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Project Management in Distributed Projects

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DECLARATION

Hereby I certify that all work presented in this diploma thesis is my own, no other than the sources and aids referred to were used and that all parts which have been adopted either literally or in a general manner from other sources have been indicated accordingly. I declare that it has not been submitted in whole, or in part, for any other degree.

Signed: _____

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1 Introduction

Siemens Program and Systems Engineering (PSE) is an enterprise dealing with research and development of software solutions. Since the 1960's, Siemens PSE has established itself as one of the main global competitors in software development [Siemens2007]. It currently consists of about 6200 employees scattered across 22 locations in Europe, Turkey, China and the USA. Consequently, this leads to an increased dependency on working with project teams abroad and with foreign external companies that need to be adequately managed in projects.

Distributed projects, also called *virtual projects*, are projects that involve human resources in two or more countries or at least two or more separate locations and are performed by *virtual teams*. Virtual teams [Lipnack2000] are defined as "a group of people who work interdependently with a shared purpose across space, time, and organization boundaries using technology." Distributed projects are crucial for any global organisation in order to break into new markets. It is important, therefore, to communicate effectively and manage resources efficiently over wide geographical distances, time zones and external companies.

Dr. Martin Kärner, head of the Learning Campus Section for Project Management at Siemens AG in Munich, endeavours to explain the reasons why virtual teams are created in his article in the monthly "projekt-magazin" [Kärner2005]. He states that Information Technology (IT) offers tools for better collaboration, which in turn help to transfer information in an easier way that bridge distances. Faster means of transport allow people and goods to travel more economically across wide distances. Traditional barriers such as geographical proximity to headquarters are no longer obstacles in making a decision on location. Site selection and commercial partners are selected based on competence and cost criteria. Virtual teams are the consequence of these decisions. One example is the technology centre in Bangalore, India. Almost every noted company focused on manufacture, support and research into IT have founded a competence centre for software development in Bangalore. Siemens AG also have a competence centre in Bangalore and use these human resources in distributed projects. Such a pool of

resources with the relevant IT know-how, can be easily employed when required to work on specific projects, which translates into a variable cost associate in a project as opposed to a fixed cost incurred on the company. Moreover, every project that uses these competences automatically changes to a distributed project.

In the past, developed countries only outsourced labour intensive manufacturing to low cost countries. Now an increasing trend has risen to relocate costly IT work to low cost countries as it can be facilitated by an upcoming educated generation in these countries. This relocation of work now creates widely distributed project teams. Another aspect for virtual teams is that in most markets the company needs to have a local presence, as in China for instance [Kärner2005].

In November 2004 a short questionnaire [Kurth2004] was completed by Siemens PSE employees, which highlighted the main problems in participating in distributed projects. The issues discovered by the questionnaire are:

Main reasons for performing distributed projects:

- Cost reduction
- Increase competitive advantage
- Use of local expertise

Main benefits for undertaking distributed projects:

- Outsourcing of some management tasks
- Acquisition of regional expertise and knowledge
- Decreased development costs
- Appropriate match of resource capabilities to requirements

The following main problems that surface in distributed projects include:

- Different languages
- Different cultures
- Lack of trust

The following critical factors for improving distributed project management have been indicated as:

- The process in communication
- The process in collaboration

- Methods for controlling

More than 45% of the projects of Siemens PSE are distributed projects [Kurth2004]. Project managers are confronted with additional complexity given the inherent problems associated with distributed projects. These issues need to be addressed for successful and efficient project implementation and the key to success is effective project management.

The issues facing project managers has also been indicated by Punzet [Punzet 2005]. She states “Due to the global presence a team is working together “virtually” – it communicates only via telephone, e-mail and Internet. Thereby the following challenges have to get mastered:

- Different time-zones
- Cultural differences
- Frequently change of employees in the community
- Lack of motivation
- Anonymity in virtual teams
- Choosing the right communication tool”

The main challenges in distributed projects faced by PSE staff are also similar to those discovered by Punzet. A detailed discussion regarding critical success factors and risks will be touched on in Chapter 3.

Based on the current situation at Siemens PSE and on the issues faced with distributed projects, further investigation is required into effective project management tools for efficient distributed project management. Implementing effective software tools to assist in project management can solve this dilemma. An effective software tool can be used for improved communication, collaboration and planning. Furthermore, determining the ideal tools for handling distributed projects for Siemens PSE to successfully address these challenges.

Broad ranges of Information Technology (IT) solutions are available on the market that can help manage distributed projects. IT is the catalyst for innovation and has transformed work practices to make life easier. Decreasing communication costs, increasing transmission-bandwidth and already existing

communication standards allow a decentralisation of organisations and the trend toward globalisation [Fleisch 2001].

Establishing the suitability of a commercially available project management tool to handle Siemens PSE's distributed projects first involves determining the complexity and key characteristics of distributed projects. Siemens PSE have considered implementing the Microsoft Enterprise Project Management Solution in the endeavour that it will address the challenges currently found in distributed projects

1.1 Research Question

This diploma-thesis investigates two key research issues concerning Siemens PSE project managers:

(1) Identify the current main activities and challenges in managing distributed projects.

(2) a) Which tool or applications are currently used to meet these challenges.

b) Investigate the benefits for Siemens PSE of employing an Enterprise Project Management (EPM) solution.

1.2 Research Method

The following research method has been applied in this study:

- Literature survey in the areas of project management and virtual project management, and relation to collaboration-tools
- Survey with experienced project managers who have been involved in distributed projects.
- Based on the survey results, determine the challenges and activities of distributed projects in Siemens PSE. Furthermore, to propose solutions to meet these challenges using collaboration tools.
- Use cases of a Siemens PSE project are analysed together with other project management experiences: introducing contents and distribution of project, introducing processes and collaboration activities. Based on investigations of the survey, improvements have been identified and the suitability of employing the Microsoft Enterprise Project Management Solution for distributed projects.

1.3 Thesis Overview

Chapter 2 presents some general topics concerning project management, provides a short of project management history and definition of basic project management terms. Project management as a profession started in the 1950's and its development is discussed up until the present moment. Challenges for project managers are presented in this chapter.

Virtual teams are discussed in Chapter 3. The structures of virtual teams are presented and the disparity to collocated teams. Furthermore the different types of virtual teams and inherent team complexity are outlined. The chapter concludes with a summary of advantages and disadvantages whereby risks and critical success factors of virtual teams are highlighted.

Since communication is very important in distributed projects, Chapter 4 describes the challenges of communication. It shows the correlation of communication and distance and explains types and categories of communication. Finally, problems with using computer-aided communication are highlighted.

In Chapter 5 capabilities of information technology are shown depicting types of software for project management. Furthermore Internet based project management software like project portals and enterprise project management solutions are exemplified highlighting the benefits for the usage in distributed projects.

Chapter 6 comprises the survey for outlining the current status of virtual projects of Siemens PSE. The survey was done via a questionnaire that was distributed to several project managers in Siemens PSE which have experiences with distributed projects. The main contents of the questionnaire are key characteristics and project management challenges as well as project management activities and project collaboration of distributed projects. Based on the rating and weighting of the questioned items the current project situations of distributed projects in Siemens PSE are investigated. Furthermore the

participants of the questionnaire have been asked which tools they use to manage the challenges of distributed projects.

A centralised Internet based Enterprise Project Management tool solution is described in Chapter 7. The Microsoft Enterprise Project Management Solution is introduced, the architecture of this tool gets explained and the benefits get outlined.
Based on this introduced solution a use case study is done referring to an own distributed project that I managed in the past for the department of Siemens PSE CSS INP3.

A use case study is introduced in Chapter 8 where first the referring project gets introduced explaining the project aims and contents, the project characteristics and the used process. In a next step the usual workflow of the use cases “planning” and “task progress reporting” is shown. Finally the same use cases are explained when using the Microsoft Enterprise Project Management Solution. Differences and benefits are contrasted afterwards.

Chapter 9 comprises interpretation of investigations and commentary. This chapter again highlights the result of the thesis by summing up the main points.

Chapter 10 comprises the conclusion.

Chapter 11 comprises a number of quotations from people who have experiences with virtual projects.

Chapter 12 comprises the appendix where the questionnaire and the complete statistic of the survey are shown.

Chapter 13 comprises references. All used references and according sources are listed in alphabetic order.

Chapter 14 comprises the glossary and abbreviations. Abbreviations and technical terms are explained and listed in alphabetic order.

2 Project Management

A short history of project management is presented in this chapter, beginning with net-planning techniques and moving on to distributed projects. Furthermore, project management fundamentals, terms and approach are also discussed in this chapter.

2.1 History of Project Management

For thousands of years humans have known that complex and difficult tasks are better solved in close-nit collaborating teams. This is evident even when the Egypt's where building the pyramids. Today, a pool of recommended working methods exists in addition to a range of tools for project management that are tailored for multinational organisations. These two elements are vital for steering the project correctly and to provide a better understanding of the main issues when managing a project, such as Siemens PSE.

Project management as a profession existed since the 1950's. However, World War II spurred a search for new methods to assist in finding innovative solutions for complex problems. The US military and international aerospace organizations pioneered research into management of large-scale projects during the war [Bartsch2001]. Following World War II, the real benefits of project management have been recognised and project management concepts began to be implemented in industry. Initially the US government preferred to deal with companies that have implemented a structured project organisation. Consequently, this increased the motivation in industry to further research into the discipline of project management. Moreover, project management concepts were also adopted in Europe. During the 1970's project management in Western Europe was essentially equal to Network Planning Techniques[1]. Developing efficient methods and tools took considerable time and were not commercially available until the early 1990's. Now project management evolved not only as a business oriented task but a set of processes that can have technical, business, juristic or a socio-psychological character [Bartsch2001]. A project manager no longer needs to have deeper knowledge or specialised expertise in several

[1] A detailed description of Network Planning Techniques can be found in the Glossary

technical disciplines; rather nowadays it can also be considered more of a social skill using appropriate PM-methods.

In the early 1990's the existing Cold War tension relaxed and a European single market economy evolved. This led to rising globalisation of the markets and enterprises that had implications to project management.
The increased globalisation leads to:

- Rising importance of international project management
- Greater prevalence of multi-cultural teams and cultural differences
- Changing organisational structures due joint ventures and virtual collaboration[2]
- Detailed survey of global market trends

The rising focus on the world economy intensified competition for certain companies. That caused a greater demand for efficient project management with a focus on:

- Greater appreciation of risk analyses and risk management.
- An increased attention on project target, efficiency and productivity.

With the growing demand to optimise time-to-market and keeping organisations lean, project management is applied to more sectors and has increased importance for multi project management activities.
Innovation in information technology enforces the interests of EDV-systems[2] and project management software[2].
Since the mid 1990's the Internet is the dominant data transfer method. This strongly influenced project management [Bartsch2001] and has led to

- New concepts for assisting in group working
- New focus of social awareness
- Increased benefit of using computer networks, the intranet and the world wide web

Since about the year 2000, IT innovations have extended our capabilities, especially when inter-working with a group of people spread out over large distances. As more people interconnect online, we increase our capacity for both independence and interdependence. Competition and cooperation both thrive in this new working culture. Cyberspace is a vast new culture, containing both

[2] For a detailed explanation please refer to the glossary

places of commerce and an already deep social life mirrored in countless conversations.
The twenty first century trend is getting “smarter together”. Smarter teams are the cells of larger intelligently networked organizations.
“Virtual teams mastering virtual projects are the people-operating system for the twenty-first century.” [Lipnack2000]

Currently, there exist two worldwide project management communities that enable support for project mangers, training, certification and further development of project management concepts. Both of these organisations define and clarify a set of recommendations for project managers. A set of standards is produced if both organisations agree to certain approaches. In Europe the IPMA, International Project Management Association, was founded in 1965 based in Switzerland, Zurich. The IPMA has about 40 national member organisations. In Germany the IPMA is represented by GPM, Gesellschaft für Projektmanagement, founded in 1979. The IPMA is publishing the IPMA Competence Baseline (ICB) which is an international standard for project management. The ICB is the basis for European national standards considering the several national specific cultural requirements. Based on this ICB national certification programs are created.
In USA the PMI, Project Management Institute, was founded independently from the IPMA, in 1969. The PMI is publishing the PMBOK[3], Project Management Body of Knowledge, standard as a basis for certifications.

2.2 Project Management 1st and 2nd Order

Project Management 1st and 2nd Order is an approached in handling projects. Saynisch presented at the GPM-Forum in 1997 the stages involved in project management order [Saynisch1997]. The two orders are touched on in the following subsections.

[3] For a detailed explanation please refer to the glossary

2.3 Project Management 1st Order

Project Management 1st order belongs to the so called “classic project management” method. That is concerned preliminary with the technical and methodical approach of engineering technology. Please refer to Figure 1 for additional details. The fact that project management should also take into account “soft skills” was enforced in Project Management 2nd Order that is explained in the next section.

2.3.1 Project Management 2nd Order

In the mid 20th century project management 2nd order resulted out of the combination of the classic and the behaviour oriented project management approach. The project was understood as a chain of independent processes. A so-called evolutional project planning comes into operation whereby the changing requirements during a project impacted project planning. This results in producing a dynamical project plan, constantly being adapted to changing requirements. Furthermore new forms of organisations and project networks for executing projects need to be use.

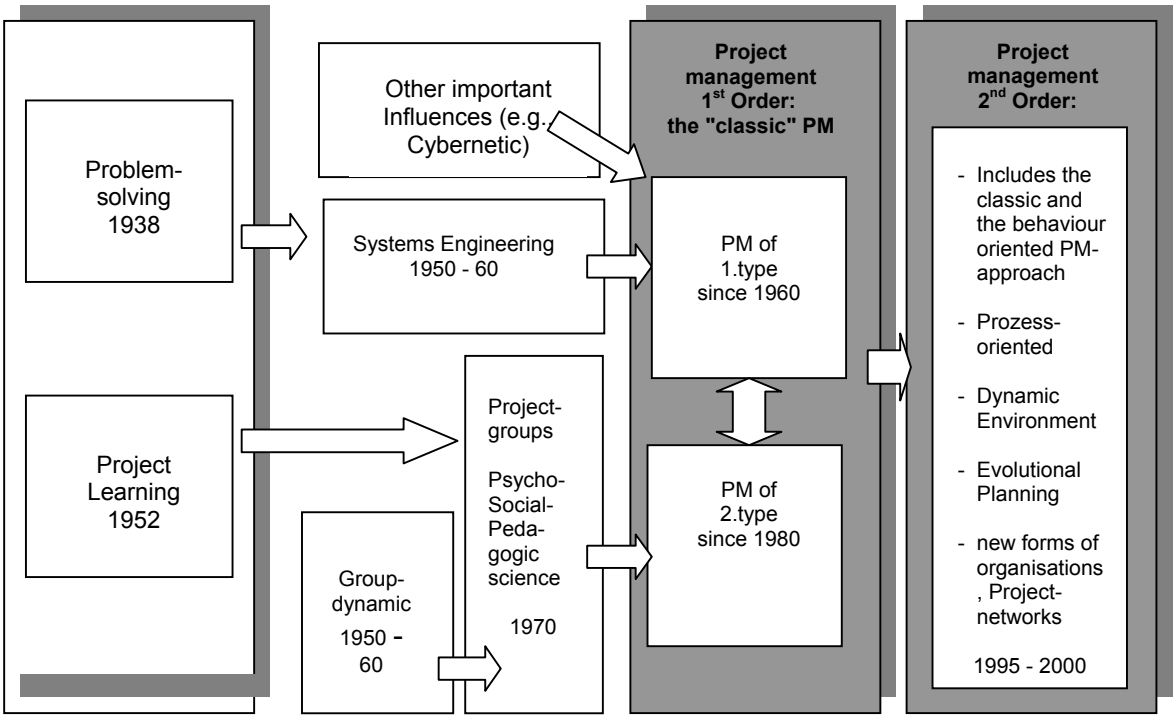


Figure 1: *Order of Project Management [Synisch1997]*

The Project Management 2nd Order approach was presented in 1997, however the study by Saynisch was not completed until the year 2000. The current practice indicates that the outlook presented by Saynisch was correct and project management is dealing more intensely with project management of the 2nd order.

2.4 Projects

A project is an endeavour that is characterized by a unique collection of terms:
Aim, time-limited, financial-limited, personally-limited, and independent of other endeavors and project specific organizations. Projects run in parallel and are sequential set of activities that are distinguished from routine tasks.
Whereby the starting position is defined, the aim is defined and the necessary measures are partly unclear so that important tentativeness exists for reaching the goal [cp. Patzak1998].

2.4.1 What is a project?

A project is a temporary endeavour undertaken to create a product, service or result [PMBOK2004]. The definitions covered in this section are taken from [PMBOK2004].

Temporary:

Temporary implies that every project has a beginning and a defined end. The end is reached when the project's objectives have been achieved, or it becomes clear that the project objectives will not or cannot be met, or the need for the project no longer exists and the project is terminated.

Unique products, services or results:

A project creates unique deliverables, which are products, services or results.
Projects can create:

- A product or artefact that is produced, is quantifiable, and can be either an end item itself or a component item.
- A capability to perform a service, such as business functions supporting production or distribution.

- A result, such as outcomes or documents.

Progressive elaboration:

Progressive elaboration is a characteristic of projects that accompanies the concepts of temporary and each project is unique. Progressive elaboration means developing in steps, and continuing by increments.

2.4.2 What is Project Management?

Project management is the application of knowledge, skills, tools (see Chapter 5), and techniques to project activities in order to meet project requirements.

The project manager is executing the related activities.

2.4.2.1 The Project Manager

The person responsible for accomplishing the project objectives is referred to as the Project Manager.
Whereby the Project Manager should bring along the following skills [Patzak1998]:

- Effective communication (see Chapter 4): The exchange of information
- Influencing the organisation: The ability to “get things done”
- Leadership: Developing a vision and strategy, and motivating people to achieve that vision and strategy
- Negotiation and conflict management: Conferring with others to come to terms with them or to reach an agreement
- Problem solving: The combination of problem definition, alternatives identification and analysis, and decision-making.

When undertaking a project, the project manager is confronted with the following tasks [Patzak 1998]:

- Project planning, execution and controlling
- Organising
- Team leading

For executing a project some main activities have to be performed as described in the next section.

2.4.2.2 Project Management Activities

Project management activities to progress a project are sequentially the following [Burghardt 1988]:

- **Project definition:** project creation, definition or the project goals, process organisation, project organisation.
- **Project planning:** planning effort, time, resource and cost
- **Project controlling:** controlling of efforts, time, costs, progress and quality. Control of the configuration management[4].
- **Project finalisation:** product acceptance, handover and project completion.

Following from these PM activities, a PM Control Cycle is often required.

2.4.2.3 Project Management Control Cycle

The main goal of the control cycle is to identify deviations from the plan as early as possible. Adjustments need to be initiated in time in order to make corrections to the origin plan without impacting project deadlines.
Executing a project does not inevitably mean to follow a strictly linear process. Rather, to mitigate project effort and time due to adjustments, effort-involving development processes need to be accomplished immediately. Usually any corrections done by development need to be tested by other teams as part of the project cycle. This process involves additional time and effort and can sometimes be very costly if rework needs to be done late in the project. This implies that similar process steps have to be passed through iteratively and this needs to be verified by the PM at the beginning of the project.

[4] "Interest Net Distributed Projects: Herausforderung an CM in verteilten Projekten", Franz Reinisch, PSE Cmsupport&Expert-Net, 18.01.2005

Within project management the terms Product Project Process correlate in a “trinity” [Burghardt 1988]. Whereby starting from an idea that an applied process leads to a product:

- The project determines the target-oriented intention.
- The product determines the manufactured item.
- The process determines the principally procedure in a project to produce a product.

That means the project management process details the planning and realisation procedure, as explained in the following chapter.

2.4.2.4 The Process

The process includes work packages that cover predefined workflows and defined actions that lead to an achievement. The definition for a process in [PMBOK2004] is:
"A process is a set of interrelated actions and activities performed to achieve a specified set of products, results, or services."
An example of a defined process is explained in Chapter 8.3.

Within a process structure and decision points are defined.

2.4.2.5 Decision-points

In [Burghardt 1988] decision points are generally defined at the end of a project phase[5] often outlined as milestones[6]. In defined processes, for instance PEPP (Project Engineering Process Plan) or SEM (System Entwicklungs Methode) that is used in Siemens PSE, also have instances that follow up on project progression. These are also called synchronisation-points may include checks, meetings or milestones to ensure synchronisation. At these synchronisation points the developing process gets valued and steered by a target/actual comparison. It is also important to identify and check possible deviations from the

[5]For a detailed explanation please refer to the glossary
[6]For a detailed explanation please refer to the glossary

plan even at non-defined decision points. Changes in a project will arise independently of time and content. Therefore revision procedures have to ensure that requirements [Burghardt1988]

- will become identifiable objects within the project,
- will contain all information for developing and processing,
- will be subject of clear unique decision for further processing, and
- Will be processed in a controlled manner.

Such changing processes have to contain the necessary exchange of information.
It is recommended to use collaboration tools for aiding PM activities and to distribute the information in the right way to the right project management team members.
That is especially important when working with virtual teams (see Chapter 3).

The next chapter describes the terms and definitions of “virtuality” and virtual teams as well as the problems of distance. Virtual teams are inter-working in different structural arrangements based on distances from organisational and national cultures and in different types of teams where each team has to master different types of challenges.

3 Virtual Teams

The term ”virtual“ mentioned in Webster’s new Collegiate Dictionary, 1977, denotes: “being such in essence or effect though not formally recognized or admitted” [Webster1977].

A (traditional) “team” is a group of people that interact via interdependent tasks. The tasks are aligned for a common aim. That means a team is a kind of organisation where a group of persons are working on a common solution of a given task [Bartsch2001].

Generally in that case we have the vision of a group who is working in the same room or at least the same building.

A virtual team is defined by [Konradt2002] as "a flexible group of employees who are working result-oriented on common aims in distributed independent locations and are information-technologic networked."

The following Table 1 contrasts the differences of traditional teams and virtual teams.

Traditional Team	Virtual Team
Co-located members	Distributed members
Face-to-face interactions	Electronic communication
Members of the same organisation	Members of different organisations
Hierarchical	Networked
Mostly informal communication	Continuous structured communication
Position authority	Process and knowledge authority
Information distribution (push)	Information access (pull)
Information on paper	Electronic information
Sharing complete work	Continuous sharing of work-in-progress
Culture learned through osmosis	Culture learned through electronic based communications and artefacts

Table 1: *Traditional Team vs. Virtual Team [Grenier1995]*

3.1 Collocated to Virtual Distance

From a personal perspective, the important distances are those often very short. How close people prefer to be for interpersonal interactions varies in cultures, from inches to feet.

Tom Allen, a professor at MIT (Massachusetts Institute of Technology), wanted to know how far away people have to be before they need to worry about compensating distance respectively and how close do people have to be to get the advantage of being on the same place. He discovered that virtual team collaboration already starts from a radius of 50 feet, as shown in Figure 2. More details regarding communication are described in Chapter 4.

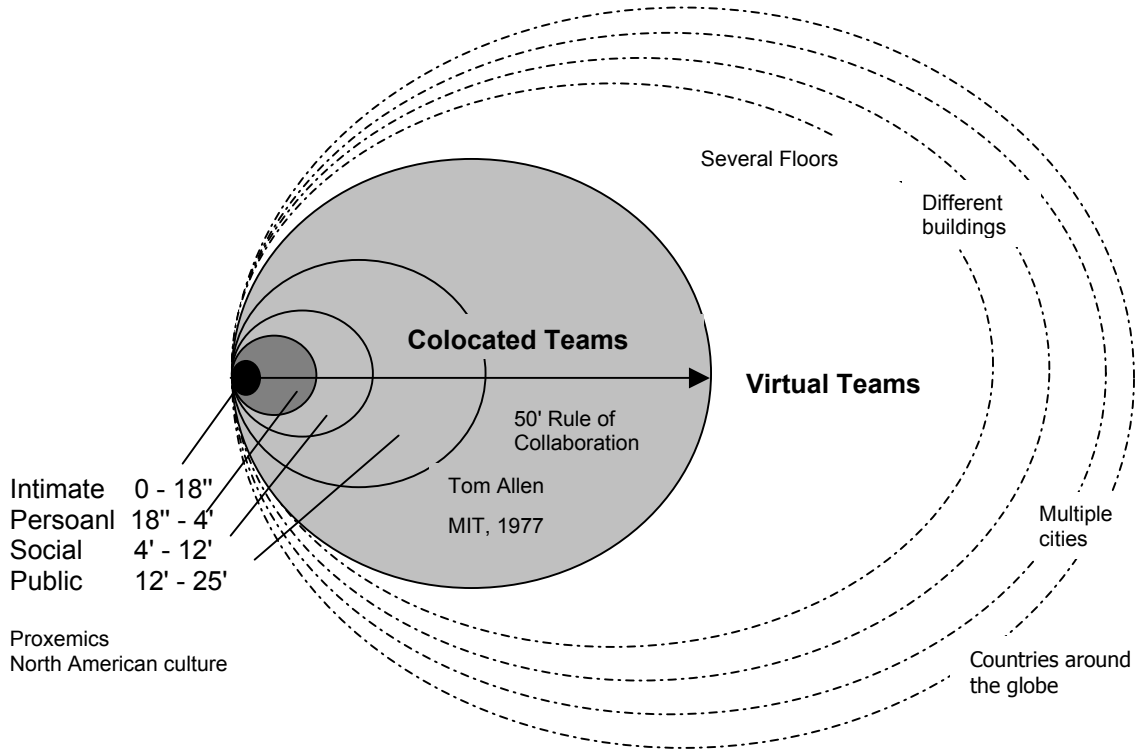


Figure 2: *Collocated to Virtual Distances [Lipnack2000]*

Based on distance different structural arrangements are defined and described in the following section.

3.2 Structural Arrangements

There are four types of structural arrangements along the following dimensions [Carmel2004]:

- Distance from the core organization's national culture (domestic-foreign)
- Distance from the core organization's organizational culture (internal-external to firm)

The four types of structural dimensions exist:

- Domestic intra-firm (domestic internal software work),
- Domestic external to firm (domestic software work with outsourcers, contractors and partners),
- Foreign intra-firm (foreign subsidiary, foreign acquisition, or offshore development centre),
- Foreign external to firm arrangements (joint venture/alliance with foreign firm or foreign outsourcing/contracting)

These points can be graphically represented, as shown in Figure 3.

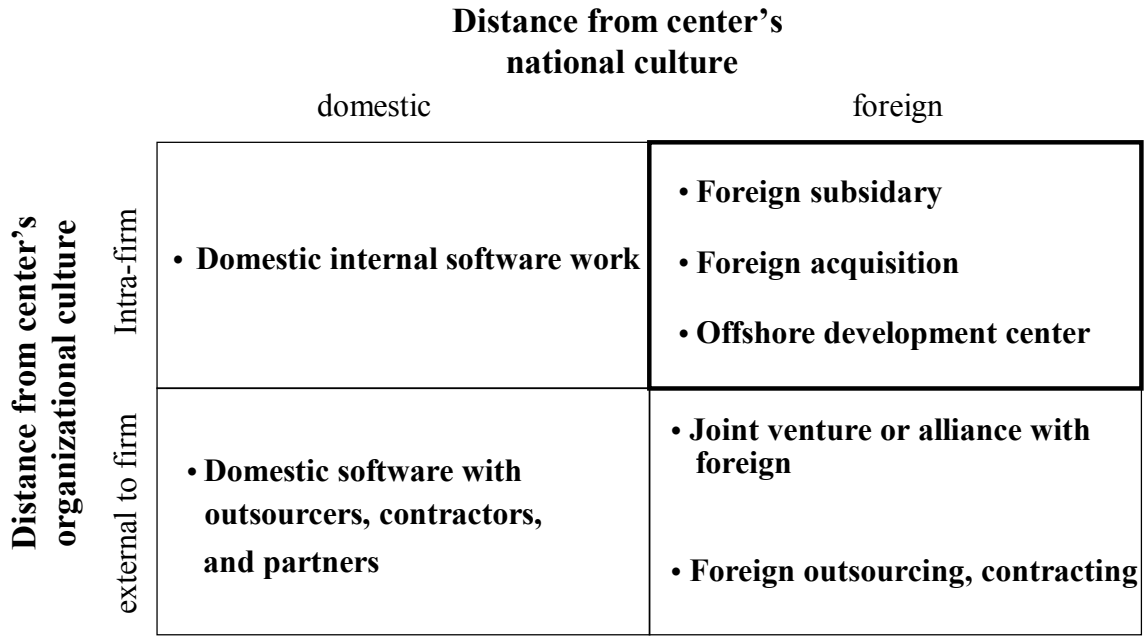


Figure 3: *Structural arrangements in software development [Heiss2005]*

Within these organisational structures virtual teams have to manage different challenges. Based on these organizational structures and inherent challenges, different types of teams are formed and this is described in the next section.

3.3 Types of Virtual Teams

There are many different configurations of virtual teams. The project manager and project team members need to have a solid understanding of the type of virtual team they are working in and the special challenges each team presents. What these teams have in common with other teams is that members must communicate and collaborate to get the work done and/or to produce a product.
There are seven types of virtual teams [Duarte2001]:

- Network teams
- Parallel teams
- Project or product development teams
- Work or production teams
- Service teams
- Management teams
- Action teams

3.3.1 Network Teams

A networked virtual team consists of individuals who collaborate to achieve a common goal or purpose [Duarte2001]. Such teams frequently cross time, distance, and organisational boundaries. One problem that typically arises is a lack of clear definition between a network team and the organisation, in that membership frequently is scattered and changeable, with team members rotating on and off the team as their expertise is needed. Team members may not even be aware of all the individuals, work teams, or organisations in the network.

3.3.2 Parallel Teams

Parallel virtual teams carry out special assignments, tasks, or functions that the regular organization does not want or is not equipped to perform. Such teams frequently cross time, distance, and organizational boundaries. A parallel team is different from a networked team because it has a distinct membership that identifies it from the rest of the organization. It is clear who is in the team and who is not. The members of a parallel team typically work together on a short-term basis to make recommendations for improvements in organizational processes or to address specific business issues. Virtual parallel teams are becoming a fairly common way for multinational and global organizations to make recommendations about worldwide processes and systems that take into account a global perspective. Parallel teams also are used domestically when expertise does not reside in one location or in one organization.

3.3.3 Project or Product Development Teams

Virtual project and product-development teams also can cross time, distance, and organizational boundaries. Team members conduct projects for users or customers for a defined, but typically, extended, period of time. Their tasks usually are non-routine and the results are both specific and measurable. A typical result is a new product, information system, or organizational process. The difference between a project team and a parallel team is that a project team usually exists for a longer period of time and has a charter to make decisions, not just recommendations. A project team is similar to a networked team in that team members may move on and off the project as their expertise is needed. It is different from a networked team in that membership is more clearly delineated from the rest of the organisation, and a final product is clearly defined.

3.3.4 Work or Production Teams

Virtual work teams and production teams perform regular and ongoing work. Such teams usually exist in one function, such as accounting, finance, training, or research and development. They have clearly defined membership and can be

distinguished from other parts of the organization. Many work or production teams are now beginning to operate virtually and to cross time and distance boundaries.

3.3.5 Service Teams

Service teams are now beginning to be distributed across distance and time. For example network support may be done as a continuous operation, with technicians located around the world taking turns dealing with network problems and upgrades. The technicians "follow the sun" and are situated so that one team always is operational. Each team works during its members' daylight hours and transitions work and problems to be next designated time zone at the end of the day.

3.3.6 Management Teams

Management teams can be separated by distance and time. Today, many management teams are dispersed across a country or around the world but work collaboratively on a daily basis. Although these teams often cross national boundaries, they almost never cross organizational boundaries.

3.3.7 Action Teams

Action teams also can work virtually. Such teams offer immediate responses, often to emergency situations. They cross distance and organizational boundaries.

Finally it is clear that the effort for building a virtual team is much higher than for a conventional, co-located team. But when a virtual team is established it can be substantially more efficient than a conventional team because of the rich common knowledge. But beforehand a virtual team leader has to be aware of the team complexity he has to manage described in the next chapter.

3.4 Team complexity

The two primary categories of variables that make virtual teams more complex are [Duarte2001]:

- Crossing boundaries related to time, distance (geographically), and organisation
- Using technology for electronic communication (share information) and collaboration (work together to produce a product)

Distance between team members increases and differences in time zones increase too. This makes communicating and collaborating at the same time problematic. Working across national boundaries complicates the situation because differences in language and access to technology handicap effective communication and collaboration.

As members from different organisations join a virtual team, integration of work methods, organisational cultures, technologies, and goals make communication and collaboration more difficult. Partners and suppliers often have conflicting goals and conflicting organisational cultures. There is even the same situation if team members come from different functional areas within the same organisation. Finally, the number of different choice for team interaction increases complexity. The complexity grows with the amount of the following categories that apply [Duarte2001]. The team:

- Has members from more than one organisation
- Has members from more than one function
- Has members who transition on and off the team
- Is geographically dispersed over more than three contiguous time zones
- Is geographically dispersed so that some team members are 8-12 hours apart
- Has members whose native language is different from the majority of other team members
- Has members who do not have equal access to electronic communication and collaborating technology
- Has members who are not formally assigned to the team

Following from the different team categories, the complexity index can be determined from the total number of above mentioned categories checked.
Therefore, the complexity index is determined as follows [Duarte2001]:
1-2=some complexity; 3-5=moderate complexity; 6-8=high complexity

Pindl [Pindl2002] differentiates complexity in external and internal complexity. His theory will be covered in the following sections.

3.4.1 External Complexity

Market requirements add to complexity and is considered "external" as it comes from outside in the network. The external complexity incentives are the result of globalisation and dynamic markets. This results in changes in demands, the number of customers as well as the amount of variety of service and products. Market changes are frequent and, as a consequence, the activities need to change accordingly in the team.

The market pressure forces companies to be different compared to their rival competitors. By increasing the number of services or products, the greater the potential number of customers since a diverse product/service range has a greater appeal in the eyes of customers.

External complexity has an influence primarily on two units in a company:

- Sales related execution of requests and distribution related processes. Raising customer complexity leads to internal rising of process related complexity and therefore to rising costs.
- Customisation of service offering that leads to an increase in internal entities and function areas, which leads to a number of distributed activities internal to the organisation.

3.4.2 Internal Complexity

Internal complexity is caused locally in the organisation and is categorised into three types:

- Structural complexity
- Communication related complexity
- Individual complexity

3.4.2.1 Structural Complexity

Structural Complexity affects the structure, that is, the operative organisation as well as the product structure.
Typical examples are:

- The left hand does not know what the right hand is doing due to long decision making processes and missing combination of tasks, competence and responsibility.
- No transparency of own tasks and too less knowledge of the tasks of the cooperating team.
- Double and multiple activities.
- Overkill of control activities.
- Long and broad reporting path.

The origin of Structural Complexity was initiated as a result of handling documentation incorrectly as well as in the acting of decision maker who was not correctly informed on how to handle documentation or are not informing team-members how to document in a correct way.

Structural Complexity and Information and Communication Complexity are very similar as to consider in the next section.

3.4.2.2 Information and Communication Complexity

Drivers of Information and Communication Complexity involve participating in inquiries, searching activities, types of clarifications, forwarding, proofing, sorting, distributing, coordinating and also transferring information manually.
Companies often try to counteract complexity driven non-value added efforts within information processing divisions by using a requirement specific folder or document system. But in administrational processes, such systems often directs to the opposite what means an overkill of complexity driven activities.

3.4.2.3 Individual Complexity

Individual Complexity is related to the individual work results of the individual employees. These working results are hard to detect especially in decentralised networks.
This complexity consists of:

- Time needed for finalize tasks
- Degree of innovation for problem solving
- Combined with different emotions, missing motivation and working atmosphere.

Complexity costs money. But no cost accounting system considers complexity costs and types of complexity costs.

3.4.3 Costs of Complexity

Predominately process related costs occur because of

- Badly created or organized workflows
- Insufficient quality of employees and missing association of tasks, competence and responsibility
- Break in media
- Inconsistent data that impacts information transfer and communication
- Product induced costs of avoidable activities

- Product induced additional costs because of inadequate standards and multiple usage

As a consequence of the process related costs, the following types of Complexity Costs result:

- Costs in exchanging both communication and information
- Coordination costs
- Decision costs
- Validation costs
- Assembling costs
- Double realising costs
- Search costs
- Costs of mixing up
- Deviation costs (quality related)
- Planning and steering costs
- Data administration and system costs
- Costs for changing the vendor
- Additional capital binding costs
- Costs of absenteeism

Who ever is leading a virtual team should know the complexity factors and the barriers which characterise such teams compared to co-located teams. It is essential to build up a suitable organisational structure, which is also mentioned in Sections 3.7.3 and 3.7.5. The “heart” should be a core team where participants should be responsible for defined interfaces of different functions in a project. With the aid of core teams it is possible to manage the complexity of virtual teams[7] [Kärner2005].

Principally a reduction of complexity is possible by thinking networked[8] [Vester2002]. From the knowledge of team or unit interaction, recognising complexity can be reduced and can be avoided through:

[7] More about complexity factors and core-team is shortly described in http://www.projektmagazin.de/magazin/abo/artikel/2005/1205-3.html, Dr. Martin Kärner
[8] More about thinking networked can be read in: [Vester2002], [Vester1999], [Dörner2000]

- Periodic proofing of the outcome
- Considering learning processes
- Running activities in parallel
- Integrating and combining activities
- And finally providing transparency and clarity

Being aware of the complexity of virtual teams has many advantages that can be pointed out described in the next section.

3.5 Advantages of Virtual Teams

The main focus of virtual teams belongs to the cooperation and collaboration between the teams that share the working operations in an organized network. Preliminary, the cost advantages due to the usage of up-to-date information technology and communication technologies are to highlight where a high capability of reuse of media is employed. Therefore mistakes can be reduced and project duration potentially be reduced. The advantages of virtual teams are highlighted in the following text [Konradt2002].

The **composition of the team** must not be focused towards local availability of team members, rather, based on professional qualification. The best team members may be available immediately even if they are working at different locations.

Regionally available **special and expert knowledge** can also flow into the team. Distance and time are no longer restrictions in solving critical or emergency problems. Resources can be utilised from any part of the world immediately with the appropriate handover of information and tasks.

Project specific communication can be done very quickly without significant delays, which implies **saving time compared to competitors**. This leads to better **time-to-market** advantages and culminates in **relay working**. Rely working has a "follow-the-sun" principle where workers in one part of the world handover the daily work to another group in another county that are just about to

begin work for the day. This handover from one working shift to another enables continuous work using the change in time zones to quicken progress. Relay working has been studied in depth by Schweifer [Schweifer2006].

Cost reduction is facilitated by costs involved in reducing employee recruitment and reducing redundancy (or dismissal) costs. Additional allowances also may not need to be paid to the employee. Peaks can be covered by flexible acquisition of team members. Moreover, costs for business trips needed for project meetings may be minimised.

Networked organizations can drop some hierarchical layers that leads to an **improved horizontal integration** of the group within the division. Hierarchical structured teams commonly administer more slowly and are fault-prone due to longer workflows.

Information Technology (IT) enables **maximum provisioning of information** because all documents, notes and news can be distributed and reconstructed at any time. This improved horizontal integration leads to a **quicker and direct relay of information** as documents are both created and distributed electronically.

Better inter-working between project members, supplier and customers without the need of being on the physical same place. Costs can be saves as rental for office space is not required, for instance, some employees are able to work from home.

Possibility of **quicker reaction for either changes on markets or problems in the project** by obtaining professional assessments very quickly. For instance, via online meeting or by providing remote access to systems.

Due to networked inter-working, usually more **mechanisms for both rationalising and flexibility are available**. For example, business process optimisation, optimisation of leadership mechanisms, working-time flexibility and total-quality-management.

However, virtual teams also have many disadvantages and risks whereby virtual teams have to confront that are critical for success. The next section presents the main disadvantages, risks and critical success factors.

3.6 Disadvantages, Risks and Critical Success Factors

Virtual teams demand certain conditions. Inherent problems surface due to increasing geographical distance between team members, language barriers, differing cultures and dissimilar technologies. These factors complicate the situation where the following disadvantages and risks are identified.

3.6.1 Disadvantages

The disadvantages of virtual project teams are:

- Lack of motivation due to lack of face-to-face contact
- Communication via collaboration-tools (like e-mail) can increase the amount of misunderstanding (refer to Chapter 4.4)
- The requirements (e.g.: communicate, collaborate) for project management increase enormous.
- Less control abilities are available.
- Higher organisational effort and administration.
- Reduced integrity, empathy and affinity within the team and the company.

These disadvantages lead to the following risks for distributed projects.

3.6.2 Risks

Potential risks for distributed projects in relation to working with virtual teams are:

- The process chain is widely spread. In many cases, the project manager and team members need to overcome communication, geographical and cultural barriers.

- Certain project members find it difficult to communicate with each other and to cross skill. Because of technical and cultural differences between team members in addition to large geographical distances increase misunderstanding. Communicating in a non-native language commonly increases misinterpretation.
- In larger virtual teams, team-members never meet together all at the same time. For the project team it becomes increasingly difficult to find a common identity in order to grow together.
- The project leader normally has very limited or no access to resources onsite and sometimes with restricted authority to these resources. Therefore, the project leader is weak in their ability to directly influence on onsite activities. The project managers' success, therefore, also depends upon the willingness of onsite teams to cooperate.
- Building trust is essential. In most instances team members have to work self-dependently and autonomously. A lack of team spirit may result due to a lack of trust.

These risks can lead to a situation where a virtual team will never be capable of working competently together and the project goals may be missed.
Being mindful of the risks and considering critical success factors, a virtual team will become a strategy for success. Organisations see virtual teams as the way to become increasingly smarter, flexible, adaptive and competitive.

Deborah L. Duarte [Duarte2001] identified the following critical success factors for virtual teams, which are described in the next section.

3.7 Critical Success Factors

Principally, technology allows the existence of virtual teams. Technology increases speed and agility by making resources available.
The effect of electronic and collaboration technologies is fundamental to the success of a virtual team. However, virtual teams entail much more than just technology and computers. When virtual teams and their leaders are asked about

success and failures, they rarely mention technology as a primary reason for either [Nunam1997].

"The best predictors of virtual team success are the clarity of its purpose and the group's participation in achieving it" [Lipnack2000]

Duarte [Duarte2001] identified seven critical success factors for virtual teams, of which technology is only one:

1. Human resource policies
2. Training, on-the-job education and development
3. Standard organizational and team processes
4. Use of electronic collaboration and communication technology
5. Organizational culture
6. Leadership support of virtual teams
7. Team leader and team member competencies

3.7.1 Human Resource Policies

Human resource policies should support virtual teams. Systems must be integrated and aligned to recognise, support and reward the people who work in and lead virtual teams.

3.7.1.1 Career-Development Systems

Team leaders can help to support virtual team members by providing career opportunities and assignments that are comparable to those in traditional team settings. Applying promotion and career development policies and actions fairly to people who work in virtual settings helps to reinforce the perception that working virtually is an accepted career option. Virtual team members often mention that they fear that they will be looked over for promotional opportunities because they are not seen every day. This fear is not unfounded. Managers who lose visual and verbal proximity to their employees often put up the strongest resistance to alternative work and team arrangements. Virtual team leaders must ensure that

the members of virtual teams have the same career-development opportunities as the members of traditional teams.

3.7.1.2 Rewarding Cross-Boundary Work and Results

Organizational reward and recognition systems often favour individual and functional work. Virtual team members, however, frequently operate in a cross-functional and/or cross-organisational environment. Changes must be made in the way in which people are recognised and rewarded. Leaders must develop performance objectives for team members that include working across boundaries and sharing information to support virtual teamwork.

In addition, performance measures must be adapted to reward results. In a traditional office environment, where people are seen putting in effort every day, it is relatively easy to at least partially reward people for effort as well as for results. In a virtual environment, effort is more difficult to discern.

The use of formal and informal public recognition of virtual teamwork through "on the spot" awards, bonuses, and other mechanisms can reinforce the perception that working virtually is valued. You can use Web-based technology, such as setting up a site for virtual team "best practices" and advertising team success and performance, as a way to publicly recognise people in a virtual setting. You also can use examples of your virtual teams success in speeches, presentations, and discussions with other team leaders and with management.

3.7.1.3 Providing Resources and Support for Working Virtually

Create and support policies that provide your team with technical support for working remotely. All team members should have equal and immediate access to electronic communication and collaboration technology, training and technical support. Many virtual team leaders set a standard for technology and make certain that everyone has access to the same hardware, intranet and Internet connections, and applications.

3.7.2 Training, On-the-Job Education and Development

Formal training in using technology is vital for success. In addition to a formal training curriculum, make certain that the team members have access to continual on-line training and technical support.

Learning how to use technology is not enough to guarantee success. Team leaders should make certain that they get the training and support they need to be adept at facilitating meetings using technical and non-technical methods. Training in facilitation skills should be an integral part of a development curriculum for project team leaders and project team members.

Provide training and support for your team in working collaboratively across organizational, cultural, and functional boundaries. Many organizations provide direct consulting support and training to virtual teams in this area.

They create and implement systems for sharing knowledge across functions, projects, and organizations. Shared lessons, databases, knowledge repositories, and chat rooms are used in organizations that include virtual teamwork.

3.7.3 Standard Organisational and Team Processes

Consider developing and implementing standard team processes. The use of standard processes reduces the time needed for team start-up and may eliminate the need for unnecessary reinvention of operating practices each time a team is chartered. Practices need to be flexible, however, to promote adaptation to a particular virtual team's situation. Common standard technical processes, especially for parallel, project, or network teams include [cp. Duarte2001]

- Definitions of requirements
- Estimates of costs
- Procurement
- Team charters
- Project planning
- Documentation
- Reporting
- Controlling

It is also a good idea to define the preferred software for each of these major processes (refer to Chapter 5). Many organizations use standard project-management software packages so that any team, virtual or co-located, is familiar with and trained in using that package. Experienced virtual teams prepare team charters that describe suggested team norms and communication standards. They use these as starting points to create processes suitable for their unique situations. Reinforce and expect the use of both technical and soft processes from the team.

3.7.4 Electronic Collaboration and Communication Technology

As a virtual team leader, you will need to select electronic collaboration and communication technology (see Chapter 5) that meets the needs of your team. You also will need to ensure that the organisation is ready to support your technical needs. Introducing electronic communication and collaboration technology needed for virtual teamwork, such as desktop video conferencing or groupware, requires that three primary organisational conditions be in place:

1. The organisation has a well-funded, respected, and established information systems staff, whose members are experienced in installing and supporting electronic collaboration technologies in many different locations.
2. There is commitment by the organisation to keep personal computer systems as up-to-date as possible, regardless of a person's title or duties. When systems fall behind, the costs of upgrades and the time to introduce them mount quickly. Productivity also may fall as people spend time attempting to fix their equipment or work around it.

The organisation has a well-maintained corporate network that has room to expand and to meet the needs of more complex systems and users.

If the organisation is lacking in any of these three areas, they could consider adopting a less complex suite of technology than if they are in place. In either case, it is important to select a reasonable set of standards for the virtual team in electronic communication and collaboration technology. Standards should meet the business needs of the team and match its mission and strategy. A global team that needs to communicate and work collaboratively, for example, must have a

minimum set of standards for technology. For communication, this includes touch-tone telephones, audio conferencing equipment, voice mail, fax capability, and access to a common e-mail system that allows people to send messages and exchange files. Video conferencing, scheduling, real-time data conferencing, electronic meeting systems, collaborative writing tools, and whiteboards can be added if the strategy calls for intensive collaborative work or if sufficient information systems resources exist to make the technology work reliably. Make certain that external partners and suppliers have access to compatible communication and collaboration technologies if they are considered part of the team.

The organisation needs to ensure that skill in using the electronic communication and collaboration technology is equally distributed among team members from different functional areas, geographic locations, and partner organizations. Technology used by each virtual team has to be available to all team members, wherever they are located.

Finally, electronic collaboration hardware and software should be directly factored into the team's budget. It is important to recognize that the benefits of technology grow over time. Virtual teams do reduce costs, but often there is an up-front and long-term investment for technology and training to make them work effectively. The more people and teams work virtually, the more quickly these business practices will translate into savings.

3.7.5 Organisational Culture

Organisational culture includes norms regarding the free flow of information, shared leadership, and cross-boundary collaboration. Helping to create organisational norms and values that focus on collaboration, respecting and working with people from all cultures, keeping criticism constructive and sharing information are all important elements that need to be addressed. The organisation's culture sets the standard for how virtual team members work together. An adaptive, technologically advanced, and non-hierarchical organisation is more likely to succeed with virtual teams than is a highly structured, control-oriented organisation.

The success of virtual teams is related to how the organisation fosters or impedes trust between itself and its external partners. Treating partners as less than equal, hoarding information, forgetting to share data or results in a timely manner, and using competitive or proprietary information inappropriately can demoralise trust quickly.

If the organization is multinational or global, norms must honour different ways of doing business if they are to be effective. Therefore, it is important to create policies on how to do business in different cultures.

3.7.6 Leadership

For virtual teams to succeed, the organisation's leadership must establish a culture that values teamwork, communication, learning, and capitalising on diversity. The key to establishing an organisational culture that promotes virtual teamwork is that managers and virtual team leaders at all levels must be open to change and must support virtual teamwork.

Virtual team leaders and members can help managers to develop supportive behaviours. They can offer specific suggestions to management regarding the four categories of leadership behaviours that advance virtual team performance:

- Communication
- Establishing expectations
- Allocating resources and
- Modelling desired behaviours

First, it is critically important to communicate throughout the organisation that working across time and distance and with organisational partners is a new way of doing business. This includes assigning virtual teams important and high-visibility tasks and projects and reporting the benefits and results of their work so that virtual teamwork is respected in the organisation.

Second, it is important to establish clear expectations about how virtual teams work. Procedures and goals must be clear, so that virtual team members know how they are to work and what their objectives are. With all the new things they must learn about operating in a virtual team, the team members need clear guidelines and objectives to steer by. The other members of the organisation also

need to understand how virtual teams operate and that the teams' end goals are aligned with organisational objectives and are the same as those of co-located teams. Setting high expectations for performance also strengthens the perception that virtual teams deliver results.

Third, leaders who allocate resources for training, technology, and travel send strong signals which message that virtual teams are important. Time and money must be allocated for training for virtual team members in areas such as cross-cultural work, project management, and technology. Time and money must be allocated for team leaders to travel for face-to-face meetings with team members at the beginning of the team's life and then when necessary. Resources also must be dedicated to acquiring and maintaining the technology needed to facilitate the team's work.

Fourth, and most important, effective leaders model the behaviours they expect. They align cross-functional and regional goals and objectives. They work with other managers across geographic and cultural boundaries. They solicit team members input and demonstrate trust in their judgment, particularly in the members' functional areas of expertise. Effective team leaders show flexibility, changing as business conditions dictate. They do not expect behaviours from others that they do not engage in themselves.

3.7.7 Team Leader Competencies

The challenges that virtual team leaders face are immense. Many report that they feel as if they are the "glue" that holds their teams together. Team leaders have to establish trust in an environment with little or no face-to-face contact or feedback. These challenges necessitate the development of an additional set of competencies that complement the skills for leading traditional teams. These competencies are as follows:

- Coaching and managing performance without traditional forms of feedback
- Selecting and appropriately using electronic communication and collaboration technologies
- Leading in a cross-cultural environment
- Helping to develop and transition team members
- Building and maintaining trust

- Networking across hierarchical and organizational boundaries
- Developing and adapting organisational processes to meet the demands of the team

Team leaders can champion their own development by training and on-the-job assignments that build competence in these areas.

3.7.8 Team Member Competencies

The people who work as virtual project team members have to develop their own competencies. Firstly, virtual teamwork is not for everyone. Serving on a virtual team may seem too transitory for some individuals who need face-to-face interaction and stability in a work environment. Without the structure of a co-located setting and day-to-day contact with team members, they may feel lonely or left out.

All members of traditional and virtual teams need solid grounding in their respective disciplines. However, virtual team members need new competencies. Team leaders can help to facilitate competence development by working with team members to create learning plans that use training and on-the-job assignments. The definitions of team-member competencies will vary, depending on the team's type, mission, and composition. There is, however, a relatively stable set of six critical competencies:

- Project management techniques
- Networking across functional, hierarchical, and organizational boundaries
- Using electronic communication and collaboration technologies effectively
- Setting personal boundaries and managing time
- Working across cultural and functional boundaries
- Using interpersonal awareness

Over time, most people can develop the competencies that are needed to work virtually. Adequate training, education, and leadership support and feedback can speed development.

Of course, all the critical success factors do not have to be in place for virtual teams to succeed. But it is shown that in all success factors sharing of information

and communication are a relevant part. A virtual team can only be efficient if the communication works properly to benefit the already mentioned advantages of distributed special and expert knowledge and the advantages of using IT, which enables a maximum provisioning and quicker direct relay of information.

Whenever a team member has a piece of the puzzle, robust communication pulls the pieces together and plays a key part in solving problems. Much knowledge can be gathered out of a big (world wide distributed) resource pool. Communication is paramount in an adaptive world and is essential to collaboration. This now leads to the next chapter concerning Factor Communication.

4 Communication

For thousands of years it was shown that communication is very important in complex projects: A very popular and often convenient example is the building of the Tower of Babel. Due to confusion of different languages the building of the Tower of Babel was never finished.

Communication within a software developing process is one of the most challenging factors [Rupp2004]. Even managing in-house software development projects, problems arise even though there are no languages and cultural barriers exist or large geographical distances [Rupp2004]. In software development there is always an apparent threat of loosing information that can cause the project team to work in different directions than what is intended. This problem is compounded in virtual teams as communication and collaboration to exchange information is more difficult due distance, different time zones, different cultures and languages.

Kärner [Kärner2005] states "It is to assume that in virtual teams up to 90% of the information you transfer may not be understood or wrong interpreted. The other way round you understand only 10% of the information you get."[9]

Communication is required to support one another in a virtual team and to cross large geographical distances; the organization needs to implement a communication concept. The concept needs to be implemented and used by all virtual team members who need to utilise all available communication channels [Bartsch2001].

Virtual teams have to deal with spatial distance and different time zones. The interdependency of communication and distance is described in the following section.

[9] English translation of the original German text.

4.1 Communication and Distance

The impact of increasing distance between team members has on communication has been touched on in Chapter 3.1. Research shows that communication drops with distance [Carmel2005], [Lipnack2000]. Lipnack [Lipnack200] states *"Based on proximity, people are not likely to collaborate very often if they are more than 50 feet apart."* This observance can be graphically presented by probability of communication verses distance, called an Allen Curve and is shown Figure 4.

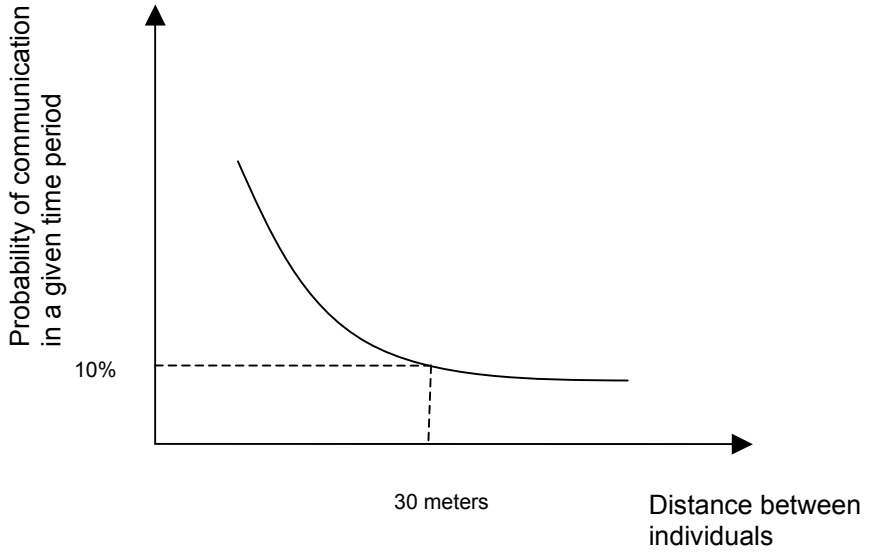


Figure 4: *Allen Curve*

As shown by the Allen curve in Figure 4, the probability of spontaneous (informal) communication between people whose working location more than 30 meters apart reduces to just 10% per day.

Distance not only influences the quality of communication. Communication is also influenced by the different communication methods and by the loss of communication channels, which have an affect on the quality of communication.

4.2 Challenges of Communication

"Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?"

T.S. Eliot (1888-1965)

It has been shown [Rupp2004] that in face-to-face meetings are ideal when communicating within a project team, however this communication method is quite often not possible in distributed projects.

Starting from models of channel-reduction it is often assumed that many computer aided communication media are transferring information, especially socio-emotional information, only in a reduced way. That leads to a loss of communication on a subjective layer [Rupp2004]. Schulz [Schulz2000], an expert in communication, aptly discusses communication techniques in a variety of situations.

"The difference between the right word and nearly right word is the same as the difference between a flash and a lightning bug."
Mark Twain

In total there are four main areas where communication media has disadvantages compared to face-to-face meetings [Konradt2002]:

- Slower feedback
- Lower amount of communication channels (optic, acoustic)
- Feel or interact impersonally
- Less comprehensive

On the other hand, the growth of personal integrity and affinity evolves as part of the communication process. Ensuring that all project team members receive information at the same time might improve both integrity and trust within the team. However, in a virtual environment it is hard to distinguish if a project team member has been systematically excluded or if only forgotten in an information distribution [Duarte2001]. In an environment where IT enables effective communication, it is difficult to justify that human oversight was not intentional.

Additionally, the following challenges in relation to communication need to be mastered [Punzet 2005]:

- Different time-zones
- Cultural differences
- Frequent change of employees in the team
- Lack of motivation
- Anonymity in virtual teams
- Choosing the appropriate communication tool

One major reason why many virtual teams fail is because they overlook the implications of the obvious differences in their working environments. People are not conscious of how different it really is when they and their colleagues no longer work face-to-face. Teams fail when they do not adjust to this new reality by closing this “virtual gap” [cp. Lipnack2000].

Principally, communication can be classified into different types and categories, which will be touched on in the next section

4.3 Types and Categories of Communication

Communication is one of the most important success factors of project management. A big part of a project managers’ work are communication-activities. Certainly, no project team can survive without communication.

There are different types and categories of communication. They are distinguished by the principle intention of the communication partner, in the underlying processes or in the clearness of outcome. But, in principle, a first view of formal and informal communication needs to be distinguished.

4.3.1 Types of Communication

This section describes the two basic types of communication, which are referred to as formal communication and informal communication.

4.3.1.1 Formal Communication

Formal communication is determined by being precise and specific with fewer possibilities for misinterpretation to present what the “sender” desires to express.
An example for specific instructions is, for instance,” Please prepare a Requirements Specification by Thursday 20.02.2020, 10:00 a.m.”
Formal communication is heavily task oriented.

4.3.1.2 Informal Communication

Informal communication shows facts in an indirect way and is sometimes wilfully ambiguous. This kind of communication is used for social intercommunication and to establish social structures. These social structures give the whole team a scope for interacting. This implies that even without precise formulated instructions and statements, team members know what behaviour and what tasks are expected.

The expectation to be skilled in the art of communication through IT consequently focuses on formal communication methods. An example is the launch of electronic forms whereby communication is only done via setting marks or clicking buttons. But for successful implementation of project management systems it is important that, alongside formal systems, informal communication interaction in addition to project management culture need to be considered. Moreover, all instances concerning project communication internally and externally become all the more important.
Both formal and informal communication can be done in two different ways. Using tools for communication in general fall into two categories – synchronous and asynchronous communication.

4.3.2 Categories of Communication

This section describes the categories of communication that distinguish real time communication and time independent communication.

4.3.2.1 Synchronous Communication

Synchronous communication enables team members to interact at the same time. In synchronous communication, the listener is able query the receipt and the correct understanding of an information in real time.

Synchronous tools include:

- Desktop real-time data conferencing
- Electronic meeting systems
- Electronic display
- Video conferencing
- Audio conferencing

4.3.2.2 Asynchronous Communication

Asynchronous communication facilitates delayed interaction. The communication is time independent. Therefore there is almost no immediate acknowledgement of sent information.

Asynchronous tools include:

- E-mail
- Group calendars and schedules
- Bulletin boards and Web pages
- Non-real-time database sharing and conferencing
- Workflow applications

Nevertheless for goal-oriented quality of communication in a distributed team it is important to know:

- Has the information received?
- Was the understanding of the information correct?
- Is the receiver working on the information?
- When is a solution expected?

Therefore especially for asynchronous communication well-defined communication processes and defined rules are helpful and to advice.

Providing an organisational and information technological infrastructure is indispensable.

But for a successful working in virtual teams a powerful technique alone is not sufficient enough. The team members need to be prepared for the type of communication technology especially when dealing with new or different tools. If team members have no or only limited experience with communication techniques in distributed teams, as well as with the types of communication, project leaders often find that virtual teams need more budget and time to achieve the same goal compared to “normal teams” [Keiser2005]. A substantial reason for that is the dramatic change of communication terms and conditions with what team members are confronted with in virtual teams.

Raising problems by using computer-aided communication are described in the next section.

4.4 Problems of Using Computer Aided Communication

The following problems need to be considered when using computer-aided communication:

- The different technical communication tools have to be mastered in order to use them in an efficient way. This is often combined with necessary learning and training effort. Know-how in such tools needs to be built up in parallel to existing job related competences each team member has. Therefore there is the risk to overload team members.
- For successful computer aided communication, an adapted project-management culture with new social rules is necessary. These rules answer questions like:
  For which communication task which medium is to be used? How to deal with negative messages? How can and should task related and social

communication be distinguished? How can integrity and confidentiality be ensured?

The spectrum of rules can be broad. It starts by rules of politeness and further develops how to react and feedback on information and at what time. Konradt [Konradt2002] proposes the following list of rules to discuss in virtual teams:

- When and how should regularly meetings be done
- How does the team make decisions
- What expectations do team members and manger have to each other
- How should feedback be done
- How to handle critics
- How to avenge braking arrangements
- How often should e-mails be recalled and how quick should they get replied
- How can or should support get ordered
- How to deal with confidential information

Duarte [Duarte2001] and Bartsch [Bartsch2001] also has some similarities to Konradt but makes some additions

- Based on location independent integration of team members often several colleagues have an expert status and therefore a disproportionate surplus working load. At the same time other colleagues only slowly build up competencies, experiences and qualification. That is destructive for the overall resource pool and both a close combination of computer aided communication and requests for knowledge management become necessary.
- If different communication tools are used the aforementioned problems increase. Especially when participating in an increasing number of projects each case using different tools and different communication rules.
- Computer aided communication can principally be logged and stored. Hence questions of data protection und information security arise. Also terms of co-determination as well as project management culture and terms of trust need to be managed:

- To what extent may the upper management have rights to access logged electronic communication data? This must be handled according the data protection act, acts of telecommunication and personal rights. On an international level these terms are more complex [Bartsch2001].
- Product specifications often have compatibility problems for different systems. That often leads to a commonly heard phrase: ”sorry your attachment can not be read because my system does not support this format”

These examples of problems are intensified in multi-project management.

Collaborative solutions are the solution for companies that are spread all over the world. They strengthen collaboration across physical, social and cultural borders. Globalisation and technological development is driving the development of collaborative solutions. Knowledge and skills have been spread worldwide as large numbers of people have emigrated to every corner of the globe.

That leads on to the usage of IT described in the next chapter.

5 Technologies

The explosion in communication technologies allows for the creation of virtual teams. Multiple, constantly enhanced modes of communication are possible, providing access to vast amounts of information and interaction. Virtual teams operate on Internet time

The administration of IT based business connections, to both internal and external business partners, is dependent on abilities of companies to cope with the information age [Österle2000].
An individual company harness globalisation trends by building up global networks and its management utilises new IT to master the new requirements. The new requirements of global operating companies lead to the development of new IT solutions that reinforces economic incentives. The diagram presented in Figure 5 shows advantages in economic and information technology related to patterns of networking and patterns of organisations [Fleisch2001].

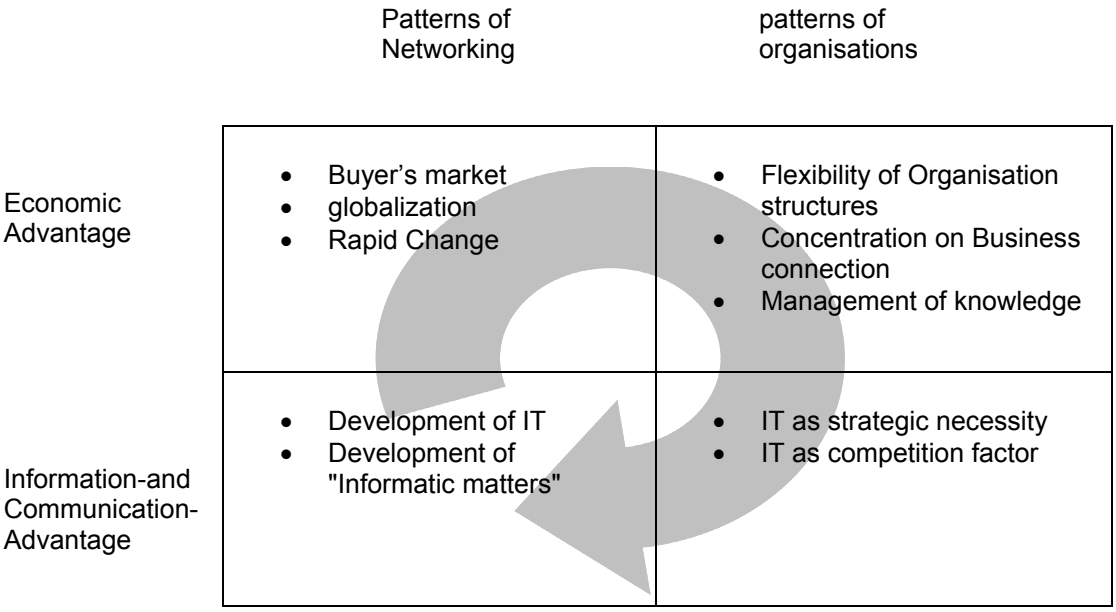


Figure 5: *Advantages and patterns of networking [Fleisch2001]*

The role of technology in virtual teamwork is a role of overcoming the complexity of time and distance in communication and collaboration. Virtual teams and their leaders need up-to-date knowledge about technology and its role in facilitating

performance. Virtual project managers and even virtual project team members need to understand the technological needs of the task and the team, matching the technology available to the task, and facilitating the technology to maximise team performance. This is aptly summarised by Lipnack [Lipnack, 2000] *"We can't solve twenty-first-century problems with nineteenth-century organisations"*.

IT support of teamwork has been a topic of research since the middle of the 1980's. With further development of Internet technologies, computer supported collaborative work (CSCW) has enhanced from isolated single-applications to integrated knowledge and collaboration management portals.

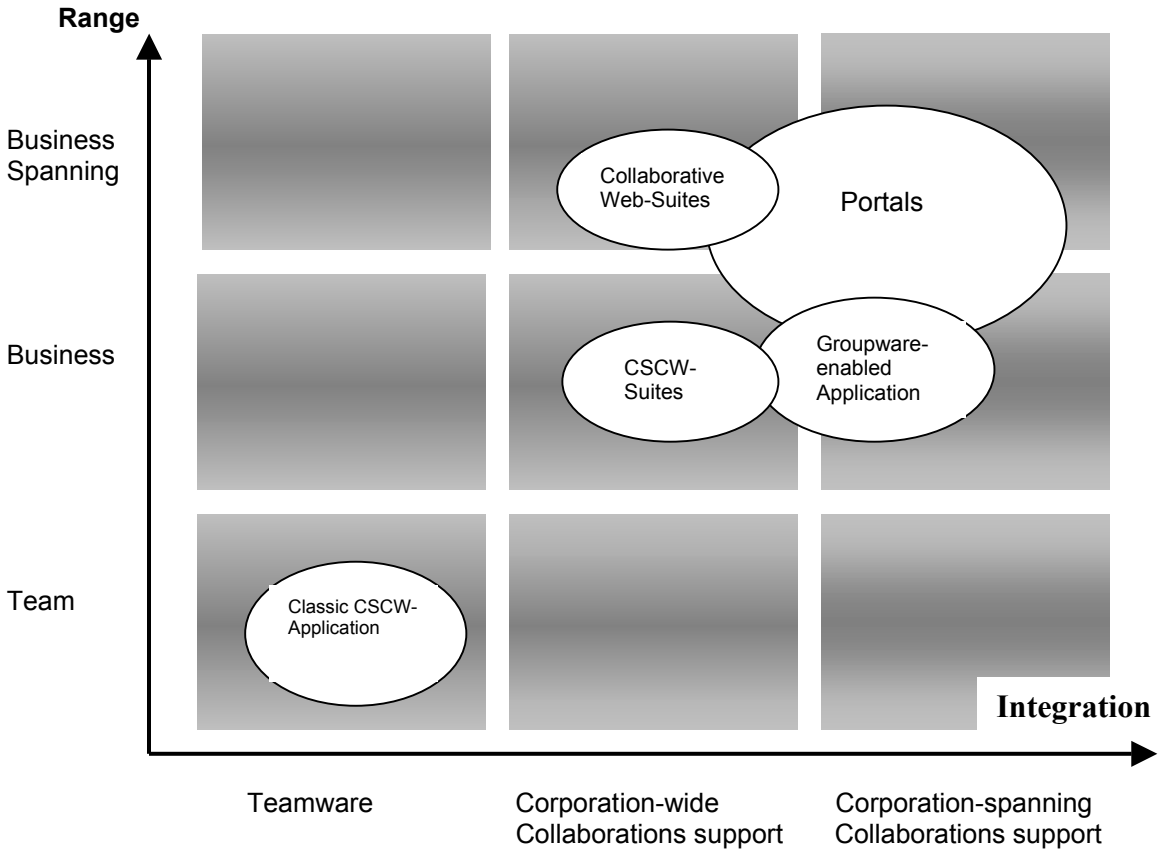


Figure 6: *Boundary of Collaboration-Application [Bartsch2001]*

A positioning of classic CSCW applications to Internet based portals is shown in Figure 6.

The core functionalities of CSCW are defined in the following application classes [Bartsch2001]:

- E-mail/messaging: applications for electronic information distribution
- Calendaring/scheduling: project planning, date book
- Electronic-Meeting/E-Conferencing: Collaborating and undertaking meetings via IT-support (video, audio, chat)
- Real Time (synchronous) Data Conferencing: common processing of objects and documents during meetings.
- Non Real Time (asynchronous) Conferencing/discussion forum: Supporting timely independent structured written discussion.
- Group Document Handling/document management: Supporting of common processing and administrating of documents.
- Workflow tools: Supporting of process-flows in groups.
- E-Collaboration: Portals and communication-, collaboration platforms

As the postal service was once indispensable, then the telephone, the fax machine and the Internet are now relevant to the point that their absence is an impediment to business, and everyday life as well [netage2005]. Lipnack adds “Every undertaking, though, has a lifecycle of some kind, and while email may be the fastest growing form of collaboration, the management of routine tasks is migrating from the phone and fax to the internet/intranet, via extranets and wide-area networks.“

The Intranet, for instance, is used by companies especially to create and administer company specific data. The intranet is thereby used as a private computer network that uses network connectivity to securely share part of the organisation information and provides application and communication tools to inter-work with employees.
Depending on the infrastructure build-up of the intranet different applications are possible [Bartsch2001] as shown in Figure 7.

Based on project management requirements and technological possibilities, different software has been developed to support project teams. The next section is concerned with software for project teams.

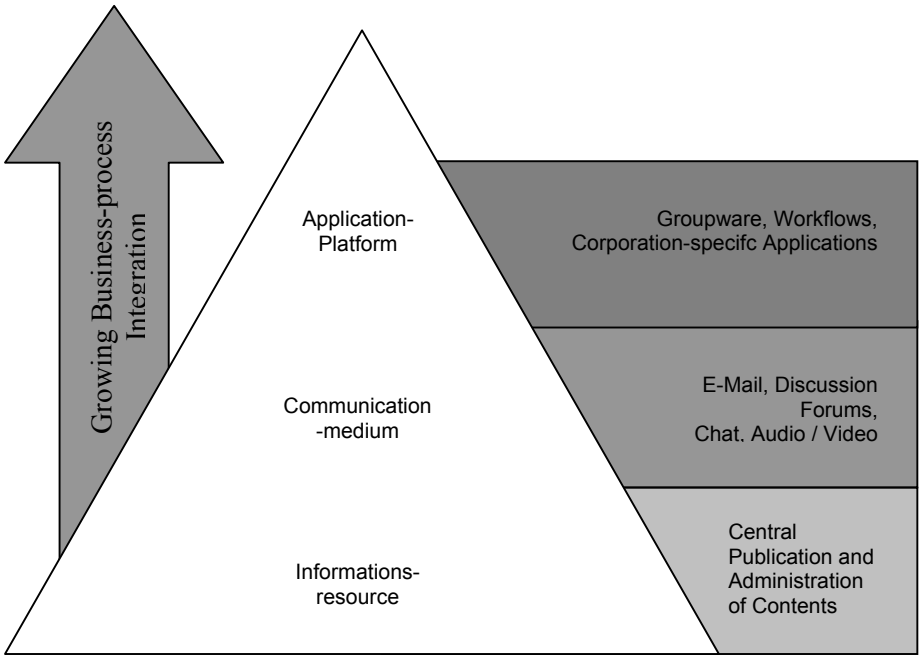


Figure 7: *Potential Intranet-Application [Bartsch2001]*

5.1 Software for Project Teams

Within most any company, there will always be resistance to new modes of communication. *"Just a few years ago, people were saying it's so hard to move people to email. We don't even remember that, but it all happened in less than a decade,"* says Jessica Lipnack[10].

Already in 1987 Dworatschek and Hayek [Dworat1987] have defined five types of Software[11], which are currently required for project work and is presented in Figure 8.

- Internet based information and communication platforms, in addition to telecommunication applications as a basis for project communication.
- Software for both project planning and steering, which enables projects to be planned in a structured way. Dates, costs and resources can be

[10] Jessica Lipnack and Jeffrey Stamps are cofounders and directors of NetAge Inc., developers of virtualteams.com. They are considered the world's leading experts in virtual teams and networked organisations.

[11] The differences of project management software and software for project management are explained in Chapter 12: Glossary/Abbreviations

monitored and the current status can be shown and reported. The software is conceived as groupware.

- Specific functional software for other project management areas and processes, such as risk analysis, configuration management, controlling, etc.
- Workstation software for word processing, spreadsheets, presentation software and databases.
- Teachware (computer based training), e-learning applications and knowledge-management.

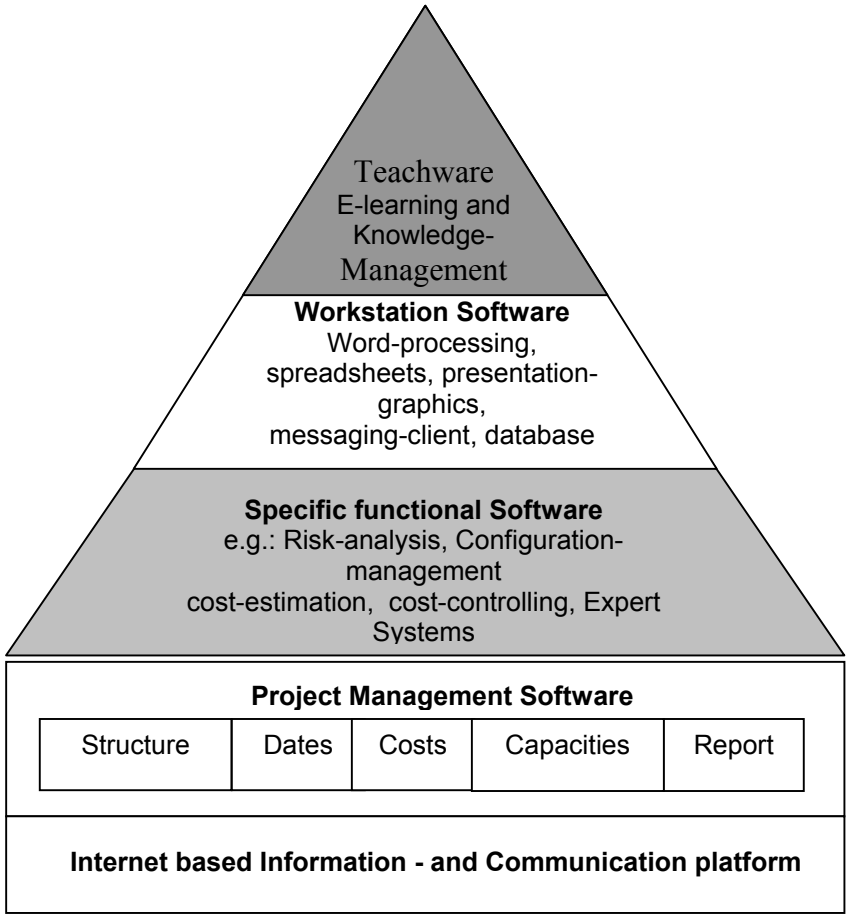


Figure 8: *Software Pyramid with five types of software for project work [Dworat1987]*

This Software Pyramid given in Figure 8 will be explained from top to bottom. Finally, these applications build up common project information and communication platform, which can be seen as a familiar part of project management office – today often called “collaboration platform”.

5.2 Teachware, e-Learning and Knowledge Management

Large differences in knowledge between the (virtual) team members will have negative effects. These tools can help to adjust the knowledge-balance within the teams. Furthermore, e-learning applications for meetings with virtual teams have e-conferencing functionalities that can be applied effectively with the possibility for moderation.

5.3 Workstation Software and Specific Functional Software

A variety of office tools and expert applications are available from different vendors to process text, spreadsheets, graphics and databases as well as processing risk-analyses, effort estimation and so on.

The remaining two functional layers of the Software Pyramid are explained in better detail in the next Section.

5.4 Project Management Software

Today the requirements for project management software[12] are more than net-planning techniques, as already mentioned in Chapter 2. Software for both project planning and steering has to satisfy many project management functions, whereby communication interfaces and Internet applications are naturally required.
The following functions belong to “classic” project management functions[13]:

- Project structure, project or process planning and time scheduling
- Capacity planning
- Cost planning and cash flow planning
- Project progress presenting
- Cost progress presenting and optimising financial efforts
- Decision making process

[12] Well known project-management packages are described and valued in [Bartsch2001].
[13] In Annex C you can find further examples of Project Management Tools and Technique Definitions sorted by alphabetic order.

- Date, capacity and cost control
- (Automatic) preparation of management information
- (Automatic) preparation of project progress
- Administration of both project documentation and outcome
- Progress-reporting
- Contract documentation
- Storing of project data (for further analysis and evaluation)

In addition to classic project management functions, the following requirements are included for working in virtual teams:

- Internet-capable
- Communication of project tasks via electronic media (e.g. e-mail)
- Interface connectivity to other software applications.

5.5 Internet Based Information and Communication Platforms

Internet based information and communication platforms for cooperating and collaborating in project teams are called *project-portals*.

The deployment of an Enterprise Project Management (EPM) solution offers the implementation of an information and communication platform, which supports optional planning and progress monitoring.

In the next section project portals and EPM-solutions will be explained in more detail.

5.5.1 Project Portal

A project portal is a website on the Internet or intranet that provides the user with simple and clear navigation. In a central area the user can find all project and inter-project relevant information. A project portal can be project specific or applied to company wide use for multi-project management.

5.5.1.1 Benefits of a Project Portal

Using a project portal

- Improves teamwork. All project participants are included (world wide) in the project information flow in real time.
- Reduces the time needed for both searching and distributing documents and information. Managing information in this way can result in saving between 15% and 20% of time due to a more simplified search and better preparation of information [netage2005].
- Improves the management of external suppliers and partners, especially in projects, which implicate a high trade-off effort with suppliers, who should be involved in information flow.
- Compress information through standardisation. Access to project information will be done via a central portal instead of diverse access to different systems, databases and hard copy information, etc.
- Leads to more transparency
- Documents project experiences
- Helps project managers and the project office in coordinating tasks

5.5.1.2 Contents of Project Portals

The contents of a project portal can be separated into Core Functionality and in Additional Components.

5.5.1.2.1 Core Functionality of a Project Portal

The most important components of a project portal are document management, standards with templates and checklists, employee administration and event tables. This is presented in Figure 9.

In **Document Management**, all important documents like status reports, contracts and request of estimations are stored.

Under **Standards** all templates and checklists (e.g. templates for protocols, reports and specifications) are stored. Under sub-item “Rules” existing company

standards, processes and defined rules according to the arrangements in the kick-off meeting are defined.

Under **Project Team** all team members and their contacts, roles and functions are stored. Hence also external members can immediately see contacts and the responsibility of other team members.

Under **Events** a calendar for events can be placed which covers an overview of meetings, telephone-conferences, customer-presentations, etc. Team members can inform themselves immediately at every time about future events.

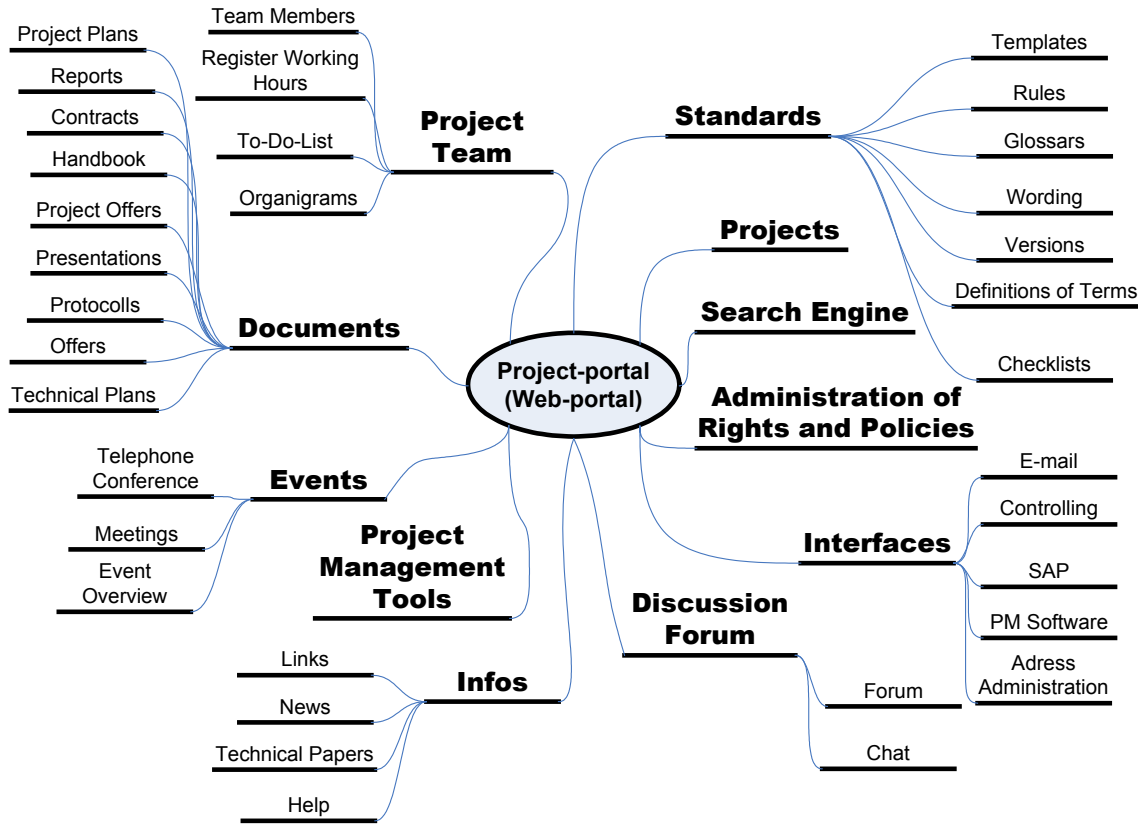


Figure 9: *Most important components of project portals [Berleb2002]*

5.5.1.2.2 Additional Components of a Project Portal

Additional components of a project portal can be a full-text search, policies for access rights, interfaces to other systems and discussion forums (see Figure 9):

Search Engines with full-text search that facilitate finding a significant amount of information.

Access Rights can be administered in relation to the role of a member in order for the team member not to see restricted or sensitive information.

It is recommended to have **interfaces** to the Enterprise Resource Planning System (ERP-System). This system can provide access to customer data, employee information and to the cost-centre. For instance, customer offers and invoices, employee hourly rate are some examples that can be exported into the ERP-system, which does not need to be administered and stored in an external system.

In **discussion forums** team members can discuss meanings, requests and specific tasks at any time. The advantage is that, in principle, anybody in the team can follow the discussion and bring in some new input. As an alternative to telephone conferences, a chat forum can be integrated.

Under **Info** important and often used links, news and support in addition to project related technical contributions could be provided.

5.5.2 Enterprise Management Tool

Additionally to the project portal features described in Section 5.5.1.2, an Enterprise Project Management (EPM) Solution offers an optimal project management tool support. The included main applications are project planning and project monitoring, as described below.

Project planning:
Includes:

- Central, reviewed and transparent planning (all project members are involved in planning activities, especially if one sub project is planned and carried out completely in a region).

- Efficient distribution of information to all team members (equal, up-to-date information) using Web Access to a project-portal.

Project monitoring:

Includes:

- Simple and systematic feedback (concept for project monitoring)
- Efficient updates of project plans (defined cycles for updating)

The use of an EPM solution has two functions that can be used as an information platform and/or as a communications platform, as shown in Table 2.

Usage as information platform	Usage as communication platform
Offers the following information: • **Project Center:** Project overview, customized project views, detailed information on task level • **Resource Center:** Resource overview, customized resource views, workload information	Offers support for: • Project planning • Project progress monitoring • Reporting (e.g. status reports) • Collaboration (e.g. documents, problems, risks)

Table 2: *Usage of an EPM-solution*

More details and capabilities provided by an EPM solution are shown and explained in Chapter 7 where the Microsoft EPM Solution is described.

Nevertheless, in many companies communication and information exchange in projects is still done with several different systems. Each project member or department has its own document management system.

To find out the current situation of virtual teams in Siemens PSE, a survey has been conducted to elicit challenges in collaboration and synchronization in distributed projects. This now leads onto the next chapter that presents the survey and survey results. This is an endeavor to answer the first research question in this work:

"*Identify the current main activities and challenges in managing distributed projects.*"

6 Current Status of Virtual Projects Activities at Siemens PSE

Currently, Siemens PSE has a so-called “in-house, low-cost and offshore“ development strategy [Heiss2005], as presented in Figure 3 (equivalent to “intra-firm/foreign”). The location of where a certain project component is undertaken depends on the expertise, resources available to carry out the work and customer proximity. Collaboration in such a distributed structure is facilitated by specific processes, terminology and development methodology.

To determine the current situation of distributed projects in Siemens PSE, a questionnaire[14] was developed and distributed to Siemens PSE virtual project leaders.

6.1 Survey Questionnaire[15]

The main goal of this PSE internal survey is to gain a better insight into issues concerning distributed projects dealing with software development. The main focus of the survey is on:
(a) The challenges faced in the collaboration between project participants and
(b) The effectiveness of current project management support tools and technical expertise from a project management and team leader perspective.

The target audience of this survey are project managers and team leaders who
(a) Have recently completed a distributed project or
(b) Are currently work in a distributed project that is close to finishing.

[14] The questionnaire has been developed together with DI Matthias Heindl who will use the input also for his dissertation (titled: “Requirements management and collaboration in distributed software development teams”) and with the scientific management of the Quality Software Engineering Research Group (http://qse.ifs.tuwien.ac.at) at TU Wien, Institute of Software Technology and Interactive Systems (Prof. Dr. Stefan Biffl).
The supervision by Siemens PSE was done by Ms. DI Karin Kroneder, head of the SC PM support centre.
[15] The distributed questionnaire can be found in Appendix A

The main part of the questionnaire consists of the following sections:

- Section I summarizes the personal context of the respondent.
- Section II identifies key characteristics of the evaluated distributed projects and the project management challenges in these projects.
- Section III elicits the project management activities performed in distributed projects and the strength and weaknesses of these activities.
- Sections IV and V elicit the importance of collaboration and synchronization in the project, their challenges and current solutions.
- Section VI gathers feedback for the Support Center Project Management (SC PM) regarding services and tools.

Only parts of the questionnaire were used to answer the research question in this thesis.[16]

6.1.1 Survey Evaluation and Summary

In total approximately 180 persons were requested to complete the questionnaire either directly or via e-mail, where corresponding e-mail lists were provided by the SC PM. Finally 36 persons responded on the questionnaire

6.1.1.1 Key Characteristics of Analyzed Projects in the Survey

The key characteristics of the examined projects in the survey are as follows:

- The respondents have been located in Austria, China, Croatia, Slovakia, Romania and the Czech Republic.
- Respondents had between 1 to 5 years experience working in virtual projects.
- The average amount of project participants of the examined projects was between 10 to 30 people.
- There have been up to 5 different sites/locations denoted for the referenced projects.
- 60% of the analysed projects have up to 3 countries involved.
- Nearly 80% of analysed projects have durations of up to 12 months.

[16] The complete results of survey are attached in Appendix B.

The next section describes the relevant questions of the questionnaire in order to answer the research question (1):

Identify the current main activities and challenges in managing distributed project,

and research question (2a):

Which tool or applications are currently used to meet these challenges.

6.1.1.2 Main Responsibilities Regarding Project Management Activities of Respondents

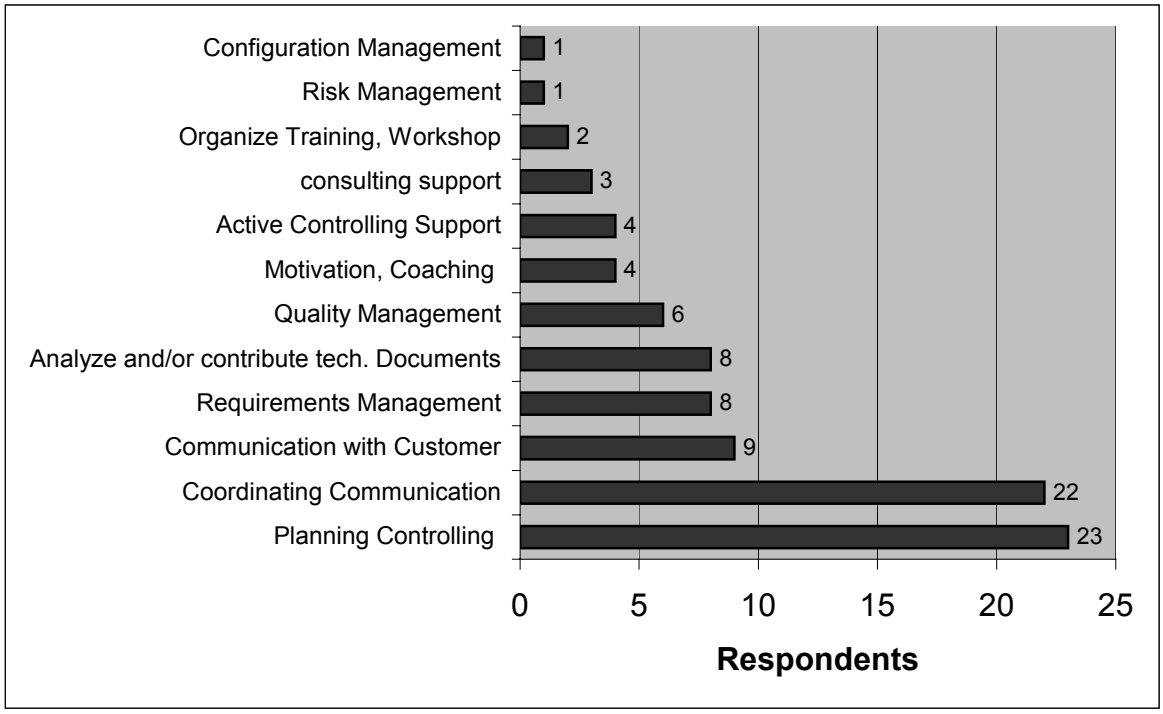


Figure 10: *Main responsibilities regarding project management activities*

Here the respondent project-manager has been asked which project management activities they mainly need to manage. Figure 10 shows that Siemens PSE project managers of virtual projects predominately have to deal with inherent project management tasks, that is planning, controlling (see Chapter 2.3.2.2. and Chapter 2.3.2.3.) and communicating (see Chapter 4). Moreover, it is interesting to note that “Motivation and Coaching” is not a challenge in virtual projects for the respondent virtual project managers although the related success factors “organisational culture”, “Leadership” and “Team Leader/Member Competencies” are mentioned as challenging in Chapter 3.7.

6.1.1.3 Potential Project Success Factors

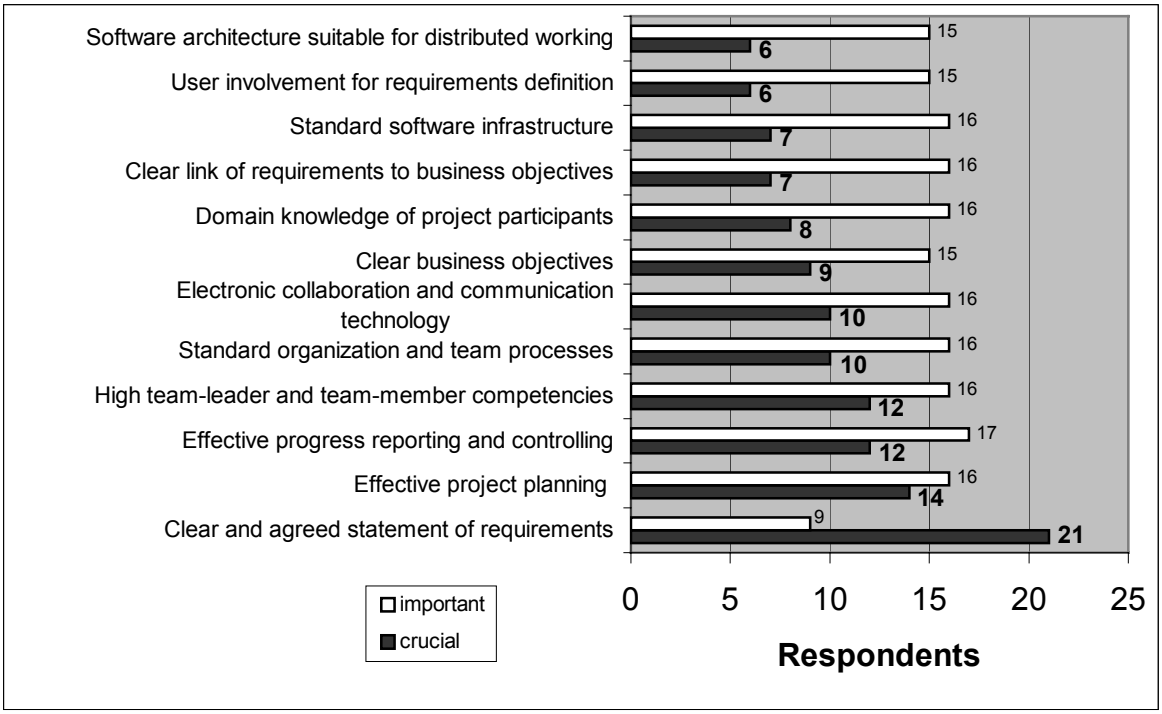


Figure 11: *Potential project success factors*

Figure 11 shows that the output of the rated project success factors almost correlates to the importance of the success factors mentioned in Chapter 3.7. Obviously, the requirements have to be clear and agreed by all parties in a project. To manage this and to ensure that there is a common understanding amongst virtual team members, both communication and collaboration are important. For virtual projects, it is obvious that this factor finally becomes more important than in non-virtual projects (see Chapter 4).

Nevertheless the remaining success factors have been seen as crucial, or at least, important factors from 60% to 80% of the respondents. Additionally, it is worth noting that “effective project planning” and “effective progress reporting and controlling” was ranked within the first three crucial factors. In Figure 10 these factors are generally outlined as the main responsibilities that a virtual project leader has predominately to deal with.

Surprisingly, it is apparent that “electronic collaboration and communication technology”, “standard software infrastructures” as well as “software architecture suitable for distributed working” is not seen as crucial factor by over three-quarters of the respondents. Such a response in the questionnaire appears to indicate that virtual teams at Siemens PSE manage their projects only with simple office technology. However, the use of tools in Siemens PSE is further investigated and is presented in Section 6.1.1.7.

6.1.1.4 Top 10 Potential Problems in Referenced Distributed Projects

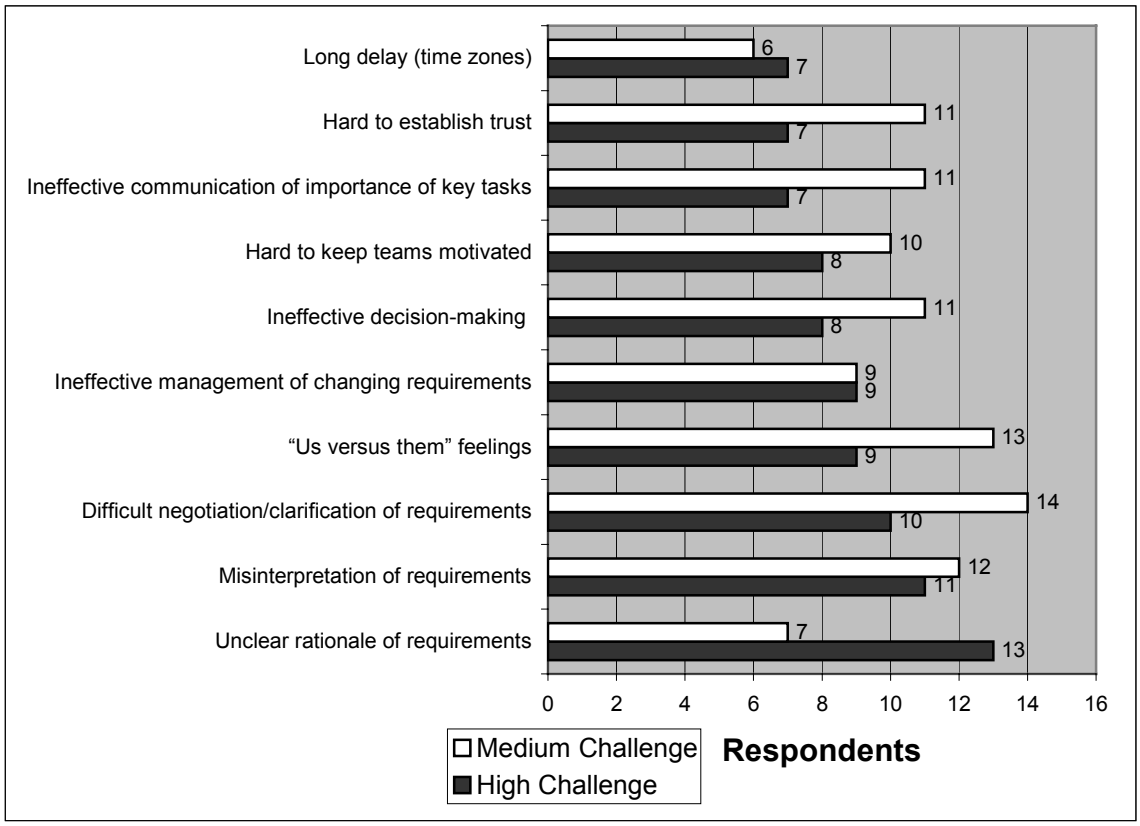


Figure 12: *Top 10 potential problems of distributed projects*

It is obvious that from the beginning of a project the requirements have to be clear and agreed upon in order to establish a firm basis that can complete a project in time and in expected quality.

Additionally it must be ensured that in revision procedures requirements

- Will become identifiable objects within the project.
- Will contain all information for developing and processing.
- Will be subject of clear unique decision for further processing.

- Will be processed in a controlled manner.

(As already learned in Chapter 2.3.2.5)
This leads us to the necessity of a clear, structured and collaborative exchange of requirements information.

In Figure 12 exactly the collaboration problems of “unclear rationale”, “misinterpretation” and the “difficult negotiation” of requirements in virtual projects are outlined as the top three problems that a virtual team has to deal with. Almost two thirds of respondents have highlighted these factors, which can be caused by structural problems (see Chapter 3.4.2.1) as well as by communication and collaboration problems (see Chapter 4).

The challenges called “ineffective management of changing requirements” and “ineffective decision making” are both caused by complexity factors, which are touched on in Chapter 3.4.2.1. Mishandling of documentation and bad decisions made by leaders/managers, who were ill-informed on how to handle documentation or who have not informed team members on documentation methods, could cause these challenges. This can lead to a situation where the project manager might miss important facts for decision-making. However, the survey results show that only 50% of the respondents see both of these challenges as a “medium or high challenge”.

Furthermore, dealing with typical challenges (see Chapter 3.6 and Chapter 4.2) of virtual projects such as different time zones, establishing trust, communication of key tasks and keeping teams motivated are not rated as high challenges by the respondents, rather, they were characterised as important (medium challenge) by about half of them.

6.1.1.5 Top 10 Project Management Activities of Referenced Projects

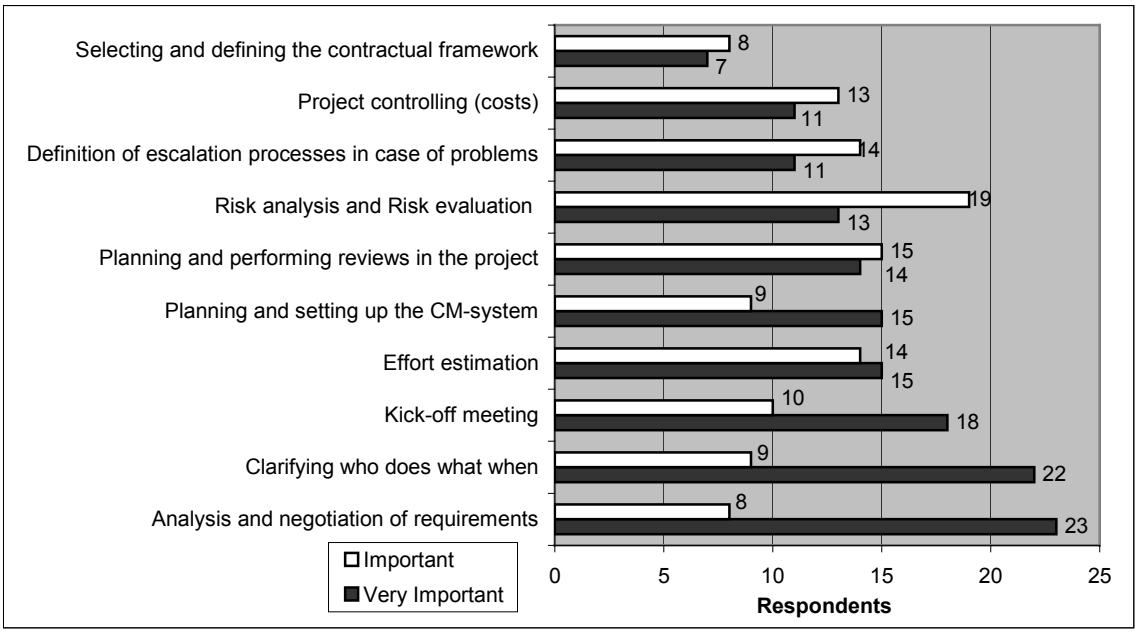


Figure 13**:** *Top 10 project management activities*

As already identified in the top 10 problems, negotiating and ensuring common understanding of requirements is the highest challenge. Here we can see the consequence is that “analysing and negotiating requirements” is also one of the most important activities in virtual projects (see Figure 13)

Certainly, “clarifying who does what when” helps to manage “analysing and negotiating requirements”. However, “clarifying who does what when” is indispensable when carrying out a project in a structured way since tasks need to be assigned to certain people and responsibilities are allocated. Therefore, especially in distributed projects, the activity “clarifying who does what when” is very important due to the fact that teams are often wide spread and therefore harder to control. Following from this fact, a consequence is that “Planning and performing reviews” is at least denoted as an important task by 80% of the respondents. Without performing this activity, consequentially it is impossible to follow up certain tasks or to follow up the project progress at all if activities are regionally distributed.

It is interesting to observe that “risk analysis and risk evaluation” was found to have least importance to almost 90% of the respondents.

6.1.1.6 Importance of Collaboration Activities vs. Frequent Use of these Activities

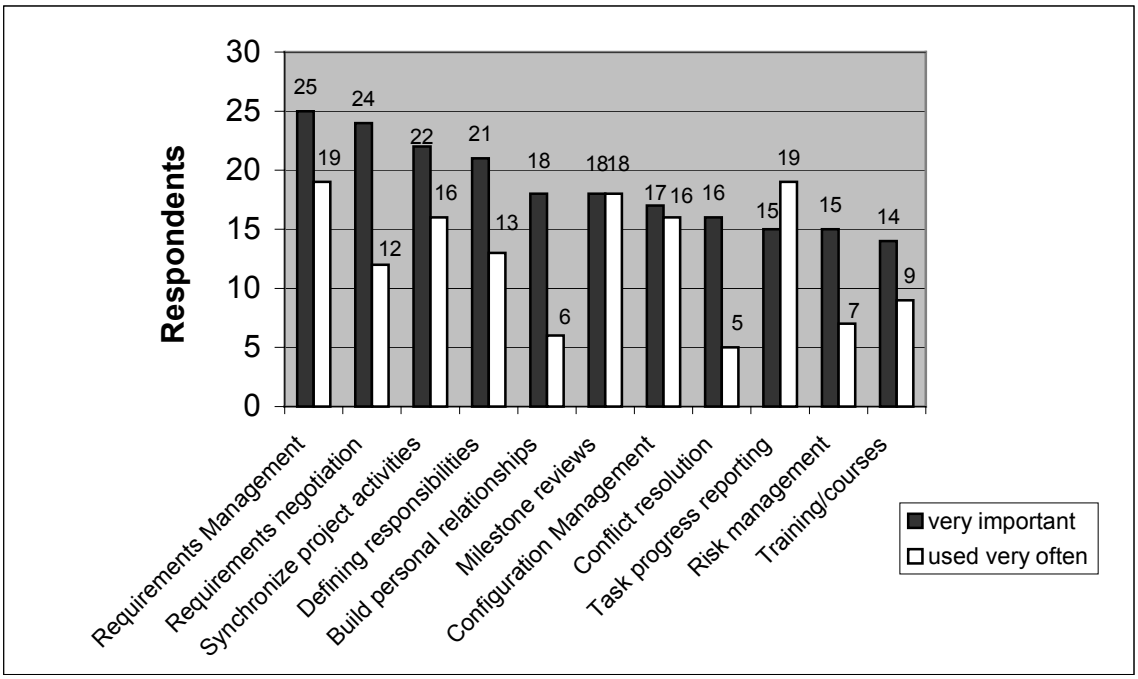


Figure 14: *Importance of collaboration activities vs. frequent use of these activities*

The chart presented in Figure 14 on the one hand confirms the already outlined great importance of “requirement management” and “requirement negotiation” as well as “defining responsibilities” but on the other hand the use of these collaboration activities compared to the importance are not frequently used. Approximately 30% to 50% of the respondents only use these three activities “very often”.

“Synchronizing project activities” (see Chapter 2.3.2.5) is also seen as a very important task but appears not to be used “very often”, since less than half of the respondents regard this activity as “very often”.

It is interesting to note the following:
Task progress reporting seems to be a more used activity because only 40% indicate this activity as very important but more than 50% use it very often.
Nevertheless it is apparent that only about 50% of the respondents use “Milestone reviews” and “task progress reporting” very often. This could endanger successful project completion since the aforementioned disadvantages and risks (Chapter 3.6). These risks are more evident in virtual teams as control abilities

are less prevalent; rather, control activities are based on trust amongst team members who predominately work autonomously.

Additionally, it is interesting to discover that activities that are typically outlined as challenges in virtual projects such as “building personal trust”, “conflict resolution” and “training/courses” are neglected.

Also the risk management is not used very often although nowadays it is an important topic in project management.[17]

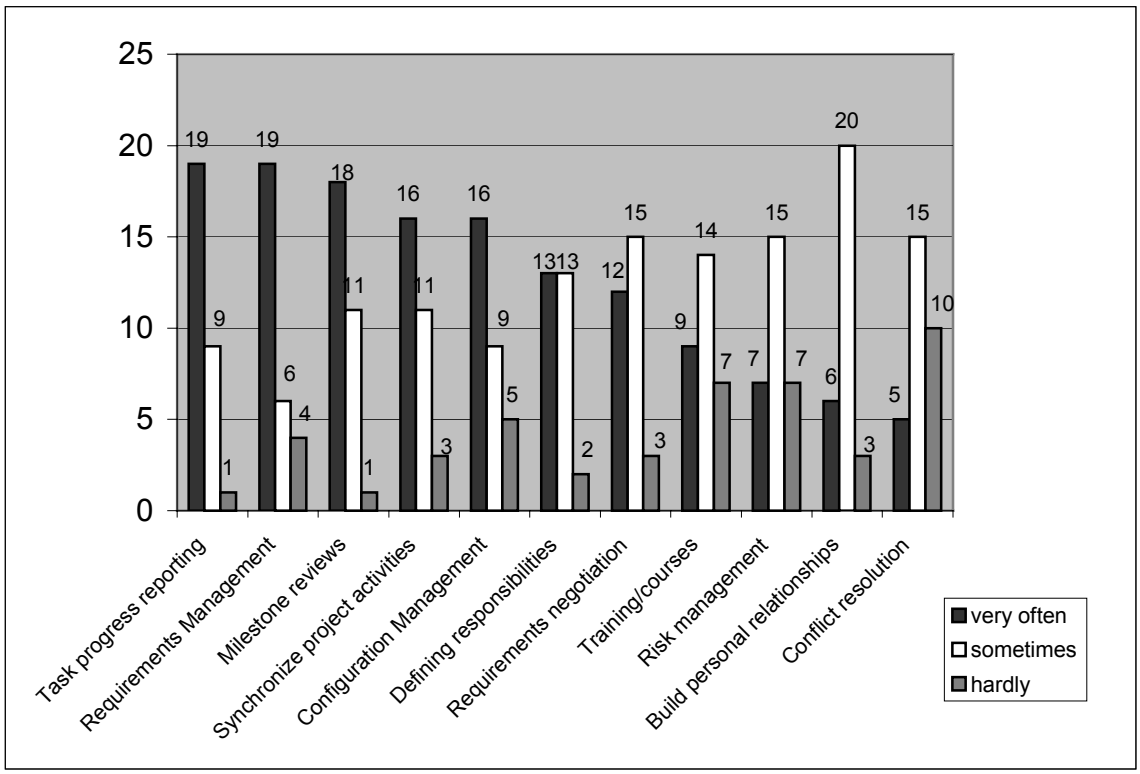


Figure 15: *How frequently activities are used in Siemens PSE*

To get a better sight on how frequently the aforementioned activities in Figure 14 are used is presented in Figure 15.

[17] cp. [PMBOK2004] page 237, chapter 11 “Project Risk Management”

6.1.1.7 Comparison of Tools Used for Particular Tasks

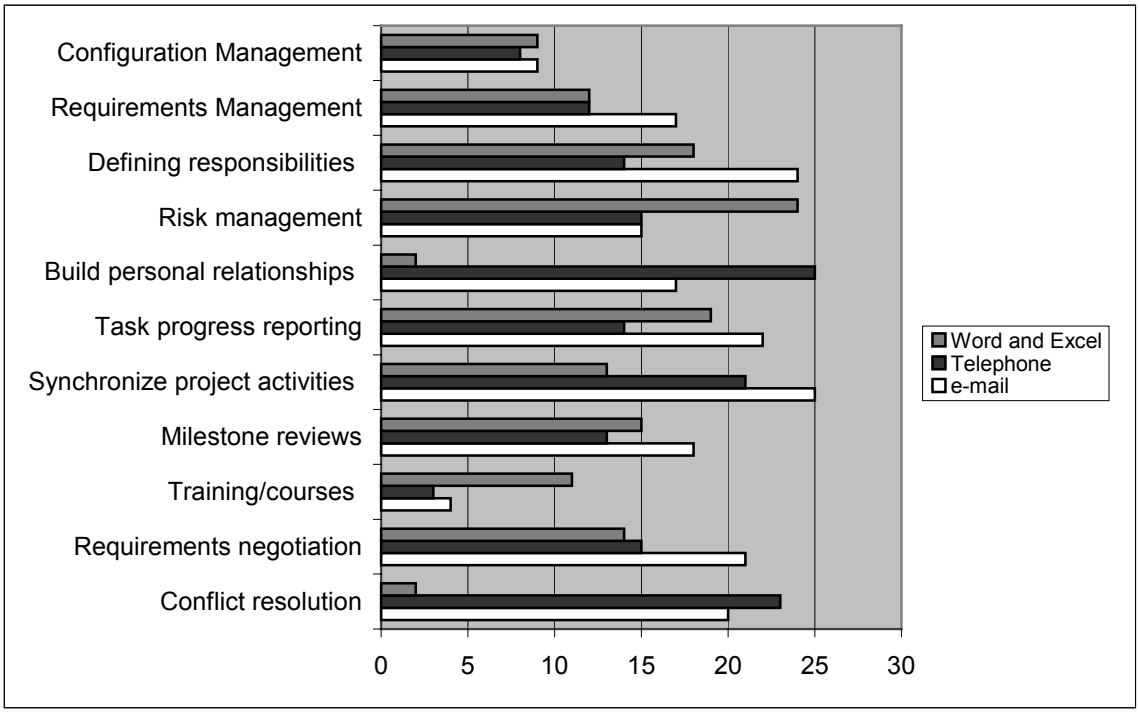


Figure 16: *Which tool is used for which particular task (Word/Excel, Telephone, e-mail)*

The results presented in Figure 16 and Figure 17 show which (collaboration) tools are used in Siemens PSE projects in order to deal with project management activities in virtual teams.

The following tools were mentioned in the survey:
Lifelink, Sharepoint + MS Project Server, Lotus Notes, Wikis, Requisite Pro, ProWeb, Videoconference (Net-Meeting), Email, Word and Excel, Telephone, Other

As we can see in Figure 16 and Figure 17 the telephone, e-mail and Word and Excel are primary tools used for collaborating in virtual teams. It was discovered that “Requirements negotiation and management”, “Synchronise project activities”, “defining responsibilities”, “task progress reporting” and “milestone reviews” are predominately done via e-mail.
Note that these activities (except “defining responsibilities”) have been outlined in Figure 15 frequently used as the first four frequently used activities.

Furthermore, it is worth mentioning that risk management is done predominately only with Word and Excel, as indicated in Figure 16.

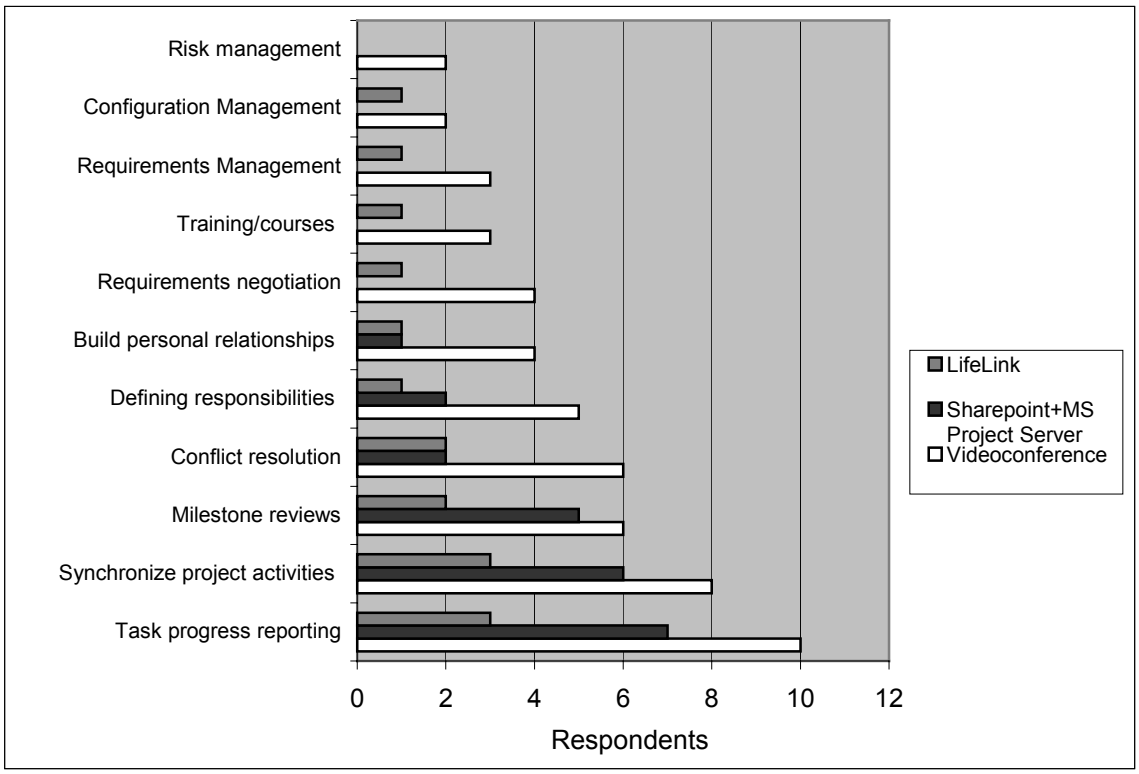


Figure 17 *Which tool is used for which particular task (LifeLink, SharepointServices+MS Project, Video conferencing)*

In Figure 17 it is shown that collaboration tools like “LifeLink” or “Sharepoint-Services plus MS project” are very seldom used and “Videoconferencing” is sometimes (less than approximately 25%) used to process particular tasks. “Wiki“, “Requisite Pro“ and “Lotus Notes“ tools are used very rarely to process certain tasks or even unknown to some respondents.

Videoconferencing is certainly a good tool for discussing options and opinions in an endeavour to reach simple compromises. On the other hand videoconferencing involves high costs and needs a high bandwidth, which often is not available for virtual team members who are spread all over the world. Additionally a limit of shared participants is often given or at least the quality of the connection lowers with each additional participant.

Tools used to manage virtual projects have only limited effectiveness. Many respondents gave an additional remark that regular meetings or personal face to face communications to clarify particular tasks or problems are seen as very important. They mention that face to face meetings should be held whenever possible. However, Figure 19 shows that co-located workshops for synchronisation tasks are not held very often.

6.1.1.8 Synchronization Activities Asked as Challenges

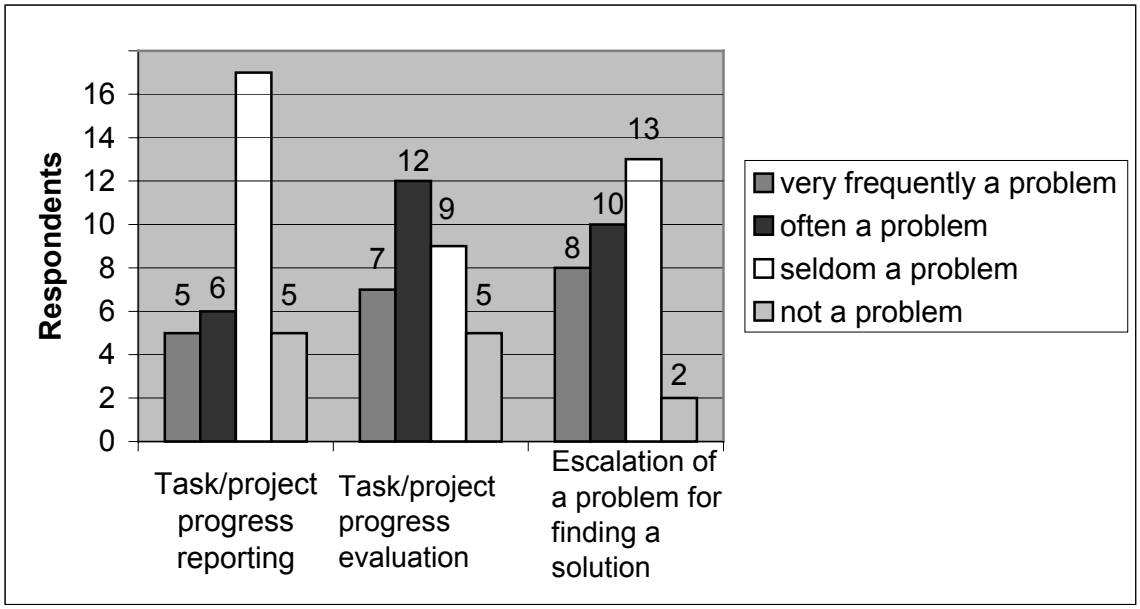


Figure 18: *Synchronisation activities asked as challenges*

Figure 18 shows three important synchronisation activities where it can be seen that the “task or project progress evaluation” is more often a problem. Progress evaluation has the problem of not reflecting the actual situation of current tasks. Status information is based on statements, various statistics and deliverables of team members that are often difficult to evaluate. The reporting itself makes rather seldom problems and is usually based on trust.

The “task/project progress reporting”, “task/project progress evaluation” and “escalating problems” are main tasks that ensure synchronisation (see Chapter 2.3.2.5). The ideal way to remain synchronised is for each virtual team member to be aware of the current situation and progress of other team members. Any changes need to be communicated promptly and done in real-time.

To ensure synchronisation, different tools are used in virtual projects as shown in the next Figure 19.

6.1.1.9 Approaches to Ensure Synchronization

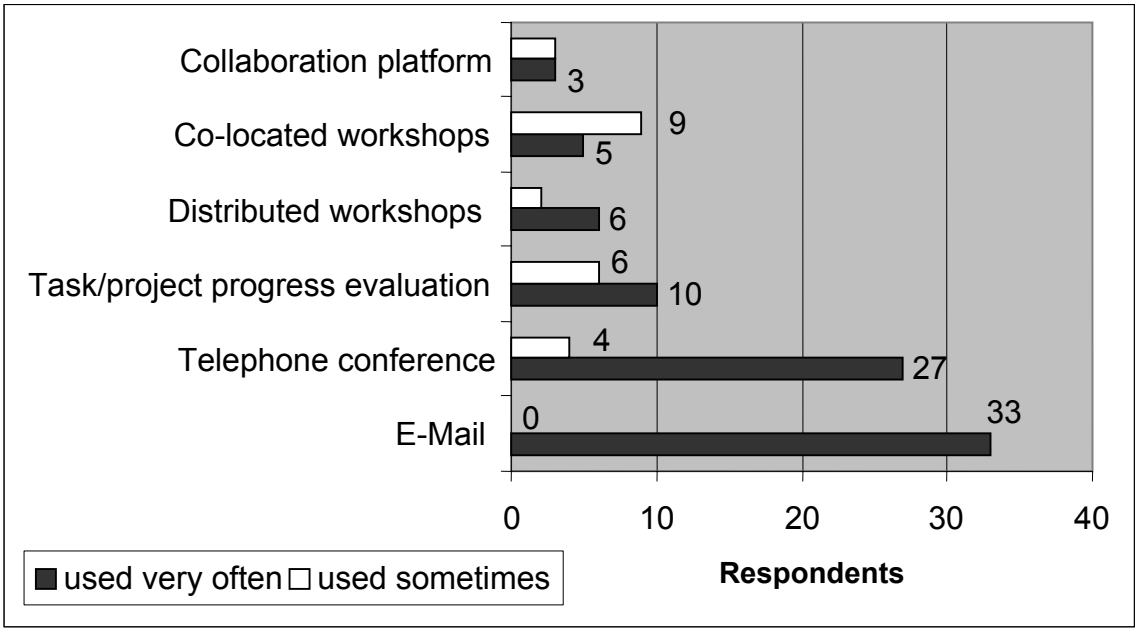


Figure 19: *Approaches to ensure synchronisation*

In Figure 19 it is clearly seen that synchronisation tasks are predominately done by e-mail followed by telephone conferences by project participants. The use of a collaboration platform is clearly not popular.

6.1.1.10 Summary and Analyses of the Questionnaire

To answer research question (1) “Identify the current main activities and challenges in managing distributed projects (concerning Siemens PSE Project Manager)” we can summarise the following:

Virtual project managers have to predominately deal with the usual project management tasks of project planning, controlling and coordinating. Whereby the communication factor plays a major role, as already discussed in Chapter 4. Especially for the major success factor “clear defined and stated requirements” communication is important to lower the potential problems of “requirements negotiation and clarification” as well as to avoid problems with “misunderstanding and unclear rationale of requirements”. “Effective project planning”, ”effective progress reporting and controlling" all count towards the most important success

factors. Allocating and documenting roles and responsibilities is highlighted as one of the most important project management activities, which were covered in Section 3.7.3.

But “electronic communication and collaboration technology” to support these entire project management tasks is not pointed out as crucial. Similarly, “suitable software architecture for distributed work” and “standard software infrastructure” is not highlighted as crucial. Note that Duarte [Duarte2001] presented the factor “use of electronic collaboration and communication technology” as one of the seven critical success factors for distributed projects, as stated in Section 3.7.4.
“Task progress reporting”, ”Synchronize activities”, “Requirements Management” and “Milestone reviews” are outlined as activities that are used very often in a virtual project. These questionnaire results indicate that these tasks demand significant time within managing virtual projects.

To answer research question (2a) “Which tool or applications are currently used to meet these challenges (in Siemens PSE)*”* we see that all these tasks are predominately accomplished only by using the telephone and e-mail, with support of Word processing and Excel spreadsheets. Collaboration tools are almost not used at all.

Considering today’s availability of collaboration tools and the associated advantages (see Chapter 5), it is an obvious fact that the current approach of tool support in Siemens PSE is much more time consuming and error-prone.

That does not mean that telephone and e-mail is dispensable. There are two primary factors that cause the choice of using the most effective tool in different situations:
(1) The amount of social presence required and (2) the amount of information richness required.

Social presence is the degree to which the technology facilitates a personal connection with others. A face to face meeting has one of the highest levels of

social presence but is seldom possible in distributed projects. Whereas an e-mail message has far less social presence.

Information richness has to do with the amount and variety of information flowing through a specific communication media. High information richness helps to accurately transfer clues to the meaning of the communication, thereby reducing confusion and misunderstandings.

Synchronous communications (see Chapter 4.3.2.1), like telephoning, have a more social presence than asynchronous, like e-mail. But it is not safe to assume that more social presence is always better. Less social presence sometimes can be better because it reduces interpersonal distractions, such as appearance, mannerisms, and being reminded of previous negative interactions with the person or group. The reality is that social presence is not inherently good or bad. Its usefulness depends on what the group is trying to accomplish in a given situation.

But nevertheless communication can be supported efficiently when using professional collaboration tools to generate ideas and plans about the team's work, distribute and exchange information to every stakeholder in real-time or collecting data and make decisions about plans (see Chapter 5.5).

Even if we should not ignore the associated problems of using computer aided communication (see Chapter 4.4) the following chapters in this thesis describe the capabilities and possibilities of a specific Enterprise Project Management (EPM) tool showing time and cost benefits by comparing use cases with and without the use of the EPM tool.

To respond to the research question (2b) "Investigate the benefits for Siemens PSE of employing an Enterprise Project Management (EPM) solution" the next chapter provides an overview on the contents, principle functions and architecture of the EPM Solution of Microsoft. Finally the benefits are getting pointed out in this chapter.

7 EPM-Tool

The Microsoft Office Enterprise Project Management (EPM)[18] Solution is ideal for organisations that need strong coordination and standardisation between projects and project managers, a centralised resource management or higher level reporting of projects and resources. However, even for project management, communication and collaboration tasks on a project level, the EPM-Solution provides obvious advantages.

7.1 Introduction

In a competitive business environment, the ability to efficiently align resources and business activities with strategic objectives can mean the difference between succeeding or merely surviving. To achieve strategic alignment, organisations are increasingly managing their activities and processes as projects (see Chapter2) in order to monitor performance more closely and make better business decisions about their overall work portfolio. By planning and tracking projects with clarity and precision, organizations can respond with greater agility to the demands of a fast-changing business environment.

Making strategic goals a reality requires technology that is robust enough to support the core business and yet flexible enough to accommodate the existing processes. The Microsoft Office Enterprise Project Management (EPM) Solution provides this infrastructure, so an organisation can gain visibility, insight and control its portfolio of projects, as well as improve productivity, reduce cycle times, decrease costs, and increase quality.[19]

[18] Please note that any further mention of features and names that fall under the Microsoft EPM Solution are protected by Microsoft copyright.

[19] [http://www.microsoft.com/office/project/prodinfo/epm/default.mspx]

***Figure 20**: Strategic alignment for enterprise project management [see: www.microsoft.com]*

7.2 Strategic Alignment for Enterprise Project Management

To achieve strategic alignment, EPM provides you with a resource, portfolio and project management solution whereby collaboration and communication tools allow project managers to interact with project stakeholders (executives, managers, team members, partners and customers) in real time. The interaction between the project manager and stakeholders is illustrated in Figure 20.
The following four sections give a short overview of the capabilities of EPM.

7.2.1 Portfolio Management with EPM

The company's project portfolio can be managed by continually identifying, prioritizing, and investing in projects that align with the company’s strategy
The Microsoft Office EPM Solution can assist in managing the project portfolio effectively by enabling the following:

- Evaluate project status and quickly identify endangered and underperforming projects using roll-up scorecard reports that graphically display key business metrics
- Integrate critical project data as web applications into the EPM executive level dashboard side-by-side with other critical information for a more complete view of the business
- Gain insight into the performance of portfolios by identifying trends and problem areas using powerful analysis tools
- Understand the impact of trade-offs and evaluating strategies to minimise risks when using what-if scenario modelling features

7.2.2 Resource Management with EPM

People are the most valuable (and often the most expensive) assets of an organisation. To maximise productivity and to be cost effective, it is critical to assign the right people to the right project teams. Obviously, managing people across organisations is complex. Resource information is often controlled in various departments, making it difficult to forecast short and long term resource needs accurately.

The Microsoft Office EPM Solution provides capabilities for resource management, such as the following:

- Accurately and consistently tracking resource use and workload to assess resource efficiency and activity across projects.
- Assembling high performing project teams using staffing tools that help managers optimise resource allocation and assignments from a central resource pool
- Determining hiring needs by forecasting short and long term resource capacity and project demands.

7.2.3 Project Management with EPM

In quick changing markets where “time to market” and “design to cost” become increasingly important, it is essential to improve project deliveries by continually reducing cycle times, minimizing costs and controlling quality. These initiatives

require skilled people, standardised processes and superior technology that is driven by an effective and unified project management team.
The Microsoft Office EPM Solution streamlines project management processes by the following:

- Achieving organisation-wide compliance and greater efficiencies in project delivery by capturing and deploying best practices and continually improving processes
- Consistently meet project goals and attain higher customer satisfaction by creating plans that reflect realistic schedules, resource requirements and budgets
- Gaining a deeper level of project governance and control through project performance, issue, and risk tracking capabilities
- Comply with government and regulatory requirements by integrating standardised methodologies with existing project management processes

7.2.4 Collaboration and Communication with EPM

Effective communication is essential to achieve project success (see Chapter 4). With clear communication processes, team members can share knowledge, work together smoothly to complete tasks and deliverables and respond quickly to changes.
Project teams are becoming more dispersed both organisationally and geographically (see Chapter 3). This leads to a need for technology that can effectively connect team members in order to maintain coordination and quality.
The Microsoft Office EPM Solution provides an infrastructure that strengthens collaboration and accountability among all levels of the organisation, namely by:

- Empowering managers and project teams to make timely, informed decisions by giving them web-based access to real-time business critical project data
- Increasing participation in the project management process by enabling team members to easily manage, track, and report on their project activities through familiar tools, like the web and e-mail
- Realising greater accountability through a central tracking system that enables project teams to record, assign and resolve issues.

- Gaining higher quality and efficiency by jointly developing and organising project related deliverables using a central document repository with version and editing control.

The following section describes the architecture of the Microsoft Office EPM Solution and elaborates on several components of this system.

7.3 EPM Solution Architecture

The Microsoft Office Enterprise Management Solution basically consists of Microsoft Project Professional 2003, Microsoft Project Server 2003 and Microsoft Office Web Access (see Figure 21).

Figure 21: *EPM Solution Architecture [see: www.microsoft.com]*

Project Server 2003 is the extensible platform that supports the project, resource and collaboration capabilities in the EPM Solution.

For effective data access, storage and delivery, Project Server 2003 is built on top of **Microsoft SQL Server 2000** that serves as the back-end database.

Project Server 2003 integrates with **Windows SharePoint Services (WSS)** for collaboration capabilities such as document management and project-related issue tracking. WSS is a component of Windows Server 2003.

Project managers use **Project Professional 2003** from their desktops to prepare project planning.

Project managers communicate and collaborate with their teams by publishing information to **Project Server 2003** through **Project Web Access.** This is the Web Portal that enables people to connect to the project and resource information like actual data acquisition, analyses and controlling.

All stakeholders can use **Project Web Access** in a web browser to view and update information. This gives them access to current data and collaboration tools without needing **Project Professional** installed on their desktop.

The EPM Solution integrates with the programs in the **Microsoft Office Systems** so employees can use familiar tools to work smarter.

With an open server architecture that allows integration with other **Line of Business** (LoB) Systems (such as SAP), the EPM Solution leverages existing investments and provides a complete picture of projects.

The following section specifies the key benefits of the Microsoft Office Enterprise Project Management Solution to answer the research question (2b) “Investigate the benefits for Siemens PSE of employing an Enterprise Project Management (EPM) solution”.

7.4 Benefits of Microsoft Office Enterprise Project Management Solution.

Microsoft Enterprise Project Management (EPM) extends the features of MS Project Professional by creating an integrated and collaborative environment. While MS Project Professional provides tools for managing a single project, EPM provides the ability to manage many projects using the same resources.
The following 10 points outline important benefits of Microsoft EPM:

1. Web Browser Access

Microsoft Project Web Access allows anyone with a web browser to access information in Microsoft Enterprise Project.

The EPM Solution provides Web-based access (see Figure 22) to timely business-critical project information, so teams can share knowledge, collaborate smoothly to complete tasks and deliverables, and adjust activities quickly to accommodate project changes and updates

Figure 22: *Project Web Access Homepage*

The Project Center (see Figure 23) enables a user to quickly access and view the current status of a project using their web browser.

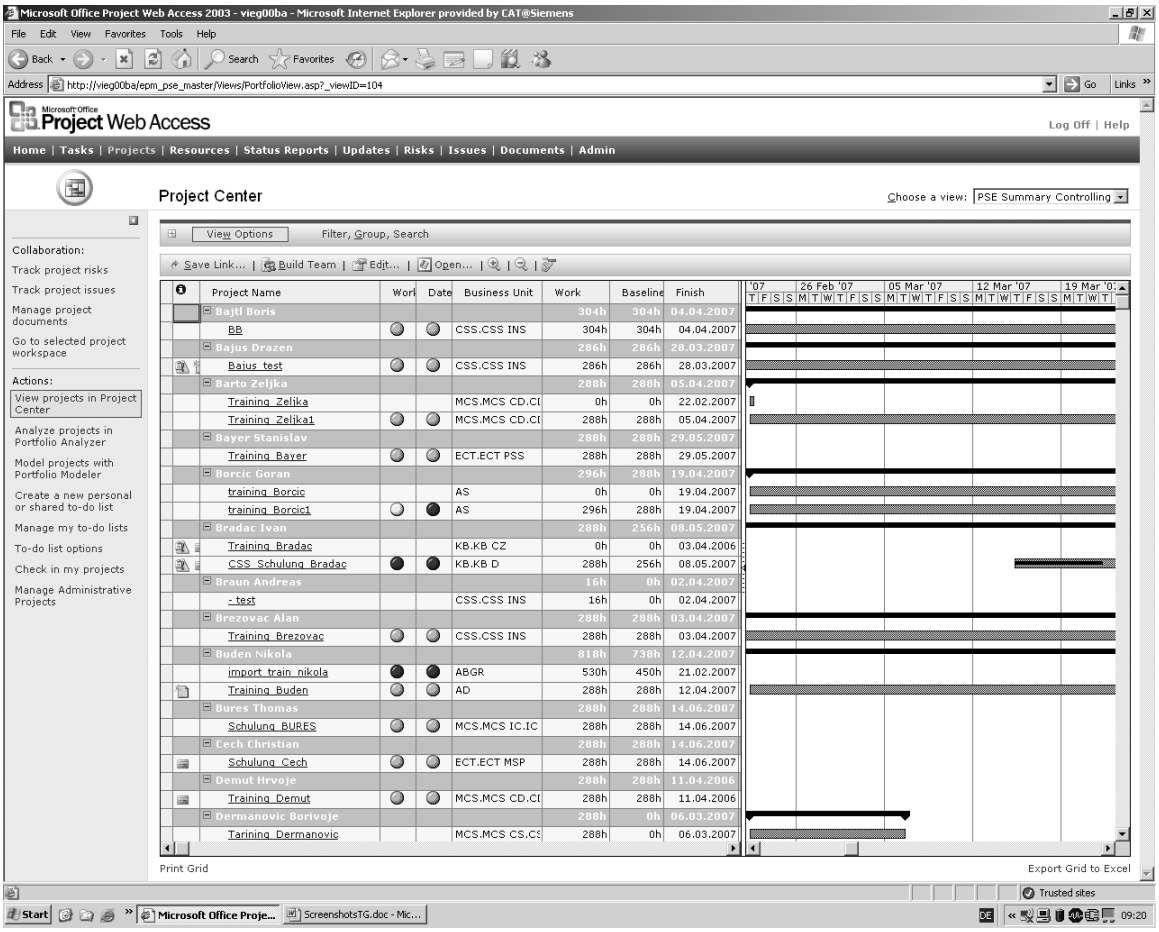


Figure 23: *Project Center*

An additional benefit is that depending on a user's role, he or she will use a different front-end client application. The products within the Office EPM Solution, especially Office Project Web Access, expose different functions and data based on role.

Product	**Role**		
	Project Managers	***Executives, Resource Managers, Team Members***	***External Users***
Microsoft Office Project Professional 2007	License required	Not required	Not required
Microsoft Office Project Server 2007	Client Access License (CAL) included in Project Professional license	CAL	CAL or External Connector

Table 3*: EPM licences required*

Table 3 shows that not all users need the complete desktop client (for example, Office Project Professional 2007) license. In many cases, users need only a CAL (Client Access License).

2. Role Based Security

Security based on roles enables the EPM solution to present the information that is of most interest to the viewer. Project and portfolio views present the information in the format that is appropriate at a user's level of interest. Executives and managers may want to see project status and financials of all projects in a portfolio, while project managers and team members want to see individual tasks in their own projects. The following list gives an example for role base system access rights:

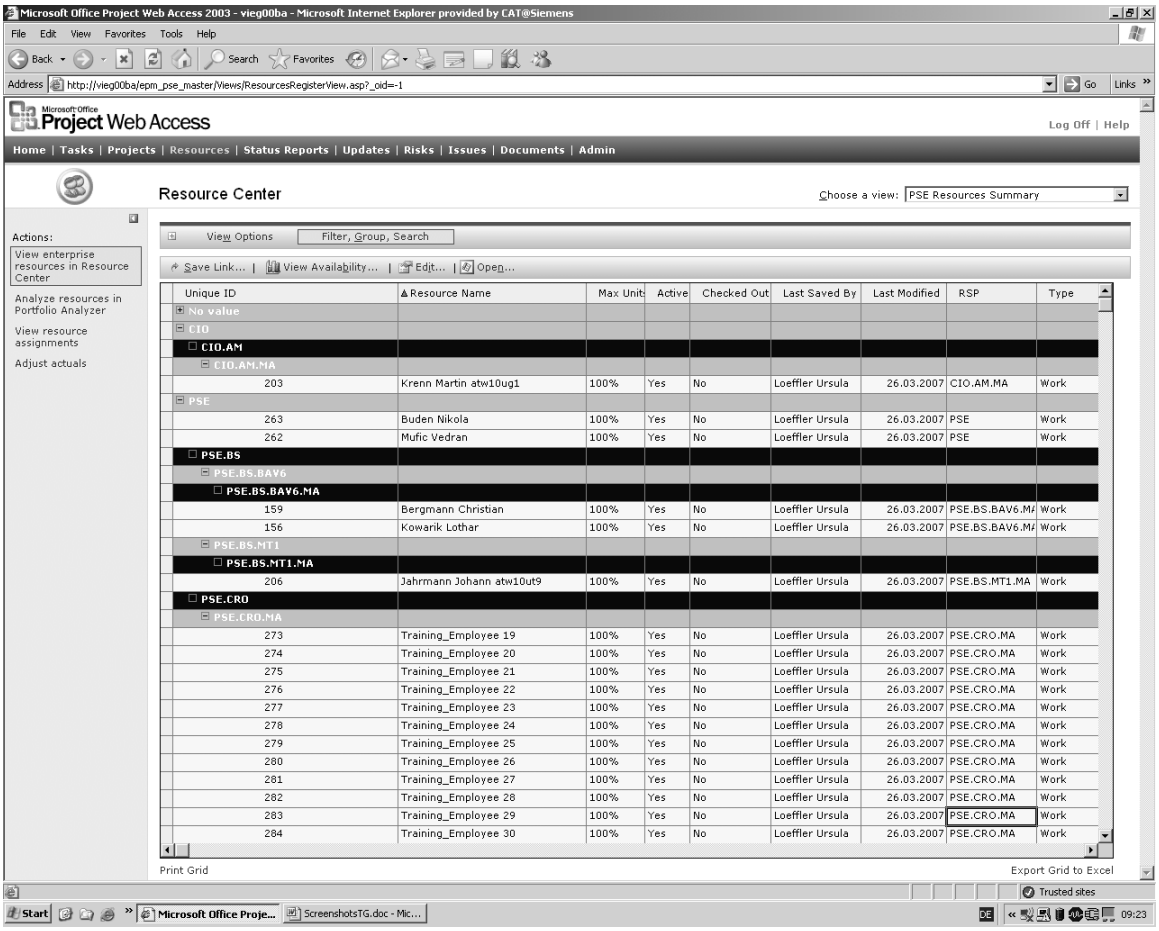
- Project Member:
  Access to all activities, operations and projects on which they are assigned to as well as to the personal resource information.
- Project Manager:
  Access to all project information in their respective projects. Access to the project overviews of all projects as well as to resource information of their assigned projects.
- Resource Manager:
  Access to all resource information of their subordinated project members
- Division Manager:
  Access to all project and resource information of their division.
- Chief Officer:
  Access to all project and resource information of their business segment.
- Administrator:
  Has access rights for maintenance, backup and data storage as well as for EPM tool updates.

3. Executive Dashboard

Executive dashboards provide up to the minute information on projects in the portfolio such as status, budget, and latest financial progress.

4. Resource Management

Enterprise Project Management presents a true representation of resource capacity. Most resources in an organisation are used on multiple projects at any one time. EPM considers all projects and provides information on which project(s) the resource is assigned. Such a report provides information on resource availability and the resource's current load. EPM allows project managers to manage resources centrally and collectively. The Resource Center in Microsoft Project Web Access lets project managers to easily view, group, and edit resource information, as shown in Figure 24.



Unique ID	Resource Name	Max Units	Active	Checked Out	Last Saved By	Last Modified	RSP	Type
No value								
CIO								
CIO.AM								
CIO.AM.MA								
203	Krenn Martin atw10ug1	100%	Yes	No	Loeffler Ursula	26.03.2007	CIO.AM.MA	Work
PSE								
263	Buden Nikola	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE	Work
262	Mufic Vedran	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE	Work
PSE.BS								
PSE.BS.BAV6								
PSE.BS.BAV6.MA								
159	Bergmann Christian	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.BS.BAV6.MA	Work
156	Kowarik Lothar	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.BS.BAV6.MA	Work
PSE.BS.MT1								
PSE.BS.MT1.MA								
206	Jahrmann Johann atw10ut9	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.BS.MT1.MA	Work
PSE.CRO								
PSE.CRO.MA								
273	Training_Employee 19	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
274	Training_Employee 20	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
275	Training_Employee 21	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
276	Training_Employee 22	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
277	Training_Employee 23	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
278	Training_Employee 24	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
279	Training_Employee 25	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
280	Training_Employee 26	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
281	Training_Employee 27	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
282	Training_Employee 28	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
283	Training_Employee 29	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work
284	Training_Employee 30	100%	Yes	No	Loeffler Ursula	26.03.2007	PSE.CRO.MA	Work

Figure 24: *Resource Center*

Resource workload and availability can both be viewed across multiple projects by using Resource Availability graphs. This feature easily assesses workload by resource or by project to determine staffing needs over time.

Figure 25 shows the availability of a resource and the actual work for a specific resource.

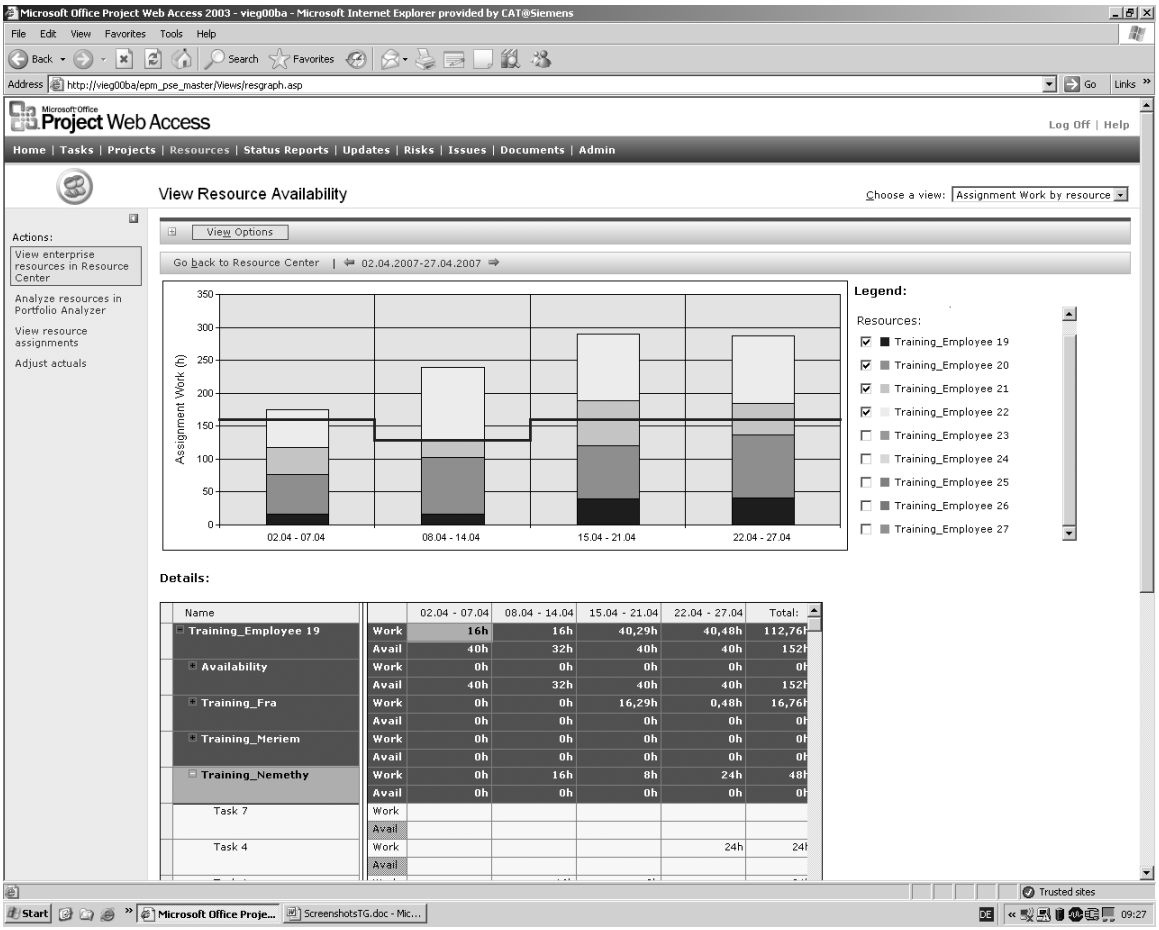


Figure 25: *Graph of Work vs. Availability*

With the “Build Team from Enterprise feature”, shown in Figure 26, it is possible to filter and query the enterprise resource database for resources with the right qualities, such as skill and availability, and then assign these resources to project tasks.

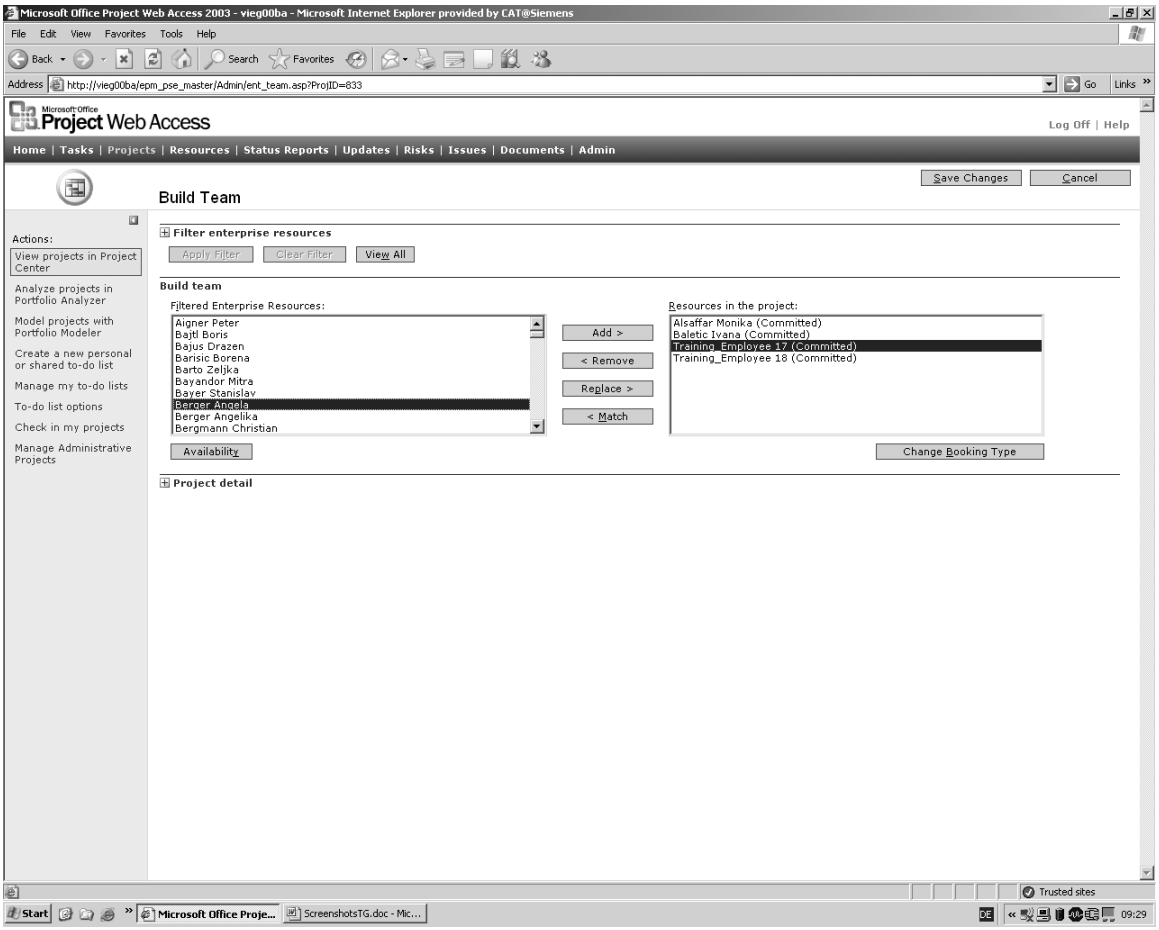


Figure 26: *Build team*

5. Portfolio Modeller

Projects do not exist in a vacuum. Adding, removing or changing one project has an impact on the other projects and resources. The web based Portfolio Modeller allows project managers to model “what-if” scenarios and to determine what the effect of changing one project will have on the other projects and resources. A screenshot of the Portfolio Manger is presented in Figure 27.

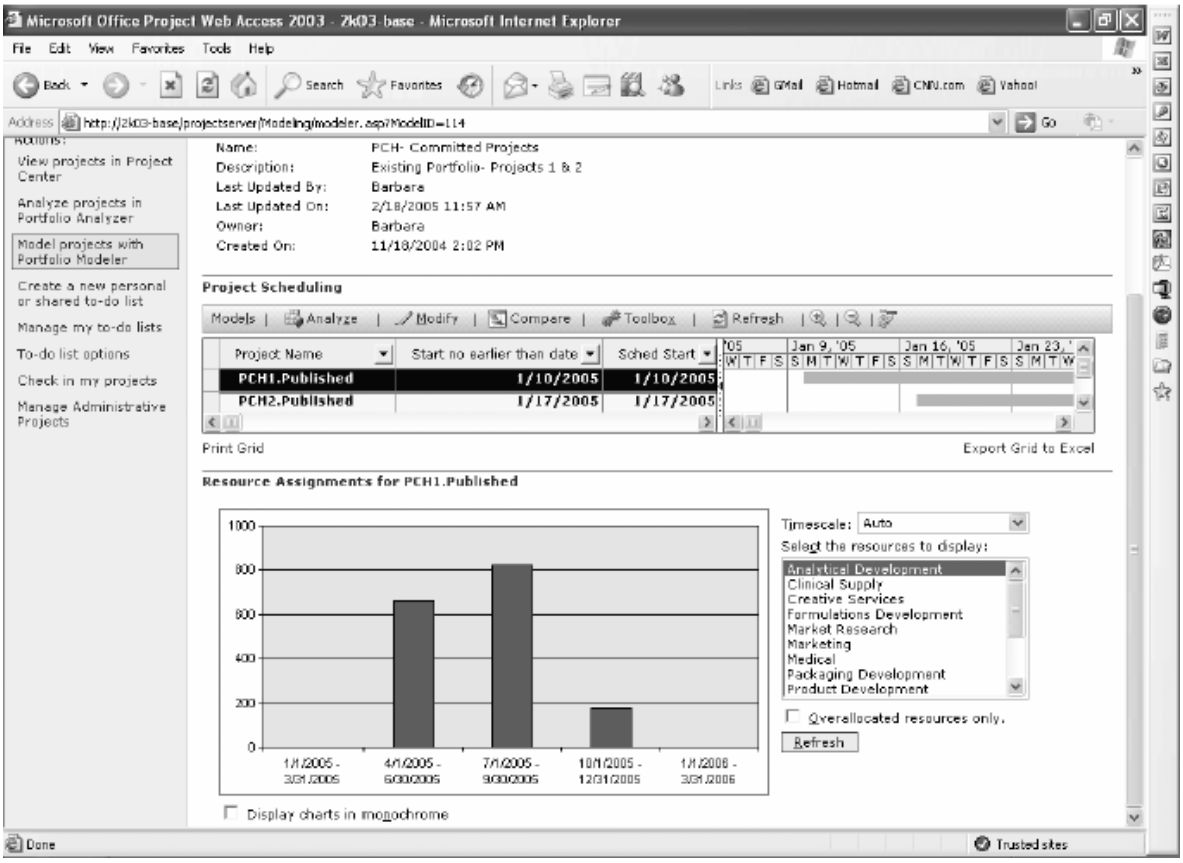


Figure 27: *Portfolio Modeller*

The Portfolio Modeller can construct “what-if” scenarios, a screenshot is provided in Figure 28 and helps to identify and evaluate options for addressing at-risk projects. The feature can model and assess the impact of modifying schedules and assignments on a portfolio of projects for more effective resource allocation and work prioritisation.

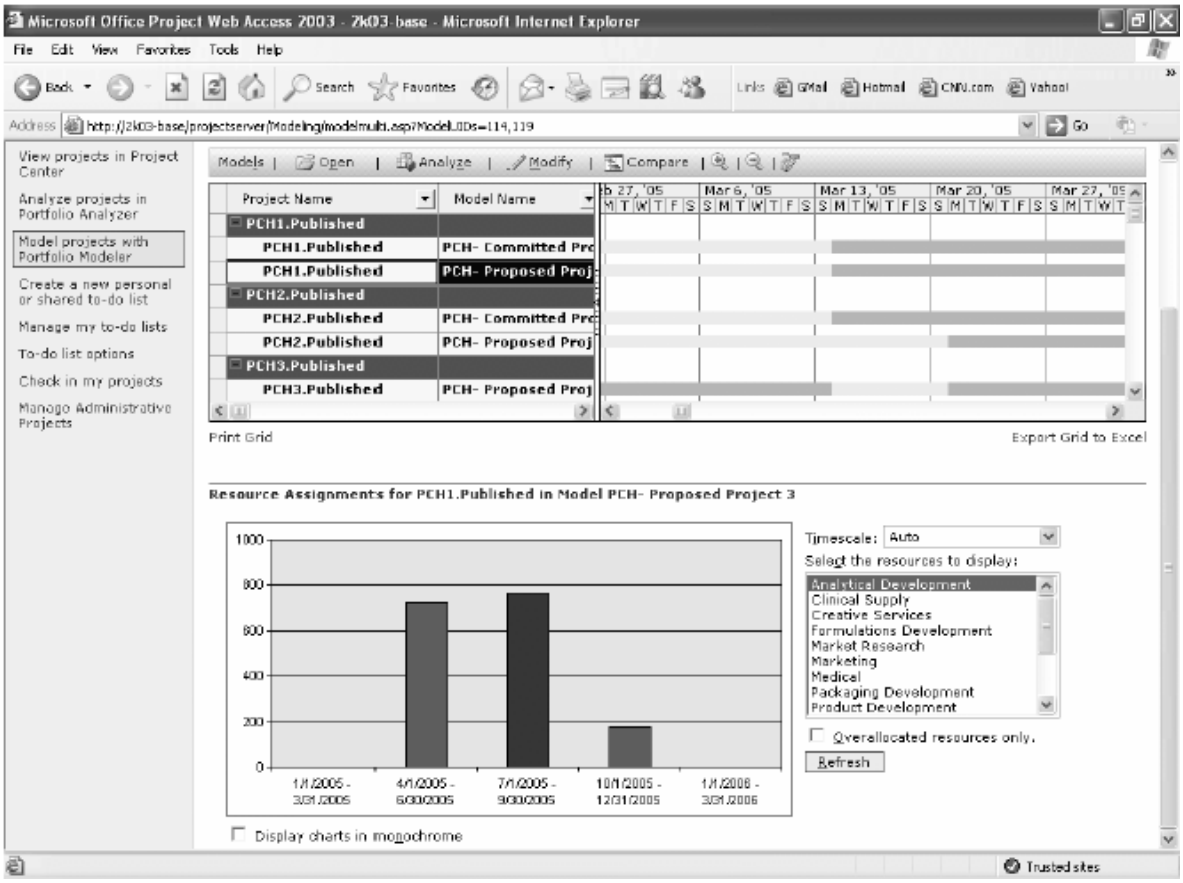


Figure 28: *Adding an additional project to the portfolio.*

6. Portfolio Analyser

The Portfolio Analyser, screenshot provided in Figure 29, provides information on projects in a portfolio. This web-based tool presents status, resource, and/or financial information that are graphically presented to help identify trends and problem areas across projects.

The Portfolio Analyser can analyse a number of parameters (e.g. financials). The "Choose a View" pull down lists the different types of views, resource, financial, work, etc. that can be configured. It is possible to expand the organisation department to show the projects as well as to expand the quarter to drill down to months, weeks, even days.

The Portfolio Analyser provides information in both graph and table format. The tables can be exported to Excel. The creator of the view can determine how to present the information. The creator can also give the users the ability to modify the models and save them in personal workspaces without changing the basic "template".

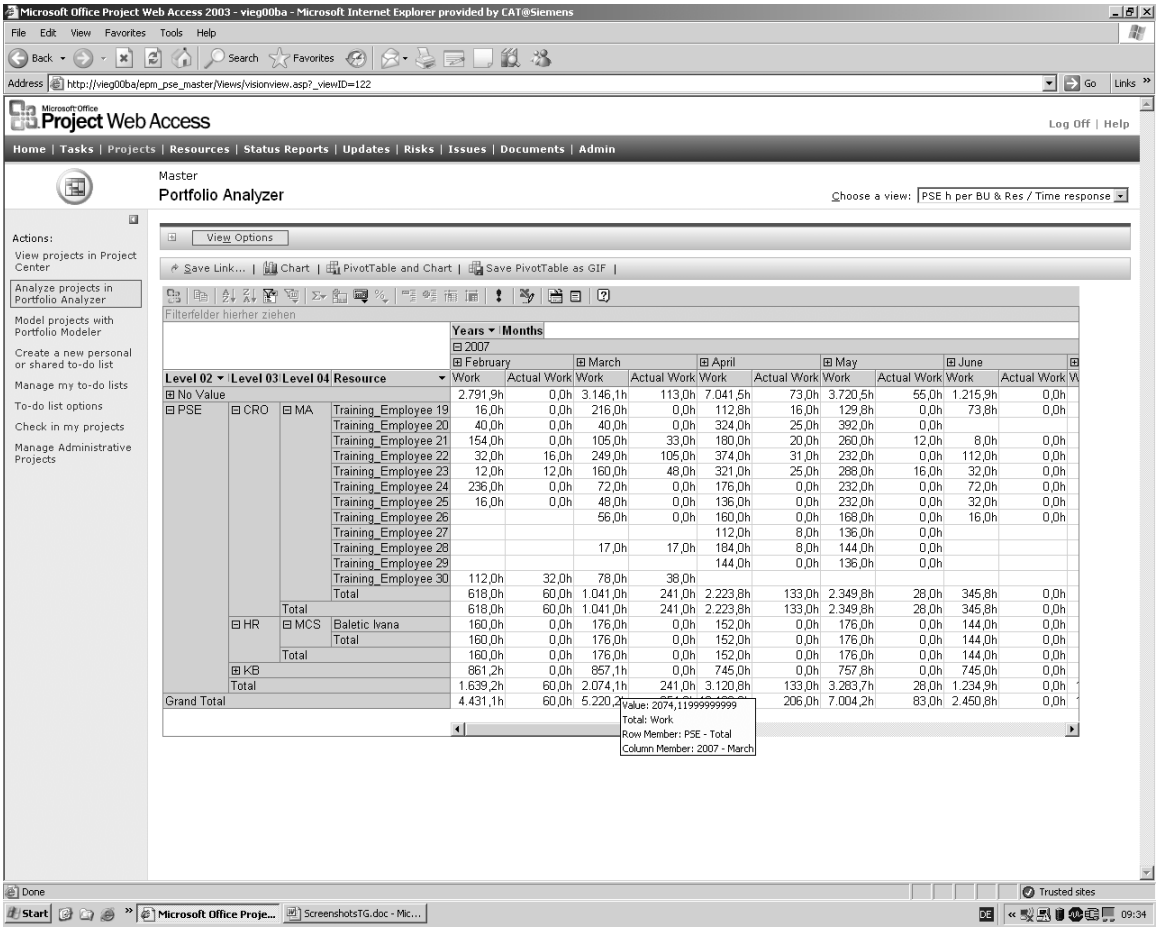


Figure 29: *Portfolio Analyzer*

7. Collaboration

Microsoft EPM stores all documents in a central repository and can even allow users to tie risks, issues, and documents to specific tasks within a project plan. EPM comes with specific forms for risks, issues, and documents that can be configured for your organisation's specific needs.

Risk Management

Risk Management helps project managers in their risk management process like identifying, analyzing and addressing project risks proactively. Risk Management forms include mitigation and contingency planning in addition to conditions that trigger a contingency plan. Risk tracking enables project managers to record, share, update, and analyse project risks.

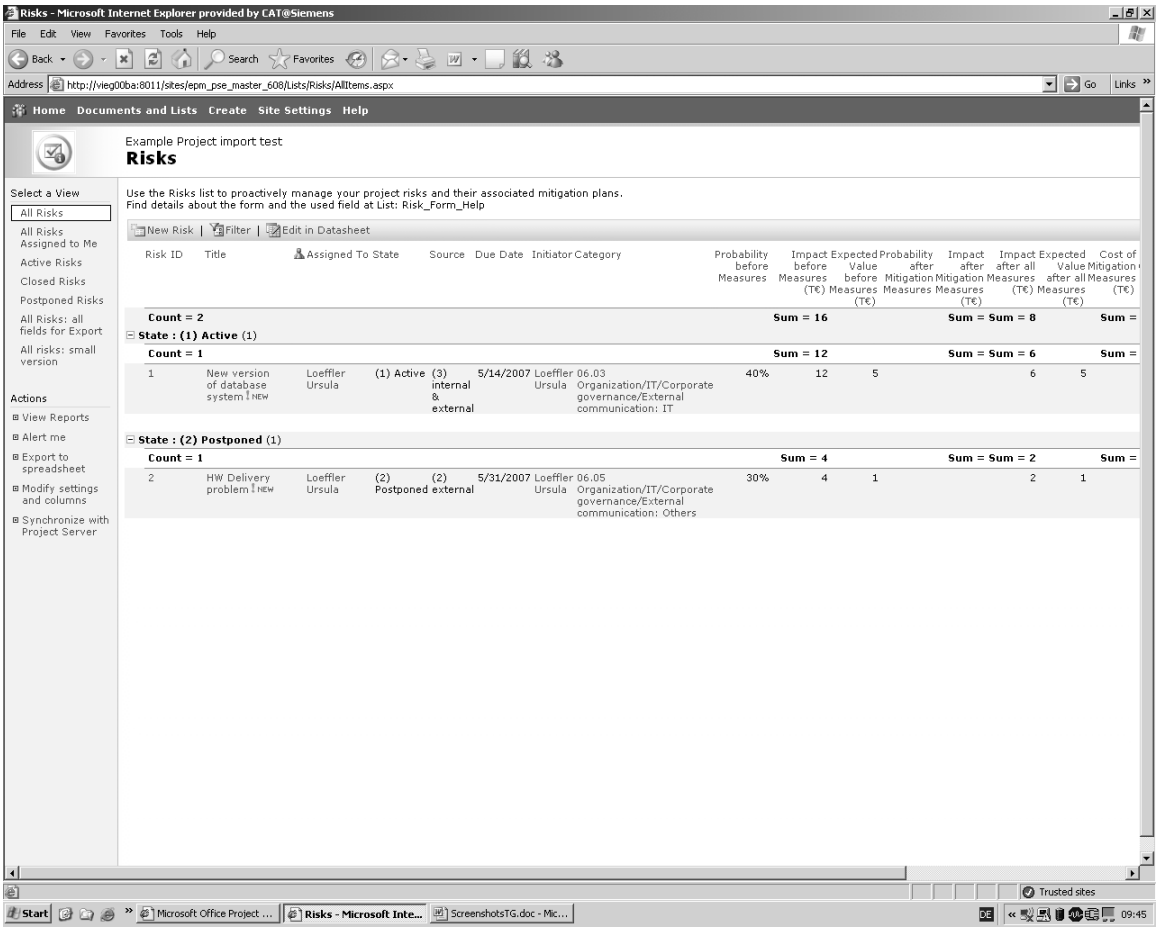


Figure 30: *Risk Manager showing risks*

Risk tracking is implemented in Project Web Access, as shown in Figure 30, where risks can be submitted, updated, and associated to elements such as projects, tasks, documents, issues, and other risks. An example of adding a new risk item in Risk Manager via the web is presented in Figure 31.

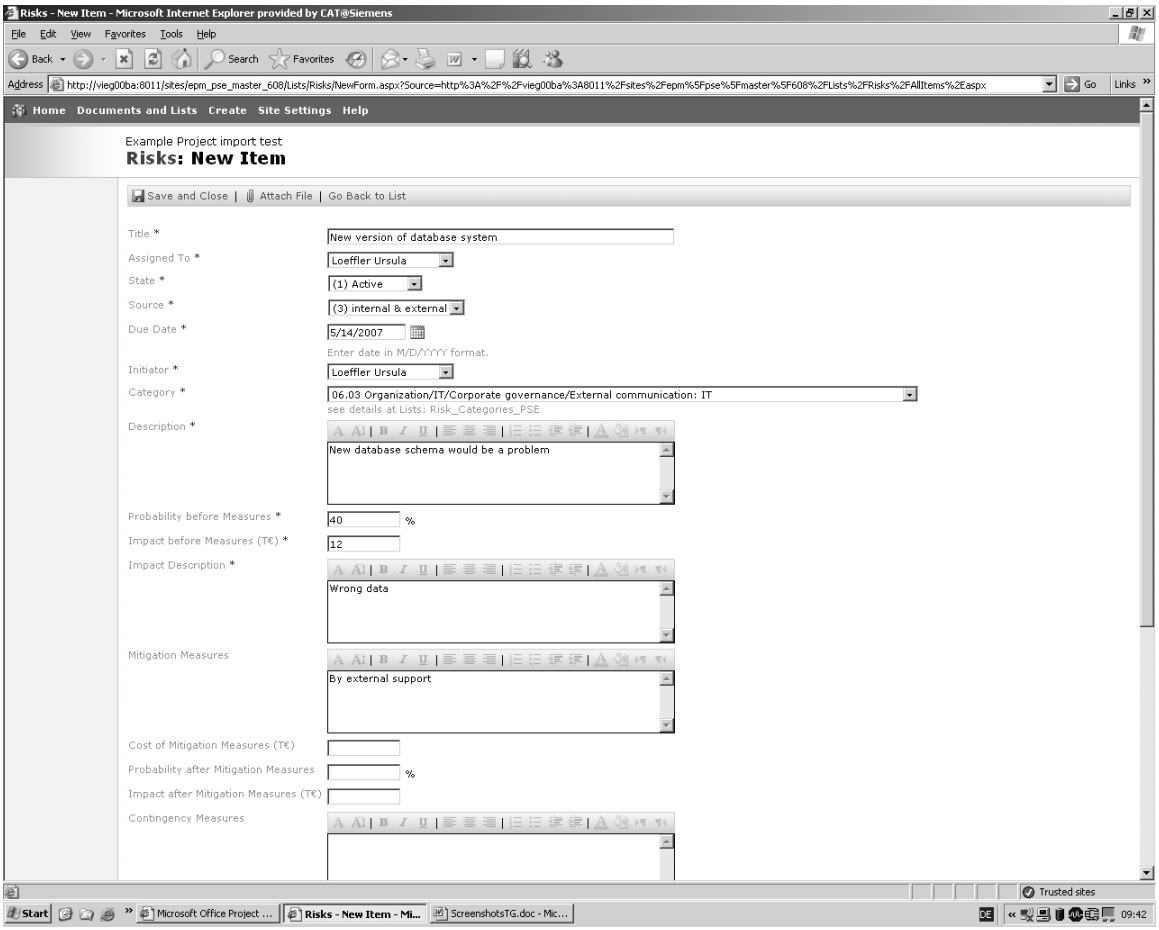


Figure 31: *Risk Manager - adding a new risk item*

Issue Tracking

Issue Tracking is a feature in EPM that improves the efficiency and effectiveness of project management. It allows the project manager to communicate effectively with team members and stakeholders concerning any problems. The Issue Tracking feature provides greater accountability through a central tracking system that enables project teams to record, assign, and resolve issues. Issue Tracking provides rich reporting, status indications, e-mail notifications, and alerts to help ensure that issues that surface during project execution receive attention and are resolved. An example for issue tracking is shown in Figure 32.

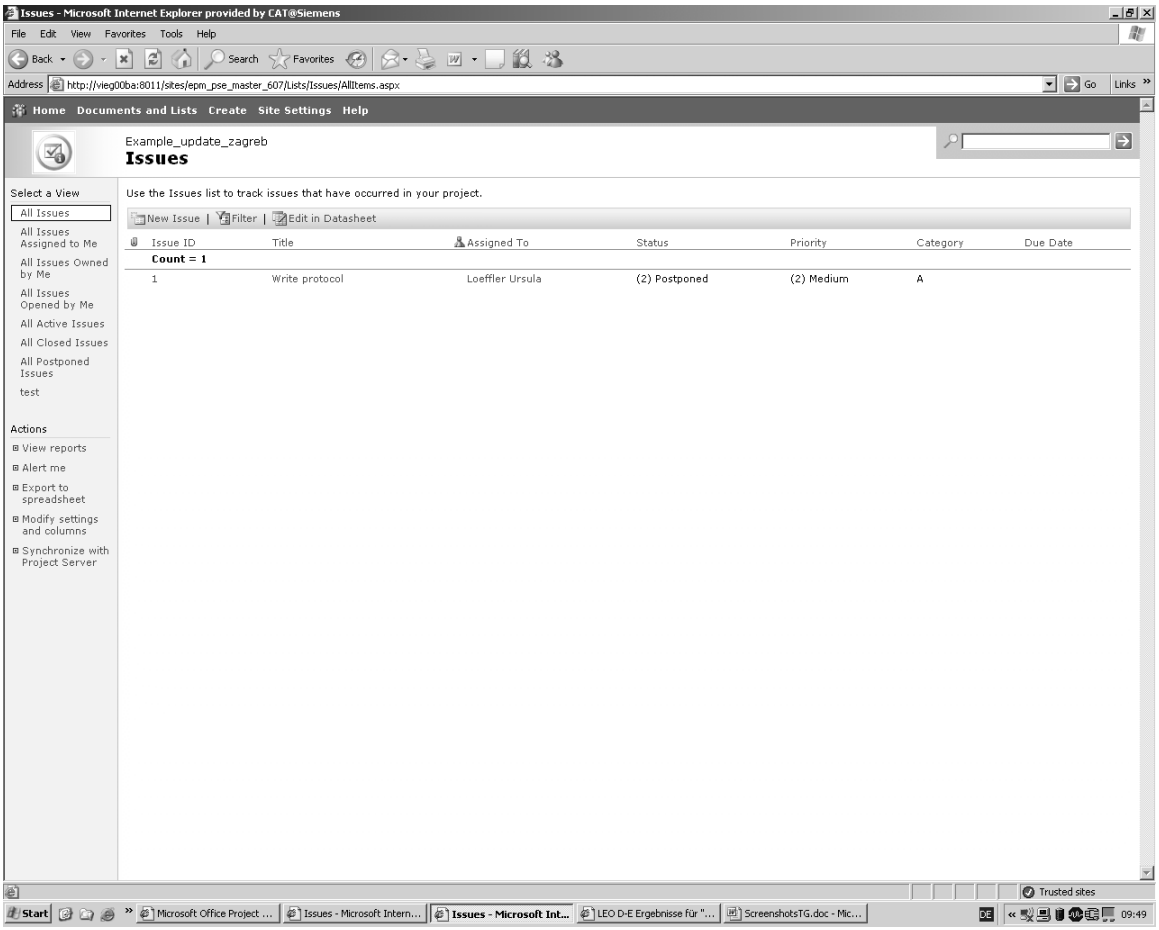


Figure 32: *Issue Tracking*

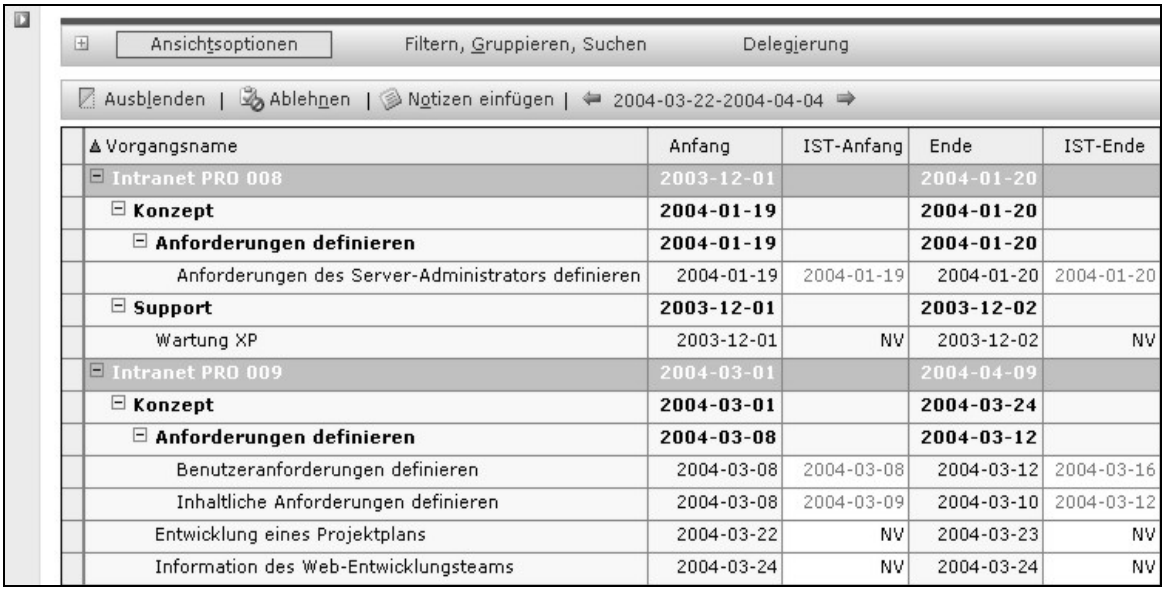
Task Progress Reporting

Increased participation in the project management process can be achieved by enabling team members to manage, track and report their project activities. Project team members use Microsoft Project Web Access for task reporting in order to record progress based on time (task duration), amount of effort and degree of completion. They can send updates to the project manager for prompt feedback. Moving the data entry out to the task owner reduces the burden on the project manager. Additionally automatic e-mail notifications indicate changes and updates in planning and progress. Notified team members get updated information in real time and changes are anchored after a confirmation from the project manager.

Time - Task Duration:

Independent of completed work (effort), it is possible to compare the planned dates and started/completed dates for each task. Project progress can be

monitored by collecting actual dates per task. Similarly a comparison of “planned duration” and “actual duration” is possible. A screenshot of planned and actual task reporting based on time is provided in Figure 33.



Vorgangsname	Anfang	IST-Anfang	Ende	IST-Ende
Intranet PRO 008	**2003-12-01**		**2004-01-20**	
Konzept	**2004-01-19**		**2004-01-20**	
Anforderungen definieren	**2004-01-19**		**2004-01-20**	
Anforderungen des Server-Administrators definieren	2004-01-19	2004-01-19	2004-01-20	2004-01-20
Support	**2003-12-01**		**2003-12-02**	
Wartung XP	2003-12-01	NV	2003-12-02	NV
Intranet PRO 009	**2004-03-01**		**2004-04-09**	
Konzept	**2004-03-01**		**2004-03-24**	
Anforderungen definieren	**2004-03-08**		**2004-03-12**	
Benutzeranforderungen definieren	2004-03-08	2004-03-08	2004-03-12	2004-03-16
Inhaltliche Anforderungen definieren	2004-03-08	2004-03-09	2004-03-10	2004-03-12
Entwicklung eines Projektplans	2004-03-22	NV	2004-03-23	NV
Information des Web-Entwicklungsteams	2004-03-24	NV	2004-03-24	NV

Figure 33: *Planned and actual task reporting in EPM*

Efforts - Amount of Work and Costs:

If project planning is based on efforts per working task (“planned work”), then task progress can be monitored by collecting actual effort values (“actual work” based on hours) in order to predict any outstanding effort. The recorded hours can be assigned with hourly rates and, therefore, monitored on a cost perspective based on these hours. An example of how efforts are recorded is presented in Figure 34.

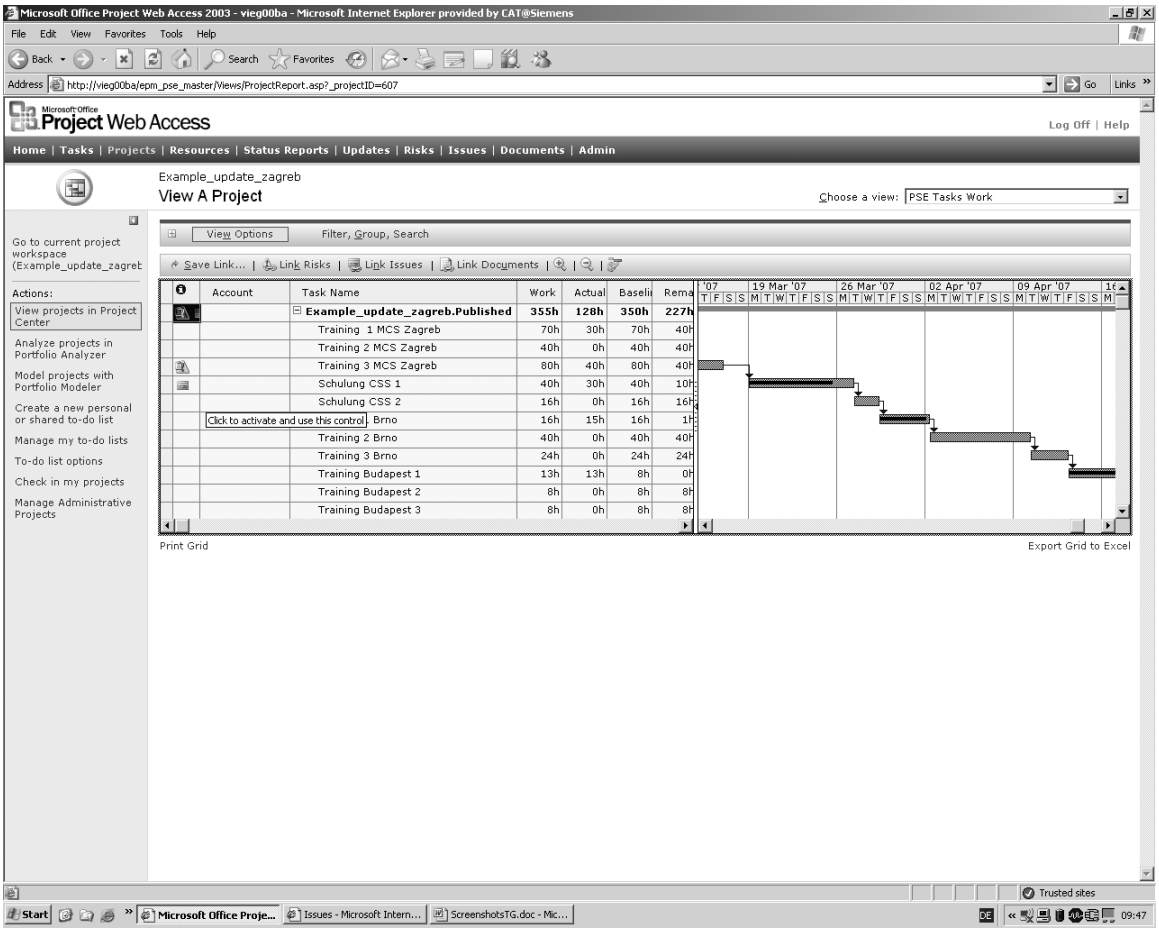


Figure 34: *Effort based on actual and completed project tasks in EPM*

Degree of Completion:

The degree of work completed for a particular task is calculated by EPM based on time and effort. This progress is presented in EPM as a percentage. A screenshot example is presented in Figure 35.

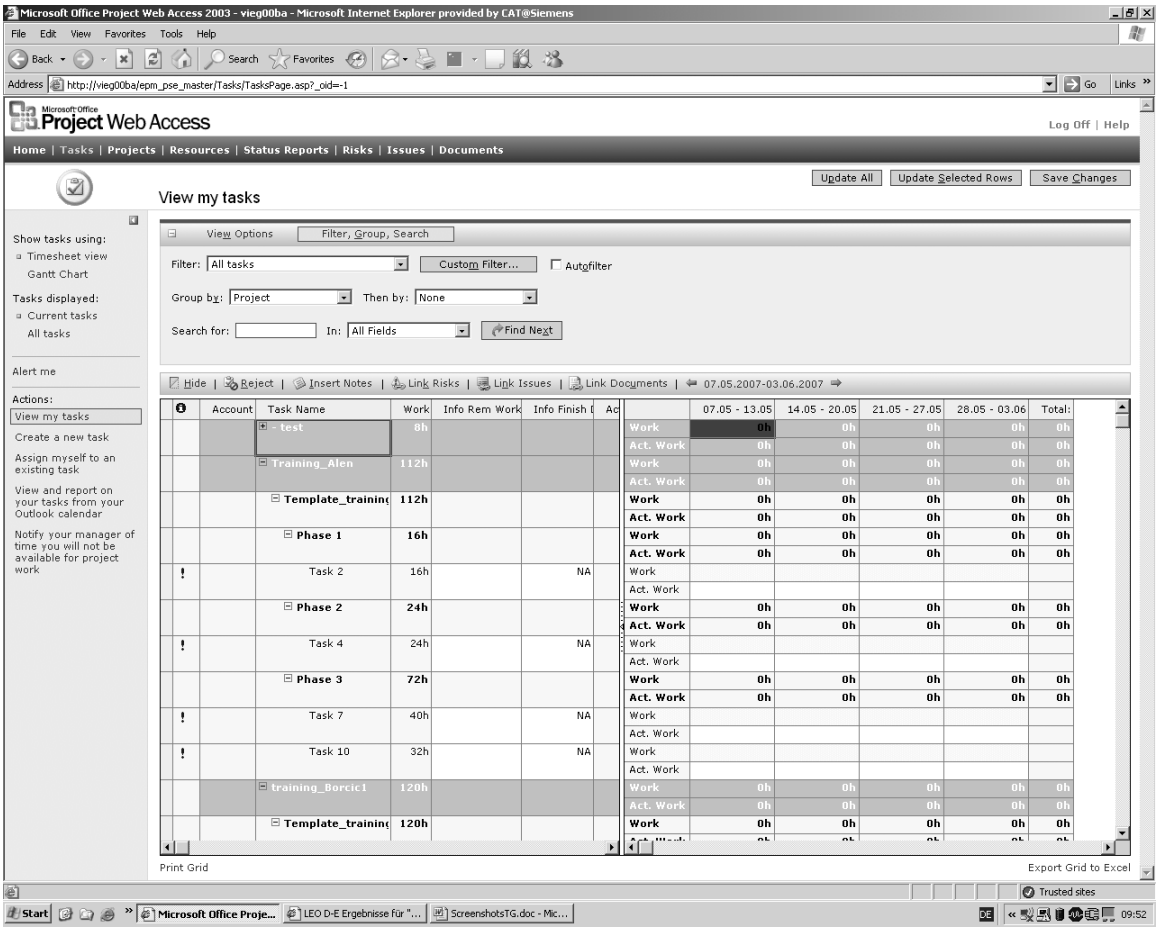


Figure 35: *Degree of completion of tasks in EPM*

8. E-mail Notification of Updates

Automated e-mail messages conveniently inform the entire project team regarding any project updates, upcoming deadlines, amongst other project changes. The project manager can set the type and frequency of automated e-mail notifications team members receive so they are alerted appropriately when they need to take action.

9. Document Sharing

With the document sharing it is possible to link documents to tasks, enhancing collaboration and knowledge sharing. Managing team documents centrally in a document repository with check-in/check-out and versioning capabilities. An example of how the document repository is accessed via the web is shown in the screenshot in Figure 36.

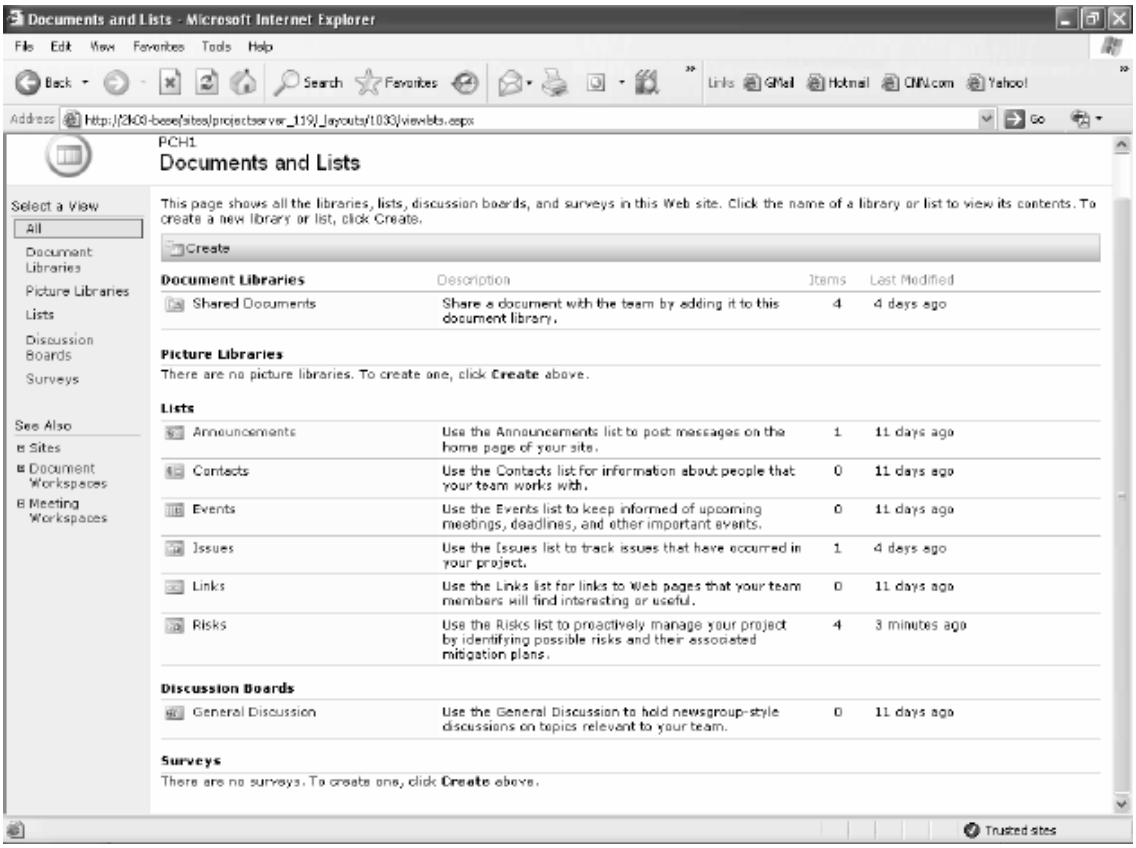


Figure 36: *Screenshot showing access to the document repository in EPM*

10. EPM Tool Customisation

Existing Microsoft Project Plans can be imported into Microsoft Enterprise Project. It is possible to manage projects on a departmental level or individual resource level. Furthermore, it is possible to configure the many custom fields for data that the organisation wants to track such as cost center, project approval, project classification, and so on. You can determine what features to implement and when, giving the organisation the flexibility to grow as needs change.

7.5 Summary and Discussion

The previous chapter presented an overview of the EPM solution offered by Microsoft. The main features have been presented and examples have been provided. EPM has been investigated in an endeavour to answer the issues encountered by Siemens PSE. The three issues that are effectively addressed by the EPM solution are 1) planning and controlling tasks, 2) wrong information handling, 3) collaboration activities.

The Project management activities “planning and controlling” and "coordinating communication”, “analysing, negotiating requirements” and “clarify who does what when” were discussed as major project management activities in Chapter 6.1.1.5. Collaboration activities like “task progress reporting”, “synchronising project management activities” and “milestone reviews” have been discussed as major collaboration activities in Chapter 6.1.1.6. These activities are well supported and effectively addressed by the Microsoft EPM Solution by collecting data, tracking information and generating analysis and reports, as presented in this chapter. The features that support these activities and the benefits of using these features are as follows:

Collect Data

- Extend information across the organization
- Microsoft Project using web access
- Tracking time more efficiently
- Receive automated e-mail notifications
- Microsoft Outlook integration

Track Information

Store and share documents and track issues and risks in one central location for improved communication through Microsoft Project Web Access.

- Issue tracking
- Risk management
- Enhance knowledge sharing
- Staff and optimise project teams
- Match the right resources to tasks
- Assemble optimised teams for projects
- Manage resources centrally
- Centralise resource information
- Evaluate resource needs for better planning

Analysis and Report Generation

- Analyse and report consistently across projects
- Quickly assess the status of portfolios

- Gain better insight into projects
- Model what-if scenarios
- Print and copy wizard

In any way it is seen in Chapter 6.1.1.7 that collaboration tools and web portals are not popular in Siemens PSE project management departments.

To respond to the research question (2b) “Investigate the benefits for Siemens PSE of employing an Enterprise Project Management (EPM) solution” the next chapter introduces an own distributed project of the Siemens PSE CSS INP3 department. Use cases are given to identify differences and benefits of implementing an EPM solution compared to existing work practices at Siemens PSE. This comparison is investigated in the next chapter.

8 Case Study

Case Studies are used to compare workflow as currently performed by the PSE CSS INP3[20] group to workflows using the Microsoft EPM solution. In these Case Studies a real distributed project handled by the author will be used as examples. The author's experience with distributed projects involves:

- Working full-time for more than two years as a project manager in Siemens PSE CSS INP3 department that is realising projects for NSN.[21]
- In this time has independently managed 6 distributed projects (one for a Taiwan Mobile Telephone Provider and the five for a Slovakian Mobile Telephone Provider) from start to finish.
- Prepared one project for an Australian Mobile Telephone Provider during the presales phase until the project kick-off.
- Responsible for several estimations and offers for Mobile Telephone Providers in Taiwan, Vietnam and Thailand.
- Close inter-working with the sales departments in Singapore, third parties in Malaysia and with the several local companies was necessary.

To gain a better picture of the above mentioned project the next sections describe some background, project characteristics, involved departments and used processes.

8.1 Introduction and Background

The Siemens PSE CSS INP3 has a project management department where projects concerning "Intelligent Networks" are realised.

An Intelligent Network (IN) is a service oriented central system that is attached on an existing telephone infrastructure (e.g.: ISDN). An IN extends a telephone network with an intelligent component which is a computer based system inter-working with the basic telecommunications network. Services are telephone services offered to the customer, such as "Virtual Private Network", "Multi SIM-

[20] Programm & Systementwicklung Communication Solution & Services Intelligent Network Abteilung 3
[21] NSN: Nokia Siemens Networks

Card Services", "Freephone Services", "Mobile Number Portability Services", "Prepaid Services", "Televoting Services" and so on. These services can be made available to a customer for specific functionalities and applications.

The handling of projects in the telecommunication business is a challenging task, because many different people, departments, strategies and approaches are involved. This leads to project organisation and project characteristic of the introducing project, found in Section 8.2.

To ensure a fast and efficient execution, project teams should follow a well-defined standard process. Moreover, the used process implemented in the project presented in the use cases is defined in Section 8.3.

For effective coordination, different tasks have to be executed by each team member on time and in the correct sequence. Therefore, the task sequence described in the standard processes play a central role within a suitable project plan. This now leads to Section 8.4 where the introduced use-cases also include the tasks and workflow involved in both creating a project plan and for monitoring and reporting the task progress.

8.2 Project Organisation and Project Characteristics

A project for a Slovakian Mobile Telephone Provider has been selected as an example of a distributed project, which the author has managed. The project, investigated as a use case in this work, is a suitable example of how distributed projects are organised and undertaken by Siemens PSE CSS INP3. The project involved customising and installing a Prepaid-System.

In summary, the main project characteristics are:

- Project duration was 16 months.
- Financial, system or subscriber information is confidential and cannot be presented.
- Approximately 50 persons were involved (not counting any special support needed from specialised support teams).

- Seven countries were involved in this distributed project: Austria, Germany, Croatia, Poland, Slovakia, Hungary and Romania (and partly we needed colleagues from South-Africa as team reinforcement).
- The team complexity, according to Duarte [Duarte2001], was moderate (see Chapter 3.4), The project team:
    - Had members from more than one organisation
    - Had members from more than one function
    - Had members who transitioned on and off the team
    - Had members whose native language was different from the majority of other team members.
    - Was geographically dispersed. But it was not so dispersed so that a team member was further than three contiguous time zones. No team member was more than 8-12 hours apart.

  These results indicate a complexity index of 4 according to the categorisation by Duarte [Duarte2001], which implies moderate complexity.
- Overall, 18 teams or departments interacted with each other to complete the project. These teams have been inter-working mainly as “Project or Product-Development Teams” together with “Work or Product Teams”, as discussed in Chapter 3.3: “Types of virtual Teams”. The teams or departments involved were:
    - 1 Project Management department
    - 1 Sales department
    - 1 Project Quality Management department
    - 3 Service Development department
    - 1 Announcement Development Team
    - 1 Customer Care development department
    - 1 Customer Care system test department
    - 1 System Test department
    - 1 System Integration department
    - 1 Interoperability Test department
    - 1 IT-Integration Team
    - 1 System Installation Team
    - 1 Technical Assistance Competence Team (TAC-Team)

(TAC-Team is split into 2 sub-teams for Onsite Preparation, Test and Acceptance)
    - 1 Documentation department
    - 1 Performance Test team
    - 1 Core Switch team
- Additionally several specialised support teams have been consulted when specific critical problems occurred. These teams provided support as "Action Teams", as discussed in Chapter 3.3: "Types of virtual Teams".

To explain in detail the responsibilities and tasks of each team is beyond the scope of this diploma-thesis. However, the project manager is responsible for success of the project, particularly from a financial and quality point of view. The project manager is supported by a Project Manager Commercial in relation to the accounting tasks. The project manager is responsible for managing, planning and coordinating all involved parties during the project realisation in order to meet the contractually agreed obligations towards the customer achieving customer satisfaction and all internally set targets.

The project manager needs to plan all tasks and workflows according to a given process, which is described in the next section.

8.3 Customer Live Cycle Process

Project initialisation to completion in Siemens PSE CSS INP3 follows a "Life Cycle Model". Products sold to customers are rolled-out in well defined processes, referred as a Customer Life Cycle Process (CLP), was defined and is motivated, amongst other things, to provide clear hand-over points (milestones) between groups. This should ensure the reusability of experiences in order to make the rollout of the products cheaper, faster and reliably.
Note that all the processes to which Siemens CSS INP3 is attending are according to guidelines that are specified in NSN headquarter.

The important milestones of the CLP are graphically represented in Figure 37 followed by a description of these milestones [Siemens2006][22]

[22] [Siemens2006] is part of a Siemens internal training. Details are under Siemens copyright

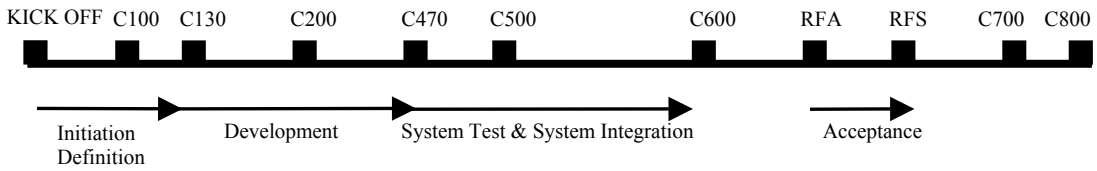


Figure 37: *Customer Life Cycle milestones*

Kick Off:

Sales organise an internal Kick Off in order to discuss further procedures, strategy and allocate involved persons, such as project manager, technical solution consultant, development project leader and service team leader.

C100: Order Processing

Represents the beginning of the project execution whereby the Sales order process is completed and the project initialisation will commence.

C130: Definition of Requirements completed

The planning phase is completed. Realisation phase begins and requirements are fixed.

C200: Completion of Analysis

All System Functional and Interface Specifications are defined and accepted.

C470: Development and Offline Tests finished

The service is finally developed. All offline tests in development have been finished. The software is delivered to the System Test department.

C500: Integrated System

All parts of the Siemens System Development are tested offline and integrated in the test bed. Installation and rudimentary testing of the system was successful.

C600: Release of Customer Project
System Network Integration Tests are completed. Customer System is ready for release to the Technical Assistant Competence Team. Documentation for the whole system is finalised.

C700: Handover to Service
The acceptance phase was successfully finished and confirmed by the customer. The system is ready for rollout. The system is maintained by service organisation.

C800: End of Customer Project
The end of liabilities and obligations towards the customer for the current project (i.e. no warranty, no service contracts, no further requirements by sales).

The Ready For Acceptance (RFA) milestone is a commercial agreement that implies that the customer site is prepared, the software is installed and the acceptance can start together with the customer.

The Ready for Service (RFS) milestone is also a commercial agreement and implies that the system has no significant errors, is running stable and can therefore be activated in live operation.

Following the definitions on project characteristics, processes, milestones presented in this section, now leads onto the introduction and analysis of project use cases presented in the next section.

8.4 Use Case

Chapter 6.1.1.3 presented an investigation into “effective project planning” and “effective progress reporting and controlling” belong to the first three crucial factors of managing distributed projects.
The surveyed project managers at Siemens PSE indicated that “planning and controlling” are their main responsibilities and that, as mentioned in Chapter 6.1.1.8, “task or project progress evaluation” is often a problem in distributed projects. Therefore, from these results the author has decided to investigate the use cases “planning” and “task progress reporting” by comparing the way these

tasks are currently done in the PSE CSS INP3 department to how these tasks are performed with the Microsoft EPM Solution.

8.4.1 Use Cases Currently Performed in PSE CSS INP3 Department

Use Case 1: Planning

Customer requirements are roughly documented in a Request For Estimation (RFE) by one or more Technical Solution Consultants. The RFE is distributed internally to provide effort estimation by the various departments potentially involved in implementing the proposed requirements outlined in the RFE. The RFE generally contains:

- Basic information about the customer.
- A list of key players.
- Proposed dates for C130, C600 and RFS (indicates proposed project start and project end).
- Technical overview about the products and versions.
- A possible draft Requirement Specification (R-Spec) or a Solution Proposal.
- A customer's traffic model (expected performances), concerned interfaces, third parties and other important specifics.

Based on this information the CLP commences and the project manager distributes this RFE to all involved departments, that is, Development, System Test, System Integration, Service Team, amongst other teams. All involved departments will respond with their estimated efforts, time and duration and possible additional costs, concerns or constraints as well as boundary conditions. Based on this information from the various departments the project manager creates a rough Milestone Plan.

The project manager's next step involves sending out this rough Milestone Plan to all involved departments. These departments make a review of this Milestone Plan and provide feedback to the project manager in relation to dates for

subtasks, re-planning proposals, concerns and constraints. Based on this information the project manager creates an overall timeline where all this review comments are considered and included. This procedure is known to have up to several negotiation rounds. Successful negotiations result in an overall timeline that is fixed. Details are further included to provide a more detailed plan with project elements provided by each department on some special aspect(s) together with dependencies. In this detailed plan the dependencies are checked and confirmed by all parties involved, again potentially taking several negotiating rounds.

In current reality, at Siemens PSE CSS INP3 project planning, review cycles and project plan adjustments are all done using e-mail, telephone and software applications like MS-Project, MS-Word and MS-Excel. Every department that is part of an IN project has its own department server for storing project related documentation, such as meeting minutes, project plans and requirements. E-mails containing relevant project related information are stored on the each team member's personal computer or laptop. Negotiations made over the telephone need to be written and stored in each department's project folder. In all of these tasks each team member is responsible for storing their own project related work on their department's server and on their personal computer or laptop. This current approach at INP3 is more prone to human error and is inefficient due to the doubling up of work involved in both storing and versioning documents.
In Siemens PSE CSS INP3 the project manager is required to store project plans and project related information on an in-house intranet based tool called POF DB (Project Office Database). Allowedly this database is the beginning try to create an own self-made intranet based platform that covers similar features like a project portal. But the POF DB is predominately developed as an information platform for quality managers and senior management to provide compressed project visibility by providing access to special status reports, checklists, milestones and requirements. This POF-DB is an island solution that needs a lot of further feature development.

One feature would be a sophisticated storage system. Because currently, when the project plan is issued to the project team and then stored on POF DB, the

project manager additionally needs to include the project plan in the Project Handbook (PHB), where the PHB is again stored on the Siemens' document server.

Updating and versioning is done manually. Updated documents are e-mailed out manually to all team-members by the project manager who takes care not to forget anyone. Finally each team member needs to ensure that they are using the up-to-date project plan version. This updated version is then stored by the project manager on POF DB, the department server and in the Siemens document server.

Use Case 2: Task Progress Reporting

There are a series of project synchronising points (e.g. milestones, regular meetings) that require reporting. At each milestone a mandatory milestone meeting is conducted as required by the Siemens' CLP process, as mentioned in Section 8.3. However, it is good practice to arrange regular meetings at timely intervals to stay up-to-date between milestones. Milestone meetings and regular meetings are done via telephone conferencing where the project manager has up to 15 people engaged online. Before starting such meetings status lists and plans need to be updated by each department and distributed to each participant. During the telephone conference updates on deliverables and changes in requirements and timeline are discussed. The possible impacts and measurements are clarified and further action items are assigned. Milestones are declared if the appropriate conditions are fulfilled. During the conference, normally every participant take their own notes, however, the project manager needs to make a summary of all discussed points and distribute the Minutes of Meeting afterwards. It may be necessary to perform re-planning of the project plan in MS-Project and is manually done by the project manager. A review cycle is started when issuing an updated project plan and ends after receiving confirmation from each team leader. Remarks and comments from the review cycle are received by the project manager via e-mail or telephone.

Again, information is obtained in various formats (e-mail, telephone or online) that need to be gathered and entered in a centralised format (MS-project).

One way out of this complicate meeting and review procedure can be a net-meeting session where every meeting participant can at least follow up which notice and changes have been done. But I have learned that this procedure is time intensive and therefore often not liked from the meeting participants.

However, some of the complicated workflows or used tools exist due to historical reasons. A big company always needs a longer time to establish new workflows or tools. It also takes longer time to disperse it in the whole company and convince and train people to work with it. And in the transition period people often have doubled work to ensure consistency by using old tools and processes but already starting to work with new ones. The POF DB is an example for such a situation. You already need to work with this system that will still needs a long time to be well engineered. But in the same time the old systems are still to be used.

However, bearing in mind the aforementioned workflows for “planning” and “tasks progress reporting”, it is obvious that complexity costs, already mentioned in Chapter 3.4.3, are hidden in the current approach by Siemens PSE CSS INP3. The next section is considering these complexity cost more detailed by referring to the before explained use cases.

8.4.2 Complexity Costs in Use Cases for PSE CSS INP3 Department

Complexity costs are hidden in the use cases discussed in Section 8.4.1.
Complexity costs are an important factor in managing projects but unfortunately never considered appropriately. In my opinion the main reason for this fact is that these costs are never analysed and highlighted in any department or even company wide cost accounting.

- **Communication and Information-Exchange Costs**

  For each review cycle and update, documents are distributed by e-mail to the team leaders. A project manager especially when handling multiple projects needs to take care when disseminating both updated documents and review comments so as to ensure that all involved team members are informed. In many instances e-mails are sent to the wrong project team in large organisations. Having more than one person with the same name in a corporate Outlook Global Address List is also reason why emails are issued to the wrong person, which is particularly annoying when distributing sensitive information. This waste of time and information loss could also have been a contributing factor in the aforementioned use cases. Of course, creating e-mail distribution lists can lower this problem.

  From past experience, a common problem in distributed projects occurs when the timeline is not forwarded to all team members. In a project with, for instance, more than 50 team members the PM will negotiate timelines only with several subproject leaders. The sub project leaders are responsible for project timeline distribution to their team members. In a project environment where team members join and leave during project execution, the subproject leader may fail to keep their team informed.

  One example where the subteam leader failed to inform their subordinates was in the aforementioned project for the Slovakian Mobile Telephone Provider. It was noticed that team members were working towards an old timeline based on an obsolete version of the project plan because the sub team leader failed to forward the updated project plan.

  A breakdown in communication and information exchange can significantly drain project costs. Information is normally cascaded from the project manager to the sub team leaders before finally reaching the bottom of the hierarchy. In this structured hierarchical approach, any specific document updates need to be disseminated to all team members again and this process may be reiterated two, three or more times. A communication break in this

type of structure leads to additional time being spent on updating and processing new information.

Furthermore, the project manager should also take into consideration e-mails with large files attached. Project plans, Microsoft Word and Excel documents can be quite large that can impact network performance and fill mailboxes. Each team member needs to maintain their mailbox and organise folders, both of which take time and documents can be misplaced. One can imagine how chaotic a situation can be when 60 or more e-mails are received in a day, which is not uncommon in Siemens PSE CSS INP3.

Preparing e-mails can also be a time consuming task. The e-mail text needs to be worded appropriately in order to avoid confusion and can often be a frustrating task when writing in a foreign language. Finding the correct e-mail attachment in a complicated folder directory on the department server is also time consuming and error prone. The correct people need to be included in the distribution list and the subject needs to be appropriately worded.

- **Assembling Costs**

  In Use Case 1 and Use Case 2 already touched on, we have the situation where much information can be transferred using different media, programs or formats. This implies that more time is required to collect all relevant data to assemble, for instance, an updated timeline.

- **Validation Costs**

  Additionally there is considerable time spent on validating feedback, remarks and data from each review participant. Input is sent in various media types, also previously mentioned. The project manager needs to crosscheck and compare the input received from a particular team is agreed with all other teams. Ideally a final project timeline that is accepted by all is reached but can take considerable time to achieve. This is evident in use case 1 and use case 2.

- **Double Realising Costs**

  The use cases show that there are significant double realising costs. After preparing a time-plan it needs to be stored. Not once but multiple times. Here every department/team stores the timeline on their own department server. Additionally the PM has to store the timeline on the POF-DB and on the document server. Sometimes the timeline needs to be limited to the important milestones and working packages for reporting purposes. This adapted timeline again has to be stored on a different server drive or distributed to team leaders.

- **Search Costs**

  Inbound e-mails with comments concerning planning and reporting are deposited in an e-mail folder structure on Microsoft Outlook. The same applies to the timeline and other data that is stored on several department servers. Every participant involved in planning and task progress reporting processes organise their own structure. If the team needs to refer to changes or comments, which where issued by e-mail, each team member needs to search for these e-mails independently. Everyone may go through a deep and complex folder structure. Of course if somebody “lost” a particular e-mail or document in their structure another copy is then sent out again to save search costs. Nevertheless double realisation costs are raised.

- **Costs of Mixing Up**

  The updating and versioning documents are both the responsibility of the project manager. They need to take care in providing both meaningful names and the correct version of documents. Additionally the project manager and subproject leaders need to take care that all team members are working according to the actual timeline. By mismanaging these two tasks it is obvious that mixing up different versions of the timeline will cause problems and ultimately result in additional costs.

  In the case where a variety of timelines in a particular project are available for negotiation in an acquisition phase, the project manager could make a mistake in providing the wrong timeline and this mistake can be fatal.

- **Data Administration and System Costs**

  In the use cases described in the beginning of this chapter, the project manager was required to record project status, planning and other documents in three different systems. These systems involve the local project management server, the central documentation server and the POF-DB. These servers need to be administrated by and IT team. Other department servers used by the sub project leader are administered by an IT team also. Maintaining and updating these systems obviously involve certain costs.

  A software licence is normally acquired for each sub team leader to have access to a particular application, such as Microsoft Project. This could become very expensive in distributed projects involving a number of sub team leaders. To overcome this problem, Microsoft EPM provides one project professional licence for the project manager. The sub team leader or project member has a client access licence. In this way, Microsoft EPM users only pay for one project profession that is given to the project manager. The client access licence is significantly cheaper than the project professional licence. In this way companies can save on system costs by using the Microsoft EPM tool even after the Microsoft Project server licence is purchased.

- **Break in Media Costs**

  In the scenario described in Use Case 1 the project team is dealing with several media and document types. Collecting and summarising data from telephone conversations, e-mails, MS-Word and MS-Excel documents, PDF documents, MS Project files and MS PowerPoint presentations is time consuming and error prone. The project manager is likely to misconstrue information when much information is at hand.

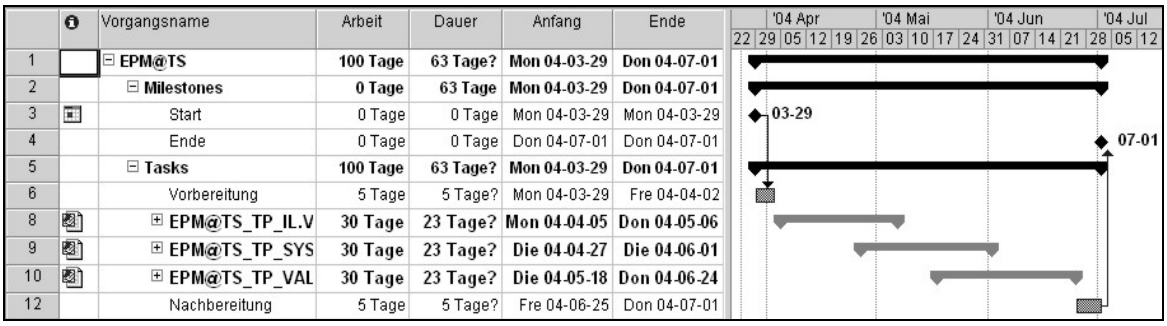
  For answering research question (2b) “Investigate the benefits for Siemens PSE of employing an Enterprise Project Management (EPM) solution” the following chapter describes the PM-tasks “planning” and “task progress reporting” if using the Microsoft Enterprise Project Management Solution and outlines the benefit.

8.4.3 Use Cases Performed with the MS EPM Solution

The same use cases already described in Section 8.4.1 will now be examined with the introduction of the MS EPM tool.

Use Case 1: Planning

The initial process for initiating an RFE remains the same in this use case as presented in Section 8.4.1. A rough milestone plan can be created by the project manager once the effort estimations have been submitted. An example of the milestone plan is presented in Figure 38. This milestone plan also includes sub projects, internal delivery dates and customer deliverables.



	Vorgangsname	Arbeit	Dauer	Anfang	Ende
1	EPM@TS	100 Tage	63 Tage?	Mon 04-03-29	Don 04-07-01
2	Milestones	0 Tage	63 Tage	Mon 04-03-29	Don 04-07-01
3	Start	0 Tage	0 Tage	Mon 04-03-29	Mon 04-03-29
4	Ende	0 Tage	0 Tage	Don 04-07-01	Don 04-07-01
5	Tasks	100 Tage	63 Tage?	Mon 04-03-29	Don 04-07-01
6	Vorbereitung	5 Tage	5 Tage?	Mon 04-03-29	Fre 04-04-02
8	EPM@TS_TP_IL.V	30 Tage	23 Tage?	Mon 04-04-05	Don 04-05-06
9	EPM@TS_TP_SYS	30 Tage	23 Tage?	Die 04-04-27	Die 04-06-01
10	EPM@TS_TP_VAL	30 Tage	23 Tage?	Die 04-05-18	Don 04-06-24
12	Nachbereitung	5 Tage	5 Tage?	Fre 04-06-25	Don 04-07-01

Figure 38: *Overall milestone plan with subprojects.*

The milestone plan is created directly in the MS project server when using the MS EPM Solution. The MS EPM Solution arranges the project environment with templates so that the project manager simply enters information in predefined templates. The MS SharePoint Service allows access to the project portal via the Internet or intranet. This portal enables the project manager and project team members to insert or obtain project information and statistics. In this way all information is centralised.

From the time the project is created in MS EPM, the project team has centralised access to project related information, such as the project plan, technical information and reports. Every document on MS EPM that is updated is versioned automatically; however project members are informed automatically via e-mail when the project plan is updated by the project manager.

Time needs to be used by the project manager to assign team members in MS EPM in order to provide access to the project server for the entire team. The same task is done currently in POF DB and, therefore, no additional effort is required by the project manager to perform this task. By using MS EPM the project manager can assign various access privileges to team members to particular information. For instance, System Test team members will only have access to System Test related tasks.

Automatic e-mail notification of a proposed milestone plan is distributed using MS EPM. This draft milestone plan is reviewed by sub team leaders, who in turn allocate resources, plan their tasks and provide this information to the project manager directly in MS EPM. The project manager and subproject leaders now all have visibility of a centralised milestone plan to refer to instead of scattered milestone information on various media types. The subteam leader will validate their milestone plan and an automatic email is issue to the project manager. This detailed plan is checked by the project manager and once validated an email notification is distributed to all team members. The milestone plan with this added information now becomes a project plan. An example of how a subproject plan is provided in Figure 39.

	Vorgangsname	Arbeit	Dauer	Anfang	Ende
1	**TP VAL**	**30 Tage**	**23 Tage?**	**Die 04-05-18**	**Don 04-06-24**
2	**Milestones**	**0 Tage**	**8 Tage**	**Mon 04-06-14**	**Don 04-06-24**
3	MST 01	0 Tage	0 Tage	Mon 04-06-14	Mon 04-06-14
4	MST 02	0 Tage	0 Tage	Don 04-06-24	Don 04-06-24
5	Nachbereitung	5 Tage	5 Tage?	Fre 04-06-25	Don 04-07-01
6	**SUB 01**	**15 Tage**	**15 Tage?**	**Die 04-05-18**	**Mon 04-06-14**
7	MST 01	0 Tage	0 Tage	Mon 04-05-17	Mon 04-05-17
8	Vorgang VAL.A	3 Tage	3 Tage?	Die 04-05-18	Mon 04-05-24
9	Vorgang VAL.B	5 Tage	5 Tage?	Die 04-05-25	Die 04-06-01
10	Vorgang VAL.C	7 Tage	7 Tage?	Mit 04-06-02	Mon 04-06-14
11	**SUB 02**	**15 Tage**	**15 Tage?**	**Mit 04-06-02**	**Don 04-06-24**
12	Vorgang VAL.D	5 Tage	5 Tage?	Mit 04-06-02	Die 04-06-08
13	Vorgang VAL.E	10 Tage	10 Tage?	Mit 04-06-09	Don 04-06-24

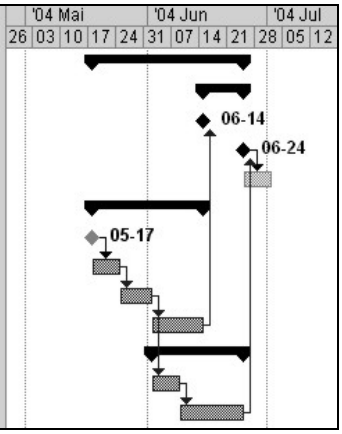


Figure 39: *A sub project plan example in MS EPM*

Short telephone calls may still be necessary to clear any doubtful points. However, the MS EPM tool saves the project manager handling various documents when confirming the project plan. All project members receive their

information in real time, which is automatically versioned and centrally stored in a common structure.

Use Case 2: Task Progress Reporting

Periodic meetings, especially milestone meetings, are indispensable from distributed projects. People are not machines that merely need some input to generate output. Face to face meetings would be ideal but even telephone conferences contribute to improve teambuilding and develop trust. Nevertheless, it is easier to explain problems and facts over the telephone rather than writing a many e-mails or performing a chat. A joke or two in a telephone conference can always help to make a more relaxed atmosphere. MS EPM cannot replace telephone conversations but will greatly support project meetings and task reporting.

Microsoft Project Web Access is used to record task progress, where each subproject team department can promptly send updates to the project manager. However, if the project manager specifies a due date for task status in the MS EPM tool, then an e-mail is automatically generated and sent to sub team leaders with this request. Status updates are entered directly into the MS EPM tool by each sub team leader. The reports are analysed by the project manager and any changes to the existing project plan are addressed. The project plan needs to be adapted to reflect any changes, which is re-distributed if necessary. This function makes it easy for the project manager to validate any changes directly in MS EPM, which makes processing changes easier compared to the current method used in Siemens PSE. Again, an e-mail is automatically sent to all team members and versioning is done automatically.

The following section shows the benefits of using the MS EPM Solution in terms of time and effort for the aforementioned Use Cases.

8.4.4 Comparison of Workflow and Effort by using and not using MS EPM Solution

Table 4 and Table 5 compare the effort in hours for performing the workflows of the described Use Cases “planning” and “task progress reporting”. The table compares each task and the according efforts if performing the workflow as usual, using MS-project as planning tool and if performing the workflow by using the MS EPM Solution.

In the project mentioned in Chapter 7.2, 17 teams or departments were involved in the planning and review process, of which 16 subproject leaders reported to the project manager.

The described efforts for the project-manager are empirically estimated.

Use case 1: Planning (only one review cycle)

PM Efforts
PL Efforts (subproject leader effort)

Usual workflow tasks with MS-project		Workflow tasks with MS EPM Solution	
Tasks	Effort / h	Tasks	Effort / h
PM creates MS-Project plan with MS-project	1	PM creates MS-Project plan directly in MS-project server	1
PM creates a folder structure for the project on the department server	0,5	PM creates new project in Sharepoint-Service via existing templates	0,2
PM distributes project plan to each sub project leader: *-Versioning and storing the plan on own department server* *-Preparing and sending an e-mail including the project plan attachment to PL*	0,5	PM distributes project plan to each sub project leader: *-PM publicise project plan* *->plan is stored on central server* *->plan is automatically correct versioned* *->automatic e-mail notification to PL*	0,01

(-phoning for clarifications -> Differs strongly on demand Therefore factored out)		*(-phoning for clarifications* -> Differs strongly on demand Therefore factored out)	
Sub project leader are reviewing the project plan including their detailed planning for their subprojects: -Create own e-mail structure on own mailing systems and store the received e-mail -Create own filing structure on the several department server and store the attachment (project plan) -Making modifications and corrections for the project *plan* Case a) *Modifications are done directly in the received MS-project plan and sent back via e-mail* Case b) *Writing only an e-mail with remarks and dates for the modifications*	1,5x16PL	Sub project leader are reviewing the project plan including their detailed planning for their subprojects: *-Reply of dates, efforts, duration and comments directly in the project plan in EPM.* *-Automatic e-mail notification to PM to signal that changes have been done in the project plan.*	0,5x16PL
PM includes the response in the project plan: -Storing received e-mail in corresponding e-mail filing		PM includes the response in the project plan: *-Analysing modified project plan directly in EPM.*	0,25x16

structure Case a) -Storing attachment (project plan) in according filing structure of the department server -Analysing the received MS-project plan. -Comparing with original project plan (original plan vs. corrected plan) -Including changes in the original plan manually. -Versioning and storing of project plan on corresponding filing structure of the *department server* Case b) -Analysing the received e-mail comments -Comparing comments (dates) from the e-mail with original project plan (original plan vs. e-mail comments) -Including changes in the original plan manually. -Versioning and storing of project plan on corresponding filing structure of the department server	1x8PL 1,5x8PL	*-Accepting and taking over modifications automatically in the origin project plan.* *-Project plan gets versioned automatically*. *-Automatic e-mail notification to PL that changes in the origin project plan has been done.*	

PM distributes the updated project plan to each sub project leader, asking for confirmation: *-Preparing and sending an e-mail including the updated project plan attachment* *-Phoning for clarifications*	0,25	Not applicable	
PL are making a final review: *-Comparing final project plan with their comments and modifications.* *-Storing final project plan on their several department server* *-Send a confirmation for accepting the final project plan*	0,25x16PL	Only necessary if the several updates of the PL interfere mutually. That is not assumed in this example.	
PM stores project plan on public server: *-Store plan on POF-DB* *-Store plan on document-server* *-Store plan in maybe different format on a different server for reporting purposes to line-manager*	0,5	Not applicable	
Overall Effort in hours	**50,75**	**Overall Effort in hours**	**13,21**
Containing PM Effort	**22,75**	**Containing PM Effort**	**5,21**
Containing single PL Efforts	**1,75**	**Containing single PL Efforts**	**0,5**

Table 4: *Comparison of effort with and without MS EPM in Use Case 1*

Use Case 2: Task Progress Reporting

PM Efforts
PL Efforts (sub project leader effort)

Usual workflow tasks with MS-project		Workflow tasks with MS EPM Solution	
Tasks	Effort / h	Tasks	Effort / h
PM asks for a status at a due date: *-Preparing and sending an e-mail to the PL*	0,1	PM asks for a status at a due date: *-Open project plan in EPM* *-Enter a due date where a status has to get delivered* *-An automatic e-mail gets generated and sent to the PL with a reminder to deliver the progress of each task to a several due date.*	0,1
PL summarises and delivers the status: Case a) *-PL enters the status in the current actual MS-project plan* *-PL send an e-mail with the attached updated project plan* Case b) *-PL summarises status with the progress of the several tasks and writes it directly in an e-mail* Case c) *-If PL is responsible for e.g.*	0,75x16PL	PL summarises and delivers the status: *-PL enters the status in the current actual MS-project plan directly in EPM.* *-For each task an according response for dates, efforts and duration will be stated*	0,25x16PL

only one or two task the status might get delivered per telephone			
PM includes the response in the project plan: *-Storing received e-mail in corresponding e-mail filing structure* Case a) *-Storing attachment (project plan) in according filing structure of the department server* *-Analysing the received MS-project plan.* *-Comparing with original project plan (original plan vs. corrected plan)* *-Including changes in the original plan manually.* *-Versioning and storing of project plan on corresponding filing structure of the department server* Case b) *-Analysing the received e-mail comments* *-Comparing comments (dates) from the e-mail with original project plan (original plan vs. e-mail comments)* *-Including changes in the*	1,5x7PL 1x7PL	PM includes the response in the project plan: *-The PM can take over the updates with possible stated delays, additional efforts and durations as well as a planned progress directly in the project plan.* *-The updated project plan is stored centrally.* *-The updates get versioned automatically.*	0,25x16PL

original plan manually. *-Versioning and storing of the project plan on corresponding filing structure of the department server* Case c) *-Taking notes of the telephone call and taking over the status in the actual project plan.* *-Versioning and storing of the project plan on corresponding filing structure of the department server*	0,25X2PL		
PM distributes the updated project plan to each sub project leader: *-Preparing and sending an e-mail including the updated project plan attachment*	0,25	PM distributes the updated project plan to each sub project leader: *-PM releases the project plan containing the updates* *-Automatic e-mails get generated and sent to PLs*	0,01
Especially at milestone meetings the actual project plan has to get uploaded to public the server: *-Store plan on POF-DB* *-Store plan on document-server* *-Store plan in maybe different format on a*	0,5	Not applicable	

different server for reporting purposes to line-management			
Overall Effort in hours	**30,85**	**Overall Effort in hours**	**8,11**
Containing PM Effort	**18,85**	**Containing PM Effort**	**4,11**
Containing single PL Efforts	**0,75**	**Containing single PL Efforts**	**0,25**

Table 5:*Comparison of effort with and without MS EPM in Use Case 2*

It is obvious that by using the Microsoft Enterprise Project Management Solution efforts in time can be saved.

There are overall 50,75 hours to spent for the use case “planning” if following the usual workflow whereby the planning is only done be the decentralised use of MS-Project and e-mail.

Opposite to this workflow the workflow by using MS EPM needs only overall 13,21 hours.

The differences are overall 37,54 hours!

There are also big differences in spending hours at use case “task progress reporting”.

30,85 hours by following the usual workflow are opposite 8,11 hours by following the workflow with using the MS EPM.

Here the differences are overall 22,74 hours!

Now consider that normally, in case that no unexpected occurrence comes up, the use case “planning” will only get performed one time. Whereby, a use case “task progress reporting” should happen weekly or at least bi-weekly.

When introducing the project characteristics in Chapter 7.2 I mentioned that the referring project had duration of 16 month.

A review meeting and therefore a “task progress reporting” was done minimum bi-weekly. What means that at least 32 “task progress reporting” have been done.

Workflow	Use Case	Quantity	Effort	Overall Effort
Without EPM	Planning	1	50,75	50,75
Without EPM	Task progress reporting	32	30,85	987,2
			Sum	**1037,95**
With EPM	Planning	1	13,21	13,21
With EPM	Task progress reporting	32	8,11	259,52
			Sum	**272,73**

Table 6: *Compared effort of Use Cases*

Table 6 shows that by using MS EPM overall 765,22 hours effort could be saved. Multiply this effort with the actual hourly rate[23] and we would see how much costs we would be able to save.

The next Table 7 and Table 8 show the differences of the spent effort in time of the PM and the single PL during the project.

Project Manager (PM)				
Workflow	**Use case**	**Quantity**	**Effort**	**Overall Effort**
Without EPM	Planning	1	22,75	22,75
Without EPM	Task progress reporting	32	18,85	603,2
			Sum	**625,95**
With EPM	Planning	1	5,21	5,21
With EPM	Task progress reporting	32	4,11	131,52
			Sum	**136,73**

Table 7: *Compared effort of Use Cases for the PM only*

The PM would have bee saved 489,22 hours during the referring project.

[23] The hourly rate is to keep secure.

Sub Project Leader (PL)				
Workflow	**Use case**	**Quantity**	**Effort**	**Overall Effort**
Without EPM	Planning	1	1,75	1,75
Without EPM	Task progress reporting	32	0,75	24
			Sum	**25,75**
With EPM	Planning	1	0,5	0,5
With EPM	Task progress reporting	32	0,25	8
			Sum	**8,5**

Table 8: *Compared effort of Use Cases for the single PL only*

The single PL would have been saved 17,25h

Consider that these highlighted hours mainly contain the administrative tasks for “planning” and “task progress reporting”. For sure these use cases cover more effort in real life. Because planning and review meetings contain a lot more efforts for conferences and discussions when the project becomes tricky because of unforeseeable occurrences like changing customer requirements, mutual interference of tasks, platform-problems, duration of test-system reservations and so on.

The next chapter covers interpretations of the investigated results. It points out the improvements in complexity costs and savings of time that can be reached by using the Microsoft Enterprise Project Management Solution.

9 Interpretation of Investigations and Commentary

This diploma-thesis investigated two key research issues concerning Siemens PSE project managers:

(1) Identifying the current main activities and challenges in managing distributed projects.

(2) a) Tools or applications that are currently used to meet these challenges.
b) Investigation of the benefits for Siemens PSE of employing an Enterprise Project Management solution like MS EPM.

(1) Identifying the current main activities and challenges in managing distributed projects:

Concerning research question (1) the following facts have been investigated by analyzing a questionnaire that was sent out to potential Siemens PSE project managers:
Virtual project managers have to predominately deal with the usual project management tasks of project planning, controlling and coordinating. In virtual projects the major success factor is to negotiate and clarify requirements and avoid misunderstandings in creating and defining requirements. All these tasks and challenges are becoming more complicate in virtual projects as the virtual project-team has to deal with difficulties like:

- Space
- Time (different time-zones)
- Borders
- Culture
- Languages
- Technologies

Therefore the activities "Task progress reporting", "Synchronise activities", "Requirements Management" and "Milestone reviews" are highly valued and used very often from Siemens' virtual project managers.
The key factor to meet all these challenges is communication and documentation. As face-to-face meetings are less possible in virtual projects project managers

have to concentrate more on the success factors “Effective project planning” and ”effective progress reporting and controlling”. It is all-important to set up effective planning in all project management processes. According to Lipnack [Leventon2002] especially a proper communication planning avoids problems during the projects: “Because they will be working separately most of the time, the team members should develop a specific plan for connecting with each other. Such a communication plan might call for daily checks of the project Web site, one-on-one telephone calls every other day, and a teleconference with all team members once a week.”

As communication is a daily process people think that there is no special expert knowledge necessary. Improvements are easy to identify by analyzing the time that is needed to create and convert a number of documents or to clarify misunderstandings by using electronic communication.

Documentation is unavoidable to keep virtual team-members informed. However, care must be taken when handling of documentation as it comprises a lot of traps and covers a lot of complexity costs (see Chapter 3.4). The consequences of too much and dispersed documentation was also investigated in research question (2b) by performing a use case study (see Chapter 8)

“*Voluminous documentation is part of the problem, not part of the solution*.”
Peopleware by Tom DeMarco and Timothy Lister (2nd ed. 1999)

Stangberg [Stangberg2007] defined the following view on documentation:

- Write only those documents which are absolutely necessary
- Leave out those which don’t.
- Face-to-face communication may be more effective
- Do not write overly large documents
  - They are prone to error
  - They are not read (at all)
  - They require frequent updates (due to changing details)

The effort you save by producing light documentation is better spent on the quality of the documents that you create.

Use sophisticated tools to support the creation and distribution of documents. We are living in an electronic age where it is hard to understand why often the same

information has to be converted, manually imported, entered twice, stored twice or even be distributed by fax.
For the success factors “Effective project planning” and ”effective progress reporting and controlling“ documentation is definitely necessary. But consider that a face-to-face meeting or at least a telephone call is more effective to find out something about problems and the real progress of a virtual project. But bear in mind the following suitable advice:

"Solange man selbst redet, erfährt man nichts."
Translation:” As long as one talks, one does not experience anything”

Freifrau Marie von Ebner-Eschenbach, (1830-1916), Austrian authoress

(2a) Tools or applications that are currently used to meet these challenges:

Concerning research question (2a) the following facts have been investigated, also by analyzing a questionnaire that was sent out to potential Siemens PSE project managers:

The analyzes of the questionnaire has shown that “electronic communication and collaboration technology” to support project management tasks is not pointed out as crucial. Moreover, Siemens PSE project managers do not highlight questions about ”suitable software architecture for distributed work “ and “standard software infrastructure” as being crucial in virtual projects.
That might be a reason for the further investigated fact that Siemens PSE project managers predominately accomplish their tasks only by using the telephone and e-mail, with support of Word processing and Excel spreadsheets. Collaboration tools are almost not used at all.
Considering today’s availability of collaboration tools and the associated advantages (see Chapter 5), it is an obvious fact that the current approach of tool support in Siemens PSE is much more time consuming and error-prone. According arising costs are outlined in chapter 8.4.2 where certain complexity

costs of a use case study are presented. In this use case study you can see that virtual teams have to deal with the following complexity costs:

- Communication and Information-Exchange Costs
- Assembling Costs
- Validation Costs
- Double Realising Costs
- Search Costs
- Costs of Mixing Up
- Data Administration and System Costs
- Break in Media Costs

Consider that all these complexity costs are never outlined in a department or company cost calculation.

When I started my research for this thesis I found out that some departments and small project teams use Tools like Wiki or Live-Link in their projects.
However, Wiki was only used by specialized small (up to six team-members) software development teams, which are not frightened about creating new sites for information exchange. You have to consider that you need to follow some rules and syntax to publish information in Wiki.
And Live-Link is predominately used as one big Knowledge-Base department or even company wide.
Investigations have shown that a specific project portal, where team members can find the following issues specific for their project, is seldom in use:

- A library of all the information received from a customer.
- All deliverables - such as project plans, schematics, specifications, and requirement documents - produced during the project.
- Contact information for everyone working on the project.
- An open issue list.
- An automated action-item tracker.
- Although communication is critical for any project, the ability to accurately track progress and issues as they arise is equally important.
- Chat rooms
- A complete history of all the design conditions and issues that have been generated during the course of the project.

- A photo gallery. Photos and images posted on the Web site can be an effective tool for enhancing communication and promoting understanding among team members.

Further contents of a project portal are described in Chapter 5.5.
In a virtual project environment only less face-to-face communication is possible. Virtual project team members have to cross boundaries facing problems with different culture, language and time zones. In such an environment it is hard to build up trust, a common social feeling and identification with a certain project. Therefore project portals become more and more important because in virtual teams it is like Lipnack [Lipnack2000] said:

"Home is where the site is".

In Chapter 8.4 I described the usage of a kind of project portal called Project Office Database (POF-DB). Here somebody might say that they are already working with a project portal. You have to distinguish if you have a project portal that was created predominately for upper-management purposes to be able to fully control the teams all the time (like POF-DB). Or if you have a project portal also for socialization in use, where also privacy within the teams is possible. Still there is a danger. "Absolute openness will absolutely kill virtual teams" stated Lipnack [Lipnack2000]. Furthermore Lipnack mentions the following:
As more information becomes more public, privacy becomes more precious. If all of its information and communications are public to everyone all the time a virtual team will

- Have more difficulty creating its identity
- Bypass critical needs for socialization
- Remove essential supports for authority

Issues of what is public, what is private, what is open, and what needs to be secure are central to virtual teams. In particular, these issues impact the design and development of cyberplaces (project portals), the true home of fully realized virtual teams.

(2b) Investigation of the benefits for Siemens PSE of employing an Enterprise Project Management solution like MS EPM:

To investigate benefits for Siemens PSE of employing MS EPM a use case study was done. Chapter 6.1.1.3 presented an investigation into “effective project planning” and “effective progress reporting and controlling” belong to the first three crucial factors of managing distributed projects. The surveyed project managers at Siemens PSE indicated that “planning and controlling” are their main responsibilities and that, as mentioned in Chapter 6.1.1.8, “task or project progress evaluation” is often a problem in distributed projects. Therefore, from these results I decided to investigate the use cases “planning” and “task progress reporting” by comparing the way these tasks are currently done in the PSE CSS INP3 department to how these tasks are performed with the Microsoft EPM Solution.

The investigation has shown that the following benefits can be achieved by using the Microsoft Enterprise Project Management Solution (MS EPM):

1.) Saving complexity costs
2.) Time saving for performing the use cases

A presentation of the Microsoft Enterprise Project Management Tool can be found in Chapter 7.

1.) Saving complexity costs by using MS EPM:

Chapter 8.4.2 presents the investigated complexity cost if performing abovementioned use cases in the usual way of PSE CSS INP3 department. In the following according savings of these complexity costs are outlined if using MS EPM Solution:

- Saving Communication and Information-Exchange Costs:
  Performing the use cases as described in Chapter 8.4.1 updates of the project plan are distributed via e-mail containing attachments. Preparing and distributing e-mails to keep the whole team informed about updates of the project plan needs time. It is also error prone if the project plan has to be

versioned manually and sent to every team member. Whereby the several sub project leader have to ensure that the correct version will be stored on the several department server and will be distributed to every sub team member.
MS EPM is versioning and centrally storing the update of the project plan automatically. At the same time an automatically generated e-mail is sent to every assigned team-member to be informed about the newest update.
Therefore less time is needed to distribute information and less errors can occur for distributing information.

- Saving Assembling Costs:
  Performing the use cases as described in Chapter 8.4.1, we have the situation where much information can be transferred using different media, programs or formats. This implies that more time is required to collect all relevant data to assemble, for instance, an updated timeline.
  In MS EPM everybody has access to the actual valid project plan that is centrally stored. Changes will be done directly in MS EPM. As every team member has access to this tool it should not happen that anybody create updates of the project plan via other media, programs or formats.

- Saving Validation Costs:
  Performing the use cases as described in Chapter 8.4.1 there is considerable time spent on validating feedback, remarks and data from each review participant. Input is sent in various media types. The project manager needs to crosscheck and compare the input received from a particular team is agreed with all other teams.
  In MS EPM the project manager defines a due date where the status has to be delivered. The sub project leaders enter the status in the current actual MS-project plan directly in EPM. For each task an according response for dates, efforts and duration will be stated.
  The project manager has not to deal with different remarks receiving from different media. The project manager can check and validate the update directly in the tool. If the update will be accepted a new version of the project plan will be automatically taken over per one mouse click only.

- Saving Double Realising Costs:
  Performing the use cases as described in Chapter 8.4.1 we have the situation that the project plan and every update has to be stored multiple times on different servers or locations.
  With MS EPM the actual project plan is only one time stored centrally. Nobody has to store the project plan anywhere twice.

- Saving Search Costs:
  Performing the use cases as described in Chapter 8.4.1, inbound e-mails with comments concerning planning and reporting are deposited in an e-mail folder structure on Microsoft Outlook. The same applies to the timeline and other data which is stored on several department servers. Every participant involved in planning and task progress reporting processes organise their own structure. If the team needs to refer to changes or comments, each team member needs to search for information independently.
  With MS EPM there only exists one centrally stored information platform where everybody can refer to the same structure. Search efforts are reduced.

- Saving Costs of Mixing Up:
  Performing the use cases as described in Chapter 8.4.1, updating and versioning documents are both the responsibility of the project manager. Additionally the project manager and sub project leaders need to take care that all team members are working according to the actual timeline. By mismanaging these two tasks it is obvious that mixing up different versions of the timeline will cause problems and ultimately result in additional costs.
  MS EPM automatically creates versions of all project plans and documents that are stored on it. Mixing up different versions cannot happen anymore.

- Saving Data Administration and System Costs:
  Performing the use cases as described in Chapter 8.4.1, a lot of systems have to be administered. These systems involve the local project management server, the central documentation server and the Project Office Data Base (POF-DB). These servers need to be administrated by and IT team. Other department servers used by the sub project leader are administered by an IT

team too. Maintaining and updating these systems obviously involve certain costs.

If using MS EPM only on central system has to be administered.

Concerning system costs MS EPM provides one project professional licence for the project manager. The sub team leader or project member has a client access licence. In this way, Microsoft EPM users only pay for one project profession that is given to the project manager. The client access licence is significantly cheaper than for instance a number of project professional licences.

- Break in Media Costs

  In the scenario described in Use Case 1 in Chapter 8.4.1 the project team is dealing with several media and document types to give input for a project plan update.

  In MS EPM project plan updates will be done directly in the tool. As every team member has access to this tool it should not happen that anybody creates updates of the project plan via other media. And nobody has an apology that he or she has no according licence on his or her computer to read, update or report the project plan.

(2) Time saving for performing the use cases by using MS EPM:

In Chapter 8.4.4 the effort in hours for performing the workflows of the described Use Cases “planning” and “task progress reporting” have been compared. Each task and the according efforts have been compared if performing the workflow as usual, using MS-project as planning tool and if performing the workflow by using the MS EPM Solution.

For the use case study a virtual project of mine has been taken as a basis. The project is described in Chapter 8.2.

The referring project had a duration of 16 month and the differences in hours that are used for the two abovementioned use cases are again illustrated in Table 9.

Workflow	Use Case	Quantity	Effort	Overall Effort
Without EPM	planning	1	50,75	50,75
Without EPM	Task progress reporting	32	30,85	987,2
			Sum	**1037,95**
With EPM	planning	1	13,21	13,21
With EPM	Task progress reporting	32	8,11	259,52
			Sum	**272,73**

Table 9: *Compared effort of Use Cases*

The use case study shows that only for the use cases “planning” and “task progress reporting” an overall time saving of about 765 hours can be achieved.[24] That is approximately 5 man month that can be saved only by optimizing the workflow with according tool support. Multiply this with the valid hourly rate[25] and you can see the saving in costs that can be achieved.

Whereby, the biggest portion of time saving can be achieved for tasks that the project manager has to execute. About 490 hours can the project manager save if using MS EPM (see Chapter 8.4.4).

Beside costs that can be saved the saved time can be used for more useful things like “Build personal relationships” and “Conflict resolution”. In the survey it was always highlighted that these tasks are important but not used very often. Out of my experiences I see one reason in managing multiple project management where the reporting and documentation effort for each project is enormous. In a matrix organisation where it often happens that managers like to have their own information flow using different tools, the management becomes blind for all the small tasks and reportings that have to be done by the project manager. Using the saved time for building trust and for attaining identification with the project within the project team would lead to more motivated team members for achieving the project goal. Conflict resolution would be easier and people won’t work like changeable resources that are not seen face-to-face in virtual projects.

[24] Of course the study was based on the suggestion that the project is running without complications. Only the clear straight running processes have been considered.

[25] The hourly rate of this projet has to be kept secure.

Another useful usage of the saved money would be to spend it for more face-to-face meetings. The questionnaire has shown that many respondents replied on the question “Collaboration Needs and Tool Support” that they would prefer more face-to-face meetings.

However be aware of the fact that this MS EPM Solution covers not only project management advantages for the single project and the assigned team. As presented in Chapter 7 this tool comprises many more admirable features that are predominately useful for the upper management. For example a permanent overview about the resource situation, a permanent overview about project progress and the ability to create different portfolio scenarios are very useful features that bring advantages in steering upper management tasks.

These advantages combined with a cost calculation for putting MS EPM into operation can be a further topic for another diploma-thesis.

10 Conclusion

As companies spread out geographically, so do their teams. Dispersed teams can be problematic, but the problems shrink when teams adopt strategies that improve communications, build trust, and establish an appropriate project structure. As highly trained people are dispersed all over the world, business started to realize that instead of shipping the people around, they could ship their intelligence around.

This leads to the fact that number of face-to-face meetings is reduced and collaboration has to be done in a virtual space.

To improve collaboration work Web based tools can be used. They support communication, collaboration and organization depending processes. However, high-tech tools can also cause many problems and they will never replace a face-to-face meeting. Therefore selecting the right tool for collaboration should be done with caution to be able to compensate the lack of face-to-face meetings.

This thesis has shown that for virtual projects the usual project management tasks are also valid in virtual projects. The only differences are that the factors communication and the way how to effective communicate and exchange information properly are very important key factors to succeed in a virtual environment.

In a virtual team it is hard to establish trust and hard to build associations with the team and the project.

Therefore establishing the right collaboration tool can save time by providing approved workflows. Additionally the right collaboration tool can prevent misunderstandings and conflicts. But consider:

“There's no way to replace face-to-face interaction," Lipnack [Lipnack2000] says. "We can only compensate for the lack of it."

Furthermore be aware of the following:

Planning, executing and controlling unified rules and policies for electronic communication is a task for both, the upper management and the project management. The upper management should predominately concentrate on the conception of the rules and policies. Whereby, the project management should

predominately care about their execution. For the success it is important that the whole management is really living these rules and policies, without exceptions. When creating such a concept you should not only orient on technical possibilities. You should plan the concept according to company specific requirements. Not everything that can be delivered should be used.

In projects a successful electronic communication presumes that communication techniques are harmonizing with the project management organization, the project management processes and the underlying rules.

11 Quotations Concerning Virtual Projects

The following quotations are taken from [Leventon2002].

EFFECTIVE COMMUNICATION

To succeed in a joint effort, people working apart must find effective ways of communicating with each other. "You don't want to work in a vacuum," says Jennie Kwo, vice president of technical development at Product Genesis Inc., a contract engineering firm in Cambridge, MA. "And it's much easier to work in a vacuum when you're dispersed. It's easy to forget that there's a development partner across the country who's working toward the same goals but has no idea what you're doing on a day-to-day basis."

Long-distance communication is usually easier among people who have built relationships with each other. "You're much more patient and understanding with people you know than with people you don't know," notes Emily Blanck, a management consultant in Moraga, CA. "When you're dealing with a person you don't know, you make assumptions that they aren't cooperating for all sorts of reasons that usually aren't true. And things go downhill from there."

Perhaps the best way to build relationships with others is to get together with them. "Nothing works better than getting everybody in one room at some point," says Peter Farrell, president of ResMed Inc. (Poway, CA), which uses dispersed teams to develop respiratory products. Blanck agrees, noting that her research and consulting experience show that teams that meet face-to-face are much more successful than teams that have never met.

Dispersed development-team members should meet as early in the process as possible, says Bill Mortimore, chairman of Merge Technologies Inc. (Milwaukee). Early meetings produce a bond that improves subsequent long-distance communications, notes Mortimore, whose company employs people in Milwaukee and Toronto who collaborate on the development of radiology systems.

After the initial meeting, additional gatherings may be particularly helpful at certain stages of a project. "There are points during design reviews where we want the dialogue between the technical staffs to be very pointed and thorough, and the most effective way to do it is face-to-face," says Jeff Castleberry, director of operations at the Boulder, CO, facility of Plexus Corp., a contract engineering and manufacturing firm based in Neenah, WI.

SPANNING THE DISTANCE

Because they will be working separately most of the time, the team members should develop a specific plan for connecting with each other, according to Lipnack. Such a communication plan might call for daily checks of the project Web site, one-on-one telephone calls every other day, and a teleconference with all team members once a week.

According to Blanck, the plan should include ground rules for communication. "If you get an e-mail, the [rule] could be that you should respond in two hours," she says. "That doesn't necessarily mean you have to answer the question in that time. Maybe you'll just say, 'I got your e-mail. I'll get back to you in two days.' This keeps people from feeling ignored."

A similar strategy can be applied to telephone calls. A telephone protocol could require team members to respond to calls within four hours. "What the protocols are doesn't matter," Blanck says. "What matters is that everyone on the team knows what they are and complies with them."

Another ground rule could establish one point of contact at each place where project staff are located. That way, says Kwo, a person in one location won't be sending e-mails to five different people in another location—and getting five different responses that could be contradictory or redundant.

Communication protocols could also address language issues. For example, dispersed teams could ban the use of "ASAP." Though often inserted into written messages to suggest urgency, ASAP "doesn't have any teeth in it," says Preston Smith, a management consultant in Portland, OR. "It means something different to each of us."

Though e-mails and other written messages are useful tools, Kwo has found that they're often misinterpreted. She recommends spoken communication among distant partners, either on the phone or in a videoconference. She believes that videoconferences are particularly effective tools for improving understanding because they enable participants to observe one another, as well as to talk and listen.

Today's videoconferencing equipment produces sharper, clearer images with fewer hassles than older systems, according to Farrell, whose dispersed development teams find teleconferencing technology particularly useful when examining plastic models. "It's show and tell," he says. "If you've got a model sitting in front of you, you can show everybody how something fits onto it, how a new feature looks, how to plug it in."

In Blanck's experience, videoconferencing has been most helpful when someone was trying to explain the details of a design flaw or manufacturing problem to a dispersed group. "In cases like this, it's a wonderful tool," she says. "You can take a video camera and point it at the problem [area]. And people around the world can actually see the problem, rather than just listen to someone trying to describe it."

BE A GROWN-UP

When dispersed groups of people are attempting to work together, even the best technology won't eliminate misunderstandings from the process. When such problems occur, their impact can be minimized by handling them in a mature manner. Unfortunately, says Lipnack, many people take the opposite course, falling prey to immature impulses.

Take the example of a West Coast person who makes an appointment to call an East Coast colleague at 10 a.m. on a particular day, but forgets that the two of them are in different time zones. On the appointed day, 10 a.m. comes and goes for East without a call from West. Instead of considering the possibility of a mistake, however, East gets annoyed at West for standing him or her up. In cases like this, Lipnack says, "we tend to jump to conclusions. That's where maturity comes in. Be a grown-up and give people the benefit of the doubt."

Perhaps more important, dispersed team members must trust each other. "Trust is the grease for the process," Lipnack explains. "Once people trust each other, work gets done more quickly."

To build trust, Kwo recommends that dispersed development teams take advantage of occasions when members are gathered in one place. "Spend time with the people you're working with," she says. "Go out and do things together as a team. This fosters the sense of team ownership of a project."

For managers, the task is to create an environment in which workers trust each other enough to be open and honest. "Every team member must feel good about sharing all aspects of the design process," says Bill Evans, president of Bridge Design Inc. (San Francisco), a contract design firm. "They should share successes and progress, but they should also tell others about any [project] warts. They shouldn't cover up problems."

To a large extent, the corporate culture created by management determines whether or not team members share information in a timely manner. "Some companies have a culture in which it's acceptable to take risks and make mistakes," Evans says. "Other companies don't, so there's a lot more covering up. And that will eventually come home to roost."

PROJECT STRUCTURE

Besides creating a culture of trust, management must structure the project in a manner suited to a dispersed product development team. According to Mortimore, the structure should "modularize" the various aspects of product development as much as possible. When the various parts of the product technology are not sufficiently modular, dispersed team members will have to be in constant communication in order to carry on with their work.

On the other hand, when the project is divided up properly "people can work at a distance pretty much independently of each other," he says. Occasional communication will then suffice to keep things moving along.

When devising the structure for a product development project, managers should pay particular attention to the boundaries between different parts of the project. "We've run into [boundary] problems a few times," Kwo recalls. "We were responsible for things up to a certain line, and our client was responsible for things beyond the line. But nobody was handling the interface."

The lesson: someone must be responsible for maintaining an interface between project areas. For best results, Kwo believes that the designated person should

have some knowledge about the other group's field. For example, an engineer handling an interface between the mechanical engineering and industrial design parts of the team should know something about the designers' work.

Even with the right structure, dispersed development teams can become disconnected over time. To prevent this from happening, Blanck advises teams to establish a series of project milestones and then celebrate when each is reached. As a milestone is achieved, "let everyone know what's happening and thank them for their efforts up to that point," she says. "This is a good way to pull people back into the project."

WEB TOOLS

Dispersed development teams need a common repository of project information, says Mortimore, whose teams share data via a virtual private network for security purposes. "People squirreling things away on their private PCs isn't a scalable business model," he explains. "We have a shared repository so people know the latest versions of the myriad pieces of software needed to build a particular product."

12 Appendix

APPENDIX A

Questionnaire

Project Management in Distributed Projects Survey Questionnaire

Over time the nature of software development projects in Siemens PSE has moved to regionally more distributed projects, with important project partners in different countries. Highly distributed ("virtual") projects, in which flexible face-to-face meetings are hard and/or costly to achieve and are thus partly replaced with electronic means of interaction, contribute an important part to PSE business.
Project management needs for collaboration support differ in collocated and highly distributed projects due to the variation in suitable means for personal interaction.

Main goal of this PSE-internal survey is to better understand in highly distributed software development projects (i.e., projects with team members in different countries)
(a) the collaboration challenges of project participants and
(b) the effectiveness of current support
from the point of view of project managers and team leaders.

Target audience of the survey are project managers and team leaders who
(a) recently finished a highly distributed project or
(b) currently work in a highly distributed project that is close to finishing.

The result of this survey will be important input to plan investments of SC PM support for project managers and team leaders (contact: SC PM head Karin Kroneder).
Research needs that come up in the survey will be input to ongoing dissertation work of DI Matthias Heindl (working title: "Requirements management and collaboration in distributed software development teams").
The survey is designed and conducted in cooperation with the Quality Software Engineering Research Group (http://qse.ifs.tuwien.ac.at) at TU Wien, Institute of Software Technology and Interactive Systems (contact: Prof. Dr. Stefan Biffl).

The main part of the questionnaire consists of the following sections:

- Section I summarizes the personal context of the respondent
- Section II identifies key characteristics of the example distributed project and the project management challenges in such projects
- Section III elicits the project management activities performed in distributed projects and the strength and weaknesses of these activities
- Sections IV and V elicit the importance of collaboration and synchronization in the project, their challenges and current solutions.

The general goal of the questionnaire is to elicit the actual state of distributed projects concerning challenges of distribution for collaboration and synchronization and to identify the need for further support, e.g., need for tool support as well as need for specific consulting services by SC PM.

Questionnaire:

The effort for answering the questionnaire is expected to take 20 to 30 minutes.
Thank you for taking your time to help improve the SC PM service for project managers and participants.

Please note the starting time: _____

Think of a highly distributed project (i.e., a project with team members in different countries) that recently finished (or that will finish in the next few weeks) and where you were responsible for project management activities.
Use this project as reference for all project-related questions.

1. Personal Background and Experience

The purpose of the following questions is to characterize your role in the example background and your experience regarding role and regarding work in distributed projects.

If you provide your e-mail address, we will be happy to send you the analysis results of the study. Further, we are looking for project participants for in-depth interviews (60 to 90 minutes) for selected projects.

1.1 Personal background

1.1.1 Personal data

Organizational unit:	
Name (optional):	
E-Mail:	
Telephone (optional):	

	Yes, I want to receive an analysis summary of this survey.
	No

	Yes, I am willing to take part in a (telephone) interview.
	No

1.1.2 Reference project

Please provide a name for the reference project you use throughout this survey (can be fictitious):

1.1.3 Role in the project

What was your main role/position/working area in the reference project you chose?

	Project Manager
	Team Leader
	Project Controller
	Software Developer
	Quality Manager or member of a quality team
	Other (please specify):

Please describe your 3 to 5 main responsibilities regarding project management activities:

1.1.4 Recent positions

What have been your (up to 3) main positions/working areas in the last 10 years that contribute to your expertise for managing software development projects?

1.1.5 Experience in project management

How many years have you personally been managing
(a) projects with all team members in one country and
(b) virtual software development projects (team members in two or more countries)?

Conventional software development projects (all team members in one country)		years
Virtual software development projects (team members in two or more countries)		years

2 Your Highly Distributed Reference Project, Its Characteristics and Challenges

Purpose of this section is:

- Elicitation of project characteristics at PSE,
- Project success factors,
- Challenges of distribution.

In the survey context we define a highly distributed project as a project with team members in two or more countries. Such projects typically exhibit the following characteristics:

- Team members do not work at the same location (significant travel from the central to other locations would be involved, e.g., more than 2 hours).
- There is less opportunity for flexible direct (face-to-face) communication: regular meetings occur less often than bi-weekly; ad-hoc meetings are impossible or very costly due to the travelling hours or high costs to establish meetings, e.g., more than 1,000 Euro for a meeting.

2.1 Project characteristics

2.1.1 Project Characteristics

Number of project participants (approximately)	Number of locations/sites involved in the project	Number of countries with offices involved	Project duration in months	Project effort in person months

List the 3 to 5 main goals (key contributions) of the reference project:

2.1.2 Rate potential success factors in your highly distributed reference project

Please rank in the following list the importance of potential project success factors by checking the relevant cell with an "x".

	Importance of PSF in your highly distributed project				
Potential project success factor (PSF)	**Crucial**	**Important**	**Desirable**	**Not Important**	**Irrelevant**
Clear business objectives					
Clear link of requirements to business objectives					
Effective project planning					
Effective progress reporting and controlling					
User involvement for requirements definition					
Clear and agreed statement of requirements					
Domain knowledge of project participants					
High team-leader and team-member competencies					
Software architecture suitable for distributed working					
Electronic collaboration and communication technology					
Standard software infrastructure					
Standard organization and team processes					
Other: *(Please specify)*					
Other:					
Other:					
Other:					

2.1.3 Rate potential problems in your highly distributed reference project

Please rank in the following list the importance of potential problems.

Potential problems	Importance of problems in your highly distributed project				
	High challenge	Medium Challenge	Littel challenge	Very little challgene	Irrelevant
Different languages of project participants					
Different understanding (misinterpretation) of requirements					
Difficult negotiation/clarification of requirements					
Unclear rationale of requirements					
Ineffective management of changing requirements					
Ineffective communication of importance of key tasks					
Communication of desired result quality of key tasks					
Communication of delivery schedule of key tasks					
Aligning participant incentives with project goals					
Unclear project status					
Lack of effective participation of future system users					
Lack of informal communication (“corridor talk”)					
Reduced awareness of local working context					
“Us versus them” feelings					
Improper knowledge management					
Lack of well-defined roles and responsibilities					
Hard to establish face-to-face interaction					
Hard to establish trust					
Hard to managing conflicts					
Ineffective decision-making					
Hard to keep teams motivated					
Low connection speed (company intranet, VPN)					
Long delay (time zones)					
Other: *(Please specify)*					
Other:					
Other:					
Other:					

3 Development Process and Project Management (PM) Activities in Your Reference Project

The contribution of this section is to identify which PM activities are considered in given processes (StdSEM, etc.) and how suitable they are for PM in highly distributed project environments.

3.1 Used processes

3.1.1 Which software process did you use in your highly-distributed project? (Please check boxes with an "x")

	Please select the process you used in your project:		**For the process you used, please determine the level of PM support the process provides for highly distributed projects:**	**Please shortly describe up to 5 potential improvements for the process you used with regard to highly distributed projects:**
	Standard SEM		Very good support for distributed projects	
	E-SEM		Good support for distributed projects	
	PEPP		Sufficient support for distributed projects	
	Other (please specify):		Insufficient support for distributed projects (Process is not suitable for distributed projects)	

3.1.2 Which PM activities did you consider important in your highly-distributed project?

Project Management activities	**Importance of activity in your highly distributed project**				
	Very important	**Important**	**Medium importance**	**Hardly important**	**Not important**
Kick-off meeting					
Analysis and negotiation of requirements					
Risk analysis and Risk evaluation					
Selecting and defining the contractual framework					
Planning and setting up the configuration management system					
Effort estimation					
Project controlling (costs)					
Clarifying who does what when					
Planning and performing reviews in the project					
Definition of escalation processes in case of problems					
Other: *(Please specify)*					
Other:					
Other:					

4 Collaboration Needs and Tool Support

Software engineering (SE) is a highly collaborative activity. SE shortfalls can often be traced back to shortfalls in group support. Facilitating the active participation and involvement stakeholders is seen as crucial for project success. However, collaboration in highly distributed projects typically takes much extra effort as flexible face-to-face meetings are hard to arrange.
The goal of this section is to identify the needs for collaboration, collaboration challenges in highly distributed projects, the available and desired support from SC PM.

4.1 Importance of Collaboration Activities

The goal of the following question is to identify the most important collaboration activities in highly distributed project.

4.1.1 Rank the importance of potential collaboration activities in your highly distributed project.

Collaboration activities	Importance of activity in your project				
	Very important	Important	Medium importance	Hardly important	Not important
Conflict resolution					
Requirements negotiation					
Training/courses (on tools, processes, methods)					
Milestone reviews					
Synchronize project activities between the different distributed teams					
Task progress reporting					
Build personal relationships to virtual team members					
Risk management					
Defining responsibilities of team members					
Requirements Management					
Configuration Management					
Other: *(Please specify)*					
Other:					
Other:					
Other:					

4.2 Tool Support for Collaboration activities

The goal of the following questions is to evaluate the current tool support for collaboration activities.

4.2.1 Which tools did you use for which particular tasks?

Please use the following symbols for answering the question in column 1: "+" very important, "0" medium importance, "-" not important
Please use the following symbols for answering the question in column 2: "+" very often, "0" sometimes, "-" hardly
Please check then the cells of the "tool columns" with an "x"!

Collaboration Activities	**How important was activity in project?**	**How frequently did you use this activity in the project?**		Lifelink	Sharepoint + MS Project Server	Lotus Notes	Wikis	Requisite Pro	Proweb	Videoconference (Net-Meeting)	Email	Word and Excel	Telephone	Other (please specify):Talk to customer	Other (please specify):
Conflict resolution															
Requirements negotiation															
Training/courses (on tools, processes, methods)															
Milestone reviews															
Synchronize project activities between the different distributed teams															
Task progress reporting															
Build personal relationships to virtual team members															
Risk management															
Defining responsibilities of team members															
Requirements Management															
Configuration Management															
Other: *(Please specify)*															
Other:															
Other:															
Other:															

4.2.2 Looking at collaboration tools that you used in your project: what tools would need the most support from the SCPM? (Please check with an "x")

Collaboration Tool	Support most important	Support important	Support medium important	Support hardly important	Support not important
Lifelink					
Sharepoint and MS Project Server					
Lotus Notes					
Wikis					
Requisite Pro					
ProWeb					
Word and Excel					
Other: *(Please specify)*					
Other:					

4.3 Requirements Traceability

Tracing helps to identify interdependencies between concurrently evolving artefacts. Requirements Tracing allows to follow the life of a requirement in a forward (where is the requirement implemented/tested) and a backward (where does an implemented requirement come from) direction.

4.3.1 Requirements Tracing

Requirements Tracing	Ad-hoc tracing when needed	Systematic tracing	No tracing performed
Did your project have traceability from requirements to design?			
Did your project have traceability from requirements to source code?			
Did your project have traceability from requirements to test cases?			

If yes, did requirements traceability ease/support collaboration between multi-site project teams in the following situations? On the other hand, how expensive was it to ensure requirements traceability?	**Very helpful**	**helpful**	**Not helpful**		**Very expensive**	**expensive**	**Not expensive**
Change impact analysis							
Implementation of requirements changes							
Consistency checking							
Acceptance testing							

5 Synchronization Needs and Tool Support

Synchronization is the dynamic aspect of project management: coordination and communication. While project planning and process definition aim at structuring future activities, good synchronization deals with adequate feedback among collaborators on project and task progress. Often this feedback needs some translation between developers, management, and customer points of view.
In normal cases such feedback supports progress reporting and progress evaluation, in problem cases the feedback means adequate escalation of the problem for finding a solution.

5.1 Synchronization

The purpose of this section is to identify project needs for synchronization, synchronization challenges in distributed projects, and the support available and desired.

5.1.1 Did you experience the following synchronization activities as challenges in your reference project?

Synchronization activities	Very frequently a problem	Often a problem	Seldom a problem	Not a problem
Task/project progress reporting				
Task/project progress evaluation				
Escalation of a problem for finding a solution				

Please add up to 3 main problems with synchronization activities:

5.1.2 At points in the project where synchronization is an important success factor, how did you ensure synchronization in your project?

Synchronization approaches	Used very often	Used sometimes	Used seldom	Used in case of ad-hoc escalation of a problem	Not used
Co-located workshops					
Distributed workshops (video-conferencing)					
Task/project progress evaluation (used costs)					
Collaboration platform					
Telephone conference					
E-Mail					
Other (please specify):					

For future projects: Based on your experience, what activities would you suggest for ensuring sufficient synchronization? List up to 5 activities, such as risk management, team-building, etc.

6 Support Center Project Management (SC PM) Services and Tools

The goal of the following questions is to gather feedback of the services provided by the SCPM.

6.1 SCPM Services

6.1.1 The list below contains an excerpt of the services provided by the SCPM.

Which services of the SCPM do you know about?
(Please check with an “x”)
How often did you already use these services?
(Please write the number in the cells of the last column)

SC PM services	**I know the service**	**I already used that service X times**
Enterprise Project Management (MS Project Server)		
PM-Tool Consulting		
PM Certification		
Function Point Analysis		
PMO support for your project		
PM Trainings and Workshops		
Other: *(please specify):*		

6.1.2 What are the main areas for improvement of support provided by SC PM?

Improvement focus	More support needed	Existing support is sufficient
More training on project management in highly distributed projects		
Process support for distributed projects		
Support for PM tool selection in distributed projects		
Training in usage of PM tools		
Other: *(please specify):*		

6.1.3 Whom would you contact if you needed support for collaboration topics?

Preferred contacts for collaboration topic	My first choice	often	seldom	never
Experienced person in your environment				
Interest/Expert Nets				
PSE KB				
PSE QM				
SBS (hotline)				
Support Center Configuration Management				
Support Center Project Experience				
Support Center Project Management				
Support Center Windows				
Other: *(please specify):*				

Please note the ending time: _____

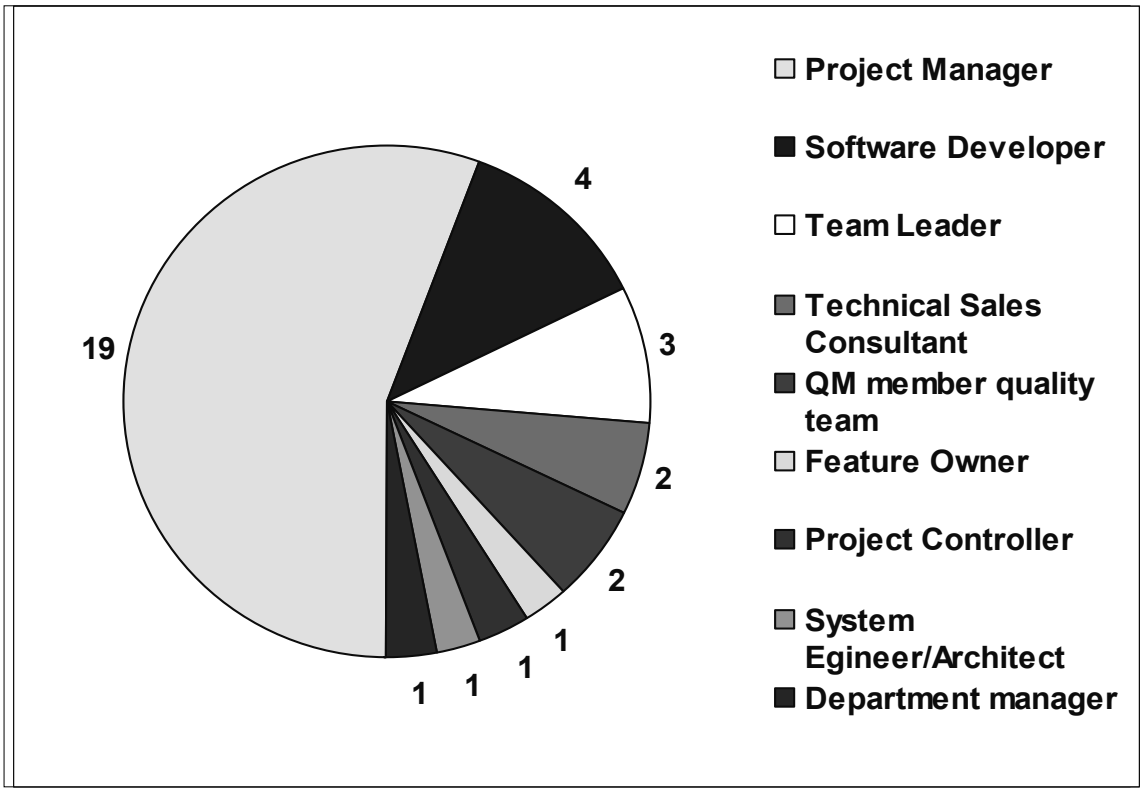
Thank you for taking your time to help improve the SC PM service for project managers and participants.
If you want to receive the analysis results of the study, make sure to provide your e-mail address.

APPENDIX B

Statistics of the questionnaire

I) Background: Role

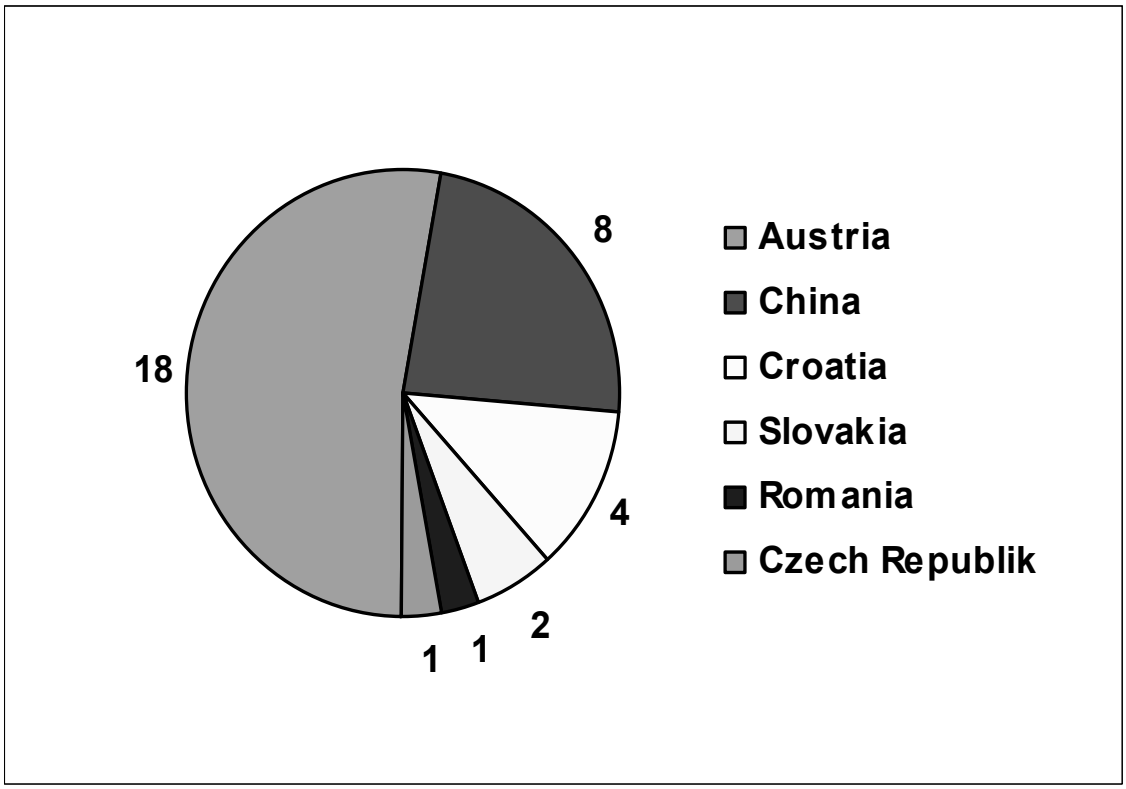
Main roles of respondents in their reference project:
The respondents have the following 9 different roles in their project.
55% of the respondents are project manager.



I) Background: Country

Countries of respondents:

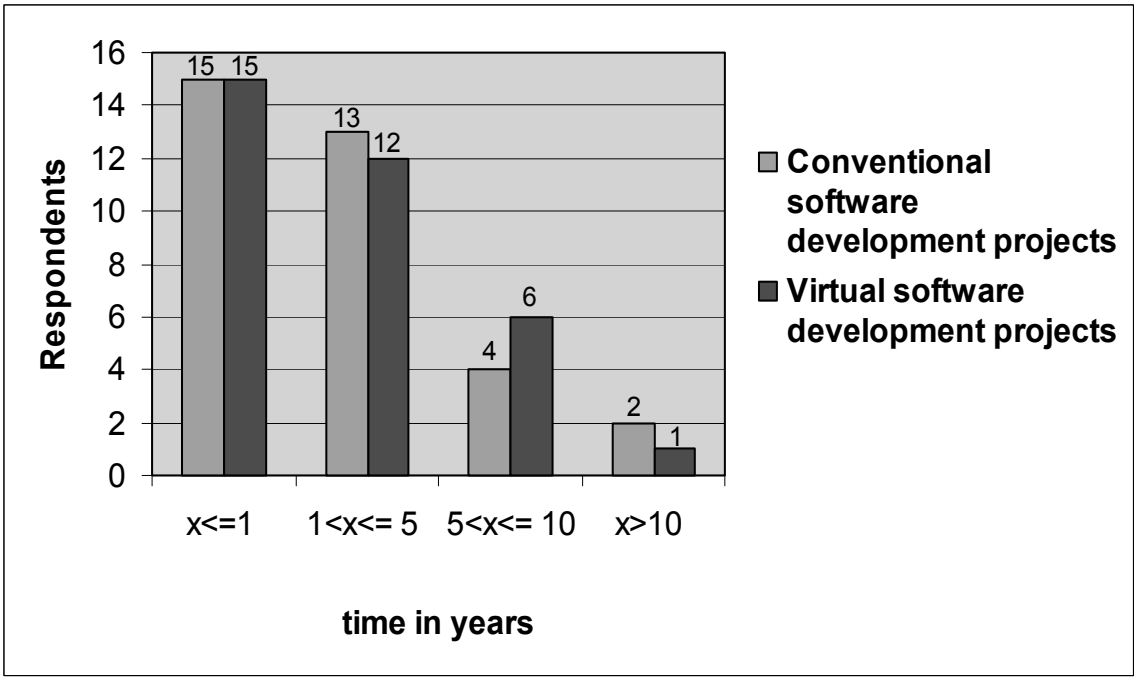
The departments of respondents are in the following 6 different countries.



I) Experience: Project management Experience

Experience in project management measured in years:

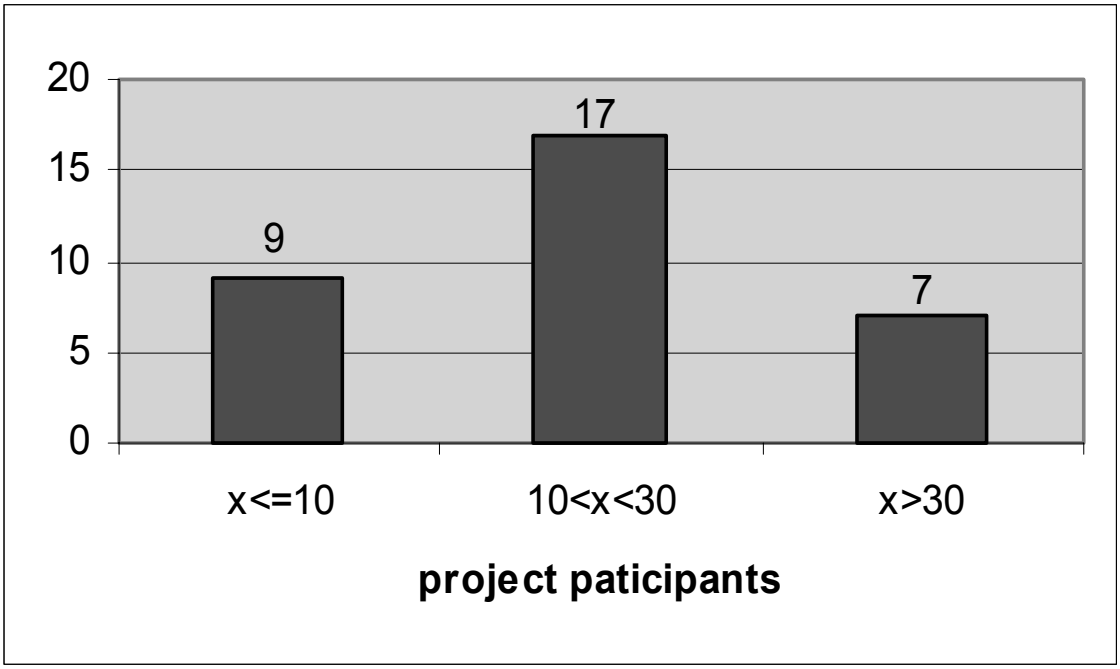
The project experience in virtual as in conventional projects of the respondents is predominately in-between 1 to 5 years



II) Characteristics of the referenced projects: Participants

Number of project participants:

Most referenced projects have up to 30 participants.

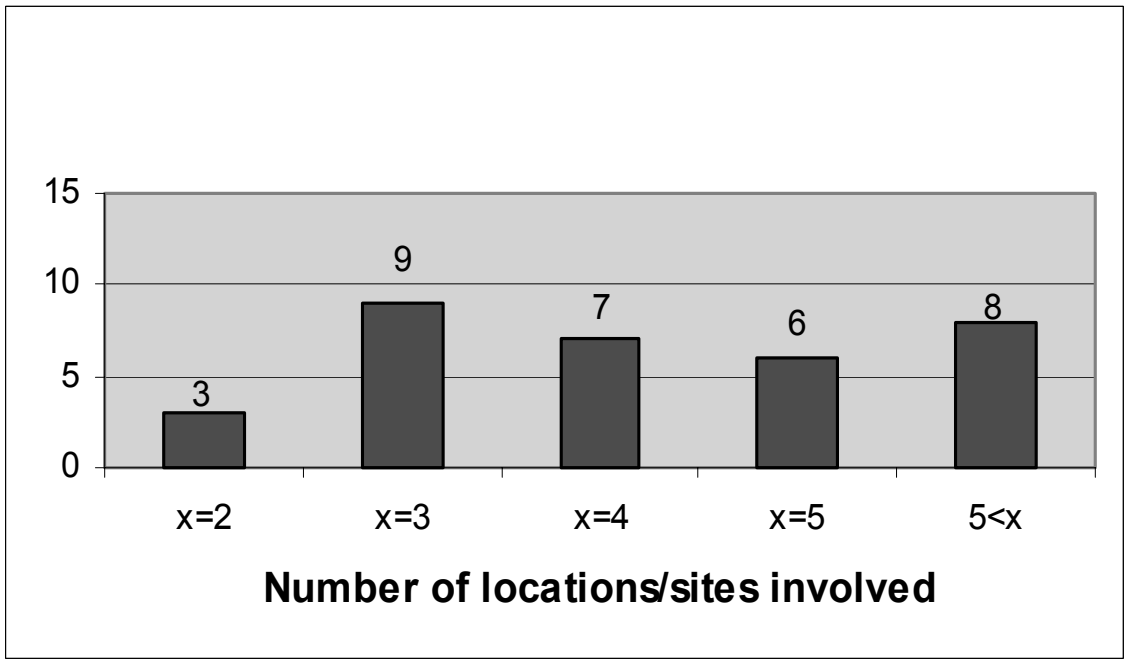


Note: classification is not based on Siemens standards

II) Characteristics of the referenced projects: Locations/sites

Number of locations/sites involved in referenced projects:

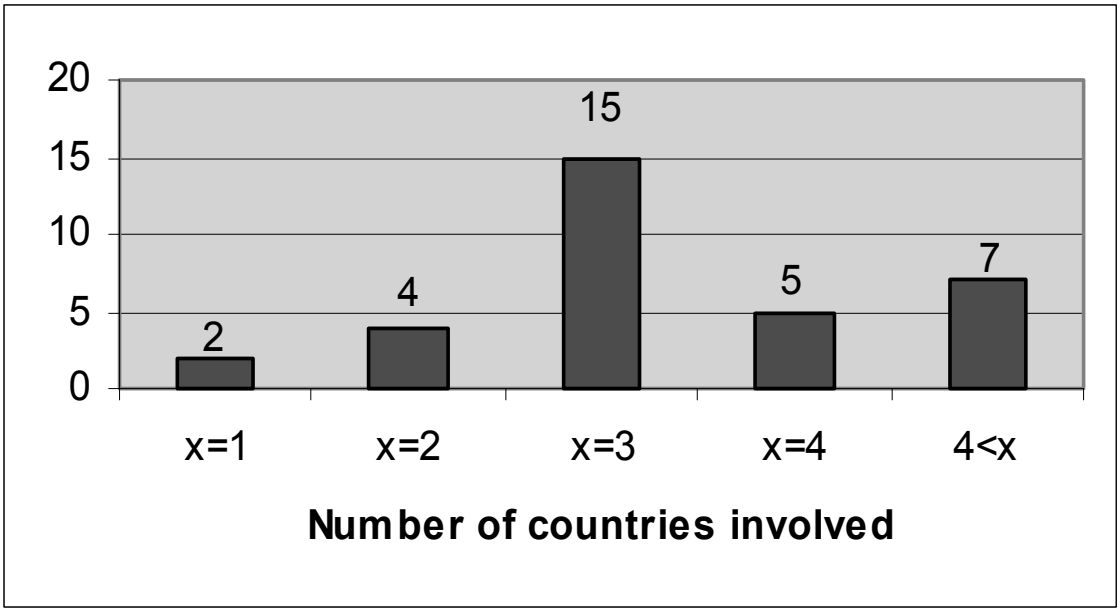
The numbers of involved locations in referenced projects differ predominately up to 5 locations.



II) Characteristics of the referenced projects: Countries

Number of countries involved in referenced projects:

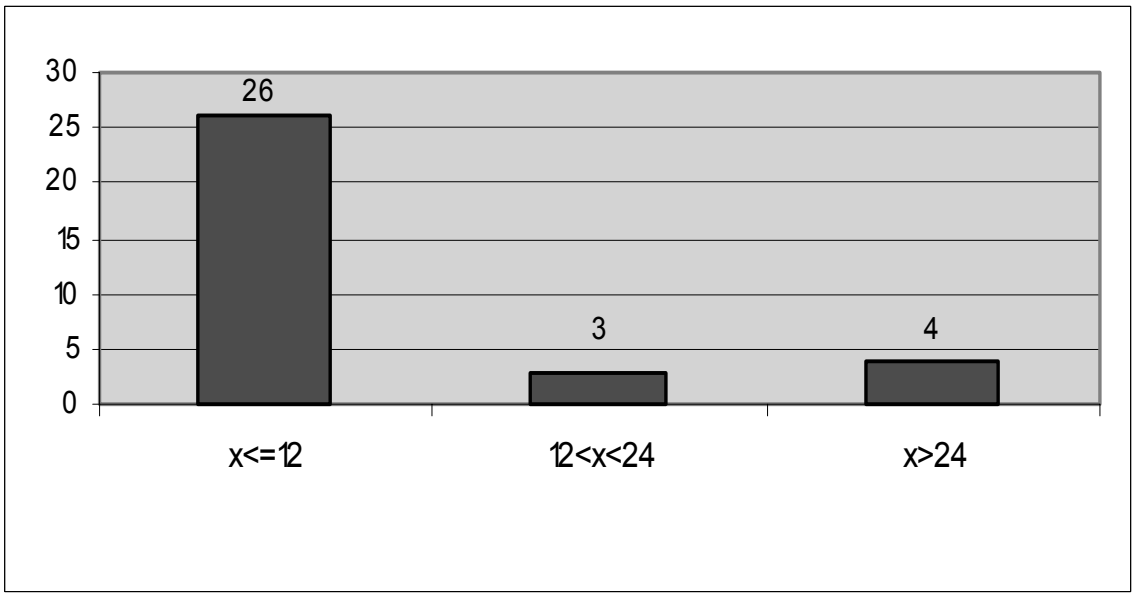
More than 60% of referenced distributed projects have up to 3 countries involved



II) Characteristics of the referenced projects: Project duration

Project duration of referenced projects:

Nearly 80% of referenced projects have a duration of up to 12 month.

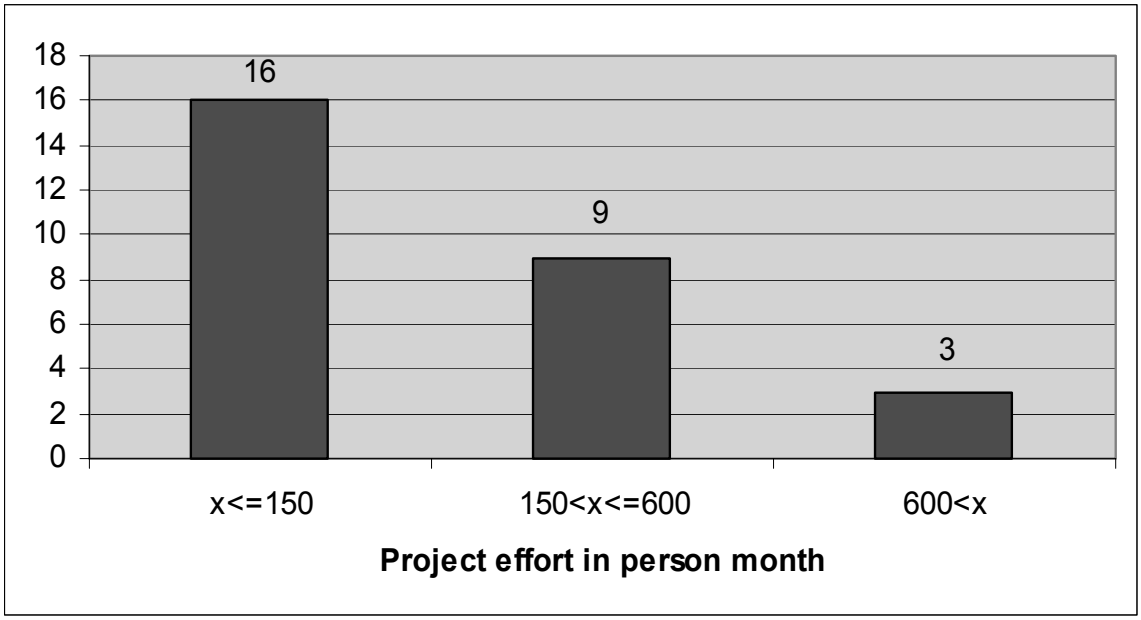


Note: classification is not based on Siemens standards

II) Characteristics of the referenced projects: Project effort

Project effort of referenced project:

Nearly 50% of referenced projects have an effort in an amount of up to 150 person month. Another nearly 30% cover 150 to 600 person months.

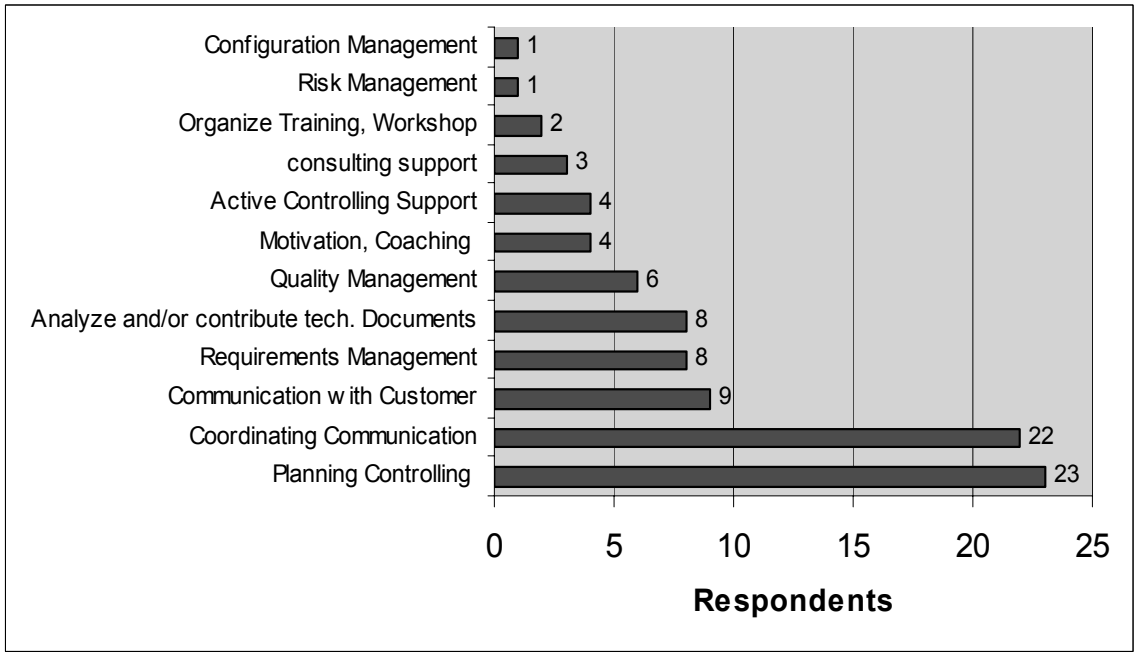


Note: classification is not based on Siemens standards

II) Characteristics of the referenced projects: Project Management Activities

Main responsibilities regarding project management activities of respondents:

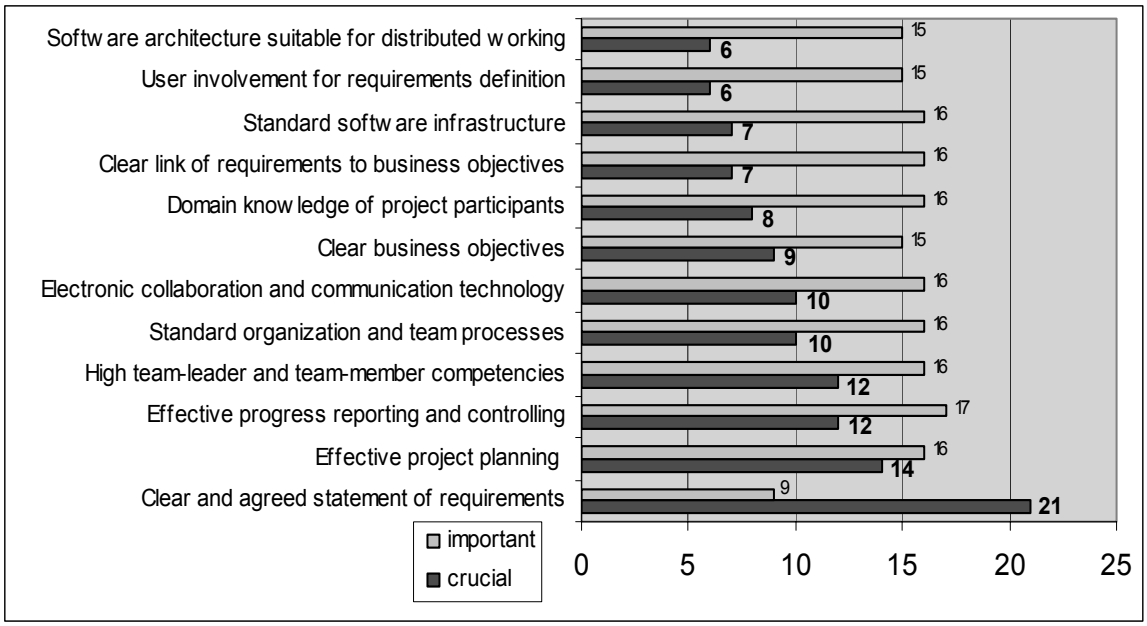
The main activities of respondents in their projects are planning and controlling respectively coordinating and communicating



II) Characteristics of referenced project: Project success factors

Potential project success factor (sorted by "crucial"):

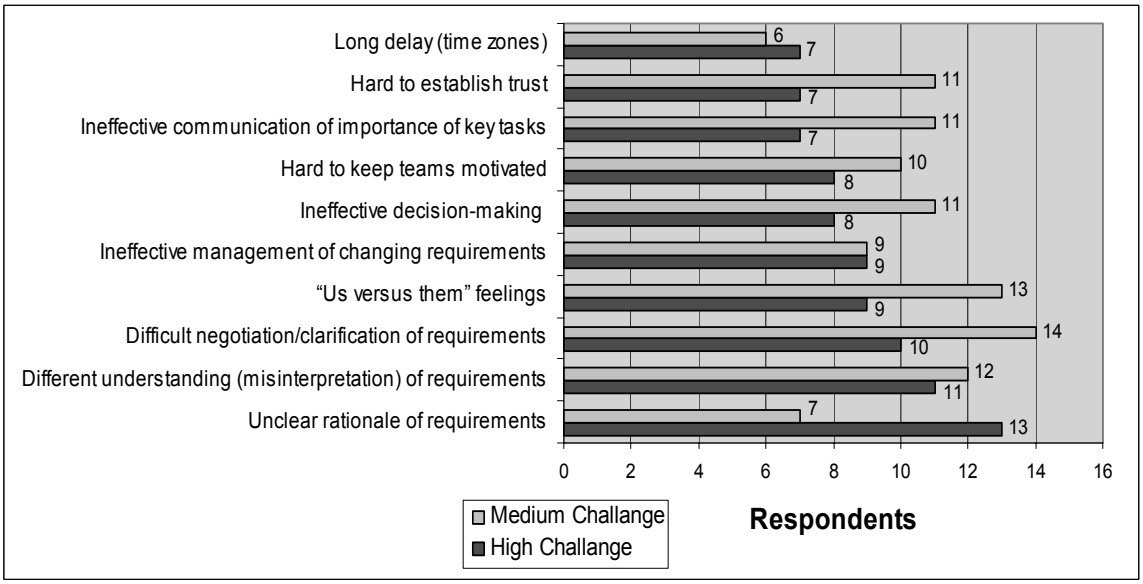
Identified most crucial (and important) project success factors are "clear and agreed statement of requirements" followed by "effective project planning"



II) Characteristics of referenced project: Project Challenges

Top 10 potential problems in referenced distributed projects sorted by „High Challenges":

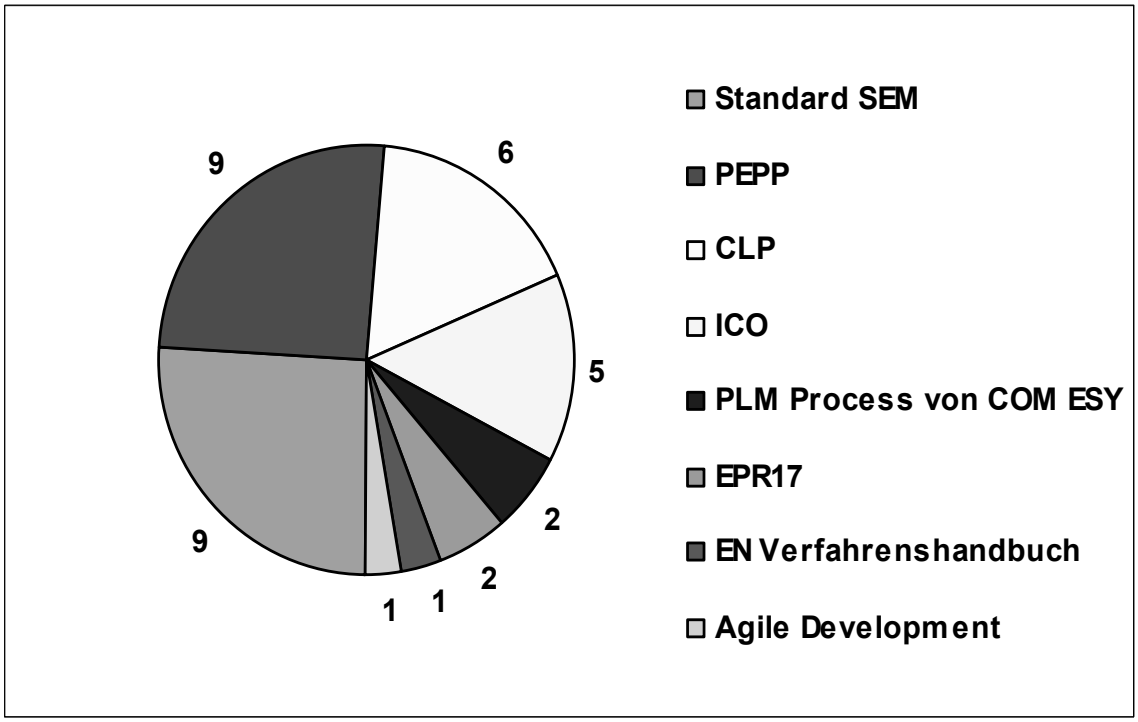
The identified main problems in referenced projects are concerns of requirements.



III) Development Process & PM-Activities: Process

Processes used in referenced projects:

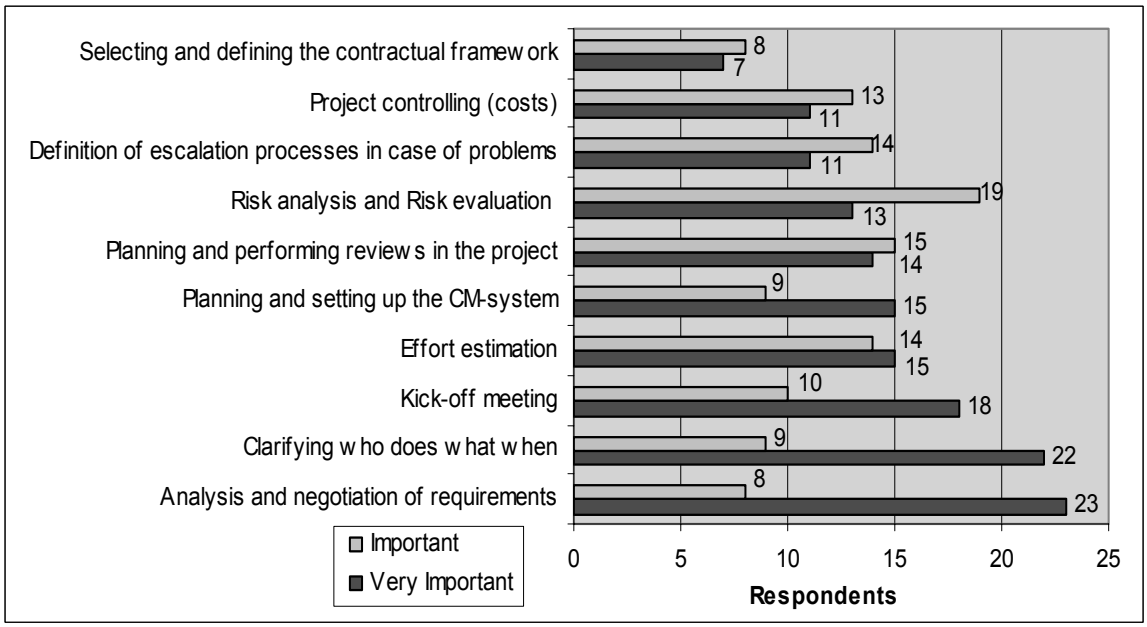
StdSEM and PEPP are the most used processes in referenced projects



III) Development Process & PM-Activities: Project management activities

Top 10 project management activities of referenced projects sorted by "very important":

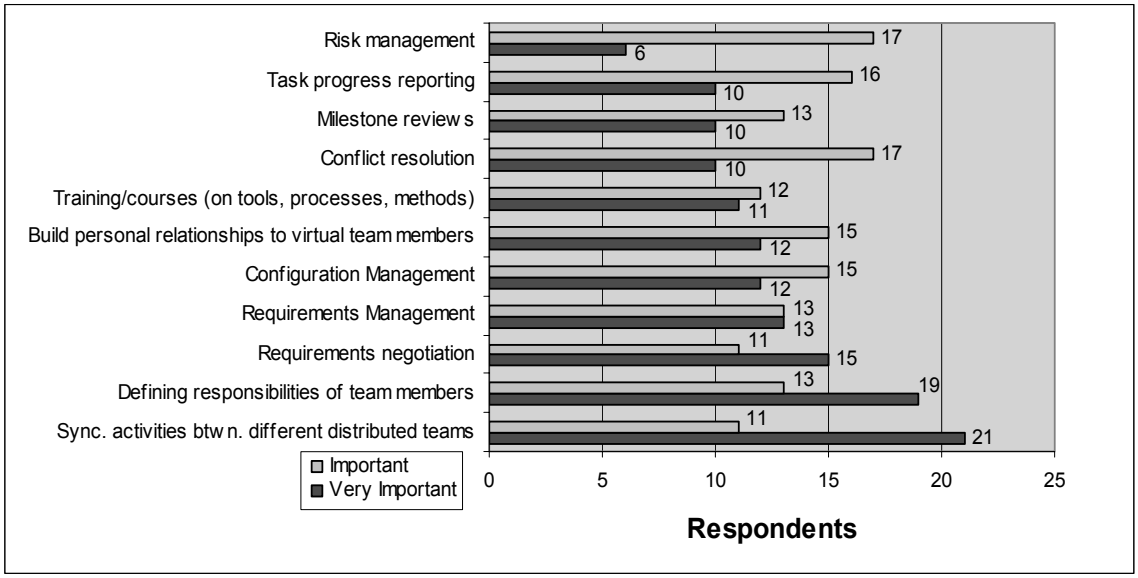
"Analysis and negotiation of requirements" is considered as most important activity followed by assigning responsibilities and doing "kick-off meetings".



IV) Collaboration Needs and Tool Support: Collaboration Activities

Importance of Collaboration Activities sorted by "very important":

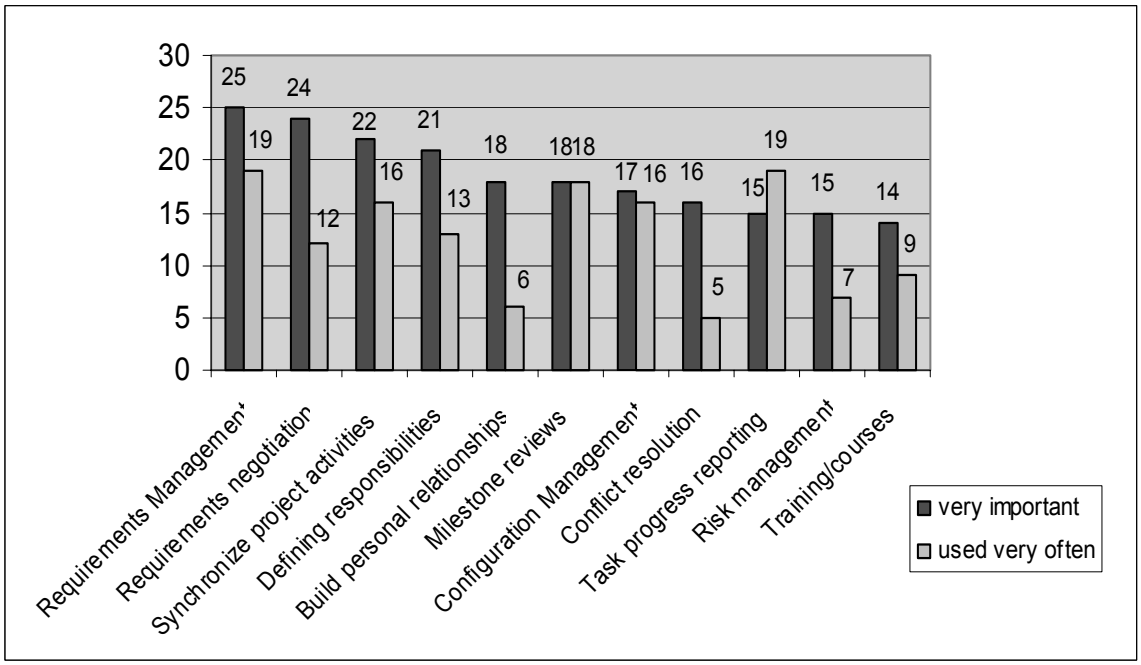
For inter-working in distributed projects synchronization activities between different teams and defining responsibilities of team members is identified as a very important fact.



IV) Collaboration Needs and Tool Support: Collaboration activities

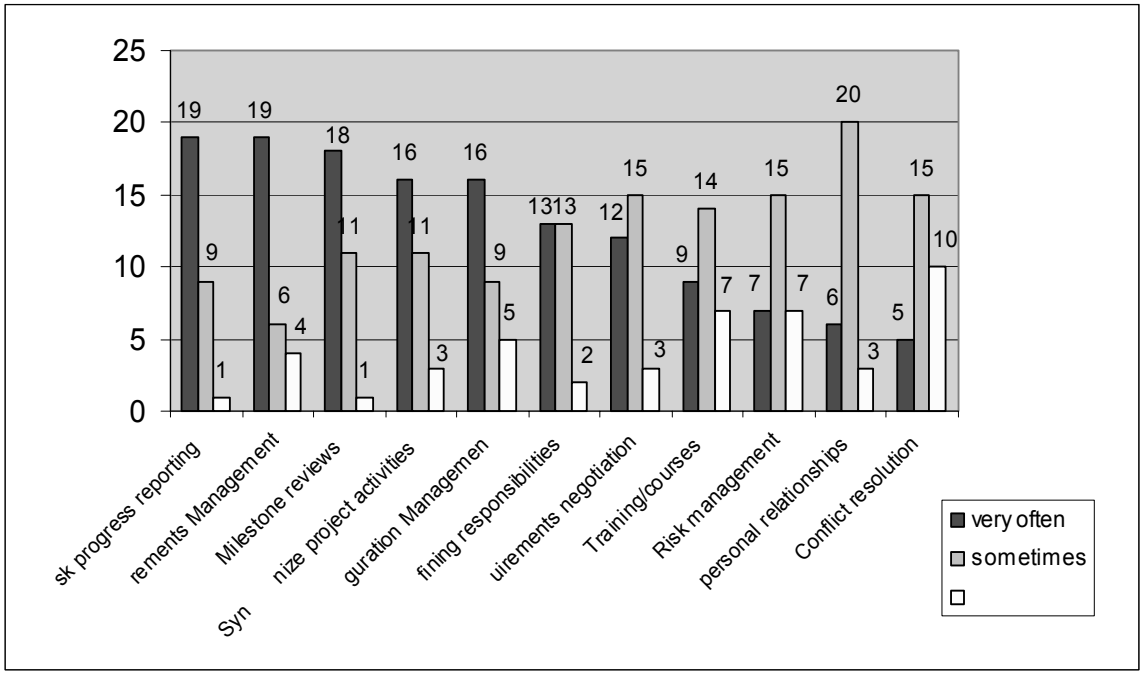
Importance of collaboration activities vs. frequently use of this activities sorted by "very important" vs. "very often":

An interesting investigation is that app. 50% of respondents mind that paying attention for building personal relationship and for conflict resolution is very important but only app. 15% handle this very often.



IV) Collaboration Needs and Tool Support: Frequently use of collaboration activities

How frequently are the following activities used in the referenced project?:
Task progress reporting, requirements management and milestone reviews are done very often (often mandatory when following process). Building personal relationships and doing conflict resolution is only done sometimes or hardly.



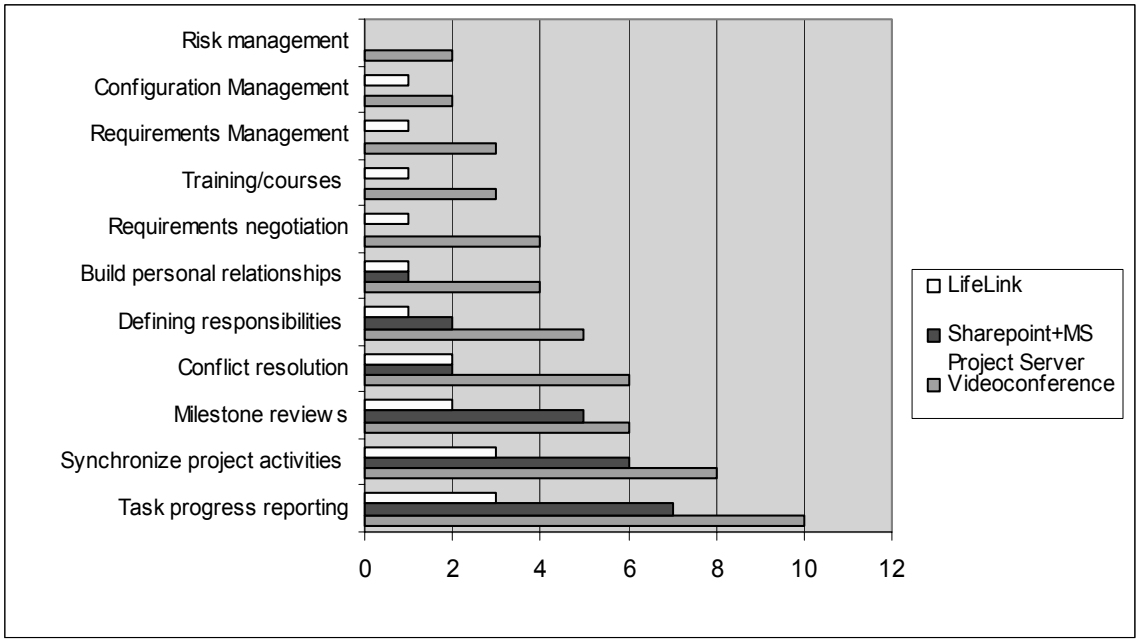
IV) Collaboration Needs and Tool Support: Usage of tools 1

Which tool is used for which particular task:
The predominately used tools for handling PM-tasks are e-mail, telephone, Word and Excel. The frequency is shown in diagram.

IV) Collaboration Needs and Tool Support Usage of tools 2

Which tool is used for which particular task:

Collaboration Tools like Life-Link or Share-Point-Services plus MS Project Server are used very seldom. The frequency is shown in diagram.



IV) Collaboration Needs and Tool Support: Usage of tools 3

Which tool is used for which particular task:

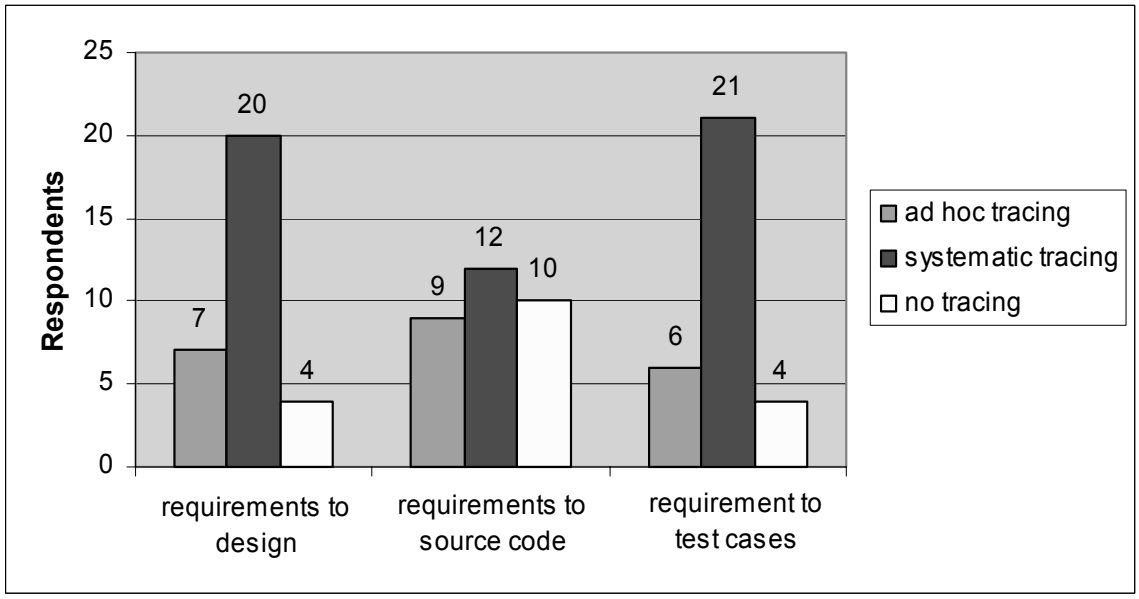
Tools like: “Wiki“, “Requisite Pro“ or “Lotus Notes“ are used very seldom or are even not known.

An interesting investigation is that many respondents gave a remark in addition that regular meetings or personal face to face communications are tried to hold when it’s possible.

IV) Collaboration Needs and Tool Support: Requirements Traceability 1

Does project have traceability from requirements to i) design, ii) source code, iii) test cases:

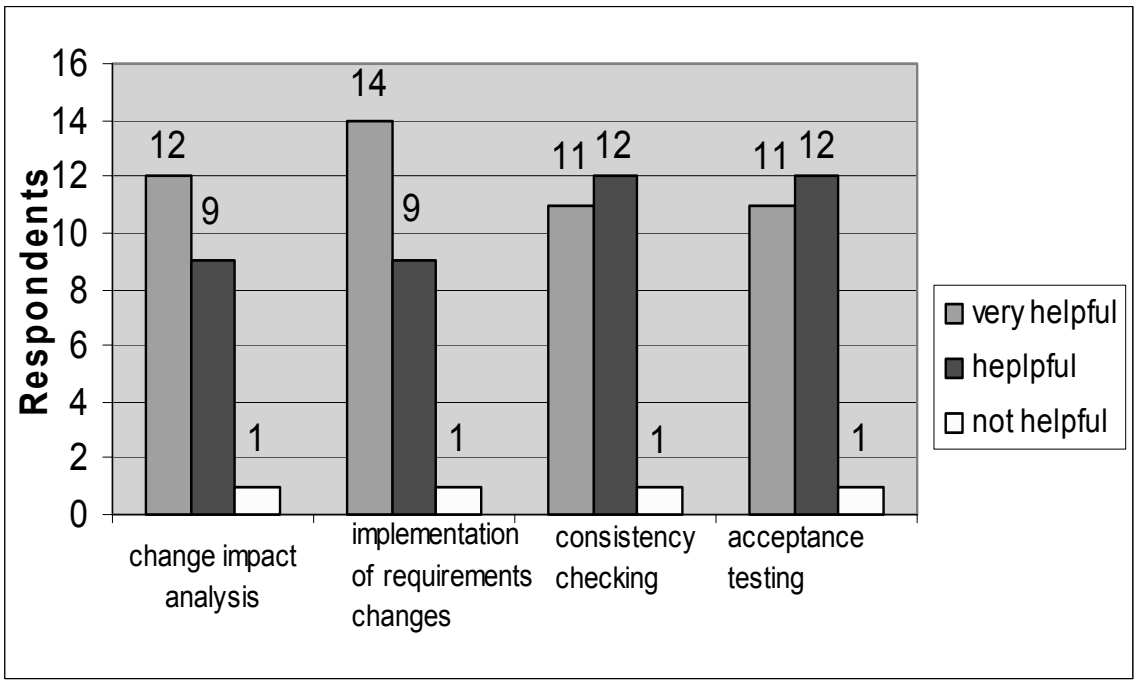
In all cases is to see that projects have predominately systematic tracing.



IV) Collaboration Needs and Tool Support: Requirements Traceability 2

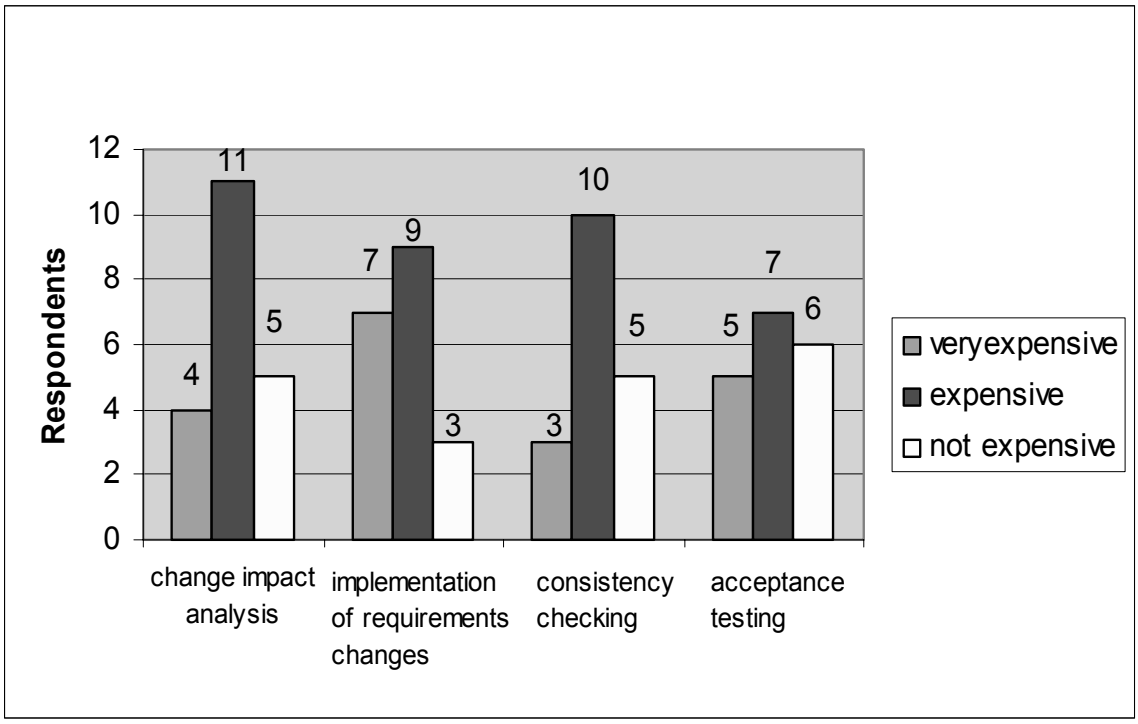
Does requirements traceability ease/support collaboration between multi-site project teams:

Requirements traceability is in fact (very) helpful in multi-site project teams



IV) Collaboration Needs and Tool Support: Requirements Traceability 3

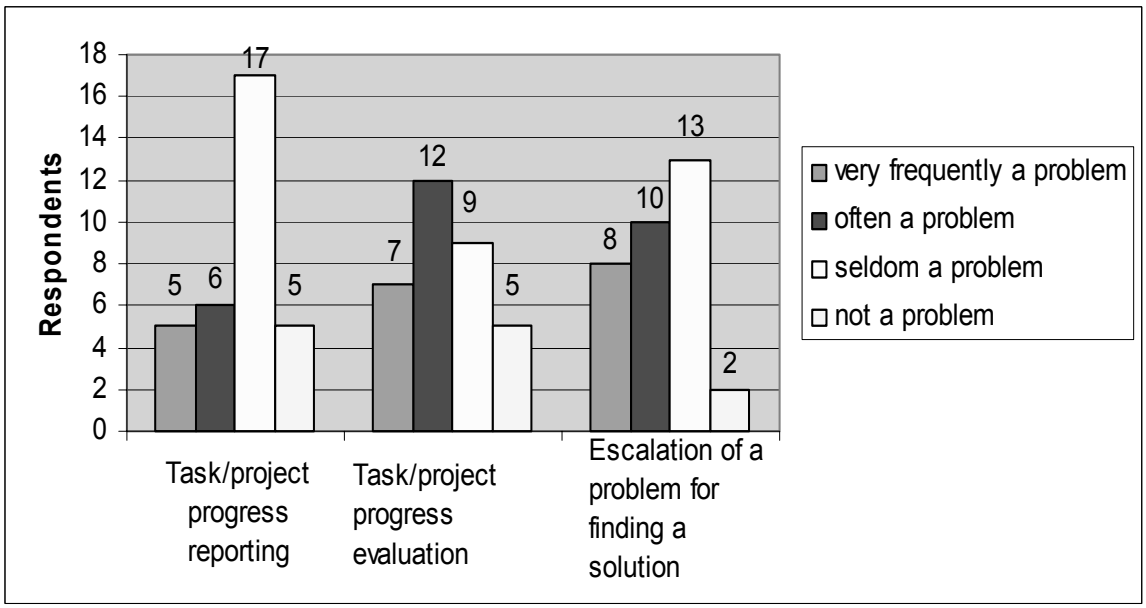
How expensive is it to ensure requirements traceability in the points mentioned in diagram:



V) Synchronization Needs and Tool Support: Synchronization activities

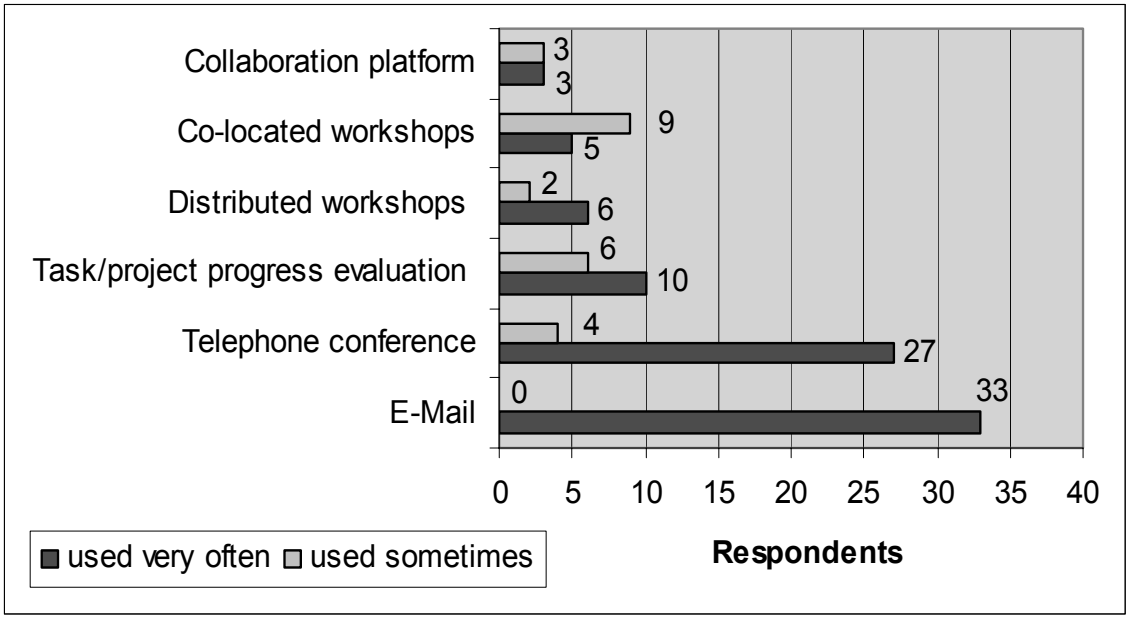
Synchronization activities asked as challenges:

Task/project progress evaluation is more often a problem as task/project reporting.



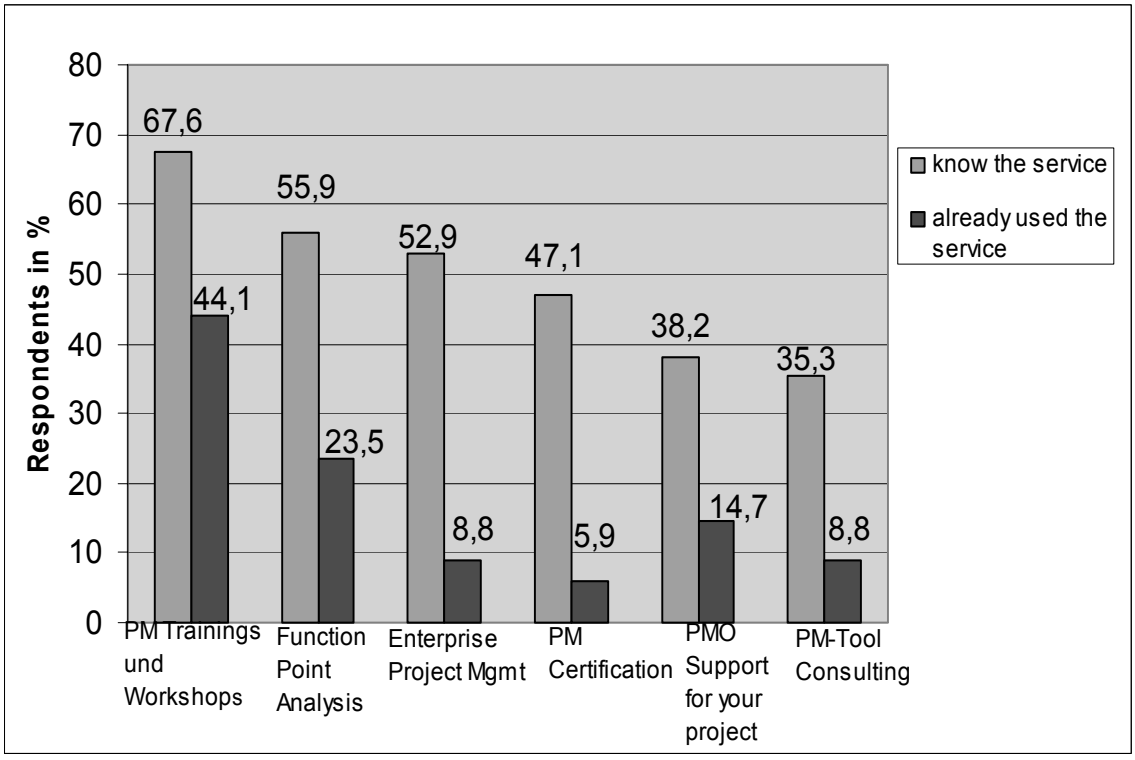
V) Synchronization Needs and Tool Support: Synchronization assurance

Approaches to ensure synchronization sorted by "used very often":
Most used method to synchronize is writing e-mails followed by telephone conferences. The use of collaboration platforms is obviously not popular.



VI) Support Center Project Management (SC PM) Services and Tools: SC PM Services

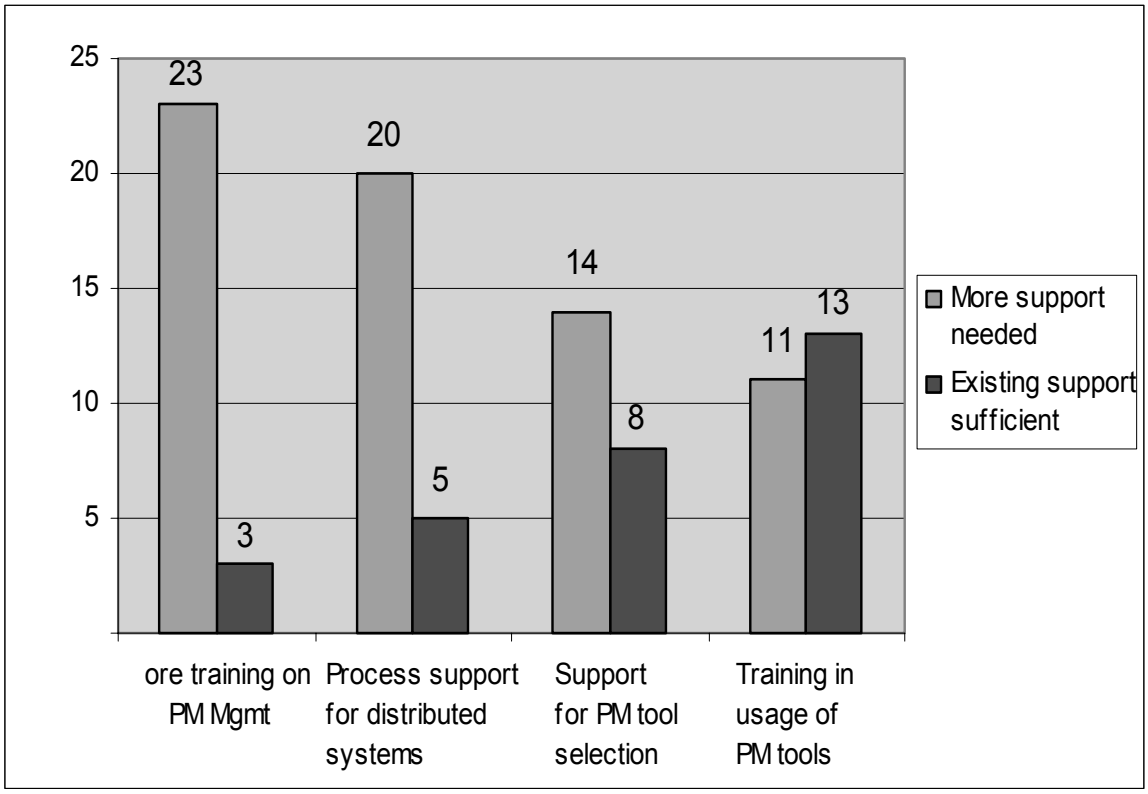
Which services of SC PM are known and which are used (Results are schown in %):
PM-Training and Workshop is well known. But PM-Tool Consulting is neither well known nor often used.



VI) Support Center Project Management (SC PM) Services and Tools: Support

Existing support sufficient vs. more support needed:

Obviously more support in training on project management and for handling distributed systems is required.



APPENDIX C:

Examples for Project Management Tools and Techniques Definitions

sorted by alphabetic order:

Name of the tool or technique	Definition
Activity list	All activities that will be performed on the project. Organized as an extension to the WBS to help ensure that it is complete, and that it does not include any activities that are not required as part of the project scope.
Baseline plan	The initial approved plan to which deviations will be compared as the project proceeds.
Bid documents	A set of documents issued for purposes of soliciting bids in the course of the acquisition process.
Bid/seller evaluation	Formal review and analysis of response to determine supplier's ability to perform the work as requested.
Bidders conferences	(also called contractor or pre-bid conferences) Meetings with sellers prior to preparation of a proposal. Used to ensure that all prospective sellers have a clear, common understanding of the procurement
Bottom-up estimating	This technique involves estimating the cost of individual activities or work packages, then summarizing or rolling up the individual estimates to get a project total.
Cause and effect diagram	Also called Ishikawa diagrams or fishbone diagrams, which illustrate how various factors might be linked to potential problems or effects.
Change request	Form to log, assess and agree on, before a change to the project can be made. Changes may affect the scope, quality, time and/or cost of the project and/or other planned aspects of the project.
Client acceptance form	Form to be signed by the person or organization for whom a project is implemented
Communication plan	A statement of project stakeholders' communication and information needs
Configuration review	A check to ensure that all deliverable items on a project conform with one another and to the current specification.
Contingency plans	A plan that identifies alternative strategies to be used to ensure project success if specified risk events occur.
Control charts	Graphic displays of the results, over time and against established control limits, of a process. They are used to determine if the process is "in control" or in need of adjustment.
Cost/benefit analysis	The analysis of the potential costs and benefits of a project which allows comparison of the returns from alternative forms of investment.
Critical chain method & analysis	Analysis of the task network to determine the longest path considering task constraints combined with resources constraints and the management of that path.
Critical path method & analysis	A network analysis technique used to predict project duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float).
Customer satisfaction surveys	Surveys used to evaluate customer satisfaction.
Database for cost estimating	An organized body of related information for cost estimating
Database of historical data	An organized body of historical data
Database of lessons learned	An organized body of information on lessons learned, for the purpose of improving future performance.

Name of the tool or technique	Definition
Database of risks	An organized body of information on risks
Database or spreadsheet of contractual commitment data	An organized body of information on all obligations or commitments that pledge actions of project participants or payment of goods or services.
Decision tree	A diagram that describes the implications of choosing one or another of the available alternatives. It incorporates probabilities or risks and the costs or rewards of each logical path of events and future decisions.
Earned value	A measure of the value of work performed so far. Earned value uses original estimates and progress-to-date to show whether the actual costs incurred are on budget and whether the tasks are ahead or behind the baseline plan.
Electronic timesheet	Timesheet that can be fill via internet or an intranet
Feasibility study	The methods and techniques used to examine technical and cost data to determine the economic potential and the practicality of project applications.
Financial measurement tools	Techniques to evaluate the financial performance of project eg. ROI, NPV, Pay-back, etc.
Gantt chart	A graphic display of schedule-related information. Activities or other project elements are listed, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
Graphic presentation of risk information	Graphical methods to represent risk information.
Kick-off meeting	A workshop type meeting in which the principle stakeholders and participants in the project are briefed on the goals and objectives of the project, how it will be organized, etc.
Learning curve	A concept that recognizes the fact that productivity by workers improves as they become familiar with the sequence of activities involved in the production process.
Lesson learned/post-mortem	A tool to learn from the process of performing the project. Lessons learned may be identified at any point. Also considered a project record.
Life Cycle Cost ("LCC")	The total cost of a system or facility over its full life, including the cost of development, acquisition, operation, support and disposal.
Milestone planning	A summary-level schedule that identifies the major milestones, which are significant events in the project, usually completion of a major deliverable.
Monte-Carlo analysis	A technique that performs a project simulation many times to calculate a distribution of likely results.
Network diagram	(Task network) Any schematic display of the logical relationships of project activities. Often referred to as a PERT or PDM or CPM chart.
Parametric estimating	An estimating technique that uses a statistical relationship between historical data and other variables (e.g. square footage in construction, lines of code in software development) to calculate an estimate.
Pareto diagram	A histogram, ordered by frequency of occurrence, that shows how many results were generated by each identified cause.
PM software for cost estimating	Use of a project management software for cost estimating.

Name of the tool or technique	Definition
PM software for monitoring of cost	Use of a project management software for monitoring of cost
PM software for monitoring of schedule	Use of a project management software for monitoring of schedule
PM software for multi-project scheduling/leveling	Use of a project management software scheduling and leveling on multiple projects.
PM software for resources leveling	Use of a project management software for resources leveling.
PM software for resources scheduling	Use of a project management software for resources scheduling
PM software for simulation	Use of a project management software for developing alternatives schedules, to simulate risk events or other circumstance.
PM software for task scheduling	Use of a project management software for task scheduling.
Probabilistic duration estimate (PERT Analysis)	Method using durations that are computed by a weighted average of optimistic, pessimistic, and most likely duration estimates.
Product Breakdown Structure	(Also called bill of materials) Breakdown of the deliverable into the components of the final product.
Progress report	Report on the partial completion of a project, or a measure of same. Also, the act of entering progress information for a project.
Project charter	A document consisting of a mission statement, including background, purpose, and benefits, a goal, objectives, scope, assumptions and constraints.
Project communication room (war room)	A central location where vital project information is displayed for all to see. Sometimes referred to as a War Room.
Project Web site	The information concerning the project is made available via a website.
Quality function deployment	Also referred to as the House of Quality. A method for translating customer needs into product/service technical requirements for design, development, implementation, and delivery of a product.
Quality inspection	An inspection carried out to determine whether or not a deliverable or product, whether intermediate or end product, meets the specified quality criteria.
Quality plan	A document setting out the specific quality practices, resources and sequence of activities relevant to a particular product, service, contract or project.
Ranking of risks	Indicate the overall risk position by comparing the risk scores. It can be used to assign resources to projects, to make a cost-benefit analysis or to support a recommendation for initiation, continuation, or cancellation.
Re-baselining	Development of a revised baseline plan. Re-baselining is required in response to changed contract requirements, funding changes, change in the project's objectives, etc. Re-baselining should only be undertaken with justification and the proper approvals.
Requirements analysis	An analysis of measurable customer wants and needs.

Name of the tool or technique	Definition
Responsibility assignment matrix	A structure that relates the project organization structure to the work breakdown structure to help ensure that each element of the project's scope of work is assigned to a responsible individual.
Risk management documents	Documents to record various information relative to risk identification or risk mitigation measure, etc.
Scope statement	A documented description of the project's outputs or deliverables.
Self directed work teams	Teams whose members are sufficiently motivated and capable, and knowledgeable of their project objectives, that they are able to perform under self-supervision, or with minimal management supervision.
Stakeholders analysis	Tool to help identification of stakeholders and the analysis of the needs of the various stakeholders.
Statement of work	A narrative description of the work to be performed
Team building event	An event organised to influence a group of diverse individuals, each with their own goals, needs, and perspectives, to work together effectively for the good of the project such that their team will accomplish more than the sum of their individual efforts could otherwise achieve.
Team member performance appraisal	Technique or template to evaluate project team members, can be linked to the process by which the project team or team members receive recognition for their accomplishments.
Timesheet (paper form)	Uniform system of time tracking for work accomplished on the project. The timesheet system can be used for learning.
Top-down estimating	The preparation of a cost estimate by using judgment and experience to arrive at an overall total amount, usually done by an experienced estimator or manager making a subjective comparison of the project with similar previous projects.
Trend chart or S-Curve	Graphic display of cumulative costs, labour hours, percentage of work, or other quantities, plotted against time. (PMBOK Guide)
Value analysis	An activity devoted to optimizing cost performance. It identifies the required functions of an item, establish values for those functions and provide the functions at the lowest overall cost without loss of performance. (Wideman)
Work authorization	A form to authorize work before it is performed on the project.
Work Breakdown Structure	A deliverable-oriented grouping of project elements that organizes and defines the total work scope of the project. Each descending level represents an increasingly detailed definition of the project work. (PMBOK Guide)

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William Leventon is a New Jersey–based freelance writer who frequently covers the medical device and diagnostic industry. Illustration by Hannah Gal/Getty Images.
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14 Glossary/Abbreviations

Close Project [Process]:

The process of finalizing all activities across all of the project process groups to formally close the project or phase.

Collaboration:

“Collaboration is the process wherein Units work together to achieve outcomes for shared stakeholders, quicker and more cost effectively than if they worked on their own, without having to change the "how" codes of any of the participating Units”[wikipedia2007].

“Collaboration is ideal when Units do not have sole control of the required resources to succeed or do not want to bear all the risks associated with sole control of resources”[wikipedia2007].

Collaboration-Tool:

A Collaboration Tool or Collaboration Software is also called Groupware and is used to support the inter working of groups over time and spatial distances.

Collaborative software is software designed to help people involved in a common task achieve their goals. Collaborative software is the basis for computer supported cooperative work (CSCW)

Such software systems as email, calendaring, text chat, Wiki belong in this category.

An emerging category of computer software, a collaboration platform is a unified electronic platform that supports synchronous and asynchronous communication through a variety of devices and channels.

Groupware can be divided into three categories depending on the level of collaboration—communication tools, conferencing tools and collaborative management (Co-ordination) tools [wikipedia2007].

Communication:

A process through which information is exchanged among persons using a common system of symbols, signs, or behaviours.

Communication Management Plan [Output/Input]:

The document that describes: the communications needs and expectations for the project; how and in what format information will be communicated; when and where each communication will be made; and who is responsible for providing each type of communication. A communication management plan can be formal or informal, highly detailed or broadly framed, based on the requirements of the project stakeholders. The communication management plan is contained in, or is a subsidiary plan of, the project management plan.

Communications Planning [Process]:

The process of determining the information and communications needs of the project stakeholders: who they are, what is their level of interest and influence on the project, who needs what information, when will they need it, and how it will be given to them.

Cost:

The monetary value or price of a project activity or component that includes the monetary worth of the resources required to perform and complete the activity or component, or to produce the component. A specific cost can be composed of a combination of cost components including direct labour hours, other direct costs, indirect labour hours, other indict costs, and purchased price. (However, in the earned value management methodology, in some instances, the term cost can represent only labour hours, without conversion to monetary worth.) See also actual cost and estimate.

CSCW:

CSCW-applications or CSCW-groupware are systems which support the cooperative work of groups by computers.

Customer:

The person or organisation that will use the project's product or service or result.

Duration (DU or DUR):

The total number of work periods (not including holidays or other nonworking periods) required to complete a schedule activity or work breakdown structure component. Usually expressed as workdays or workweeks. Sometimes incorrectly equated with elapsed time. Contrast with effort.

EDV-Systems:
EDV is the German abbreviation for “Elektronische Daten Verarbeitung“. Translated in English it means “electronic data processing“. EDV is the collective term for collecting and recording data processing them by using electronic machines.

EPM:
An Enterprise Project Management (EPM) solution offers the implementation of an information- and communication platform, which additionally supports planning and progress monitoring optimally.

Estimate [Output/Input]:
A quantitative assessment of the likely amount or outcome. Usually applied to project costs, resources, effort, and durations and is usually preceded by a modifier (i.e., preliminary, conceptual, feasibility, order-of-magnitude, definitive). It should always include some indication of accuracy (e.g., ±x percent).

IN:
An Intelligent Network (IN) is a service oriented central system which is attached on an existing telephone-net (e.g.: ISDN). An IN extends a telephone-net with an intelligent component which is a computer based system inter-working with the basic telecommunication-network

Information Distribution [Process]:
The process of making needed information available to project stakeholders in a timely manner.

ISDN:

Integrated Service Digital Network (ISDN) is a circuit switched telephone network system, designed to allow digital transmission of voice and data over ordinary telephone copper wires, resulting in better quality and higher speeds than available with analogue systems. More broadly, ISDN is a set of protocols for establishing and breaking circuit switched connections, and for advanced call features for the user.

IT:
Information technology

Matrix Organization:
Any organizational structure in which the project manager shares responsibility with the functional managers for assigning priorities and for directing the work of persons assigned to the project.

Milestone:
A significant point or event in the project.

Monitor:
Collect project performance data with respect to a plan, produce performance measures, and report and disseminate performance information.

Network planning Technique:

The term network planning technique covers all procedures for the analysis, planning, control and monitoring of expirations on the basis of the graph theory, whereby time, costs, resources and/or resources can be considered. A network plan is the graphic or tabular representation of expirations and dependencies. The network planning technique is in particular applied in the scheduling of projects

The goal of the network planning technique is the planning of the logical relations between the procedures and the temporal situation of the procedures.
The network plan represents the basis for creating communication instruments like a milestone plan, bar graph or production bar graph.

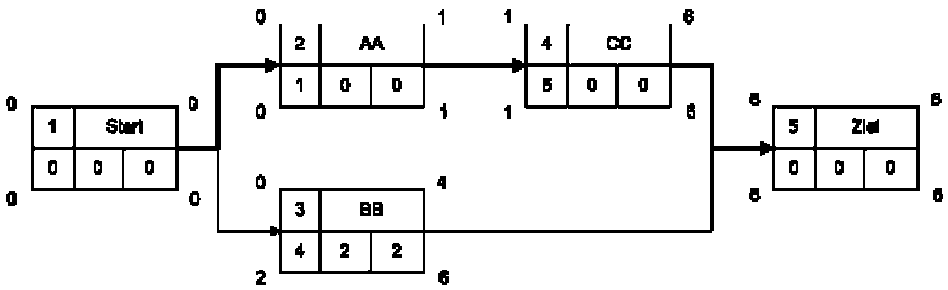
Applying the network planning technique covers the following important topics:

- How long will the whole project last?
- Which risks can arise within the project?
- Which critical activities can retard the entire project, if they do not become finished in time?
- Is the project within the scheduled time, copes it sooner or later?
- If it has to become finished earlier, what is best to do to reach an acceleration with the smallest costs?

The critical path method represents an aid, which serves above all the following purposes:

- The logical connections of a project from the beginning to the end of a project can be represented clearly.
- For all procedures of the project a schedule can be developed with the help of the network planning technique.
- A critical path and resources bottlenecks, which can endanger the adherence to the completion date can be identified easily.
- Network plans form the basis for the project control and date monitoring

The following picture shows an example of a network plan:



There are different kinds and variants of network plans. The following kinds of network plans are differentiated:

- Critical Path Method (CPM)
- Decision Network Plan
- Program Evaluation and Review Technique (PERT)
- Metra Potential Method (MPM)

PEPP:

The Product Engineering Process Plan (PEPP) is a process for product development used by some Siemens Austria departments.

PL:

Sub Project Leader

PM:

Project Management

PMBOK:

The Project Management Body of Knowledge (PMBOK) is an inclusive term that describes the sum of knowledge within the profession of project management. As with other professions such as law, medicine and accounting, the body of knowledge rests with the practitioners and academics that apply and advance it. The complete project management body of knowledge includes proven traditional practises that are widely applied and innovative practises that are emerging in the profession. The body of knowledge includes both published and unpublished material. The PMBOK is constantly evolving.

Prepaid System:

Prepaid telephone calls are a popular way of making telephone calls which allow the caller to control spend and not be tied into ongoing commitments with the telephone operator.

“Prepaid Phone Cards” is a service provided by various telecom companies that sell their service in advance. When you purchase a prepaid phone card, you are paying for long distance connection time in advance. When you make calls using the phone card, the card's value is deducted based on connection fee, duration of connection, surcharges and any maintenance charges associated with the phone card.

Prepaid mobile phones are offered by most mobile phone operators around the world. Typically all the usual mobile phone services are available to prepaid users, except that they have to top up their balance in advance before they can

be used. This is done via a variety of mechanisms - vouchers (commonly called "power cards"), swipe cards, debit and credit cards
(cp. http://en.wikipedia.org/wiki/Prepaid_telephone_calls)

Procedure:
A series of steps followed in a regular definitive order to accomplish something.

Process:
A set of interrelated actions and activities performed to achieve a specified set of products, results, or services.

Product:
An artefact that is produced, is quantifiable, and can be either an end item in itself or a component item. Additional words for products are materiel and goods. contrast with result and service.

Project Communications Management:
Project Communications Management includes the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information. The Project Communications Management processes provide the critical links among people and information that are necessary for successful communications. Project managers can spend an inordinate amount of time communicating with the project team, stakeholders, customer, and sponsor. Everyone involved in the project should understand how communications affect the project as a whole. Project Communications Management processes include:
Communications Planning - determining the information and communications needs of the project stakeholders
Information Distribution - making needed information available to project stakeholders in a timely manner
Performance Reporting - collecting and distributing performance information, including status reporting, progress measurement, and forecasting
Manage Stakeholders - managing communications to satisfy the requirements of, and resolve issues with, project stakeholders.

Project Management Software [Tool]:

A class of computer software applications specifically designed to aid the project management team with planning, monitoring, and controlling the project, including: cost estimating, scheduling, communications, collaboration, configuration management, document control, records management, and risk analysis.

Project Management System [Tool]:

The aggregation of the processes, tools, techniques, methodologies, resources and procedures to manage a project. The system is documented in the project management plan and its content will vary depending upon the application area, organizational influence, complexity of the project, and the availability of existing systems. A project management system, which can be formal or informal, aids a project manager in effectively guiding a project to completion. A project management system is a set of processes and the related monitoring and control functions that are consolidated and combined into a functioning, unified whole.

Project Phase:

A collection of logically related project activities, usually culminating in the completion of a major deliverable. Project phases (also called phases) are mainly completed sequentially, but can overlap in some project situations. Phases can be subdivided into subphases and then components; this hierarchy, if the project or portions of the project are divided into phases , is contained in the work breakdown structure (WBS)

Project Team:

All the project team members, including the project management team, the project manager and, for some projects, the project sponsor.

Project Team Members:

The persons who report either directly or indirectly to the project manager, and who are responsible for performing project work as a regular part of their assigned duties.

PSE:

Program and Systems Engineering. Department of Siemens Austria.

Quality:

The degree to which a set of inherent characteristics fulfils requirements.

Qualitative Risk Analysis [Process]:

The process of prioritizing risks for subsequent further analysis or action by assessing and combining their probability of occurrence and impact.

Resource:

skilled human resources (specific disciplines either individually or in crews or teams), equipment, services, supplies, commodities, materiel, budgets, or funds.

Risk:

An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives.

Role:

A defined function to be performed by a project team member, such as testing, filing, inspecting, coding.

SC PM:

Support Centre Project Management

SEM:

System Entwicklungs Methode. Is a defined process mainly used by Siemens PSE.

Skill:

Ability to use knowledge, a developed aptitude, and/or a capability to effectively and readily execute or perform activity.

Software for Project-Management:

The meaning of software for project-management denotes all software applications which support project-work in general in the context of different project-processes (e.g.: internet platforms respectively project-portals). At this the user is seen as the whole project-team.

Specification:

A document that specifies, in a complete, precise, verifiable manner, the requirements, design, behaviour, or other characteristics of a system, component, product, result, or service and, often, the procedures for determining whether these provisions have been satisfied. Examples are: requirement specification, design specification, product specification, and test specification.

Sponsor:

The person or group that provides the financial resources, in cash or in kind, for the project.

Stakeholder:

Person or organization (e.g., customer, sponsor, performing organization, or the public) that is actively involved in the project, or whose interests may be positively or negatively affected by execution or completion of the project. A stakeholder may also exert influence over the project and its deliverables.

Standard:

A document established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the achievement of the optimum degree of order in a given context.

Task:

A term for work whose meaning and placement within a structured plan for project work varies by the application area, industry, and brand of project management software.

Tool:

Something tangible, such as a template or software program, used in performing an activity to produce a product or result.

Unit:

A Unit can be a person, a family, a team, a business unit, an organisation, a community, a country, or society, which has their own treasured identity and way of working. This identity is built around “how” each unit does work or delivers success

Virtual:

The term „virtual“ mentioned in Webster’s new Collegiate Dictionary, 1977, denotes: “being such in essence or effect though not formally recognized or admitted”.

Virtual Collaboration:

Virtual collaboration comes up if units collaborate result-oriented on common aims in distributed independent locations and are information-technologic networked overcoming the major barriers time, distance and culture.

Work Breakdown Structure (WBS) [Output/Input]:

A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of the project work. The WBS is decomposed into work packages. The deliverable orientation of the hierarchy includes both internal and external deliverables. See also work package, control account, contract work breakdown structure, and project summary work breakdown structure.