of each.
- Risk quantification: evaluating risks and risk interactions to assess the range of possible project outcomes.
- Risk response development: defining enhancement steps for opportunities and responses to threats.
- Risk response control: responding to changes in risk over the course of the project.

The different risk management processes will interact with all the other processes in the project.

In a distributed project, which for instance may cross significant juridical, political, social, and cultural boarders, there is a broad spectre of project risks. Therefore the risk management must take especial consideration to the distribution of the project. IT tools can to some extent facilitate this, by applying statistical software and software for distribute and communicate risk management information, but one should also consider the organization of the project activities and the responsibilities for these.

The different risks a project might face must be systematically identified. This identification is especially important in the planning phase of a project in order to make appropriate plans at an early stage as possible. In addition these identification routines must be present during the whole project life cycle in order to identify new risks or changes in already identified risks in the project environment.

Risk quantification routines consist of evaluating risks and risk interactions to assess the range of possible project outcomes. The outcome of different project risks is difficult to quantify and therefore makes this a complex process. Thus the techniques to apply range from advanced statistical methods, such as simulation, to the use of expert judgment and previous experiences, depending on what the project or situation require.

When the different risks are identified and quantified the project management must identify how to respond to these risks. The response development includes defining who is responsible for controlling different risks and reacting if unfortunate events occur, planning for tackling of crisis/unfortunate events and developing organizational settings to tackle risk. The advantage of giving a premium for carrying a specific project risk in order to increase the motivation to minimize the consequences of unfortunate events is often identified.

The risk management process in a project is a continuous process, thus it has to be continuously controlled. Control aspects to be considered are the identification of additional risks, the improvement of existing risk response routines and changes in risk plans, routines or organizational settings based on new knowledge.

3.5.4 Project quality management processes

Project quality management includes the processes required to ensure that the project will satisfy the needs, for which the project was initiated in the first place. It includes all the activities of the overall management function that determine the quality policy, objectives, and responsibilities and implements them by means such as quality planning, quality control, quality assurance, and quality improvement within the quality system. The major project quality management processes are:

- Quality planning: identifying which quality standards are relevant to the Project and determining how to satisfy them.
- Quality assurance: evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.
- Quality control: monitoring specific projects results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance.

The very first step in implementing quality management in a project is to have a clear understanding of where the organization is and where it ideally want to be by the end of the project. Quality objectives should be developed in accordance with this, both in the eye of the project organization and third parties such as customers or end users needs and demands.

The topic of continuously improving is well established in most literature about quality management. Thus one have to establish a quality control and assurance system, both to react to changes in the project and to improve the existing quality system. The definition of the different quality processes given above separates between quality assurance and quality control. Quality assurance is concerned with all the planned and systematic activities implemented in a quality system to assure that the project will satisfy the relevant quality standards. Quality control is the monitoring of quality results in order to decide whether they comply with quality standards. Quality control should also identify the processes leading to unsatisfactory results in order to avoid them in the future. Thus most of the tools and techniques applied in quality control is statistical, while assurance tools are planning and quality system audits.

In addition to the importance of continuously improving, much of the theory about quality management include critical project success factors such as: top management involvement in quality thinking, the presence of a quality system in the whole project organization and all project phases, and the involvement of third parties (customers, suppliers etc.) in the quality and design processes.

When entering new markets, and maybe also new geographical regions, one can experience that there exists other quality certification requirements, or that these are nonexistent. Even though the ISO 9000 is well incorporated in European companies, and to some extent in American European-based companies, this is not the case for all other regions. Thus it can be harder to evaluate the quality of foreign suppliers and project participants. This is not facilitated by the fact that it can be more challenging to perform quality controls and audits over large distances.

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4 Best practise identified in distributed projects

It would be pretentious to claim that good practices identified through benchmarking five companies alone are the best practices. Therefore it has been decided to use the term “good practice” instead of “best practice”. However, the results indicate that elements of the good practice most probably will be found in a description of the best practice as well.

The following sections outline managerial guidelines based on the good practices identified through the benchmarking study of distributed project management processes, carried out in the CoDisCo project. These "good practices" are arranged and structured according to the project management process group they belong to: initiating processes, planning processes, controlling processes, executing processes and closing processes.

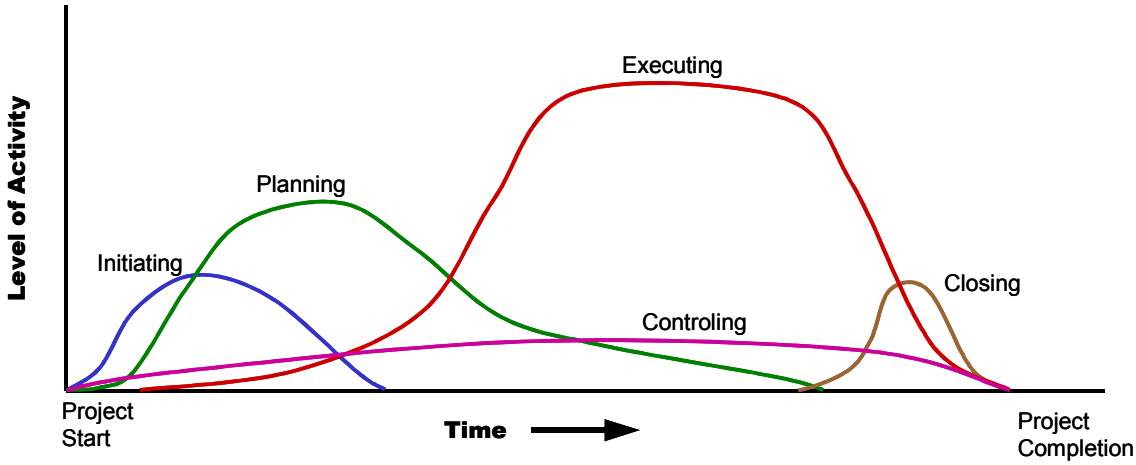

Figure 9 The five project management processes groups [PMI, 1996]

Figure 9 describes the how the five process groups interact and depend on each other throughout the project life cycle. As mentioned above, this chapter will describe the good project management practice identified according to these groups.

In Appendix A, you can also find this good practice described in perspective of our four initial project management knowledge areas; Time, Cost, Risk and Quality Management. In addition, “Best Practices” found during the international project “Benchmarking study of large projects”; under the research programme IMEC, where 60 major projects where benchmarked, are outlined in appendix B. The results from the IMEC study together with the results from our benchmarking study served as the basis for the conclusions in this chapter.

4.1 When initiating a distributed project

Initiating a distributed project, require that the project team members, the project organisation, and the project resources be aligned and dedicated. This is normally done by focusing on four elements; Shared reference, common tools, processes and skills.

Shared reference

A distributed project team needs a shared reference in order to work effectively. A shared reference consists of a common goal understood and shared by all the project team members, and just as important, a common understanding of the scope of work, the complexity of the task and the context in which the project is carried out. The shared reference is vital for the team members to feel commitment to the project, and it should deliberately be nurtured through teambuilding, processes of developing common goals[1], and other processes. Most likely, the project objectives or goals will be changed as the project develops and runs. If the team members do not have a shared reference, they will not feel committed to meet the new goals and instead pursue their own original objectives at heart, resulting in an unmanageable project. A shared reference will give the team better chances to handle changes, and even change the goal if that is required.

Example:

Building a shared reference is not a common and deliberate process in most companies, which we also registered during our study. It is most common that a shared reference is built by accident or by individual project managers, who have understood its importance. The IMEC study points in this direction as well, as it indicates that joint and innovative problem solving is a key to project success, as well as social agreements. Social agreements are vital bricks in build a shared reference, while joint and innovative problem solving is the effective outcome.

A small company like company A should have small or no problems with building a shared reference, in spite of being distributed. A small number of employees get a number of opportunities to build a shared reference by social interaction and close co-ordination. In any organisation, building a shared reference has to be a planned and deliberate process.

Alignment of tools, processes and skills

A truly distributed team have the same tools, are taught in the same processes, or at least understand the different processes involved, and together the team members have the skills needed to construct the project result. They also need skills in using the tools and the processes involved in a distributed project.

Example:

Once the team is build and they have a shared reference, it is vital that they administer the resources required to carry out their objectives. It should be a deliberate process of aligning the tools, processes and skills of the team. The alignment relies to a great content on education and training, as project personnel have to be introduced to the tools, they have to be trained and perfected in their working processes, and their skills have to be improved and distributed by training and exchange of experience.

Normally, a large company should be better prepared for this task, as they already have an established educational program and are very focused on improving processes and skills. In addition, they have the financial resources needed for investing in such activities. This was observed several times during our study. However, this does not exclude the smaller organisations from aligning their tools, processes and skills. They will just have to face the fact that this is an investment they have to do in order to improve their competitiveness in distributed environments, as well as their non-distributed activities.

[1] This is a method developed by SINTEF and PTL Løken AS, a project management consultant company in Trondheim, Norway.

4.2 When planning a distributed project

The planning processes are characterised by searching for information in order to reduce the risk involved in making the final plan and estimates. It is vital that the information is up-to-date, and that all partners and competence resources are consulted during the planning processes, and thereby committing them to the project plan and objectives.

Repositories of data

Many processes within project management are based on historical information and experience. Project time management processes, cost estimating and risk identification are especially important here since they are all central processes and strongly based on historical information and experience.

The way of keeping and the availability of this information needed to manage the project are crucial for the success of the project and other future projects. Recording of historical project data and use of it is essential for managing project time, risk and cost. Examples of historical data can be the time, the cost, the resources that were really used in a certain project or the risk linked to some activities. A good way of keeping that valuable historical information is in structured, user-friendly databases.

One advantage of keeping repositories of data is minimising the risk of loosing the information contained in people's minds. In addition, use of historical data prepares the organisation to handle many tedious and reoccurring elements, thus allowing time to focus on unique and special elements.

Example:

Most organisations document their projects and processes in a satisfactory manner. However, there is great difference in how the different organisations prepare this information, and how they prepare to reuse this information in later projects.

The CoDisCo project had an additional objective to develop and test an application based on web technology, to manage documentation, communication and competence in distributed projects. The experience from the participants of the CoDisCo project proved that such an application would provide a single source of information, and an easy access point and user interface for storing and retrieving project information. It is important to stress the fact that an organisation will not improve its performance by implementing a single source of information alone. Training and motivation of the users are equally important in order to use the application in a constructive and effective manner.

Locally activity duration estimating
Those participants that will actually perform each task are best equipped to estimate its duration. Establish first schedule through democratic approach, and not by dictation the time windows for each deliverable, is a recommended practice.

Example:
Most of the companies studied used a top-down estimation, that is, the project owner decides the framework for the project in cost and time. Then the suppliers and sub-suppliers do their estimation within these frames. This approach has its advantages, but it is also a primary cause for changes in project plans and objectives later in the project. Our study showed that by using the right competence in the estimation process, a better estimate would be provided. This is especially important in distributed projects, where the competence of the distributed partner will provide the best estimate based on knowledge of the local project context. Company D used a combination of these two approaches with good results, so we should keep our eyes open to this option as well.

Ask, don't assume!
The distribution of the project and involvement of parts in different countries or organisations give rise to different business processes, different cultures and languages. Special considerations due to that fact should be taken when planning the project by keeping a dubious attitude, that is to say, by asking as much as possible instead of assuming. It is recommended to pay special attention to geographical and cultural constraints.

Example:
All of our studied companies operating in a multi-cultural environment had this as a rule of thumb; always ask when in doubt! And ask even when not in doubt, just to double- and triple-check. The reason for this is simple; differences in culture are reflected in communication. For example. One company experienced that a representative for a distributed partner always answered in a positive manner, even though a negative would be more appropriate or natural. By further investigation, it was discovered that the representative was afraid to loose face, thus not answering with the truth, but what he thought the company wanted to hear.

Double-check of the contributions from the participants
A clear definition of the scope of the project and the contributions from each participant is a key for success. In a distributed environment it is even more difficult to get a common understanding. In addition to use work breakdown structures, every partner involved in the project should make an abstract of their roles and give it to the project manager so that he/she can detect deviations or misunderstandings at an early stage. During project execution and control, and at handover of results or information, it should be checked that the partners still have the same understanding of project objectives and context.

Example:
Objectives and scope will change during a project life cycle. This is inevitable, and the project organisation should be flexible and adapt to these changes. A shared reference forms the basis for this flexibility; however, this reference should be maintained as often as possible, preferably continuously.

Jointly risk identification
The development of checklists based on errors anticipated to occur, is essential for risk planning and risk management. This checklist is based on experience from similar projects or situations. It is important to highlight that people from different departments and with different competencies and backgrounds should be involved in developing these checklists.

Example:
Company C extensively used multidisciplinary meetings to identify and describe risk elements. All project participants had the opportunity to raise questions to elements they felt should be evaluated as a risk element, and they met with regular intervals to re-evaluate the risk situation and allocating risk elements.

4.3 When executing a distributed project

The main executing processes focus on making the project organisation work as smoothly and efficiently as possible. Conflicts have to be confined and solved, the team should carry out continuous team building, and both the formal and informal organisation should support the communicative processes during project execution.

Periodically project team building
Co-workers can really be co-workers even with thousands of miles separating them by using Internet. Internet-based technology can help us in managing distributed competencies but the challenge of creating a project team still remains. Team processes are essential to optimise project management in general, and the team will not work properly if communication is poor. Furthermore optimum communication relies heavily on social relations between the individual team members. Experience shows that team building becomes more difficult when the members are distributed. To be aware of that, when managing a distributed project, is a key to success. Running workshops and spending some days together periodically contributes positively to teambuilding.

Example:
The social part of building a team is undervalued and often regarded as an individual responsibility for the team. Many organisations have seen that social relations are important in all teamwork, and it is especially important in distributed projects to arrange social events where these relations can be nurtured, which the IMEC study (Appendix 3) also singled out as a major contributor to project success. The CoDisCo project was a distributed project itself, and building and maintaining social relations were important from day one. In this regard, the project has given valuable input to identifying the importance of periodically teambuilding.

Cultural awareness
Having a good knowledge and understanding of cultural differences is in itself a key to success.

Example:
Having cultural awareness is easy to say, and the single sentence above is based on a lot of experience from the different benchmarking partners. Company D experienced that a project in India was halted and later terminated due to problems based in cultural difference, and that the project organisation had not done their research and preparation properly, though they had performed an initial survey. The results from the initial survey worked as a sleeping pill to the organisation, and they did not become aware of local religious constraints.

Information distribution
Retrieving rather than sending information is another major issue when working distributed. The information needed to manage a project should be available in a common place. In order to get the information, one has to retrieve it, minimising in this way the traffic of information. On the other hand to achieve good results, strong self-discipline and good information on where, when and how the information can be retrieved, is needed.

Example:
How many people have not experienced it - to literally drown in emails. In a distributed project, information technology will be used for better and for worst. The ease, with which an additional copy of an email can be sent by a single click, has increased the information flow to such a point, where people insert a filter in their inbox to automatically delete messages containing their name in the CC field. This is a "no good situation" for a distributed project.

One part of the solution is to implement a single source of information, like the TuoviWDM web application, tested in the CoDisCo project. The other part of the solution is to familiarize the project team with a new method of distributing information; retrieving instead of receiving. This requires a change in attitude, and the process has to be supported by education, training and continuous follow-up by management. In the CoDisCo project we experienced this situation, as all participants did not use the TuoviWDM application to store up-to-date information as originally intended. The situation improved as the project progressed.

4.4 When controlling a distributed project

Throughout the project life cycle, the project management should ensure that the project is carried out as planned, and if not, corrective action should be taken. In order to avoid unnecessary time delays from deviations are identified until corrective action is taken, certain elements should be implemented; elements like reporting procedures and processes, individual responsibilities and attitudes, and finally organisational measures like controlling and guiding mechanisms for the project.

Active use of progress meetings
When working distributed, the flow of information does not happen so often and easily as when working face to face. Therefore a very active use of the progress meetings is crucial for the success of distributed projects. It is in these meetings where the exchange of information

regarding major issues occurs. During the meetings, physical or virtual, it is extremely important to be open and not to keep back problems. Just remember that in a distributed project there cannot be communication around the coffee machine.

Example:
Progress meetings were used by most benchmarking partners. It is no doubt that such meetings where everybody are attending, are important to ensure complete reporting, to maintain the shared reference and motivation, and to ensure full commitment from all project participants.

Proactive reporting
The reporting of the progress in a distributed environment should be proactive. This means that all the members know what to report, how and when, without being previously asked.

Example:
The progress meeting and a maintained shared reference are important elements in the basis for proactive reporting. Some of the benchmarking partners actively promoted proactive reporting in their projects, as this allows them to take precautions and reduce impact on the project from inevitable changes. This is closely connected to the method described in Total Quality Management, where each individual is responsible for the quality of his or her work.

Trust vs. control
Even if being time and resource consuming, when controlling the project, special considerations are taken in form of more precautions (further investigation, on-site visits). In order to have an effective control process, the distributed partners should trust each other and not rely on control mechanisms only to ensure project success.

Example:
One of the benchmarking partners was very clear on this point. The only control mechanism implemented was assembly and testing prior to customer shipment. In order to do so in an effective manner, much effort had been put into educating their own employees in Total Quality Management (TQM), and qualifying them according to the ISO 9000-series. The company also demanded the same from their partners, suppliers and sub-suppliers. Trust became more important than control.

Allocating risk elements
A good practice when controlling the risk is that one of the project team members already has the direct responsibility to monitor the risk and its development, and will also be responsible for the new situation. Responsibility for single risk elements must be allocated to the partner best suited to absorb and mitigate them.

Example:
The principle of allocating risk elements is a continuation of a principle from TQM; the worker is responsible for the quality of his or her work. Under planning we mentioned the element of "Jointly risk identification". Once potential risks are identified, each risk element is dedicated to one project team member, and it is his or her responsibility to control this element at any time and report any changes. One of the benchmarking partners used this method to full extent.

Review board
A good practice is to appoint a review board, where the project manager reports about the development and status of the project. The main function of the board is to help the project manager in accomplishing the project objectives. This board should consist of senior project managers.

Example:
The review board should not only be used when controlling the project, but also throughout the project life cycle. However, we have chosen to present it under the controlling processes, since this phase of the project is critical for the project manager, and since he could do with some guidance and help from the mother organisation(s). The review board was already implemented by one of our benchmarking partners, and they have had good experience by using this board in distributed projects. The board is able to supplement the project manager in any field or competence area where he or she would need some additional experience.

4.5 When closing a distributed project

In the closing processes, the single most important thing in the view of a distributed project would be to make sure that experience gained in this project is documented and distributed or made available for further and future use.

Updating repositories of data
It has been mentioned that a good way of storing valuable historical information regarding project management is in databases. Special attention should be paid to updating the data after a validity check when the project is concluded.

Example:
This is a vital point for distributed projects; if someone is going to use the experience from a distributed project in the future, the repositories should be updated continuously. And at project closure it is important to include the final experience and an evaluation of the project. This is seldom done, due to the fact that the project resources are spent at this point, and no one seems to take responsibility for doing the final closing of the repositories. This problem was widespread in our selection of benchmarking partners.

4.6 Other issues

The issues addressed in this section are common and relevant for all the project management phases or processes.

4.6.1 Educational approach to project management

A good educational approach to project management is a combination of courses and on-job-training. Courses on both project management techniques and tools will give general knowledge, while the experience-based learning will help all project members to get specific knowledge about project work in their specific organisation. Specifically, following a project until the end and

training about what is being estimated are good tools to enhance experience-based learning about respectively time management and cost management.

Several of the companies benchmarked used education extensively as a tool to align the team members and give them a better theoretical and practical qualification to manage project processes like risk and quality management. These processes are also vital to distributed projects. The educational processes were carried out in regular intervals of three or six months. In a distributed project, however, the education should include more processes and be carried out with shorter intervals. Some parts of the education may for instance be given through virtual sessions on Internet combined with physical classroom teaching.

Furthermore, a good practice is to use the same educational approach e.g. same course, for all the partners involved in the project. This gives a common base to all the members, which in turn improves the communication.

Example:
Throughout the examples presented in this chapter, we have illustrated the need for an educational approach to distributed projects. The new tools, advanced technology and new forms for co-operating and working in teams require better preparation of project team members. They need new skills and more experience in working with new tools, and the processes of working distributed have to be taught. Nearly all organisations in the benchmarking study had educational approaches already; however, we believe that they could improve their education to reflect the challenges in distributed environments in a better manner.

4.6.2 Experience reporting and competence development

In a broad perspective, the only thing really distinguishing a good distributed team from a good co-located project team is the ability to analyse experiences, and use the results to develop distributed competence in a constrictive manner. A co-located team does not have to worry about this, since they share their experience through working together and aiding each other when needed. A distributed team will have to rely on their ability to learn from each other through sharing experiences and competence by other means.

Some of our benchmarking partners used education and regular report meetings or workshops to share experience and competence, which are some of the basic techniques recommended. In a distributed project no effort should be saved to facilitate these processes. However, our study does not give any certain pointers to how we can solve the process of experience reporting and competence development. This should be investigated further in order to describe it in an operational manner, thus making it easier to put it to practical use.

Example:
As mentioned above, our study did not provide us any practical examples or profound description of experience reporting and competence development. Some of our benchmarking partners used regular progress meetings and closure meetings at certain milestones during the project to discuss the lessons learned and share experience with others. However, there was no other competence development mechanism involved than word of mouth. In a distributed project it will be of vital interest to identify and describe a process more independent of meetings and verbal transfer.

4.6.3 IT-tools used in distributed projects

In distributed projects, IT-tools are the major methods for co-operation and spreading of information. Standard office programs, project management software and electronic mail are widely used, yet more complex configuration management tools are still in its infancy.

In distributed projects it can be of use for simultaneously access to the tools and documents. During the execution of the project, the so-called GroupWare tools, offering from online chat sessions to videoconferences, are valuable. There are many interesting software-package in the market, and it is not as easy issue to chose the right one for the necessities.

The distributional degree (chapter 2.2) and organisational maturity will give some clues on which technological platform to be chosen. Higher distributional degree calls for more sophisticated systems and tools, like web based "mobile project work areas". But regardless of distribution, organisational and individual maturity in using these advanced systems will decide if there is any point in introducing them. To ensure proper use, the project team should be educated, trained and motivated for using the tools provided.

Example:
Most of our benchmarking partners used standardised office programs and email as the major tools for communicating in a distributed project, as well as the "non-distributed" everyday activities. In other words, they mostly communicated in the same way, independent of distributional degree.

In the CoDisCo project, a web based application for storing and sharing information was introduced to the project partners, TuoviWDM. This application had some of the functionality required by a "mobile project work area", as mentioned above, namely the opportunity to have access to project information independent of time, place and software platform. To be a truly "mobile project work area", it lacked the possibility to perform informal communication (chat groups, or discussion groups), and the functionality required to plan and control the project (dynamic planning, reporting functionality, milestones, etc). The introduction of the TuoviWDM application opened the eyes of the CoDisCo partners to the possibilities of improving communication and team processes by providing the required and up-to-date information when needed.

4.6.4 Communication and team processes

Throughout this chapter, we have identified communication and team processes as the common denominator for all the elements in the good practice for managing distributed projects. All activity described above depends on communication or team skills in one way or the other, i.e. building and maintaining a shared reference, reporting activity, risk assessments, education and competence development through sharing experience. Hence, we have dedicated chapter 5 to investigate this element in further detail.

4.7 Good practice in managing distributed projects - A short summary

In order to sum up the good practice described previously in this chapter, we have presented its elements and placed them in accordance to the process groups presented in Figure 9; the result is shown below.

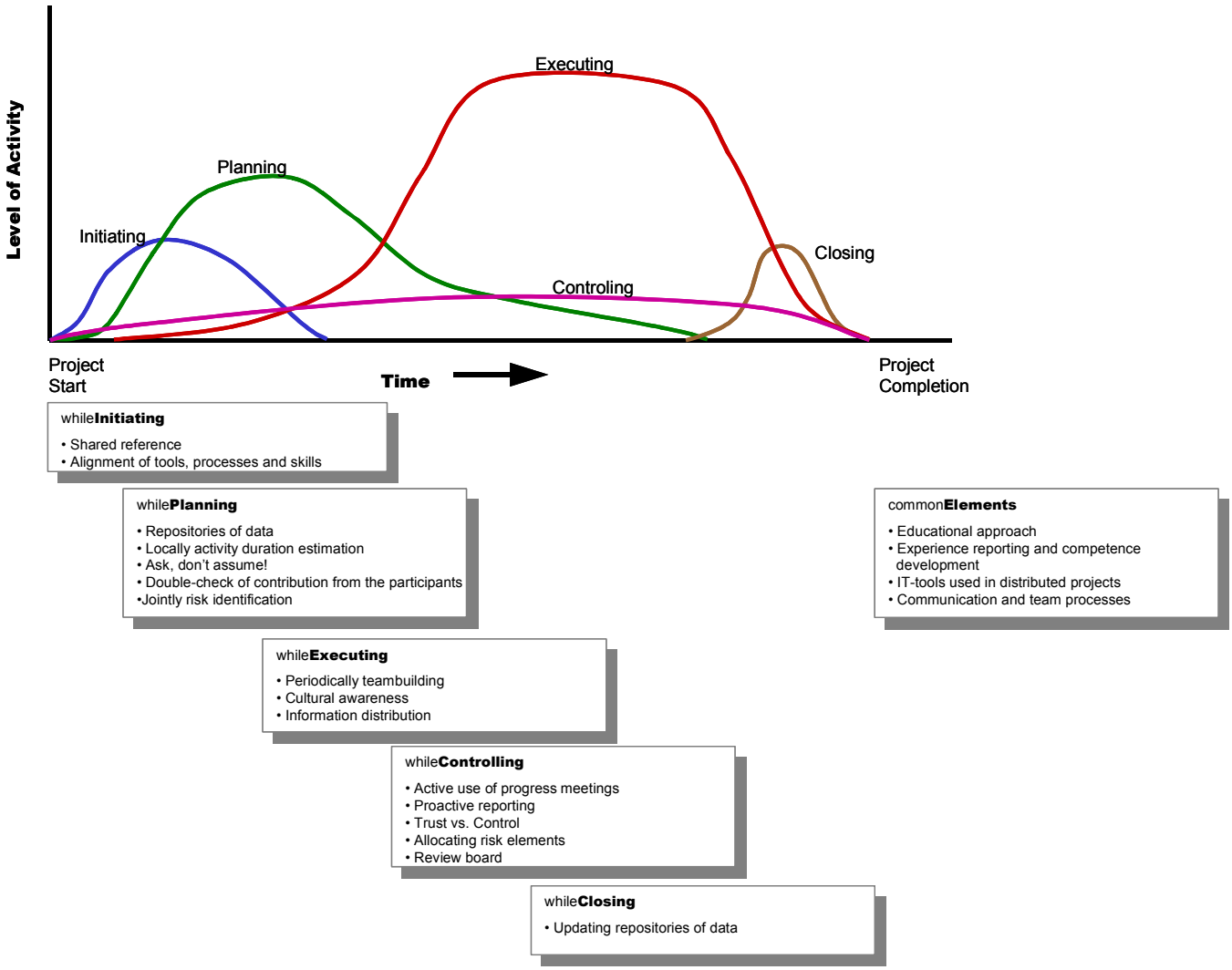

Figure 10 Good practice in managing distributed projects according to the process groups

Figure 10 should give a good picture of the elements, and help to better understand how these elements combine to describe the identified good practice in managing distributed projects. Next chapter brings more focus to communication and team processes, the elements that "glue together" the remaining elements to a totality.

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5 The important elements of “Communication” and "Teamwork"

Distributed projects are facing several challenges that differ from those, which “traditional” projects are facing, as mentioned earlier in this report. These challenges involve many different subjects and professions, but this chapter will focus on two important elements identified by some of the major findings in the CoDisCo project – communication and teamwork.

It might be said that it is too obvious to focus on these elements. However, communication is essential to all organisations, and due to the nature of a distributed project, even more important in such projects. Communication is essential for building and integrating the team, and it is essential for making the organisation efficient and productive. In short, both elements are essential for all interactions between human beings, and a distributed environment stretches normal communication skills to new limits.

This chapter will try to give you, as a reader, some insight to exactly why communication and teamwork are so important, both in general and in specific in distributed environments.

5.1 The importance of communication

Everybody communicate all the time. It is natural for all human beings to communicate, and they are communicating without thinking of how important it actually is. This fact naturally makes it harder to explain why communication is important, and why this should be a major focal point in a report on distributed projects.

The word communication itself comes from the Latin word “communicare”, which means, “make common” or “bring together”. Communication has been essential for all human interactions since the dawn of mankind, and it has proven to be the element that makes people able to work together for a common goal. Good communication brings people together and prevents misunderstandings, and thus is essential for effectiveness.

To give you an example: The significance of communication is enormous, both in everyday functions and in all organisational relations. An empirical study by Furnham and Gunter (1992) proves that the two single most important skills of newly educated professionals within economy and administration were verbal and written skills in communicating. These skills were found to be more important than working experience, technical competence and educational achievements.

A critical factor in effective leadership is effective communication. To give you another example; Mitchell and Larson (1987) performed another survey, in order to find correlations between personal qualities and effective leadership. They found that the communicative skills are essential components in the everyday activities and tasks of an effective leader or manager.

These facts are sustained by the results of Pinto and Slevin (1987) where they have identified ten Critical Success Factors in projects. The ninth factor is “Communication”, and how this is influencing on the performance of the project team and the mother organisation. Good co-ordination between project, mother organisation, customer and other project stakeholders is fostered by effective communication. The remaining Success Factors rely heavily on communication, also. These are factors like problem solving, commitment from top management and evolution of inter-human relations in the project team.

From this we conclude that communication is essential for human interaction, both individually and organisationally.

5.2 What is "Communication" actually?

Grenness (1999) describes communication as "transport or distribution of energy and information across or through a border between two or more systems". An important element here is "information", which he describes as "reduction in uncertainty", that is, a signal that creates a change, which in turn has an impact on humans and their interaction with other humans and their surroundings. Communication has certain properties that we will describe, in order to give a better understanding of the nature of communication.

First of all communication is dynamic, both in terms of process and relations. The communication process is always changing. Different individuals constantly bring new elements to the process, thus keeping it dynamic. If these individuals are put together in the same context for a prolonged period of time, some of their communication process will eventually fall into a certain, structured pattern. They are forming an "organisation" or a "system".

The individuals in this organisation or system will have different roles in different situations. This alters the normally static "sender"/"receiver" situation to a dynamic situation. In order to understand the message, you have to understand the complex and dynamic relations between the different individuals.

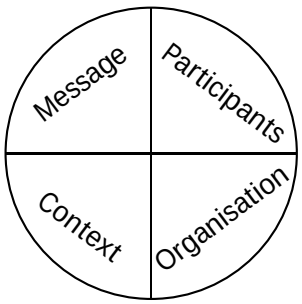
All communication is taking place in a context, which gives a setting or a set of boundaries that describes the current communicative situation. The context describes and stabilises the relations between the individuals, hence making communication between them easier and more effective, but only as long as everybody has the same, common understanding of the context. In the modern society, this stability is fragile, and is constantly broken by internal and external factors. The context is dynamic as well.

Finally, communication is taking place on different levels at the same time. When a human is speaking, he is communicating on other "channels" or "levels" as well, such as body language, the use of irony, sarcasm, and satire.

The combination of all these properties proves, that communication is not an easy task, and that humans have a constant need of learning new communicative skills and improving their current skills. This is important both to the individuals and the organisation. Individuals with good communicative skills working together in a communicative environment are important for any organisation.

In order to understand the complexity of communication, Grenness (1999) describes four groups of factors to be used in analysing the communicative process. They are:

- Properties of the message
- Properties of the participants
- Organisational properties
- Contextual properties



Properties of the messages could be shape, contents, quantity, time, relevance to the receiver, intensity, distinctness, availability, direction, foundation, representative and reliability.

Properties of the participants could be represented by former experience, knowledge and anticipations, attitudes and individual values, prejudice, organisational roles, status and position, mutual trust, individual power and influence, personal ambitions and conflicts.

The third group, organisational properties, consists of elements like hierarchic structure, distribution of authority, internal rules, standards, climate and culture, information technology, information network, team development, sharing of labour, and management.

Finally, the firth group, contextual properties, is made up of national culture, traditions and language, historical background, legal framework and other regulating conditions. [Triandis & Albert, 1987]

It is important to be aware of all these elements and how they interact, in order to understand communicative behaviour and communicative systems when analysing them. Especially when analysing organisational communication, where the balance between formal and informal communication will play a major role in effectiveness and productivity of the organisation. It is not possible to describe this analysis to the outmost detail, hence the remark above 'to be aware of these elements'. Nonetheless, we will stress the fact that both formal and informal communication are essential for distributed projects, as in any organisation.

5.3 Organisational communication

The American Professor and research scientist Karl E. Weick claims that inter-human communication is the single most important property of an organisation, since communication creates the structures deciding what to be said and what to be done [Weick, 1987]. In other words, humans create systems and structures for efficient decision-making by communicating, and the decision-making process depends on communication as well. And all members of the organisation base these processes on a joint and common understanding of the context and a common set of values.

Roughly speaking, we can divide organisational communication in two: formal and informal communication. They follow two different ways or maps of communication lines. The formal communication follows the organisational chart. These formal channels of communication create and maintain authority and control, thus legitimating the messages given. However, this can also restrain communication by forcing it through an unwanted and sometimes slow-working bureaucracy. Hence, informal standards and communication channels are created. The different informal communication channels constitute the informal organisation. In order to have an efficient and productive organisation; the informal organisation should support the formal. [Grenness, 1999]

In other words, a balance between the formal and informal organisations is important, as the figure below tries to demonstrate.

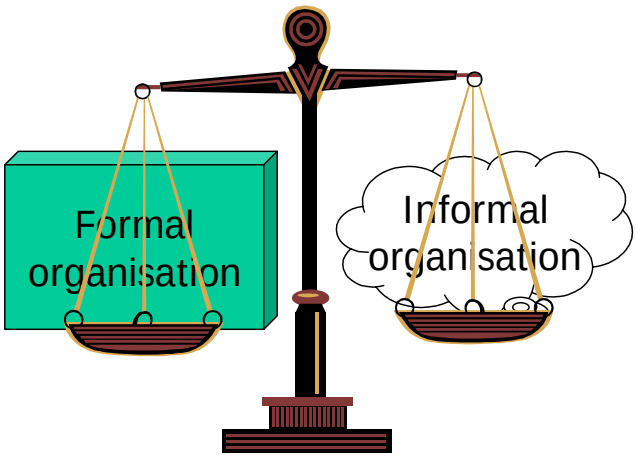


Figure 11 The balance between the formal and informal organisation

The importance of this balance can be described through an example. If an individual or a group of people tries to pass some information through the formal communication channels, and don't succeed, they will revert to the informal channels. This is important for a flexible organisation. However, if too much information is passing through informal channels, the formal organisation will be ineffective and not able to support the individuals or group. And the other way around, if all information is handled through formal channels, both internal and external communication will be too slow and inaccurate, hence slowing down the productive processes. The solution will be to find a balance between formal and informal communication, satisfying both demands for creativity and control.

5.4 Informal communication is essential in all organisations

The statement in the heading above is based on the fact described in the previous chapter. We will now give you some more examples and evidence to consolidate this statement.

First, a survey conducted by Mintzberg (1983) showed that most mangers use more than 75 % of their time to communicate. They are spending most of their time communicating vertically and horizontally in the organisation, and thus facilitating the productive processes. Managers are role models with formal authority and are distributing relevant information to their employees. Hence, managers use a lot of their time to communicate with their employees.

Grenness (1999) points out that employees feel most comfortable with open and face-to-face communication. Their level of well-being depends on the ability of their closest superior to communicate upwards in a swift and effective manner. His ability to give relevant feedback is equally important, as well as his skills for effective handling of conflicts. All these skills relate to the manager's skills in using informal communication.

Third, Mueller (1991) claims that most of an organisation's living knowledge exists in informal networks and is cultivated by informal communication. This fact is supported by the benchmarking study carried out in the CoDisCo project. None of the organisations studied had any formal standards or formal procedures that could capture and cultivate the knowledge and competence gained by the individuals in their projects. Educational activities are, however, used to improve knowledge levels and subsequently process performance in some organisations.

All these facts substantiate the importance of informal communication in all organisations and all teamwork. In a distributed project, generally there is no natural playground or arena for informal communication between team members. The “smoking room” could be one example of such an arena. You have probably experienced it yourself; as a non-smoker you sometimes feel you have to join the smokers in their “free smoking zone”. Otherwise you may be left out of the “decision loop”. Some project team members have experienced that smoking team members have discussed issues related to the project during a break, and actually made a decision based on the informal conversation. Such arenas for informal communication are important, and have to be established for distributed projects as well.

In order, to better understand the importance of communication in teams and projects, both formal and informal, we will describe some basic conditions for effective teams in the nest chapter.

5.5 Basic conditions for effective teams

Generally speaking, teams will outperform individuals or a group of individuals. But this also implies that we have to do something to build this “team”.

Katzenbach and Smith have in their book “The Wisdom of Teams – Creating the High-Performance Organisation” (1993) identified eight common approaches to building team performance. They are as follows:

1. Establish urgency and direction.
2. Select team members based on skills and skill potentials, not personalities.
3. Pay particular attention to first meetings and actions.
4. Set some clear rules for behaviour.
5. Set and seize upon a few immediate performance-oriented tasks and goals.
6. Challenge the group regularly with fresh facts and information.
7. Spend lots of time together.
8. Exploit the power of positive feedback, recognition, and reward.

There is no point in explaining all the items above in detail, but we can clearly see that communication, both formal and informal, plays a vital part in building a team. Katzenbach and Smith stress the fact that an effective team must be committed to its task, and that a demanding performance challenge is vital for effectively creating a team. This demanding challenge is the driving force for the team, and it drives the team through the initial processes.

After some time, as the team develops and the members get familiarised, social and inter-human relations will bind them together, thus creating a stronger commitment for the team. This is why it is important to spend time together.

Katzenbach and Smith (1993) describe the development of a team in terms of what they call "Team Performance Curve". This curve has five levels:

1. Working group
2. Pseudo-team
3. Potential team
4. Real team
5. High-performing team

It is an accepted fact that teams are surpassing the individuals as the primary performance unit in a company. Thus, improving a team to reach a higher performance level require commitment, training and education of the individual team members. When choosing "the team path" instead of the working group, the team members commit themselves to risks of conflict, joint work-products and collective actions necessary to build a common purpose, set of goals, approach and mutual accountability. The stronger the commitment, the higher is the team performance. Communication plays a vital part in improving team performance, especially through maintaining and strengthening the commitment of the team members and, as mentioned earlier, solving potential conflicts. To improve further and become a high-performing team, the members also have to be deeply committed to one another's personal growth and success.

In this view, a distributed project will have some disadvantages. First of all, commitment to the team and other team members will meet obstacles due to the distribution of the team members and the distance separating them, both geographically and organisationally. Secondly, building the team in a distributed environment is not easy. Team members will lose the social environment and the daily processes of maintaining the common goals and commitment of the team. Thirdly, simultaneous commitment to other projects and to different mother organisations may weaken the commitment to "our project". This is a reality in most projects of small and medium size, where the team members are not occupied 100 %.

On the other hand, once we have a real or high-performing team, organisationally and geographically distribution of the team members will not have much effect, as they already know each other and are committed to each other. Especially as long as they meet regularly, have the opportunity to socialise, and have technology supporting informal communication and ad-hoc meetings available at any time. This observation means that a well-working team will have a better chance of succeeding with carrying out a distributed project.

Haywood [Haywood, 1996] describes an Alignment Model for development of distributed teams. This model suggests that all project members, the project resources and project organisation should be aligned in order to optimise distributed performance. This alignment is a continuous process, and relies on education and training. The Alignment Model focuses on four elements: goals, process, tools and skills.

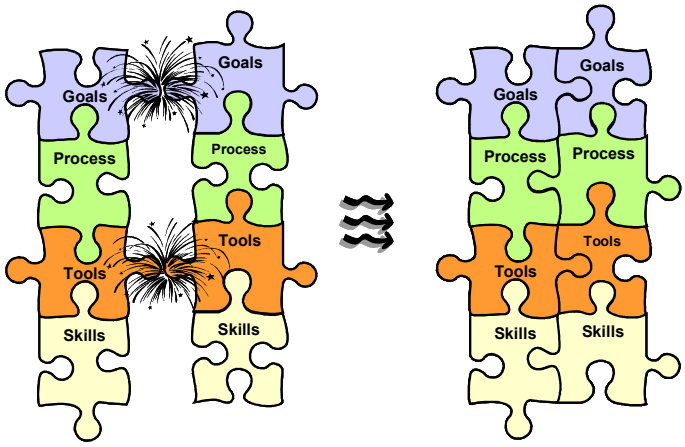


Figure 12 The Alignment Model [Haywood, 1996]

A distributed project consists of individual "units" with their own goals, processes, tools and skills, and it is essential that each individual "unit" are aligned, as our benchmarking study also revealed. Figure 12 describes this situation, as two non-aligned team units (to the left) will not work as good together as the two aligned units to the right. As mentioned in chapter 4, a shared reference is essential for this alignment, and both the shared reference and the team commitment have to be maintained. This maintenance is a continuously ongoing process aligning team units both during projects and in between projects. Important elements in aligning the team units are building team identity, facilitating relationships, building trust among team members, and making sure that team members have fun. These are simple rules, but not always easy to live by.

5.6 Why is communication significant in distributed projects?

To summarise this chapter, and show you why communication is essential to distributed projects, we have made a list of the most important arguments. We have found that communication is essential for:

- communication complexity increases in distributed projects
- building and maintaining an effective project team
- co-ordinating the project team and resources
- providing sufficient information for project control and project execution

To analyse the **complexity of communication**, we will use the four groups of communicational factors presented to you in chapter 5.2. To recapitulate, the four groups were:

- Properties of the message
- Properties of the participants
- Organisational properties
- Contextual properties

The complexity will vary with the degree of distribution, described in chapter 2. The degree of distribution will have effects on all four groups. Just to give you an example: Once different cultures are involved, both national and organisational, this will have impact on the creation, forming and distribution of a message. People tend to create and form a message based on their own cultural reference, which sometimes makes it more difficult for someone outside this reference to understand the message. The distributional degree makes the making and understanding of a message more complex. The same goes for properties of the participants, the organisations and the context. Hence, we can conclude that communicational complexity increases as the degree of distribution increases.

Building and maintaining an effective and functional team in no easy task, as Katzenbach and Smith (1993) described in their eight common approaches to building team performance, as we mentioned earlier. All the eight approaches either need to be communicated or are based on communication with the team members. For teambuilding in distributed projects, special attention should be paid to the fact that the team needs to spend time together in the beginning of the project. All eight approaches depend on social interaction and face-to-face communication in the initial phases of the project.

Co-ordinating a team effort is a demanding task under any circumstances. In a distributed project, the team members and other resources are distributed and not under direct command of the project manager. Each individual will have a greater responsibility to the team, and to achieve both his or her individual tasks and common goals. In order for the project manager to co-ordinate this joint and distributed effort, he will rely heavily on continuous and sufficient communication. Processes and standards for this communication will have to be developed and adapted by the team.

Project execution relies on a string of decisions. Risks are connected to each decision, and **project control** is used to reduce probability for risks to occur. One definition of risk is “a shortage of information at a decision point”. As we have mentioned, distributed projects often imply a shortage of information due to its distributed nature, or that the information is hard to get in due time. Traditionally, this shortage has been solved through a strong centralisation of authority to give the project manager better control. Centralisation means more use of formal communication channels. This is also what we observed during our benchmarking study. We found that there is a tendency towards using meetings and increased reporting frequency to provide information both to the management and to the team members. This is useful in a “traditional” project, where team members easily can compensate by using informal channels, and where the project management may use these channels as useful feedback. In a distributed project there few such channels, and if there are any, they are not suited for giving feedback to the management.

Hence, in a distributed project, it is important to establish an arena where team members regardless of time and place can share informal information, and where the management can get the feedback it needs to manage the project. Thus, this arena should provide sufficient information for project control and project execution.

Our benchmarking study does not give any answers to how this arena may be created, but we observed that frequent project meetings were used widely throughout the project life cycle. The frequency would change in the different phases, though; short intervals in the start-up, longer intervals during execution phases, and shorter intervals as project closure approaches. While it

certainly would be possible to develop tools for this arena, it is of more importance to initiate the informal processes in the team, and develop them further by education, training and sharing experience.

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6 Ten Critical Success Factors for Distributed Projects

How do we ensure success for our distributed project? There is no definite answer to that question, however, we can take some precautions and prepare our organisation(s) and ourselves. During our study, we have come upon many elements to consider when managing a distributed project, and based on our findings, it is impossible to give project managers a detailed description on how to do it. Personal experience is much more important than a theoretical description, thus we have tried to sum up our findings in some "rules of thumb". In this chapter, we have listed some important elements, or rules of thumb, that we have chosen to call critical success factors.

We came upon a quote when preparing this report.

> "A Bus Station is a place where the bus stops.
> A Train Station is a place where the train stops.
> And here I find myself sitting in front of a Workstation…"

This quote is quite intriguing, and describes some of the challenges provided by the modern age of computers and an increasing degree of distributed working environments. The main challenge is to open eyes to the possibilities provided by technology, and to stimulate and activate the workers sitting in front of workstations. This especially applies to distributed projects, which heavily rely on computers and modern information and communication technology.

In order to help project managers and organisations to implement and use distributed projects, we have identified some critical success factors. They are grouped in three groups, depending on which level in the project organisation they are intended for. We have observed the importance of these factors both through our studies in the CoDisCo project and in our general working days. The ten critical success factors are:

Individual level	**Team** level	**Organisational** level
1. Single source of information	6. Education and training of project personnel	9. Review board
2. Common workplace independent of time and place	7. Shared reference and commitment to the project	10. Management of external relations
3. Data discipline	8. Periodically teambuilding	
4. Overcome "Sign-on-fear"		
5. Change in method of work; retrieving vs. receiving information		

1. Single source of information
In a distributed environment, the workers need access to all information necessary to carry out their assignments. They also need it to be the latest information, as old and outdated information leads to futile work and extra changes. An example: In an offshore project building a platform, one storage tank had to be painted several times, due to changes not know to the builders. For each time something had to be altered inside the tank, it had to be repainted. In addition, there were several changes already decided by the management, but these not distributed to the workers or brought to their attention in any way. Subsequently, the tank was repainted after each change,

the workers not knowing that another change was coming soon. This could have been avoided by using a single source of information and a direct access to it for each working team.

Another example is the challenges experienced in the final stages of building an onshore petroleum plant in Norway. As the deadline for project closure and plant completion approached, change orders were rampant, and the intervals between them were decreasing. At the end, change orders were in fact invalid and replaced before they were executed. However, inadequate distribution of the orders, made it impossible to annul them. A single source where the workers could have retrieved the latest information, would have prevented this situation, and made it easier for both workers and management to carry out the correct change orders.

2. Common workplace independent of time and place

It is of vital interest to all parties involved that information is exchanged using common standards. For some organisations, a policy of using a certain software or software system prevent them from proper interaction with collaborators and partners. For a distributed project team, multiple software platforms and systems would restrain team development and team effectiveness. Thus, the best solution would be for everybody to work on a common workplace, or with software based on the same and interchangeable standards.

In some situations, project members will need to travel a lot. Frequent meetings at different locations could mean that there is no way of keeping you and the team updated on the latest developments. The solution is simple, and we have tried the available technology during our CoDisCo project; a web server with all the information stored at one place, accessible through any browser at hand no matter where you are. This means that you don't even have to carry with you a portable PC and get it online to share your files with others. You can just use any computer with web access and a suitable transfer rate to upload and download your files of interest.

Such a web server, with all the relevant files and project information, fulfils the first two critical success factors: a single source of information and a common workplace independent of time and place. However, today's solutions still have potential for some improvement. For instance, a web server and a browser do not make you independent of word processor and other software office tools. You will be completely independent of software once you can **process** your information through your web browser, not just **uploading** and **downloading** your files.

3. Data discipline

The electronic age has one major Achilles' heel, data discipline. If each individual does not record relevant information and upload all relevant files to the single source of information (also known as a 'vault') at once, the vault would be of less importance and probably of no use. All users have to thrust that they will find the information they need at the time they need it to do their work.

One equally important side of data discipline is to filter non-essential information and not store it in the vault as well. Too much information will "drown" the other users and make it harder for them to find the information they need.

Data discipline is something the project members have to be taught and trained in. It does not come natural to most human beings, and a set of 'information handling rules' has to be established for the project.

4. Overcome "Sign-on-fear"
All electronic files and communication leave trails, and it is possible to track the flow of every piece of information. This makes it impossible find out who did what and when it was carried out. Hence, you have to account for all your work and all your actions. Not all workers are comfortable with this tracability. Some people tend to prefer to avoid responsibility and let others take the blame if something goes wrong. This "sign-on-fear" could be restraining on team efforts.

For instance, the TuoviWDM application used during the CoDisCo project kept track on all access to the documents stored in the application. While providing the project manager detailed information on the use of the system, not all workers are comfortable knowing this, thus restricting its use. If this tendency continues, soon a large number of workers will use other and less traceable means to do their work. The result will be a less manageable project.

The solution will be education and training, once again, and to make it clear that the tracability information will be made anonymous and not used on an individual basis. However, this problem will decrease, as the coming generations probably will be more comfortable with and willing to accept this situation. Overcoming "sign-on-fear" would be an important element in aligning the team units.

5. Change in method of work: retrieving vs. receiving information
Traditionally, workers are used to being told what to do and where to find the information they need to do their job. Information on an assignment and its background information are normally stored in a paper-based dossier, which is handed over to the worker at assignment.

This situation is changed when electronic information is stored in a vault or single source of information. Now the workers have to retrieve the information in the vault required to do the job. This change in work method implies that the individual worker has to take more responsibility for his or her task. The best way to foster this change in work method will be to educate and train the workers involved.

6. Education and training of project personnel
Several of the elements described above have shown the need for education and training. Distributed working environment requires new skills and attitudes from the workers, and the only solution to this is education and training. Our benchmarking study showed that most organisations already used education as an important tool in this regard, but we cannot stress this fact too much.

In chapter 4.6.2 we mentioned that effective distributed project teams depend on good processes for capturing, analysing and distributing experience and competence gained. These processes have to be taught, facilitated and supervised at all times. Education and training of team members form the basis for future and further team and project improvements.

7. Shared reference[2] and commitment to the project
In chapter 5 we discussed the importance of communication and teamwork. Shared reference and commitment were emphasised as two of the most important elements of making a team work properly and efficiently. This especially applies to distributed projects, where the two elements are absolutely vital. A shared reference is important to ensure that all team members pull in the same direction and all work leads towards a common goal. Commitment to the goal and each other is the thing that makes the team efficient.

8. Periodically teambuilding
The common goal will most likely change during a project, so also for a distributed one. This is a natural consequence of changes that will occur in any project. To ensure that all team members still share the same goal, the project team should have physical meetings at given intervals, where the changes are presented and the consequences they have for the team's common goal. These meetings also give the members a chance to socialise and strengthen their commitment for each other and the team. Thus, periodically teambuilding is of vital importance for a distributed project.

9. Review board
In our benchmarking study, we found that for some organisations, a review board would be of great interest for a distributed project. A review board consists of persons in the management with relevant competence, power and authority to assist the project manager in the different phases of the project. The board should help the project manager to put decisions into action, and also make sure that the project purpose coincides with the organisations strategic goals.

The review board is summoned at each reporting point in the project, and the project manager presents the status and further plans. The review board has the authority to approve or reject actions, and at any time terminate the project if they find it to be the best strategic or tactical solution. A review board also should function as a link between distributed projects, and ensure that the projects are benefiting of mutual exchange of experience, competence and results.

When several organisations are involved as partners in a distributed project, the review board will consist of representatives from all organisations. Here, the board will have the same function as a traditional steering committee.

10. Management of external relations
Management of external relations is often neglected, and the consequences can be fierce. Lately, a number of projects in Norway have experienced strong negative publicity due to poor handling of external relations. During project execution, stakeholders have introduced changes subsequently resulting in budget overruns and delays. Both governmental and non-governmental organisations have a strong impact, and could even result in project termination if not taken into account at early stages.

One example experienced during the CoDisCo project, was the building of Aluminium smelter in Iceland. Norsk Hydro wanted to build an aluminium smelter in Reydarfjordur on the northeast

[2] A shared reference consists of a common goal understood and shared by all the project team members, and just as important, a common understanding of the scope of work, the complexity of the task and the context in which the project is carried out.

coast of Iceland. This initiative was strongly supported by the local authority, but experienced heavy resistance from the public, mainly in Reykjavik. The project would have required the building of a large barrage and an electrical plant to produce the electricity needed in the smelter. By law, the project had to meet this resistance and inform the public in a neutral manner by conducting an environmental impact survey. To communicate the information to as many people as possible, the result of this survey was available on an open public web server. All information on the barrage, electrical plant and smelter were published, giving the public free access to all information.

This is one way of managing external relations; however, this was a passive method. It is also necessary to actively establish contact with important stakeholders, open communication channels and initiate co-operation with the stakeholders with strongest influence. This is subject for further research and investigation in an ongoing research project financed by Norwegian Centre of Project Management.

These ten critical success factors are by no means the only important issues, and success is not guaranteed by fulfilling these factors alone. Based on our results from the benchmarking study and work package 1, however, we found that the ten factors described are key elements for accomplishing a successful distributed project.

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7 Conclusions, Evaluation and Suggestions for further research

This final chapter will summarize the results from our benchmarking study and give a total basis for the best practice identified during the CoDisCo project. Our findings of a best practice for distributed projects will be presented, and we will compare these findings with our initial starting point, the research hypotheses. Furthermore, the results and conclusions will be subject for evaluation, due to the limitations presented in chapter 3.3. Finally, we would like to present which issues we, based on our experience from the CoDisCo project, think will or should be subject for further research.

7.1 Best practice in managing distributed projects

The CoDisCo project succeeded in identifying and describing what we would like to call good practice in managing distributed projects. The good practice is described in both perspectives of the project life cycle and the four initial project management areas.

The good practice, in the perspective if the phases of the project life cycle, was identified to be:

- When initiating a distributed project
  - Common goal
  - Alignment of tools, processes and skills
- When planning a distributed project
  - Repositories of data
  - Locally activity duration estimation
  - Ask, don't assume!
  - Double-check of the contributions from the participants
  - Jointly risk identification
- When executing a distributed project
  - Periodically project team building
  - Cultural awareness
  - Information distribution
- When controlling a distributed project
  - Active use of progress meetings
  - Proactive reporting
  - Trust vs. control
  - Allocating risk elements
  - Review board
- When closing a distributed project
  - Updating repositories of data
- Other common elements
  - Educational approach to project management
  - Experience reporting and competence development
  - IT-tools used in distributed projects
  - Communication

These elements of the good practice served as the basis for the **ten critical success factors** identified for distributed projects. The objective of these critical success factors is to help project managers and organisations to implement and use distributed projects more efficiently. They are

grouped in three groups depending on which level in the project organisation they are intended for.

The ten critical success factors are:

Individual level	**Team** level	**Organisational** level
1. Single source of information	6. Education and training of project personnel	9. Review board
2. Common workplace independent of time and place	7. Shared reference and commitment to the project	10. Management of external relations
3. Data discipline	8. Periodically teambuilding	
4. Overcome "Sign-on-fear"		
5. Change in method of work; retrieving vs. receiving information		

These ten critical success factors are by no means the only important issues, and success is not guaranteed by fulfilling these factors alone. Based on our results from the benchmarking study and work package 1, however, we found that the ten factors described are key elements for accomplishing a successful distributed project.

Two of the most basic, and yet vital, elements in managing a distributed project are **communication** and **teamwork**. Special constraints on these two elements will surface in a distributed project due to the nature of a distributed environment. Geographical distribution and cultural distribution are only two of the constraints mentioned. An effective team needs a shared reference[3], and aligned tools, skills and processes in order to be truly effective in a distributed environment. Communication is a vital tool for the team in terms of reaching and maintaining the common goal, and continuously co-ordinating the team effort. Communication also plays a major part in sharing experience and competence.

7.2 Back to the starting point: Did we end up where we wanted?

This is the fun part, where we go back to the beginning and our initial goals, and try to find some conclusions on where we ended our effort. Did our results give us any help in answering our initial hypotheses?

In chapter 1.4 we presented the hypotheses that served as the basis for our research, and they where as follows:

- Best practice in managing distributed projects can be identified by benchmarking organisations in different professions using distributed projects, and thus prove that the benchmarking methodology is suited for identifying best practice in managing distributed projects.
- Best practice in distributed projects can be identified by focusing on four project management knowledge areas; time, cost, quality and risk management, as they most

[3] A shared reference consists of a common goal understood and shared by all the project team members, and just as important, a common understanding of the scope of work, the complexity of the task and the context in which the project is carried out.

likely are the first knowledge areas an organisation will introduce and implement in a distributed environment.
- Special attention should be paid to communication and teamwork in distributed projects due to the impact from specific distributional factors, like stretched communication lines, cultural differences and co-ordination of distributed partners.

The first hypothesis proved to be true. We found that benchmarking was a well suited tool for identifying best practice in distributed projects, just as it has been an excellent tool for identifying best practice in other professions and areas previously.

Hypothesis number two also proved to be true. By focusing on the four project management knowledge areas, we have identified a best practice in managing distributed projects. Even though we cannot justify this to be best practice in managing distributed projects in general, the elements identified are of vital interest and importance to achieve success in distributed projects.

Finally, the third hypothesis also proved to be true. Out benchmarking study proved that communication and teamwork are even more essential to a distributed project than in non-distributed projects. This fact is also supported by the findings done by other research initiatives, such as virtualteams.com (http://www.virtualteams.com).

7.3 Evaluation of research result validity

In this project we have mainly used benchmarking, which is a qualitative method. Initially, we also started up with a quantitative questionnaire; however, it soon proved to be unsuitable. The reason was both that the low number of research objects could not justify this to have the reliability of a quantitative method, and secondly that the resources in our project were too scarce to perform a full-scale quantitative survey. On the other hand, the qualitative study would provide better results for less funding.

We will evaluate the validity of our results by using the same perspectives in chapter 3.3:
- Research profile
- Research design
- Data acquisition
- Data interpretation

Research profile

We have obtained a very good picture and understanding on how to manage distributed projects by using the benchmarking methodology. The method has give us a chance to investigate in detail the processes used in distributed projects today, and our selection of objects gave us examples from totally different professions and cultures. When we then still could find points of resemblance, we knew that these elements are vital to managing distributed projects.

Research design

The research design gave us the necessary flexibility to perform our interviews and to accommodate our questionnaire from organisation to organisation, and also from individual to individual in each organisation. Still, the results where comparable due to the structure of the questionnaire and the preparations we made prior to each interview. This contributed to our understanding and rapidly building knowledge on distributed projects.

Data acquisition
Project execution and project management are strongly influenced by the culture, routines and processes in each basis organisation. The qualitative method allowed us to get beyond these distinctive organisational characteristics and search for the genuine common practice in distributed projects. The benchmarking methodology truly was a helpful tool in this regard.

Data interpretation
The benchmarking methodology helped us to validate our findings of a best practice in managing distributed projects. The best practice described in this report is based on the experience and knowledge from all the organisations benchmarked. However, the selection is too small to claim a general validity and uphold that we have found the best practice in managing distributed projects in a reliable manner. This is why we have claimed that the CoDisCo project has identified and described a general good practice in managing distributed projects.

7.4 Suggestions for further research activities

A good suggestion would be to prove that the good practice in managing distributed projects actually is the best practice. This can be accomplished in two ways. First alternative is to prolong the benchmarking study and find new benchmarking partners, thus giving improved validity and reliability to the results of this research project. The second alternative would be to conduct a quantitative study to confirm the reliability of the results.

Another suggestion would be to implement the good practice identified, and make regular follow-ups to ensure that the good practice actually helps the project to become more successful. It could also be of interest to study communication and teambuilding processes in order to provide a better and more operational description on how to execute these processes.

References

[Andersen, 1995] Andersen, B.: *The Results of Benchmarking and a Benchmarking Process Model*. Norwegian University of Science and Technology, 1995

[Andersen and Pettersen, 1995] Andersen, B. and Pettersen, PG.: *The Benchmarking Handbook*. Chapman & Hall, 1995. ISBN 0-412-73520-2

[Dragsund, 1998] Dragsund, H: Benchmarking of Distributed Processes, Diploma Thesis, Norwegian University of Science and Technology, 1998.

[Furnham & Gunter, 1992] Furnham, A. and Gunter, B., *Corporate Assessment.* London: Routledge, 1992

[Grenness, 1999] Grenness, Carl Erik: *Communication in Organisations – An introduction to communicative theory and techniques*. (Written in Norwegian) Abstrakt forlag 1999. ISBN 82-7935-004-7

[Haywood, 1996] Haywood, Martha: *Managing Virtual Teams: Practical Techniques For High-Technology Project Managers*. ISBN: 0-89006-913-1

[Miller et.al., 2001] Miller, Roger and Donald R. Lessard; *The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance.* ISBN 0-262-12236-7

[Mintzberg, 1983] Mintzberg, H., *Structures in Fives: Designing Effective Organizations.* Englewood Cliffs, NJ: Prentice-Hall, 1983.

[Mitchell & Larson, 1987] Mitchell, T.R. and Larson, J.R., *People in Organizations.* New York: McGraw-Hill, 1987.

[PMI, 1996] Project Management Institute: *Project Management Body of Knowledge.* ISBN 1-880410-12-5

[Riis, 2000] Riis, Eva: *Klar tale - introduktion til begreper omkring virtuelle prosjekter.(pp 301-304)* Paper presented at the Project Management Conference Nordnet 2000 in Copenhagen. ISBN 87-985726-5-2

[Rolstadås, 1997] Rolstadås, A.: *Praktisk Prosjektstyring*. Tapir, 1997.

[Triandis & Albert, 1987] Tridanis, H.C. and Albert, R.D:, Cross-Cultural Perspectives. In F.M. Jablin, L.L. Putnam, K.H. Roberts and L.W. Porter (eds), *Handbook of Organizational Communication.* Newbury Park: Sage. 1987.

[Weick, 1987] Weick, Karl E.: *Theorizing About Organizational Communication.* Article in Jablin, Putnam, Roberts & Porter, *Handbook of Organizational Communication (pp 97-122).* Newbury Park, CA: Sage Publications, Inc. 1987

[Westhagen, 1995] Westhagen, Harald, et al.: *Project work.* (Written in Norwegian) Universitetsforlaget, 1995. ISBN 82-00-22459-7

Bibliography

- Dragsten, Håkon, *Benchmarking of Distributed Processes*, Diploma Thesis, Norwegian Universtiy of Science and Technology (NTNU), 1998
- Gilhus-Moe, C. and Andersen, J.C., *Time and Risk Management in Distributed projects*, Pre-diploma thesis, NTNU, 1999
- Holme, I.M. and Solvang, B.K., *Metodevalg og metodebruk.* TANO AS, 1996. ISBN 82-518-3427-9
- Kløvstad, Jørn, *Risk Management and Quality Processes in Distributed Projects*, Pre-diploma thesis, NTNU, 1999.
- Kløvstad, Jørn, *Change Management in Large Engineering Projects using an EDMS*, Diploma thesis, NTNU, 1999.
- Nitter, Peter, *Quality Assurance Procedures in a Large Engineering Project Aided by EDMS: A study*, Diploma thesis, NTNU, 1999.
- Raugstad, Morten, *Cost Management in Distributed Projets*, Pre-diploma thesis, NTNU, 1999
- Raugstad, Morten, *Large Projects: The Impact of the Front-End on Success in Execution*. Diploma thesis, NTNT, 1999 (In Norwegian)
- Selmer Thon, Jens, *Decision Communication in Distributed Projects*, Pre-Diploma Thesis, NTNU, 2000 (In Norwegian)
- Virtualteams.com, from NetAge Inc. (http://www.virtualteams.com)
- Aasgaard, Gisle, *Benchmarking Analysis of Distributed Projects*, Pre-Diploma Thesis, NTNU, 2000

Dissemination of project results

Andersen, Bjørn; Acedo, Jimena and Langlo, Jan Alexander: *Experiences in Benchmarking Distributed Projects*, 1999, Paper in Artto, Karlos A., Kähkönen, Kalle og Koskinen, Kai (editors): Managing Business by Projects, Proceedings from NORDNET '99, ISBN 951-22-4671-6, Project Management Association Finland, Helsinki, Finland.

Andersen, Bjørn; Acedo, Jimena and Langlo, Jan Alexander: *Distributed projects: Best practice identified*, 2000, Paper in Project Management Research at the turn of the millennium, Proceedings of PMI Research Conference 2000, ISBN 1-880410-88-5, Project Management Institute, Inc, Pennsylvania, USA.

CoDisCo - IT and information management in distributed projects, workshop arranged by Norwegian Center of Project Management, June 27 2000

Appendix A Good practice in processes: time, cost, quality and risk management

Appendix A Good practice in processes: time, cost, quality and risk management

Good practice regarding project time management

Good practice identified within time management seems to have special characteristics compared with the time management in non-distributed projects.

Schedule planning
Since the scheduling process is strongly based on historical information and experience, the best way of keeping that historical information is in databases as explained in the previous section.

During the activity definition process, in addition to the use of work breakdown structures, every partner involved in the project makes an abstract of their roles so that the project manager can detect deviations or misunderstandings.

Schedule control
When working distributed, the flow of information does not happen so often and easily as when working face to face. Therefore a very active use of the progress meetings is crucial for the success of distributed projects. It is in these meetings the exchange of information and communication regarding schedule control take place and milestones are checked. During the meetings, physical or virtual, it is very important to be open and not keep back problems. It is important to remember that in a distributed project there can be no communication around the coffee machine.

The reporting of the progress in a distributed environment is proactive. This means that all the members know what to report, how and when, without being previously asked. The activities are reported twice, when started and when finished, so that the project manager may have a better picture of progress of the project.

IT tools and educational approach
From the benchmarking study it can be said that standard office applications and project management programs are used for the scheduling, while e-mail, shared areas and information management applications are used to distribute schedules and all the related information. The degree of standardisation in the IT tools is a relevant question for a smooth running of the project, and it should be as high as possible. Even if the IT tools used are different in the different locations, at least the interface should be the same.

Following a project until the end seems to be a good practice to enhance experience-based learning about time management, in addition to courses about both scheduling techniques and tools.

Good practice regarding project cost management

Good practice identified within cost management seems to have special characteristics compared with the cost management in non-distributed projects.

Project budgeting
The cost management process is based on historical information and experience. Databases are used to keep that important information in the way mentioned previously in this document. Updating the information after checking the validity is decisive here.

A common way to handle a lack of resources is by outsourcing. It is interesting to highlight the advantage that the fact of working distributed can give in this respect. Working distributed across several organisations and countries facilitates to find the right human resources and to make the most of this chance has been seen as a good practice.

Regarding documentation of the cost estimating process, this is thoroughly documented describing all assumptions made during the process. The documents follow guidelines to ensure correct and complete documentation and are used in future projects.

Specific good practice in small organisations with small projects:

- The company manager and the project manager are the responsible ones for resource planning.
- The project manager carries out the cost estimation and is the responsible person for the budgeting process.

Specific good practice in large organisations with medium projects:

- The head of each department or the project manager is in charge of resource planning.
- The budgeting department carries the cost estimation or it is done in each department while the responsible person for the budgeting process are the project initiators or the economical department.

Specific good practice in large organisations with large projects:

- The head of each department is in charge of resource planning.
- The budgeting department carries out the cost estimation and the responsible person for the budgeting process is the project manager with the assistance of the budgeting department or the project team.

Cost control
The responsible person for the cost control is the project manager. The costs are reported and followed up to ensure adherence to the budget. Monthly performance reports are used but the frequency of the reporting is adjustable and can vary for a project to another, for example it increases at the end of the project. The performance report has fixed format and is as thin as possible.

IT tools and educational approach
In cost management, standard office programs and project management software are used, while e-mail, shared areas and information management applications for distributing cost related information are the IT tools used in cost management.

On-job-training aimed at knowing what is being estimated seems to be a good practice to enhance experience-based learning about cost management, in addition to courses about both estimating techniques and tools.

Good practice regarding project quality management

Good practices identified within quality management in distributed projects do not differ from good practices in general quality management. The same principles and basis rules are applied, in order to optimise quality management processes in distributed projects as well as "ordinary" projects. The challenge, however, is closely connected to communication and facilitating team processes. How does the project manager manage to control quality management processes in a distributed environment?

Extensive communication
Extensive use of communication and distribution of information is a key aspect of quality management in distributed projects. All relevant information is available for all team members at all times. However, uncritical distribution of information is not doing any good. Hence, the use of guidelines for regulating this communication and storing of information.

Facilitating teamwork
Teamwork is essential for quality management. A good practice is therefore to facilitate teamwork and make the team members socialise at an early stage of the project. Knowing each other (both socially and professionally) makes it easier to communicate and carry out the different processes in the best possible way. Thus, regular project meetings and social events in conjunction to these meetings are essential for quality and project success.

Quality focus
In order to optimise quality management, the focus has to be put on individual skills and on process rather than end product. In a distributed environment, solely end product control will not be economical or practical. Thus much effort should be put in educating and following up each individual, and giving each individual the responsibility for the quality of his or her process. These are the same principles as in Total Quality Management (TQM), but it is of essential importance that the Quality Management is carried out in this way in distributed projects.

Good practice regarding project risk management

Most challenges within risk management are similar in national and international projects. But there are some aspects that become more important when executing a distributed project - other than the fact that the risk is very distributed given the distributed nature of the project. The most difficult part of such projects is to get a common understanding between the partners, and ensure that all the information they provide is collected and processed in a proper manner. Another difference to "ordinary" projects (non-distribution) is the use of compensating measures, i.e. reducing risks by adding more and bigger buffers to time and economic estimates. It is also important to have a good knowledge and understanding of cultural differences which in itself could be a key to success The participants will have cultural differences that have to be surmounted. Introduction of a "social scorecard" might help this effort. The team building becomes more difficult because of small misunderstandings in the exchange of the information, and one should run workshops to mitigate it

Five elements stand out as a best practice in risk management. These are:

- Record of historical data
- Checklists
- Individuals responsible for different risk elements
- Review board
- Continuous follow-ups

Record of historical data

Recording of historical project data and use of it is essential for risk management. The use of historical data nearly automates the tedious and reoccurring elements, thus allowing time to focus on unique and special elements. After project hand over, each project team should complete a report describing their experience from this project as well.

Checklists

The development of checklists is based on errors anticipated to occur. This anticipation is then again based on experience from similar projects or situations. People from different departments and with different competencies should be involved in developing these checklists. These lists are to be actively used in the projects, and gained experiences from each project should be recorded or use in subsequent projects. All involved in the project should have access to these lists and the information they are based on, and it is an advantage if this information is actively used.

Individuals responsible for different risk elements

The project manager should be overall responsible for the risk management, but can distribute responsibilities for different risk elements to individuals. If a risk become critical, the project manager will still be responsible for taking appropriate actions, but all the others should support and participate in the extra work that has to be done. Usually one of the project team members already has the direct responsibility to monitor the risk and its development, and will also be responsible for the new situation.

Review board

There is also possible to appoint a review board, where the Project manager reports about the development and status of the project. The main function of the board is to help the project.

Continuous follow-ups

Projects regularly have follow-up meetings in order to identify and describe any new risks that may come into consideration. These meetings are held once a month.

It is important to recognise the fact that we have to have a differentiated perspective on Risk Management, depending on time aspect. In the early phases of a project, the main focus of risk management is to identify the right project. Later on in the project, the main focus is to find a way to make the best out of the project. The single most important element in risk management is to create and maintain an arena where risks and risk elements are presented and discussed openly and freely. Focus on communication and information to establish a “common goal”.

Appendix B Summary of the IMEC study

Appendix B Summary of the IMEC study

In this appendix, the main findings from the research programme IMEC (International Programme on the Management of Construction projects) are presented. In the period between 1995 and 1999, IMEC undertook an analysis of about 60 projects around the world and within different sectors and industries. As opposed to CoDisCo, these projects were not selected based on their being distributed projects, but rather to represent a wide selection of large projects. However, most of these projects did anyhow represent distributed projects, and thus we have tried to extract the most relevant findings for the CoDisCo research. Since this research has not been part of the CoDisCo project, these findings have not been included in the main part of this report. However, if the reader finds them interesting, much more detail can be found in The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance [Miller et.al., 2001].

The bad news learned through the IMEC programme was that close to 40% of the studied projects displayed a poor performance level. Instability created by external and internal shocks create crises. When such a dynamic has been set in motion, disasters develop unless the project's constitutional framework is able to function as a stabilizer. The good news is that project managers have learnt ways to handle risk and manage such projects. The IMEC studies generated new knowledge about which factors that affect a project's degree of success or failure. Four main factors seem to govern the success rate:

1. The extent to which the institutional framework of the country where the project is located has been developed.
2. The extent of strategic systems implemented by the project sponsors.
3. The surrounding difficulties in the shape of risk, technology, and social disturbances.
4. The coordination toward suppliers, authorities, other affected parties, as well as international players.

A majority of the projects did in the end fulfill the objectives defined by the sponsors and were evaluated as positive, both the involved and other affected parties. A considerable share of the projects did, however, run into problems, crises, and much trouble, both in the front end, the execution phase, and the first years of operation. In fact, crises or restructuring are so common that they should be viewed as a normal part of the game of large projects. The table below gives a brief overview over the projects' performance levels.

Criteria	Share
Projects that fulfilled the defined objectives	45,1%
Projects below the objectives, but still satisfactory and without crises	19,4%
Projects that stayed within budget	81,9%
Projects that stayed within schedule	71,4%
Projects that were restructured after having experienced crises	16,1%
Projects that were terminated after problems in the strategic development phase	6,5%
Projects that experienced degeneration but were taken over by public forces after bankruptcy of private sponsors	9,7%
Projects that were terminated as they were seen as unnecessary	3,5%

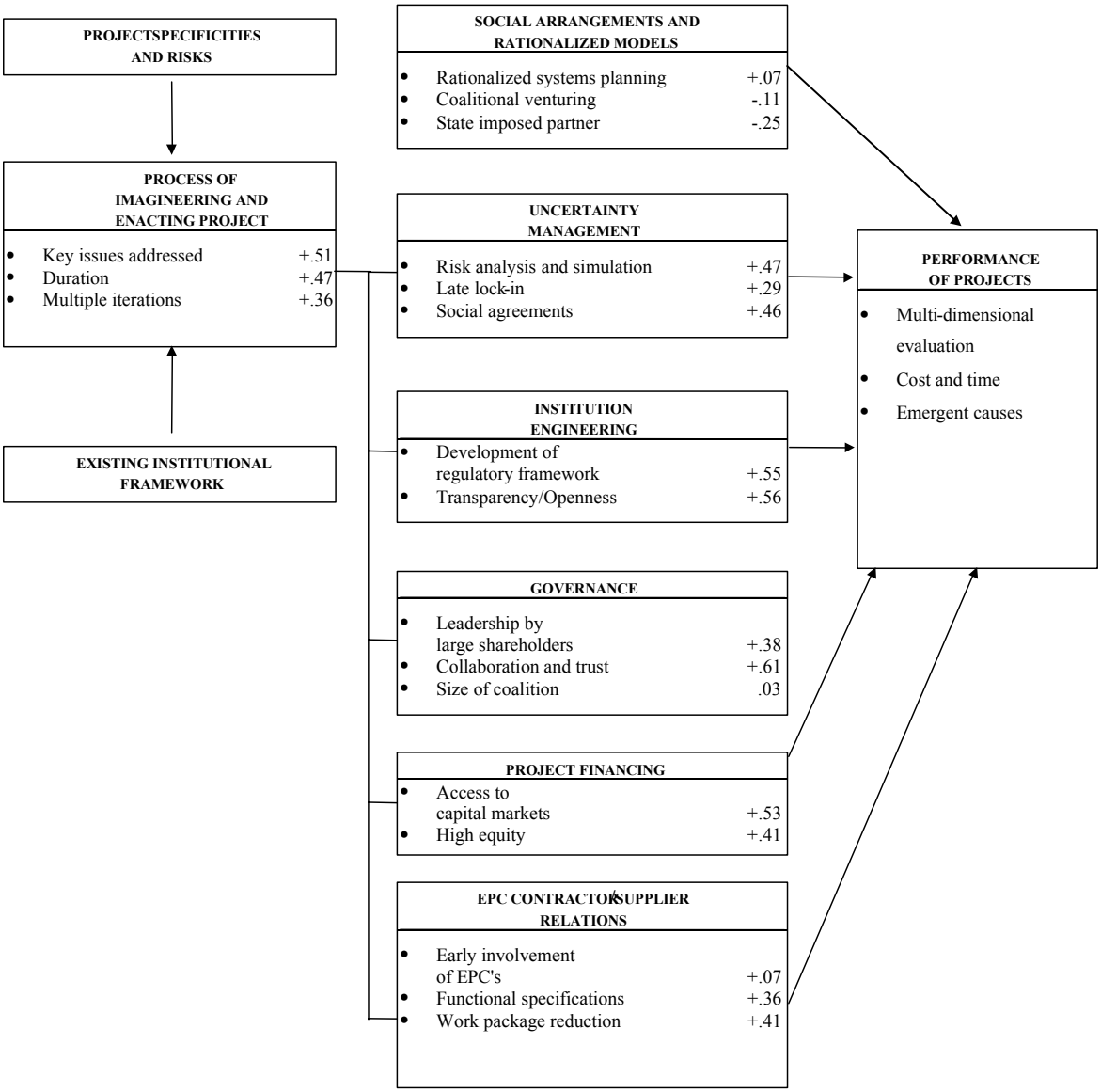
The long list of difficulties observed by IMEC might be interpreted to mean that such large investment projects are unmanageable. After studying 60 such projects, IMEC's conclusion was, however, that they are definitely manageable. But managing them cannot only be based on

traditional management theories. Planning can not alone ensure a safe future. Projects are made manageable through developing strategies to (i) handle risk (ii) shape institutions (iii) build governance structures (iv) create suitable financial frameworks, and (v) develop innovative execution methodologies.

Despite the many difficulties, it is possible to manage projects through a strategic effort to handle risk, establish agreements, and responding to crises that might arise. From the analysis of the sixty projects, a number of means for controlling projects were identified. The figure below shows that strategies to manage projects are not individual factors, but configurations of many different interacting elements. The strategic areas in the figure are linked to performance levels through correlation factors, and these are as follows:

- Social arrangements refer to the set of models that managers can choose among, e.g., a rationalized systems approach, relational joint venture, etc.
- Uncertainty management is practices to identify potential risk and strategies to mitigate them should they occur.
- Institution engineering, when projects require laws and regulations that do not exist today.
- Governance, exerted to establish coalitions with sponsors, public authorities, and other affected parties.
- Project financing, that fits the project's nature and risk profile.
- EPC (engineering, procurement, and construction) contractor/suppler relations, that can give innovative designs that dramatically reduce costs.

The factors given in the figure represent the degree of correlation between the different elements and project success. For example, risk analysis and simulation has a factor 0f +.47, which indicates a very strong correlation with project success.



During the front end of projects, a number of characteristics of successful projects were identified (where again the correlation figures represent correlation between the factor and project success):

Coalition

- Leader is large shareholder +.38
- Ownership dispersion +.18
- Variety of coalition membership +.26
- Complementary symmetry +.36
- Leader with operational experience +.28

Front-end processes

- Duration of FE process (long) +.51
- Late lock-in +.29
- Domination by one sponsor +.32

- Multiple iterations +.42
- Joint and innovative problem-solving +.46
- Deliberative and innovative joint problem-solving +.37

Agreements and protocols

- Risk allocations to competent partners +.58
- Agreements with opponents +.52
- State-imposed partners -.25
- Strong partnership +.23
- Key issues addressed +.52

During the execution phase, a similar set of performance promoting best practices were identified:

Coordination agreements with government regulators

Efficiency inducing
- Public policy framework for project delivery
- Open/transparent rules
- Smart, small bureaucracy
- Partnership between state and private parties

Inefficiency inducing
- BOT framework unclear as to goals
- Powerful uncooperative bureaucracy
- Deals and privileges approach
- Government refuses partnership

Coordination with opponents

Efficiency inducing
- Simulation of expectations
- Readiness to redesign and negotiate
- Participation of international agencies
- Formal EIA framework

Inefficiency inducing
- Disregard of strength of opponents
- Lack of legitimating framework
- Fear of conflicts as failures
- Absence of communication strategists

Coordination to form ownership coalition

Efficiency inducing
- Credible,varied strategic investors
- Protocol to share rent/residual claims
- Contention system for resolving legitimate issues
- Leadership from operator with strong equity position

Inefficiency inducing
- Extensive asymmetries
- Narrow coalition
- Government guarantees
- Domination of decision-making
- Entrepreneurial leadership ready to strike deals fast

Coordination in strategic project definition

Efficiency inducing
- Progressive definition within varied team
- Co-engineering with experienced elite engineers from owners and suppliers
- Structured debates and contention framework for joint search and discovery

Inefficiency inducing
- Early lock-in under urgency
- Rigid standards from past learning and experience
- Waterfall approach

Finally, some correlation factors were calculated that show the connections between different aspects of the execution phase and project success:

Dimension of EPC process	Correlation with project performance
Team diversity	nil
Concurrence of design, engineering, procurement and execution	+.27
Trust between partners	+.37
Effort to reduce number of work packages	+.32
Data exchange between owner, contractors and suppliers	+.39
Extent of co-decisions between owner, contractors and suppliers	+.41
Effort to learn from project	+.37
Alternative conflict resolution mechanisms	+.35
Relational contractual forms	+.22

We realize that this has been a mere appetizer of the results from the IMEC project, but since this is a report from CoDisCo and since these results were not specifically made with reference to distributed projects, it is all we have chosen to include. To gain further insight into the results and conclusions from the IMEC programme, please refer to the recent book based on the programme: The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks, and Governance [Miller et.al., 2001].

Appendix C Benchmarking Methodology

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SINTEF Industrial Management

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CoDisCo

Work Package 1 – Benchmark:

Draft Benchmarking Methodology

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Draft BM Methodology

PROJECT NO.	DATE	PERSON RESPONSIBLE/AUTHOR	NUMBER OF PAGES
387220.01	December 4th, 1998	Bjørn Andersen, Jan Alexander Langlo, and Jimena Acebo	30

1 INTRODUCTION

This document constitutes a first draft benchmarking methodology to be used in the benchmarking work package of the CoDisCo project. It will be refined over the coming weeks and months, but will also be used from the start of the data collection activity in this work package.

2 TABLE OF CONTENTS

3 BENCHMARKING BACKGROUND

The term benchmark means:

A benchmark is a measured "best-in-class" achievement recognized as the standard of excellence for that business process.

An operational definition of benchmarking is shown in Figure 3.1.

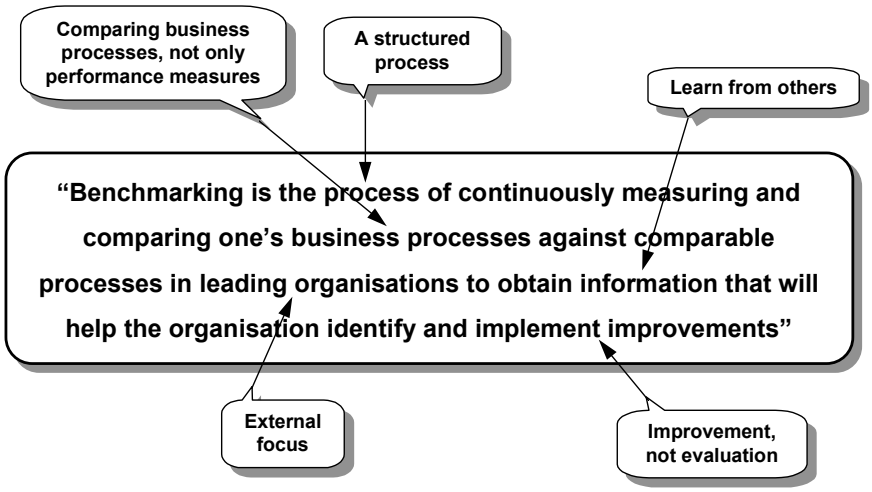

Figure 3.1 Operational definition of benchmarking

Based on the highlighted issues in this definition, the following can be deemed the most important purposes of benchmarking:

- The purpose of a benchmarking study is not only comparing for the sake of evaluation, but also learning for achieving improvements.
- One does not compare only key figures, although performance measures are an important element in the comparison. Processes, i.e., how tasks are performed, are the central element in the comparison.
- By looking at how those who are better perform their processes, one can learn from the companies that have already achieved a higher performance level than oneself.
- The learning effects are not limited to information available from competitors. It is rather encouraged to take an external view, seeking the best companies, regardless of industry.
- Benchmarking is not some left-hand task that one hires a consultant to do. Benchmarking should be done according to a structured process, where one self harvests the learning effects.

There exists a number of different benchmarking methods, most of which are quite similar in approach. At SINTEF, the so-called benchmarking wheel has been developed, see Figure 3.2. This is a benchmarking process model that describes the steps to be performed in a standard benchmarking study.

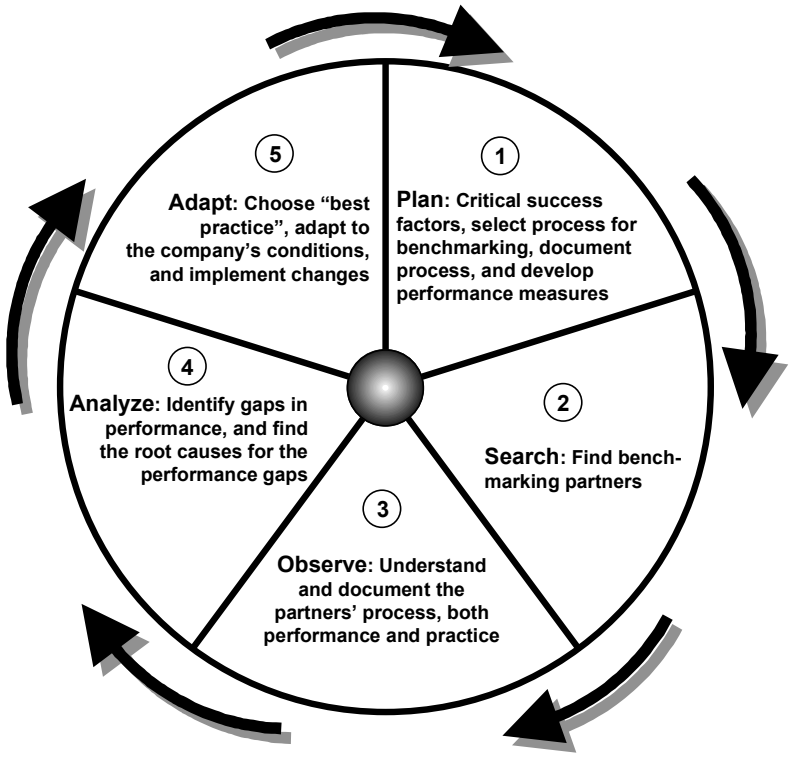

Figure 3.2 The benchmarking wheel

The approach has been adopted both in the projects TIME GUIDE, ENAPS, and SMArTMAN SME, and we recommend that the benchmarking wheel also is chosen as the basic benchmarking method in CoDisCo. Even if the benchmarking wheel forms the basis of the benchmarking method in CoDisCo, quite some work still remains to be performed in terms of defining the specific quantitative performance measures and qualitative business process and practice descriptions to be collected. This work has been briefly started, and the initial results follow later in this document.

The basic content of the benchmarking process is:

- Select and document the process to be benchmarked.
- Identify who performs this process best.
- Observe and analyse how the benchmarking partner performs this process.
- Analyse the causes for the gap in performance.
- Implement improvements based on this analysis.

In CoDisCo, the processes to benchmarked have already been selected. These are:

- Scheduling routines.
- Budgeting processes.
- Risk management.
- Quality processes.

These descriptions are, however, rather wide, and there is therefore a need to specify which aspects are desirable to study. Through the connections of the consortium and general literature searches, best practice projects and companies must be identified that can be used as benchmarking partners. During the data collection phase, performance and practice data about

these best practice projects and enterprises and how they perform the processes in question will be collected. In the data analysis phase, the collected data will be analyzed for the purpose of identifying elements of best practice that contribute to superior performance levels.

Thus, the benchmarking activity in CoDisCo logically follows the steps of the benchmarking wheel, which should therefore be well suited as a framework for these tasks.

4 NECESSARY INFORMATION AND DATA

In order to decide which information will be needed, we have to consider how the information will be used. In the CoDisCo project, the results from the benchmarking will support the development of a software tool for connecting distributed competencies.

Information needed in the analysis can be divided into two groups:

1. Qualitative information, in the form of descriptions of the processes selected for benchmarking. Typical questions that should be answered are:

- How is this activity performed?
- Who performs this activity?
- When/under which circumstances does this activity occur?
- Which tools are used?

2. Quantitative information, concentrating on the parameters of time, cost, quality, flexibility, and environmental impact. Performance data for these processes will be used to determine which processes constitute best practice.

For both of these types of information, a data collection tool will be developed that guides the interviewers during the visits at the benchmarking partners. The first draft for this data collection tool is presented later on.

5 BENCHMARKING PARTNERS CONTRIBUTING BEST PRACTICE INFORMATION

As the heading attempts to indicate, the term benchmarking partner is used to describe an organization or a project that is studies to identify elements of best practice. It goes without saying that the host must be willing to allow the data collection to take place.

To address the number of benchmarking partners first, general advice suggests a balance to enable cross-fertilization among ideas from different benchmarking partners, while costs tend to explode with increasing numbers. A suggestion is that for each of the four processes to be studied, there should be two to three benchmarking partners. On the other hand, one benchmarking partner might very well give input on more than one process. We therefore suggest that we include the following as benchmarking partners in this project:

- The consortium partners that might have relevant information to surrender, hopefully Aker Finnyards, Hönnun og Ráðgjöf, and Kockums Computer Systems.
- Four to eight external organization or projects identified as having good or best practice in the area of one or more of the four processes to be benchmarked.

The second issue under this heading is how to identify the benchmarking partners. Normally, several different sources for information about potential best practice companies are utilized:

- The company's own network, including suppliers and customers.
- Industry associations and other professional organizations.
- Media attention.
- The Internet.
- Etc.

In the CoDisCo project, it is recommended that the knowledge and networks of the consortium be utilized for the purpose of finding benchmarking partners. In addition, general searches for benchmarking partners must be undertaken.

6 CONDUCTING THE BENCHMARKING

During the fall of 1998, a data collection tool to be used when visiting the benchmarking partners will be developed. This tool will be based on work done previously in other projects, for example SMArTMAN SME and Project 2000. The tool will probably contain:

- Description of the benchmarking approach and data collection methods.
- Forms to identify the relevant interviewees in the best practice companies.
- Questionnaire/interview guide for data collection.
- Hints for the benchmarking activity.

SINTEF will have to play the major part in the data collection phase. However, to ensure that all partners learn and gain experience in the use of the benchmarking method and gain insight into the best practices observed, this task should be carried out in cooperation with these. Furthermore, this can also ease the data collection job if any of the best practice enterprises are located in the home countries of one or more of the consortium partners.

After the data collection has been completed, the data must be analyzed to determine what best practice elements have been found. For this purpose, SINTEF will also develop an analysis methodology, again based on previous work done, during the fall of 1998.

7 DATA COLLECTION TOOL

This tool will be refined during the course of the CoDisCo project and the aim is for it to contain the following elements:

- Guidelines to what the selected project processes include.
- Guidelines for selecting the respondents and interviewees when collecting data.
- Qualitative questions to be used when collecting best practice descriptions about the projects that are benchmarked.
- Quantitative performance indicators to be used when collecting performance data about these projects.
- Guidelines and tools for analysis of the collected data.

In some more detail than the benchmarking wheel is able to convey, the sequence of activities when undertaking the actual benchmarking information collection is:

❶ Before any primary data is collected from participants in the project, secondary data about it should be collected and studied. Such information can often quickly give the benchmarkers a good overview over the project and enables more effective use of the time allowed for data collection than simply taking down well-known facts.

❷ Deciding on the time when the data collection will be undertaken, which must be done in close cooperation with the project owners. The data collection period will normally last one to five working days, depending on the complexity of the project.

❸ During the agreed period of time, information and data about the project are collected based on the qualitative and quantitative questions given later in this data collection tool. Before the data collection starts, a confidentiality agreement should be signed guaranteeing that the data will only be used to derive general best practice descriptions and not linked to any specific project or enterprise. During this period, interviews are held with typically five to fifteen persons involved in the project. Typical interviewees, from one or more of the organizations involved in the distributed project, are:

- Project managers.
- Project planning personnel.
- Cost estimating and budgeting personnel.
- Quality planning, control, and assurance personnel.
- Risk management personnel.

A form that can be used to identify the relevant interviewees can be found later in this data collection tool. Before setting up the specific appointments with the interviewees, it must be made sure that the project management has informed these about the benchmarking activity and cleared their participation in it. Each interview normally lasts between one and two hours to minimize the load put on each individual.

❹ After the data has been collected, a report describing the most important findings from the project must be generated and circulated among the interviewees to verify the conclusions. This report will in turn be the main basis for the analysis of all the studied projects to infer conclusions about best practices.

7.1 Detailed Project Process Selection

To make it easier to focus the data collection efforts toward the same areas in each interview and project, the following sub-processes of the main project processes selected for benchmarking should be studied:

- Project scheduling routines:
  - Developing a work breakdown and activity descriptions.
  - Deciding on a sequence of activities.
  - Estimating durations of activities.
  - Establishing distributed schedules.
  - Distributing and updating the schedules among the project participants.
  - Handling of changes in the schedule.
  - Monitoring progress and schedule control.
- Project budgeting routines:
  - Resource planning.
  - Cost estimating.
  - Budgeting.
  - Cost control and follow-up.
  - Contracting and payment procedures for third party assistance.

- Risk management:
  - Risk identification and definition.
  - Risk assessment.
  - Developing risk responses.
  - Managing risk responses in critical situations.
- Quality processes:
  - Quality planning.
  - Quality assurance.
  - Quality control.
  - Project process documentation.
  - Integration of third parties in the quality processes.
  - Certification principles.

7.2 Respondent and Interviewee Selection

When identifying the right persons within the project to talk to, it is essential to cooperate with one key contact person within the project. Links to this contact person must be established when searching for and deciding on the benchmarking partners, i.e., the projects to study more closely. The following template can be used when asking the contact person to systematically indicate which persons are useful to interview:

To: Project manager/contact person

As agreed earlier, we will use your project as a benchmarking partner in the CoDisCo project for the purpose of documenting any best practices developed and used in the project. To ensure that we collect the right information from the right persons within the project, we are depending on your assistance. Keeping in mind that we will focus on the following project processes:

- Scheduling routines.
- Budgeting processes.
- Risk management.
- Quality processes.

We ask you to fill in the table below and return it to us. Please also feel free to add other roles in the project that those predefined by us. As we will start scheduling interviews with these persons in the near future, we also ask that you inform them about the benchmarking activity and grant them permission to conduct these interviews.

Role in the project	Name	Telephone	Fax	E-mail
Project manager				
Project planner				
Schedule monitoring				
Cost estimator				
Budget developer				
Cost control				
Contract manager				
Risk identifier				

Risk manager				
Quality manager				

On behalf of the CoDisCo project,

NN
CoDisCo

When entering into agreement with a project about using it as a benchmarking partner, the following template confidentiality declaration can be used as a basis for establishing trust in the data collection and ensuing analysis process:

Confidentiality Declaration

In connection with the benchmarking of the _____ project as part of the CoDisCo research project, the following researchers:

- NN
- NN
- Etc.

Commit to not publishing, divulging, or in any other ways making available to third parties information and data collected during our work on benchmarking the project. We will keep confidential information strictly secret and take all precautions necessary to ensure that such information does not reach any third parties.

Place: _____ Date: _____ Signature: _____

7.3 Qualitative Questions

This section contains the qualitative questions that should be sought answered during the data collection phase. In addition, the sequence of the questions more or less constitute a template for writing the report from each project. Since there are very many questions, not of equal importance, they have been divided into three levels. These are as follows:

- Level 1: Crucial for the understanding of the process, includes questions that represent what is seen as the core information that *is needed* in order to understand the process. In other words, the questions that have to be answered by the interviewee(s).
- Level 2: Complementary information, includes information that is not crucial for the understanding of the process, but that can complement the information in level 1. Thus this information should *preferably* be answered by the interviewee(s).
- Level 3: Information about details in the process, this information is the lowest level of information needed, and consist of details describing factors from level 1 and 2. These

questions can be viewed as *optional* since they contain information that is not necessary for understanding the processes but information that can give a more fulfilling picture of the process.

For the purpose of more easily being able to navigate through the questions, they are presented in the following fashion:

❒ Level 1
❒ Level 2
➢ Level 3

7.3.1 INTRODUCTION

Project name:

One to two pages describing key aspects of the project, e.g., how it started, what the main purpose it, the main schedule, important size figures, key participants, etc.

7.3.2 SCHEDULING ROUTINES

General

❒ Who is responsible for the scheduling process of the different project activities? Are the scheduling process centralized or decentralized?

❒ How are the different scheduling activities, such as activity definition and activity sequencing, organized and coordinated among distributed project participants?

❒ How is the whole scheduling process being conducted? Can you draw a flow chart of the process?

❒ What kind of IT-tools are exploited in the scheduling process, including the distribution and coordination of scheduling information?

❒ How are the project schedulers being trained to be able to exploit the possibilities of new scheduling software and applications?

Activity Definition

❒ How is the total amount of work in the distributed project broken down to manageable work packages and activities, especially considering the coordination of work among the distributed project participants?

➢ Are work breakdown structures and organizational breakdown structures included in this process?

Activity Sequencing:

❒ By what means are the different project activity sequenced?

❒ What especial consideration is taken to sequence activities that include distributed project participants and/or distributed project activities?

Activity Duration Estimating:

- ☐ By what means are the duration of the different activities estimated?
  - ➢ Do you use a historical data base, computer software or other tools?
- ☐ Are there taken into consideration special effects due to the distribution of the project, like different cultures or languages among the project participants or geographical distances?

Schedule Development:

- ☐ By what means are the project schedules being developed?
  - ➢ What kind of scheduling tool do you apply to your main schedules? PERT, CPM, Bar Charts?
  - ➢ Which software are applied in this process? How was this software selected?
- ☐ How are the different schedules combined to one master schedule? Who is responsible?
- ☐ How are these different schedules distributed and to whom?

Scheduling Control:

- ☐ What approaches are used to monitor the progress in the different work packages and activities to ensure that delays are avoided?
- ☐ What especially considering is taken to controlling distributed project activities?
- ☐ How often are progress meetings scheduled?
- ☐ By what means are important project milestones being controlled?
- ☐ How do you calculate effects from delays?
- ☐ How are changes in the schedule handled?
- ☐ How often are the project schedules updated?
- ☐ What distribution routines exist for updated schedules? Who receives these schedules (customers, suppliers, project participants)?
- ☐ Who within each project activity is responsible for the different scheduling control activities?

7.3.3 BUDGETING PROCESSES

General

- ☐ How are the budgeting processes being performed? Can you draw a flow chart of the

process?

- What IT-tools do you apply in the budgeting processes, including the distribution and coordination of budgeting information?

- How are the budgeting personnel being trained to exploit both budgeting techniques and new software/technology?

Resource Planning

- How are the project resources identified and quantified in order to define the resource pool?

- What especial consideration is taken to the identification and the planning of use of resources among the distributed project participants?

- What methods are used to allocate these resources to the different project activities?

- How are these resources leveled? What is the leveling criteria?

Cost Estimating

- By what means are the cost of the different project resources estimated? Are these based on a database with historical cost data, experienced personnel, software or other methods?

- How are uncertainties in these estimates handled? What extent of uncertainty is approved?

Cost Budgeting

- How is budgeting performed in the project?

- Who is responsible for budgeting in the different project processes? Are the budgeting process centralized or decentralized?

- How are the different project budgets coordinated to a major budget? How is this coordinated among distributed project participants?

- Who reviews these budgets before they are approved?

- What criteria must be fulfilled for the different budgets to be approved?

Cost Control

- Throughout the project, how are costs reported and followed-up to ensure adherence to budget?

- Who is responsible for following up the costs of the different project activities? What about the control of the overall project budget?

- Are external cost factors, such as fluctuations in exchange rate being controlled? Are plans made to ensure that the organization are prepared for this?

- What plans are made to ensure that appropriate actions are taken if the budget is exceeded?

Contracts

- What kind of contracts are used with suppliers and other project participants and how are these being paid?

- What kind of reward/punishment system do you have with suppliers and other project participants? Do the contracts have incentives tied to them depending on project or process outcomes?

- What is the procedure for reviewing contracts?

  - Who is responsible in the contracting reviewing process?

  - Are there records for contract reviews?

7.3.4 RISK MANAGEMENT

General

- How is the organization/cooperation of risk management processes between distributed project participants? Are the risk management centralized or decentralized?

- Is the project organization prepared for the special effects due to the distribution of the project?

- How are the entire risk management process being conducted? Can you draw a flow chart of the process?

- What kind of IT-tools do you apply to the risk management processes, including the distribution and coordination of risk management information?

- How are risk management personnel being trained to be able to exploit both risk management techniques and software that are applied in this process?

Risk Identification Routines

- What kind of risk analysis was performed in the different stages of the project?

- Who conducted the main studies and when where they performed?

- To what extent are different project managers involved in the identification process of project risks? Are they identified in a close cooperation between the different managers?

- To what extent are external project risks due to the distribution of the project investigated, such as the identification of political risk and risks due to cultural differences?

- What about the identification of interactions between different risks, for example decreased exchange rate combined with increased interest rates?

Risk Quantification Routines

- ☐ By what means are the different project risk quantified?
  - ➢ What elements are emphasized in the definition of risk levels?

Risk Response Development

- ☐ By what means are risk response developed?
- ☐ Who are responsible for responding to the different project risks?
- ☐ How are risk response plans developed?
  - ➢ Who are responsible for developing these plans?
- ☐ What actions are taken to decrease the effect of risks due to the distribution of the project?
  - Political risks
  - Exchange rate risk
  - Risk due to communication problems
  - Market risk due to increased international competition
  - Competence and stability of foreign organizations supporting the project

Risk Response Control

- ☐ How are the different identified project risk continuously controlled? How is this coordinated among distributed project participants?
- ☐ Who are responsible for controlling the different project risks?
- ☐ How are the routines for continuously identifying risks?
- ☐ What actions are taken when the interpretation of a risk or its consequences changes?
- ☐ In critical situations where a risk element has become a real threat, how are these responses managed?

7.3.5 QUALITY PROCESSES

General

- ☐ How is the quality management processes being performed? Can you draw a flow chart of the process?
- ☐ What kind of IT-tools do you apply to this process, including the distribution and coordination of quality management information?

Vision/Leadership

- ☐ What is the project's strategies in relation to quality?

- ☐ Who is responsible for the quality of the different project features? Are the quality management centralized or decentralized?

- ☐ Are all employees aware of quality policies and quality standards in force? What actions are undertaken to ensure this?

Planning

- ☐ How is quality planning for the project handled, i.e. defining target levels and means of achieving them?

- ☐ Is the quality management activities a part of the main stream activities or does it exist as a parallel system?

- ☐ To what extent was the quality system defined in the definition phase of the project?
  - Quality goals
  - Quality standards
  - Defining the need of quality certification of own and others processes
  - Routines for quality assurance and control

- ☐ Is there a written quality policy?

- ☐ Does this address the company's position with regards to these key areas?
  - Customers
  - Suppliers/project partners
  - Employees
  - Community/environment
  - The business environment

Communication/Documentation

- ☐ What certification requirements are imposed with regards to quality management systems on the part of the project participants and suppliers?

- ☐ To what extent is project processes documented and used as a basis for process improvement?

  - ➢ Are process documentation easily retrievable?

- ☐ By what means is relevant quality information distributed to project participants (employees, customers, suppliers etc.) and to whom is it distributed?

  - ➢ Is the effectiveness and quality of this distribution being measured?

On-job Training

- ☐ By what means are the project personnel being trained?

- ☐ Who receives training in the project organization?

- How and in what subjects are they being trained? Does there exists training to ensure that the communication skills, including language skills, are satisfactory to ensure that the coordination between distributed project participants is satisfactory?
- In what intervals are they being trained?
- How is the effectiveness of the training being measured?
- How and to what extent are the documentation of the project processes used as a basis for training personnel?

Employee Involvement

- How are employees encouraged to participate in product or service improvements?
- How are the effects of participation tracked and used for future improvements?

Third Parties Involvement

- How are third parties (customers, suppliers etc.) integrated in the quality processes?
- How are the third party satisfaction and performance determined?
- How is this information used for future improvements?
- What reporting routines exists? To whom is this reported?
- What selection criteria are used in the selection of suppliers and other project contributors?

Assurance

- How is quality assurance performed during the different project processes?
  - How often are audits performed?
- How is this coordinated among the distributed project participants?
- Which tools and techniques are applied in the quality assurance?
- What mechanisms exist to ensure timely and effective corrective action?

Control

- How is quality control performed during the project?
- Which tools and techniques are applied in this process?
- What measures are taken to assure that incoming products meets specified requirements?
- What procedures exist for in-process inspection and testing? What about final testing of end product?

- ❒ To what extent do you control the quality of suppliers/subcontractors products and services?
- ❒ What are the procedures for corrective action when the results does not conform with requirements?
- ❒ How is the effectiveness of the corrective action measured?
- ❒ How is this coordinated among the distributed project participants?
- ❒ Who is responsible for the quality control in the different project processes?

7.4 Quantitative Questions

This section contains numerical performance indicators that should be completed for the project. The purpose of these are to enable comparisons among the project with regard to the success of the practices employed, in turn to determine what are the best practices observed.

7.4.1 SCHEDULING ROUTINES

To measure the actual performance of the scheduling routines in general and some of its sub-processes, we would like you to fill in the performance measurements stated below, if they are applicable:

If the project is finalized, what was the final deviation between scheduled and actual project completion? (Percentage of total duration)

❒ On time ❒ Delay:____% ❒ Ahead of schedule: _____%

If the project is not finalized, what is the Schedule Performance Index, SPI?
(SPI = Budgeted Cost of Work Performed/Budgeted Cost of Work Scheduled = BCWP/BCWS)

❒ SPI = _____

SPI<1.0 if the project is behind schedule, SPI = 1.0 if project is on schedule and SPI >1.0 if the project is ahead of schedule.

To what extent did you have to redefine the activity sequences:

$$\frac{\text{Number of changes in the logic sequence of activities}}{\text{Total number of activities}} = \_\_\_\_\_\%$$

To what extent did you redefine the activity durations:

$$\frac{\text{Sum of actual activity duration}}{\text{Sum of estimated activity duration}} = \_\_\_\_\_\%$$

To what extent was the original project schedule accurate:

Total number of changes in schedule =_____%
Total number of activities in schedule

In the following questions we seek to find why the project was on schedule, behind schedule or ahead of schedule. Based on your previous answer, please give your interpretation of these effects influence on the experienced process result (on schedule, ahead of schedule, or behind schedule):

0 = No effect, 1 = Little effect, 5 = Crucial.

Causes	**Rank**					
	0	**1**	**2**	**3**	**4**	**5**
Scheduling processes	❒	❒	❒	❒	❒	❒
Acceleration/pacing (time pressure)	❒	❒	❒	❒	❒	❒
Change control	❒	❒	❒	❒	❒	❒
Scope changes	❒	❒	❒	❒	❒	❒
Resource shortage (materials/personnel)	❒	❒	❒	❒	❒	❒
Contractual factors	❒	❒	❒	❒	❒	❒
Supplier/subcontractor's competencies failures	❒	❒	❒	❒	❒	❒
Financial conditions/cash flow	❒	❒	❒	❒	❒	❒
Effects from project risks	❒	❒	❒	❒	❒	❒
Quality issues	❒	❒	❒	❒	❒	❒
Technological complexity/ innovation	❒	❒	❒	❒	❒	❒
Coordination of budgets and resources	❒	❒	❒	❒	❒	❒
Communication between project participants	❒	❒	❒	❒	❒	❒

To get additional information about the process performance, we would like you to characterize the different subjects concerning scheduling processes by rating the following paired attributes:

	1	2	3	4	5	
All activities were accurately defined in the beginning of the project	❒	❒	❒	❒	❒	Activities were inaccurately defined and were extensively redefined during the project
The sequencing of activities defined early in the project lead to an efficient use of time and resources	❒	❒	❒	❒	❒	Activity sequences were inaccurately defined and lead to delay and additional usage of resources
The duration of the activities were always accurately defined at an early stage in the project	❒	❒	❒	❒	❒	Activity durations were inaccurately defined in the planning stage of the project and were extensively redefined during the project
The schedules developed lead to good communication of schedule information and could be easily updated	❒	❒	❒	❒	❒	The schedules developed were over-complex and led to inefficient schedule communications and complicated the updating process

Schedules were updated on a regular basis and was satisfactory distributed to project participants	☐ ❒ ☐ ❒ ☐	Schedules were rarely updated and updated schedules were distributed in an unsatisfactory fashion
Progress control prevented unnecessary delays and lead to an efficient use of resources	☐ ❒ ☐ ❒ ☐	Lack of progress control lead to additional use of resources and/or delays
Change orders were handled efficiently and did not represent a disadvantage for the project organization	☐ ❒ ☐ ❒ ☐	Change orders lead to additional use of time and resources for the project organization that were not compensated by the project owner
Schedules were efficiently coordinated and distributed among distributed project participants	☐ ❒ ☐ ❒ ☐	Schedule coordination and distribution were complex and time consuming
Schedule documentation was sufficient and easily retrievable	☐ ❒ ☐ ❒ ☐	Schedule documentation was insufficient and difficult to retrieve
Delays during the project life cycle were handled efficiently and did not lead to either extended use of resources or delayed project completion	☐ ❒ ☐ ❒ ☐	Delays during the project life cycle lead to additional use of resources and delayed the project completion
Choice of communication tools and techniques lead to efficient and satisfactory project communications	☐ ❒ ☐ ❒ ☐	Choice of communication tools and techniques lead to inefficient and unsatisfactory project communications

What means of communication where used in the scheduling process, including applications in the development process of schedules and scheduling documents and the distribution of these? Please rank them according to usefulness in project communications:

N/A = Not Applicable, 1 = Not useful, 5 = Very useful.

Means of Communication		**Usefulness in Project Communication**				
	N/A	**1**	**2**	**3**	**4**	**5**
Personal computer	❒	❒	❒	❒	❒	❒
Telephone	❒	❒	❒	❒	❒	❒
Hand-carry documents	❒	❒	❒	❒	❒	❒
Video conferencing	❒	❒	❒	❒	❒	❒
Fax	❒	❒	❒	❒	❒	❒
Letters	❒	❒	❒	❒	❒	❒
E-mail	❒	❒	❒	❒	❒	❒
Intranet/Internet applications	❒	❒	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒	❒	❒

7.4.2 BUDGETING PROCESSES

To measure the actual performance of the budgeting processes in general and some of its' sub-processes, we would like you to fill out the performance measurements below, if they are applicable:

If the project is finalized, what was the final overrun/underrun in percentage of scheduled total cost (total budget)?

❒ Overrun:_____% ❒ On budget ❒ Underrun:_____%

Did you meet targeted profit:

Actual profit / Planned profit =_____%

If the project is not finalized, what is the Cost Performance Index, CPI?
CPI = Budgeted Cost of Work Performed/Actual Cost of Work Performed = BCWP/ACWP

CPI =_____

CPI < 1.0 if the project is over budget, CPI = 1.0 if the project is on budget, CPI > 1.0 if the project is under budget

How accurate where the resource estimates[1]:

Actual man hours/ Estimated man hours =_____
Actual amount of resource 1/Estimated amount of resource 1 = _____

In the following questions we seek to find why the project was on budget, over budget or under budget. Based on your previous answer, please give your interpretation of these factors influence on the experienced process result (on budget, over budget or under budget):

0 = No effect, 1 = Little effect, 5 = Crucial

Causes	**Rank**					
	0	**1**	**2**	**3**	**4**	**5**
Scheduling processes	❒	❒	❒	❒	❒	❒
Acceleration/pacing (time pressure)	❒	❒	❒	❒	❒	❒
Change control	❒	❒	❒	❒	❒	❒
Scope changes	❒	❒	❒	❒	❒	❒
Resource shortage (materials/personnel)	❒	❒	❒	❒	❒	❒
Cost budgeting	❒	❒	❒	❒	❒	❒
Cost control	❒	❒	❒	❒	❒	❒
Contractual factors	❒	❒	❒	❒	❒	❒

[1] For this actual measurement, the different resources has to be adjusted for each individual project: the objective is to pick the key resources in each project and look at the accuracy of the quantity measurement of these.

Supplier/subcontractor's competencies failures	❒	❒	❒	❒	❒	❒
Financial conditions/cash flow	❒	❒	❒	❒	❒	❒
Effects from project risks	❒	❒	❒	❒	❒	❒
Quality issues	❒	❒	❒	❒	❒	❒
Technological complexity/innovation	❒	❒	❒	❒	❒	❒
Coordination of budgets and resources	❒	❒	❒	❒	❒	❒
Communication with managers and others involved in the budgeting processes	❒	❒	❒	❒	❒	❒

To get additional information about the process performance, we would like you to characterize the following subjects concerning budgeting processes by rating these paired attributes:

	1	2	3	4	5	
The resource estimates were accurate for all project activities	❒	❒	❒	❒	❒	The resource estimates were inaccurate for all project activities
One never experienced that the project were delayed as a result of lack of resources	❒	❒	❒	❒	❒	Lack of resources resulted in significant delays
The estimated costs for the different activities complied accurately with actual costs	❒	❒	❒	❒	❒	There was a considerable difference between estimated and actual cost for the different project activities
The process of coordinating the different project budgets ensured that the overall project budget was in adherence with actual cost	❒	❒	❒	❒	❒	There was a significant lack of budget coordination, which lead to a significant variance between budgeted and actual cost
Costs were followed up and controlled significantly to ensure adherence to budget	❒	❒	❒	❒	❒	One experienced over-budget as a consequence of missing control and following-up of costs
Contractual agreements accurately defined responsibilities and scope of work	❒	❒	❒	❒	❒	One experienced additional cost and/or delays as a consequence of inaccurate contractual agreements

What means of communication where used in the budgeting process, including applications in the development process of budgets and budget information and the distribution of these? Please rank them according to usefulness in project communications.

N/A = Not Applicable, 1 = Not useful, 5 = Very useful.

Means of Communication		**Usefulness in Project Communication**				
	N/A	**1**	**2**	**3**	**4**	**5**

Personal computer	❒	❒	❒	❒	❒	❒
Telephone	❒	❒	❒	❒	❒	❒
Hand-carry documents	❒	❒	❒	❒	❒	❒
Video conferencing	❒	❒	❒	❒	❒	❒
Fax	❒	❒	❒	❒	❒	❒
Letters	❒	❒	❒	❒	❒	❒
E-mail	❒	❒	❒	❒	❒	❒
Intranet/Internet applications	❒	❒	❒	❒	❒	❒
Statistical simulations, Monte Carlo etc.	❒	❒	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒	❒	❒

7.4.3 RISK MANAGEMENT

To measure the actual performance of the risk management, we would like you to fill in the performance measurements stated below, if they are applicable:

Did you experience any effects of risks during the project that had not been identified?

❒ Yes ❒ No

If yes, how many unidentified risk elements did you experience?

=_____

How accurate was the risk identification:

$$\frac{\text{Number of occurred unexpected risk events + planning omitted potential events}}{\text{Number of risk events identified during planning}}$$

=_____%

How accurate where the definition of risk quantities estimated:

$$\frac{\text{Actual cost of risk items occurred during project}}{\text{Estimated cost of risk items occurred}}$$

=_____%

In the following questions we seek to find additional information about the process performance. Please give your interpretation of the process performance by rating the following paired attributes.

	1	2	3	4	5	
All risk elements were identified before the effects of these occurred	❒	❒	❒	❒	❒	Many risk elements that occurred during the project had not been identified prior to occurrence
The quantification of the effects from different risk elements were accurate for	❒	❒	❒	❒	❒	Many of the effects of different risk elements were poorly quantified

all risks		
The risk response was satisfactory for all the experienced risk elements in the project	❒ ❒ ❒ ❒ ❒	The responses to several risk elements that were experienced during the project were unsatisfactory
There was no opportunities for the project that were not taken advantage of		There was several opportunities for the project that were not taken advantage of
Risk response control procedures made sure that all changes in the risk environment were controlled sufficiently to be discovered before the effects of these changes occurred	❒ ❒ ❒ ❒ ❒	Lack of risk response control lead to that many changes in the risk environment were not discovered
The risk control routines made sure that there was no extra cost or delays as a consequence of the effects from project risks	❒ ❒ ❒ ❒ ❒	Lack of risk control lead to additional cost and/or delay due to effects from risk elements
Risk response plans gave risk management personnel necessary guidelines to handle all the risk elements that were experienced during the project	❒ ❒ ❒ ❒ ❒	Risk response plans were unsatisfactory and lead to a lack of knowledge about how to respond to several project risks
Risk management information has been distributed in an efficient and satisfactory fashion	❒ ❒ ❒ ❒ ❒	Risk management information distribution were complex and time consuming
Risk management personnel had sufficient knowledge and experience of special risk effects due to the distribution of the project	❒ ❒ ❒ ❒ ❒	Lack of consideration to special risk effects due to the distribution of the project lead to a less than satisfactory outcome of risk management processes

What means of communication where used in the risk management process, including applications in the development risk management documents and the distribution of risk management information? Please rank them according to usefulness in project communications.

N/A = Not Applicable, 1 = Not useful, 5 = Very useful.

Means of Communication		**Usefulness in Project Communication**				
	N/A	**1**	**2**	**3**	**4**	**5**
Personal computer	❒	❒	❒	❒	❒	❒
Telephone	❒	❒	❒	❒	❒	❒
Hand-carry documents	❒	❒	❒	❒	❒	❒

Video conferencing	❒	❒	❒	❒	❒	❒
Fax	❒	❒	❒	❒	❒	❒
Letters	❒	❒	❒	❒	❒	❒
E-mail	❒	❒	❒	❒	❒	❒
Intranet/Internet applications	❒	❒	❒	❒	❒	❒
Statistical simulations, Monte Carlo etc.	❒	❒	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒	❒	❒

7.4.4 QUALITY PROCESSES

To measure the actual performance of the quality processes, we would like you to fill in the performance measurements defined below, if they are applicable:

❒ Customer satisfaction with end product and services _____%

❒ Extra cost due to rework during production _____% of total budget

❒ Cost of after-sales work due to unsatisfactory product _____% of total budget

❒ Average number of incomplete/unsatisfactory deliveries from suppliers _____pr. supplier

❒ Number of deliverables on time _____% of total deliveries

❒ Average hours of training per project participant _____hours/year

❒ Training and educational cost _____% of total budget

❒ Number of employees that have been trained during the project _____% of total employees

In the following questions we seek to find the reasons for the actual process outcome. Based on your previous answer, please give your interpretation of these factors effect on whether the product(s) and/or services complied with customer requirements:

0 = No effect, 1 = Little effect, 5 = Crucial

Causes	**Rank**					
	0	**1**	**2**	**3**	**4**	**5**
Management's commitment to quality	❒	❒	❒	❒	❒	❒
Quality objectives	❒	❒	❒	❒	❒	❒
Quality standards	❒	❒	❒	❒	❒	❒
Employee involvement	❒	❒	❒	❒	❒	❒
Communication of quality information	❒	❒	❒	❒	❒	❒
Distribution routines for quality information	❒	❒	❒	❒	❒	❒

Qualifications of employees	❒	❒	❒	❒	❒	❒
Understanding of third party needs and requirements	❒	❒	❒	❒	❒	❒
Quality assurance processes	❒	❒	❒	❒	❒	❒
Quality control processes	❒	❒	❒	❒	❒	❒
Change orders	❒	❒	❒	❒	❒	❒

To get additional information about the process performance, we would like you to characterize the different subjects concerning quality management by rating the following paired attributes:

	1	2	3	4	5	
Management was committed to quality and enhanced the quality focus in the organization	❒	❒	❒	❒	❒	Management lacked commitment to quality
There was a clear definition of adequate quality goals and standards	❒	❒	❒	❒	❒	The definition of quality standards and goals were unclear and inadequate
The distribution of quality information lead to a clear understanding of quality issues among the all project participants	❒	❒	❒	❒	❒	The distribution of quality information was inadequate and lead to a lack of understanding of quality issues
All employees had sufficient training to perform their work according to project demands	❒	❒	❒	❒	❒	One experienced difficulties and/or insufficient quality due to lack of training or knowledge about the work that was performed by project participants
Employees were involved in all decision processes that influenced themselves, their actual assignments or their working environment	❒	❒	❒	❒	❒	Employees had little influence on their own job situation and the project decision processes
Third parties were involved in all quality processes	❒	❒	❒	❒	❒	Third parties were never involved in quality processes
Third parties were involved in all planning and design processes	❒	❒	❒	❒	❒	Third parties were rarely involved in planning and design processes
All project features were in adherence with customer's or end-user's needs and demands	❒	❒	❒	❒	❒	There was a significant lack of adherence between the different project features and customer's or end-user's needs and demands
All deliverables and services from suppliers and subcontractors where in compliance with the requirements for	❒	❒	❒	❒	❒	There was a significant lack of conformance between required and actual deliverables and services from

these suppliers and subcontractors

What means of communication where used in the quality management process, including applications in the development of quality standards/plans and quality information and the distribution of these? Please rank them according to usefulness in project communications.

N/A = Not Applicable, 1 = Not useful, 5 = Very useful.

Means of Communication		**Usefulness in Project Communication**				
	N/A	**1**	**2**	**3**	**4**	**5**
Personal computer	❒	❒	❒	❒	❒	❒
Telephone	❒	❒	❒	❒	❒	❒
Hand-carry documents	❒	❒	❒	❒	❒	❒
Video conferencing	❒	❒	❒	❒	❒	❒
Fax	❒	❒	❒	❒	❒	❒
Letters	❒	❒	❒	❒	❒	❒
E-mail	❒	❒	❒	❒	❒	❒
Intranet/Internet applications	❒	❒	❒	❒	❒	❒
Statistical simulations, Monte Carlo etc.	❒	❒	❒	❒	❒	❒
Other: _____	❒	❒	❒	❒	❒	❒

7.5 Data Analysis

There are three key questions that need to be answered during this phase of the benchmarking activity:

- What performance gaps exist among the benchmarked projects?
- More importantly, what are the reasons why these gaps exist, in other words, what do the best performing companies do that create higher performance levels?
- As a conclusion, what are the best practices found in the sample of benchmarked projects?

To answer each of these questions, there are some tools available that might be utilized during the analysis phase. These are as presented in the following. Other tools and analysis approaches may also be used, or the collected data might be of a nature that makes the analysis conclusion readily available without performing any detailed analysis. Thus, these are merely suggestions for tools that can be used.

7.5.1 IDENTIFYING GAPS IN PERFORMANCE LEVELS

There are in principal two different methods for identifying these gaps in performance, which are presented in the following.

The performance matrix compares different performance measurements collected from different benchmarked projects. An example of a performance matrix is given in Figure 7.1.

Performance Measurement \ Project	A	B	C	D
Budget overrun	- 5%	10%	13%	5%
Schedule overrun	20%	10%	-5%	12%
Customer satisfaction	80%	75%	84%	77%

Figure 7.1 Performance matrix

The quantitative performance measurements can also be presented in a histogram, as displayed in Figure 7.2. Graphical presentations can often be easier to understand and analyze. A histogram can easily display variations in a performance for different projects by sorting the performance in order to display variations between the projects.

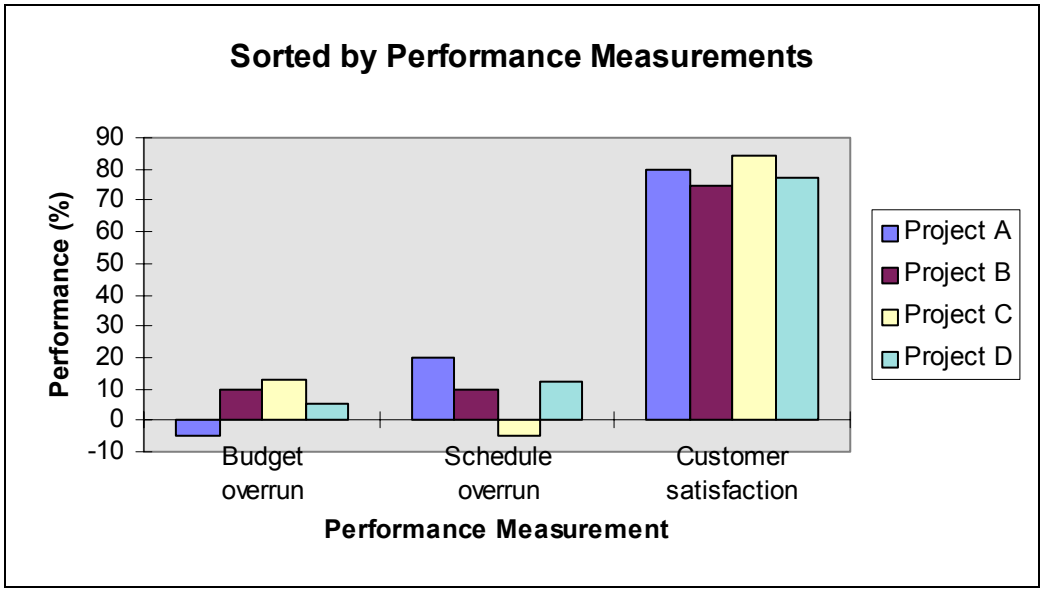

Figure 7.2 Histogram for performance measurements

7.5.2 IDENTIFYING THE CAUSES FOR THE GAPS

The information collected from the benchmarking partners must be analyzed to understand why there is a gap in performance, through identifying the root causes for it. There are several tools and techniques available for conducting this analysis:

- Comparison of flow charts.
- Cause-and-effect chart.
- Root cause analysis.
- Tree diagram.

Probably the easiest way to identify differences in practice that lead to gaps in performance is simply comparing flow charts for the process in question, see Figure 7.3.

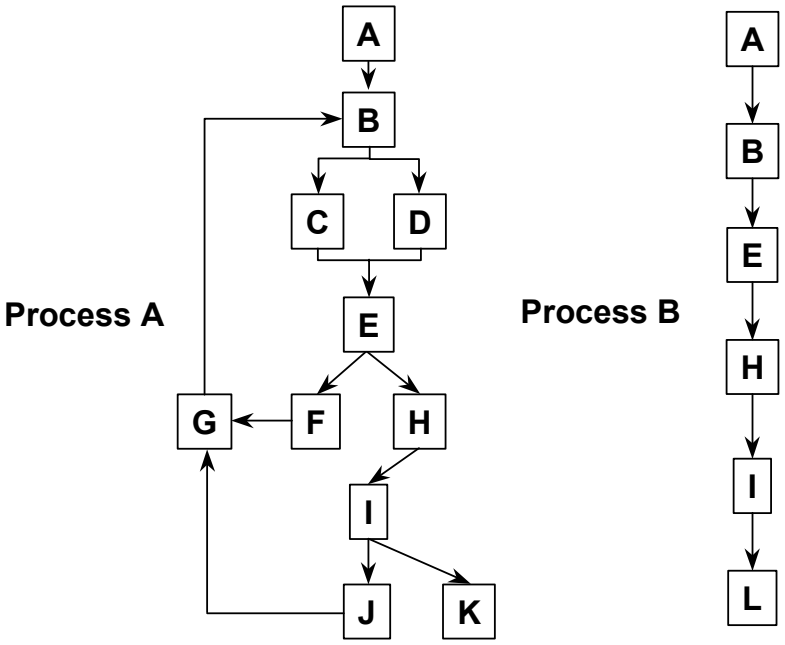

Figure 7.3 Example of comparison of flow charts

What to look for when comparing flow charts:

- Steps that occur only in one of the processes.
- Loops that occur only in one of the processes.
- Different grouping of tasks into steps.
- Different sequence of steps.
- Different organization of steps in relation to others, parallel versus serial.
- Different connections between steps.
- Etc.

A cause-and-effect diagram, also called a fishbone chart, is a brainstorming tool that helps organizing the thoughts and aiding the search for a solution. Figure 7.4 shows an example.

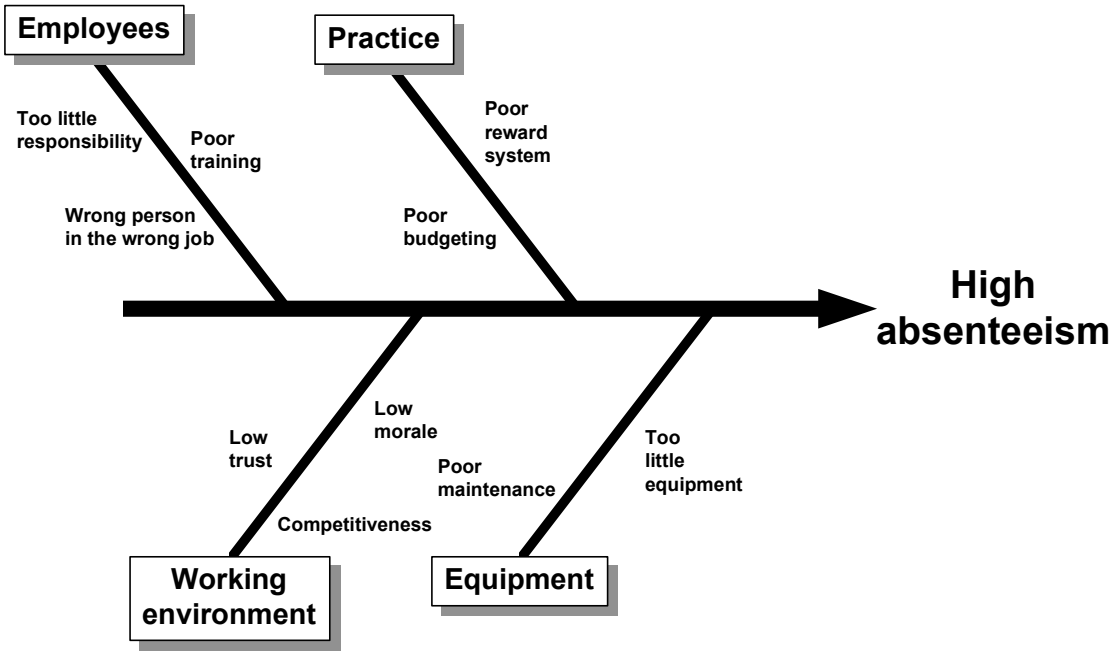

Figure 7.4 Example of a cause-and-effect diagram

The procedure for using a cause-and-effect diagram is:

1. Identify the effect or problem you want to investigate.
2. Place the effect at the right-hand end of a thick, horizontal arrow.
3. Identify main categories which the different causes for the effect can be grouped into.
4. Place the main categories in boxes with arrows leading into the main arrow. Below each category, ideas for causes are brainstormed.
5. Remember that the objective is to cure the *problem*, not the *symptoms*!

This diagram can be used to locate the underlying causes for a particular effect. In benchmarking, this effect, for which one seeks to find the causes, will often be the unusual high performance level of a partner.

Root cause analysis is a technique for breaking down a complex problem, in this case a performance gap, into sub-causes. Each identified sub-cause is seen as a problem of its own, for which one tries to find the causes. Thus one assures that the true root cause of the problem has been found, as can be seen in Figure 7.5.

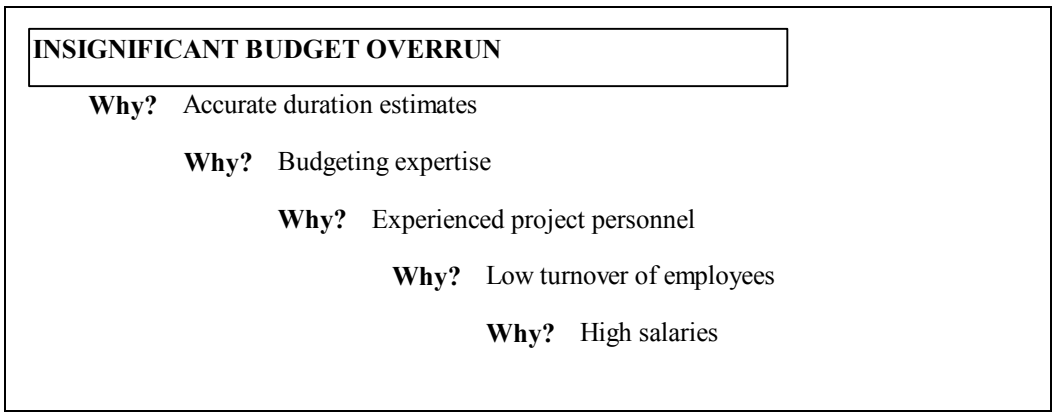

Figure 7.5 Example of a root cause analysis

The procedure for conducting a root cause analysis is:

1. Identify and define the main problem (in benchmarking the performance gap).
2. Use brainstorming to find causes for the gap.
3. For each identified cause, ask the question: "Why is this a cause?"
4. For further identified causes, this is continued until no more causes are identified when asking this question. The root cause for the performance gap has then probably been found. As a rule of thumb, this will usually take 5 questions of "Why?".

In order to display all these sub-causes, one can develop a tree as shown in Figure 7.6.

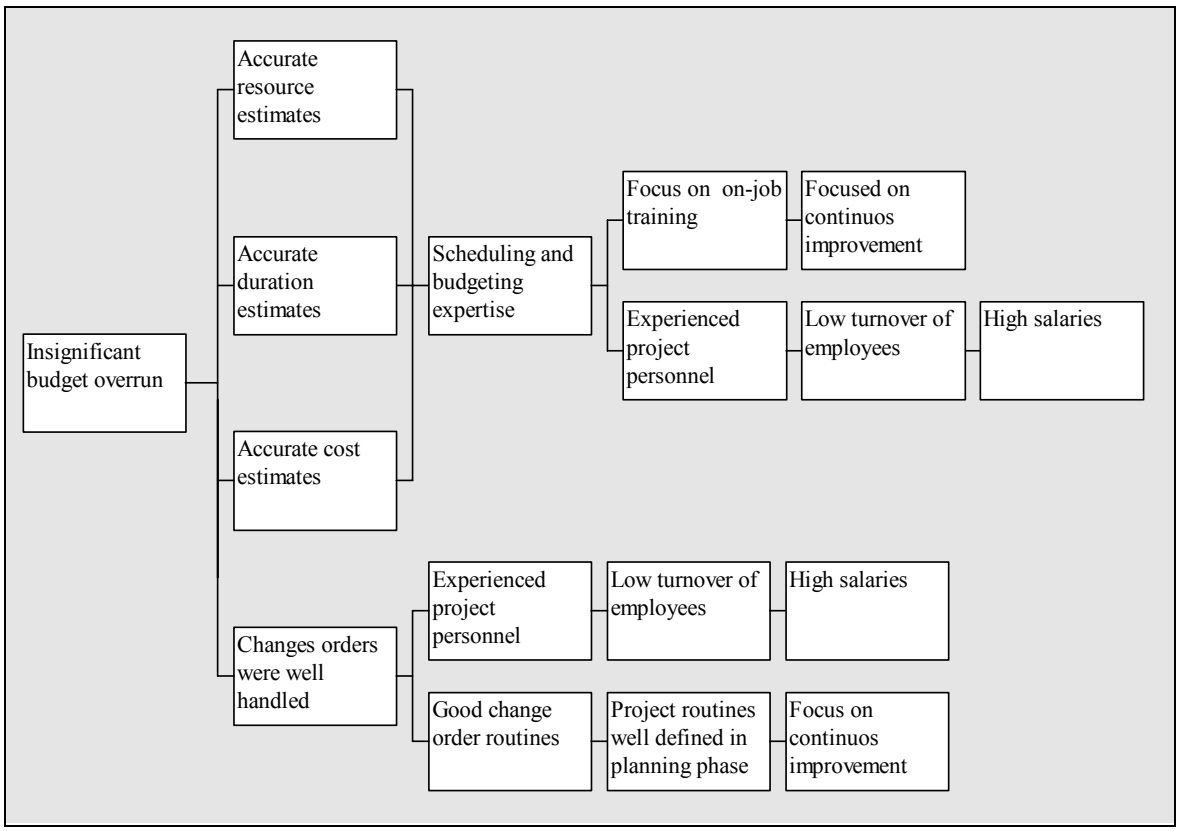

Figure 7.6 Root cause analysis with multiple branches

7.5.3 DEFINE BEST PRACTICE

During the two preceding analysis steps, information about both performance gaps and the causes for these should have been identified. Based on this information, one can identify so-called best practice standing out from the already analyzed material. Only one technique for defining best practice is presented here, the qualitative data matrix. An example of such a matrix is presented in **Error! Reference source not found.**.

Process \ Project	A	B	C	D
Organizing of the quality management	Decentralized	Centralized	Decentralized	Centralized
Third party involvement	High	Medium	Low	Low
Employee involvement	Medium	Low	High	Low

Figure 7.7 Qualitative data matrix

8 TASKS FOR THE CONSORTIUM PARTNERS IN THE NEAR FUTURE

These are the tasks that need to be tended to during the next few weeks to ensure that the benchmarking activity gets properly under way:

1. All partners must go through this document describing the benchmarking methodology and comment on it if there are suggestions for improvements or adjustments. The document will be continuously improved, but the first set of comments should reach SINTEF by February 1st, 1999.
2. SINTEF must revise the benchmarking methodology based on comments from the consortium partners and work done by the student who is working on the task.
3. All partners must assess whether their organizations manage or are part of any distributed projects that are worthwhile studying as part of the benchmarking activity. The result of the assessment should be sent to SINTEF as soon as possible.
4. SINTEF will start the creative and systematic process of identifying external distributed projects that seem to have something to offer in terms of good or best practice. However, all partners are strongly encouraged to make suggestions if they know of any exciting projects. We aim to find a mixture of projects from different sectors and geographical areas.
5. As contacts are made with projects internally to the consortium as well as externally, we must make plans for the data collection. It is clearly SINTEF's responsibility to guide to the data collection, but we invite everyone who wants to participate to join. Especially if a project belongs to one of the partners' organizations, if it is located in the home country of one of the partners, or if the partner has good contacts with some of the participants. Details regarding schedules and roles in the data collection must be decided on later, but we hope to make this a team activity.