Mirja Väänänen

COMMUNICATION IN HIGH TECHNOLOGY PRODUCT DEVELOPMENT PROJECTS

PROJECT PERSONNEL’S VIEWPOINT FOR IMPROVEMENT
MIRJA VÄÄNÄNEN

COMMUNICATION IN HIGH TECHNOLOGY PRODUCT DEVELOPMENT PROJECTS
Project personnel's viewpoint for improvement

Academic dissertation to be presented with the assent of the Faculty of Technology of the University of Oulu for public defence in OP-sali (Auditorium L10), Linnanmaa, on 16 October 2010, at 12 noon
Väänänen, Mirja, Communication in high technology product development projects. Project personnel’s viewpoint for improvement
Faculty of Technology, Department of Industrial Engineering and Management, University of Oulu, P.O.Box 4610, FI-90014 University of Oulu, Finland

Oulu, Finland

Abstract

Product development plays a crucial role in the survival of high technology companies. High technology product development projects typically are multi-technical, multicultural, geographically dispersed, inter-connected and organized in a network of companies. These settings pose extra challenges for communication.

In this qualitative multiple-case study, communication challenges and possible solutions for developing communication were studied. The empirical data were collected from five high technology product development projects. Each project represented a different high technology company operating in the Oulu area, in Finland. Multiple data collection methods were used, including interviews, studying organizations’ internal documents, web-based surveys among project personnel and case-internal focus groups. After studying each of the five cases separately, a cross-case analysis was conducted by the researcher.

The findings of this research show that communication challenges depend on the business role of the company. Efforts to enhance communication should be considered in relation to the business realities of companies. Typical challenges include a lack of communication planning, lack of project personnel’s communication competence and obstacles caused by physical & organizational boundaries.

Possible solutions for developing communication include systematic planning of project communication and defining communication development targets based on internal analyses and the business realities of the company. Data management systems should be set up to enhance the work done and information flows in projects. Another solution is continuous trust building through feedback between the companies participating in the same product development project.

According to the results of this study, companies can direct their efforts when enhancing communication in product development projects. Companies can also utilize the process described in this research to identify their communication challenges and to define communication action plans.

Keywords: communication, information, product development, project management
Acknowledgements

I started as a researcher in the Department of Industrial Engineering and Management (DIEM) at the University of Oulu in 2003 by joining a project aiming to improve project management education and industrial practices in Northern Finland. This research started during this project as I realized the importance of project communication and found interesting methods to study personnel’s viewpoint for improvement.

Writing this dissertation has taken some time. Now that I am writing these last few pages, I notice that there are many people that believed in the completion of my dissertation project much more than I ever did. I feel dearly grateful for the persons involved in this research process.

I would like to thank Dr. Tauno Jokinen, the first supervisor of my dissertation, who was innovative and inspiring and helped me getting started with the research. The second supervisor, Dr. Pekka Belt, has been a marvellous advisor for me. When I started to pull together the pieces of theory and research data, the thesis was like a mosaic with pieces mixed. I only had a vision in my head, but a not clear story in paper. Pekka’s joyfulness and encouraging feedback helped me put the mosaic into a more organized and focused document.

I am especially grateful to Professor Pekka Kess who as a thoughtful manager of the DIEM has provided me the opportunity to work with this thesis. I would also like to thank Professor Esko Alasaarela for technical support in organizing the surveys among the studied companies. In addition, I would like to express my gratitude to the great staff members of DIEM, Professor, Vice Dean Harri Haapasalo, Dr. Matti Möttönen, Dr. Janne Härkönen, researchers Hanna Kropsu-Vehkaperä and Osmo Kauppila and Dr. Pauliina Marjala, for their encouragement, advising discussions and practical tips during this research project.

Special thanks go to the European Union, the city of Oulu, and the companies who financed the original project. In addition, the companies involved in this research also deserve warm thanks for providing me the opportunity to learn and study these phenomena in practice.

I am grateful to the foundations that gave me financial support during my doctoral studies: Tekniikan edistämissäätiö, Oulun yliopiston tukisäätiö, Otto A. Malmin lahjoitusrahasto and Tauno Tönningin säätiö.

I would also like to thank the pre-examinators of my dissertation, Docent, Dr. Kaj Koskinen and Dr. Stina Immonen for their valuable comments and recommendations. Their inputs have significantly improved this thesis.
In addition, I am grateful to certain women who have encouraged me in my technical career. Kaisu Mäkynen, Sonja Ruuskanen, Ulla Säilä have shared their examples of how to be both strong and kind-hearted. I feel privileged knowing persons like you.

To my Mom and Dad, warm thanks for being helpful and supportive during this research project. My lovely sisters, Auli and Jenni, you have always been there for me, thank you. Other closest relatives that I would like to thank include my uncle Kalervo and his family, and my aunt Aila and her family, thank you all for your positive attitude during these years.

I am fortunate for the support from my husband Samppa. His continuous encouragement and patience has been important to me. In addition, for most I am grateful to our son Arttu for being the reason I had the willpower to complete the thesis.

Oulu, September 2010

Mirja Väänänen
## List of abbreviations and definitions

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSQ</td>
<td>Communication Satisfaction Questionnaire</td>
</tr>
<tr>
<td>DSP</td>
<td>Digital Signal Processing</td>
</tr>
<tr>
<td>GSS</td>
<td>Group Support Systems</td>
</tr>
<tr>
<td>HR</td>
<td>Human Resources</td>
</tr>
<tr>
<td>HW</td>
<td>Hardware</td>
</tr>
<tr>
<td>ICA</td>
<td>International Communication Association</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IPMA</td>
<td>International Project Management Association</td>
</tr>
<tr>
<td>NDA</td>
<td>Non-Disclosure Agreement</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PMI</td>
<td>Project Management Institute</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>RF</td>
<td>Radio Frequency</td>
</tr>
<tr>
<td>SW</td>
<td>Software</td>
</tr>
</tbody>
</table>
# Contents

Abstract

Acknowledgements 5

List of abbreviations and definitions 7

Contents 9

1 Introduction 11

1.1 Background and motivation for the study ................................................11
1.2 Objective and scope ................................................................................ 13
1.3 Research approach and methodology ...................................................... 15
1.4 Outline of the thesis ................................................................................ 19

2 Theoretical part 21

2.1 Communication as a multi-faceted process ............................................. 23
2.2 Communication competence ................................................................... 25
2.3 Communication media ............................................................................ 26
2.3.1 Information behavior .................................................................... 28
2.4 Communication in project groups ........................................................... 31
2.4.1 Manager’s role in communication ................................................ 34
2.4.2 Communication culture ................................................................. 37
2.4.3 Intercultural, virtual and technology-aided communication ............. 40
2.5 Auditing organizational communication ............................................... 43
2.6 Theory synthesis ..................................................................................... 46

3 Research process 49

4 Empirical analysis on project communication 59

4.1 Case A ..................................................................................................... 61
4.1.1 Current communication practices .................................................... 62
4.1.2 Communication challenges and best-functioning practices .............. 65
4.1.3 Development targets ....................................................................... 69
4.1.4 Main findings from case A .............................................................. 71
4.2 Case B ..................................................................................................... 75
4.2.1 Current communication practices .................................................... 76
4.2.2 Communication challenges and best-functioning practices .............. 77
4.2.3 Development targets ....................................................................... 81
4.2.4 Main findings from case B .............................................................. 82
4.3 Case C ..................................................................................................... 85
4.3.1 Current communication practices .................................................... 86
4.3.2 Communication challenges and best-functioning practices .............. 88
1 Introduction

1.1 Background and motivation for the study

The product development plays a crucial role for high technology companies. Short product lifecycles, continuous launches of new products, and new technologies are typical for a high technology company in order to survive in its business. Increased speed of new product introductions is critical for the business (Mallick & Schroeder 2005). To a great extent, the business logic is based on functioning product development: succeeding in high technology business requires efficient and effective product development. Product development is the life-blood of a high technology company. (e.g. Barczak 1995, Campbell & Holmes 2004, Mallick & Schroeder 2005).

Product development of a high technology company involves a network of companies and subcontractors. Typically, product development projects are executed in a complex network of organizations (van Echtelt et al. 2008). On the one hand, the network of organizations makes it possible to split the risk of product development between companies (Wognum et al. 2002). On the other hand, exigency for efficiency requires companies to focus on the essentials – core competencies – and via networks, companies acquire knowledge and competencies that they need but do not have in-house. A network allows for more innovativeness and efficiency (Miles & Snow 2007).

From the project team member point of view, a working environment is complex for many reasons. More and more project personnel are working in different locations i.e. are geographically distributed (Paasivaara 2005, Harvey & Griffith 2007) (multi-site). Also – especially in high technology organizations – there are often many national cultures involved (multi-cultural working environment) (Harvey & Griffith 2007), even though the project may not be multisite. In addition, in product development there are several on-going projects and the personnel may be involved in more than one project at the same time (multi-project) (Killen et al. 2007). Furthermore, in high technology projects the product itself is complex (complex product structure) (Birk & Heller 2007) and may involve professionals with different technical backgrounds: e.g. software

---

1 E.g. Butchart (1987) defines high technology sectors as the ones that have higher than average expenditures on research and development as a proportion of sales or ones that employ proportionately more qualified scientists and engineers than other sectors. According to OECD definition, high technology companies are those with high R&D intensities (OECD 2009).
designers, electronics designers, mechanics designers, system designers (multi-
technical projects) (Edmondson & Nembhard 2009). According to Zika-
Viktorsson et al. (2003), compared to e.g. construction project, product
development projects require more cooperation and communication from project
personnel. These all have several consequences for working practices and
communication by project team members.

Factors that contribute to product development success have been studied
widely from different perspectives\(^2\). Several studies consider communication
critical for project success (e.g. Rothwell 1992, Akgün et al. 2004, Song & Noh
2006, Cooper & Kleinschmidt 2007). Pons (2008) argues that while
communication and human resource management are essential for product
development success, the existing literature is limited. Brown and Eisenhardt
(1995) name three research streams for product development success: a Rational
plan (success via superior product, market and rational organization),
Communication web (success via internal and external communication), and
Disciplined problem-solving (success via problem-solving with discipline). The
stream “Communication web” describes a product development project as a
network of interactions where communication supports the players pursuing a
shared goal (Brown & Eisenhardt 1995). Research has discussed following topics:

- **Project internal communication** i.e. communication inside the project team,
e.g. communication mechanisms (McDonough III et al. 1999), effectiveness
  and efficiency of communication (Moenaert et al. 2000, Herbsleb & Mockus
  2003, Kidane & Gloor 2007), sources, uses, and forms of data (Zahay et al.
  2004), formal and informal networks (Allen et al. 2007, Cataldo & Herbsleb
  2008, Cheng et al. 2009), trust (Bstieler 2006), conflict management (Lam &
  Chin 2005), collocation of team members (Moenaert & Caeldries 1996),
cross-functional diversity of project teams (Keller 2001), infrastructures for
collaboration in virtual organizations (Wognum & Faber 2003), global,
virtual and collocated teams (McDonough et al. 2001), use of technological

\(^2\) Most of the studies name different aspects of the product development process (Cooper &
Kleinschmidt 2007) – e.g. a product development project and its preparation (Lester 1998), a new
product launch or development after the launch (Lynn et al. 1999) – to be critical. Also, characteristics
of the new product itself have been claimed to be important (Cooper 2001). On the other hand, some
organizational elements have been named as critical factors: the commitment and support from the
organization and especially from the top management, organization structure, and commitment and
competence of relevant resources i.e. persons involved (Cooper & Kleinschmidt 2007).
advancements (electronic media) (e.g. Hameri & Nihtila 1997, Boutellier et al. 1998, Ganesan et al. 2005, Durmusoglu et al. 2006, Kock et al. 2006);

- Project external communication i.e. communication that occurs between persons within a project and those outside. Topics typical to academic research on project external communication include communication between different functions (e.g. Moenaert & Souder 1990, Pinto & Pinto 1991, Ancona & Caldwell 1992, Maltz et al. 2001, Massey & Kyriazis 2007, Swink & Song 2007) and communication with suppliers (e.g. Hoegl & Wagner 2005, Petersen et al. 2005, Sherman et al. 2005, Carr & Kaynak 2007, Jayaram 2007). Tushman’s study about gatekeepers was one of the earliest (Tushman & Katz 1980), continued by Ettlie & Elsenbach (2007).

This research studies communication that project team members are involved in when accomplishing their duties. Project communication, as it has been understood in this study, is part of the larger topic of organizational communication. A research stream continuously interesting scholars and practitioners is the field of organizational communication effectiveness (Zorn & May 2002). The questions of how to organize communication and how to develop communication remain interesting while the way of organizing work – work design – has changed: product development in a network of organizations has increased the complexity of the overall organizational system (Sinha & van de Ven 2005). The focus in this study is on communication in very complex projects – which are simultaneously multisite, multicultural, multi-project, multi-technical and where more than one organization is involved.

Engineers spent a considerable amount of their working time – one fourth, according to Allard et al. (2009) – just on communicating. Special interest in this study is on gaining wide understanding on how personnel working in projects perceive communication, and based on this information, giving direction for companies to improve their internal practices and processes. Communication audits are a means to survey personnel perceptions of communication and to provide information for organizational communication development (Goldhaber 2002).

1.2 Objective and scope

As stated in the previous chapter, both industrial managers and researchers have emphasized a need for new research to address communication in multisite,
multicultural, multi-project, multi-technical product development project settings in the high technology sector. In these settings, companies have often realized that communication is important. In addition, advances in information and communication technology are typically utilized to enhance communication. However, companies need tangible advice on how to improve communication in practice.

This research studies developing organizational communication in the context of high technology product development projects. The thesis identifies communication challenges and clarifies possibilities for improvement. The focus is on communication that project team members are involved in when accomplishing their duties. From the communication viewpoint, the main interest is on how project personnel perceive communication and on how to develop communication based on their perceptions. The study aims to deepen existing knowledge over communication in high-tech product development. The study also aims to generate knowledge to support development work in companies. In this study, the research problem is stated as follows:

Research efforts and new knowledge are required for defining how to manage and improve communication in product development projects of high technology organizations.

The research problem is addressed through two research questions:

RQ1: What type of communication challenges are encountered in high technology product development projects as perceived by personnel?

RQ2: What are the possible solutions for addressing communication challenges encountered in product development projects?

The first research question is answered on the basis of the empirical study in this research and previous research by other researchers. The empirical part of the research is a multiple case study of five product development projects from different high technology companies. To answer research question one, a survey was carried out, using a web-based questionnaire, on how project personnel perceive communication. By finding answers to research question one, the researcher aimed to identify the current state of project communication development needs.

Research question two covers the topic from the point of view of practical solutions to enhance communication in projects. To answer research question two, focus groups were organized in each of the cases. The knowledge gained in
finding answers to research question one provided a starting point for focus groups. Research question two is answered mainly through the empirical part of the research but also earlier literature is reflected. The suggestions for improvement by the focus group participants and case representatives are considered and compared with similar and contrasting literature.

The empirical material for the research was gathered from five product development projects from different high technology companies. All the companies are operating in the Oulu area but have offices also elsewhere in Finland and in other countries. All the case companies were from the electronics or telecommunication industry. The case companies were selected so that they would well represent the high technology industry in the Oulu area.

This research studies how project personnel perceive communication. Perceived communication may be different in different phases of a project. During the dissertation process, the studied projects were at the execution phase and thus the members of the studied projects had already been working together for some time when the data were gathered.

Consequently, this research focuses on product development projects:
- that are executed in complex high technology environment;
- whose outcome may be a totally new product or new version of an existing product;
- that are on their execution phase when the research data were gathered;
- that are typical product development projects in the organization.

There are several issues to be communicated in a project. In this thesis the emphasis has not been on what is communicated but rather on how the communication system supports the communication needs of project members.

1.3 Research approach and methodology

According to Arnbor & Bjerke (1997), the way a researcher studies a phenomenon in question i.e. operative paradigm is affected by the presumptions of the researcher and can be articulated in terms of theory of science. The theory of science can be approached through concepts of ontology and epistemology.

A discussion of ontology concerns the nature of what exists: does the reality exists as it is (objectivism) or is it more a creation by human perceptions and consequent actions (subjectivism). According to objectivism it is possible to observe processes, regulations, rules, and job descriptions etc. of an organization
– and the organization works as a machine according to these (Bryman & Bell 2007). On the other hand, subjectivism sees reality as a social construction; e.g. organizations are created through perceptions and actions by social actors, due to which the reality is also constantly changing (Saunders et al. 2007).

The discussion of epistemology is about information and knowledge: what kind of knowledge is possible to gain of the reality and how to share it with others. Positivism reflects a world view that seeks regularities and causal relationships between the elements of the reality. Interpretivism emphasizes that the social world can be understood only by and through those involved in it. People are seen as social actors in the organization like actors in a theatre. (Saunders et al. 2007).

Rather than being opposites to each other, philosophies can be considered to constitute a continuum. If at one end there is objectivism and positivism, then at the other end there is subjectivism and interpretivism. (Saunders et al. 2007). In management science, this study is positioned somewhere between these two ends, still, being nearer to subjectivism and interpretivism. The philosophical paradigm shows in the interest in the research at hand: although it is important for an organization to have processes, directives, and guidelines for practices, these may or may not be effective or used by the personnel and thus need to be studied through the personnel to identify how they can be improved.

The research approach describes the logic of reasoning in the research. In a deductive approach, based on existing theory, hypotheses are defined and then tested in empirical settings. Deductive research is typically quantitative involving numerical data and data analysis methods. In an inductive approach empirical data provide the starting point for creating theory. Inductive research is typically qualitative: qualitative data provide an in-depth understanding of the studied phenomena. (Bryman & Bell 2007). In this research the inductive approach is used: although an earlier theory provides a basis for the questionnaire as a study instrument, the true interest for creating theory is based on the findings of the challenges and possibilities to enhance communication in the studied cases. This research is mainly qualitative in nature, although some quantitative data are also utilized. Figure 1 illustrates the researcher’s understanding on the hierarchical positioning the terms of theory of science, research approach & methodology due to the variety in scientific literature.

---

3 Philosophical paradigm “…is a way to examine social phenomena from which particular understanding of these phenomena can be gained and explanations attempted” (Saunders et al. 2007: 112).
The research strategy chosen for this dissertation is a *multiple-case study*. A case study is an all-encompassing method used when the aim is to study a phenomenon in its real environment and when the boundaries between the phenomenon and its environment are unclear. A case study has a strong empirical emphasis. (Yin 2003). A multiple-case study, also called comparative design, means, that the findings from two or more cases are compared – i.e. what is unique and what is general – thus, promoting theory reflection (Bryman & Bell 2007). Case study is a suitable method when wishing to research practical realization in a true environment. One of the benefits of case study is it enabling the use of multiple data collection methods for studying the phenomena in depth. The researcher had an access to multiple companies that were adequately different providing desired variety.

When doing a case study a researcher selects a point of view from which to study a phenomenon, acknowledging that there could also be a number of other ways to approach it and other kinds of information available on the phenomenon. Triangulation is used to give weight to conclusions made from collected data and the phenomenon: different kinds of information complement each other – the more the information is gathered via different methods the more the researcher is able to understand the study area. (Yin 2003).
This thesis studies organizational communication in product development environment. The topic is approached from the perspective of individuals working in projects, trying to understand how they perceive communication challenges in their everyday work. Challenges may relate to individuals, teams, projects, and organizations.

The main phases (Fig. 2) of this study adapt the process for developing theory from a case study described by Eisenhardt (1989). The research process started by formulating the research topic and reviewing background theories. This phase involved a preliminary review of literature and increasing understanding for the selected research approach. In addition, in this phase more detailed research problem and research questions were defined (Saunders et al. 2007). The second step was to select cases. The cases – the product development projects – for this study were chosen from a specific population i.e. from high technology companies operating in the Oulu area. Use of a specific population reduces unnecessary variation and helps discuss the limits for generalizability (Eisenhardt 1989).

The third step was to define the methods to be used. In this study, multiple data collection methods (triangulation) were used (see in detail Chapter 3). Both quantitative and qualitative data were used (mixed-methods according to Saunders et al. 2007), which, according to Eisenhardt (1989) give synergy of evidence. The fourth step was to enter the field i.e. start the actual data gathering and analyses, which overlapped in this research.

The fifth step was first to focus on data analysis within each case and, then, on cross-case analysis. Cross-case analysis broadens the view gained from each case specific story (Eisenhardt 1989). The sixth step deepened the analysis and gained understanding by finding logic and evidence across the cases. Finally, in the seventh step the findings from the empirical study were discussed in the context of similar and conflicting literature.
Chapter 1 presents the background and motivation for the research, a discussion of the objectives and scope of the research and a discussion of the research approach and process of the study.

Chapter 2 describes the theoretical background of this study. This chapter includes a collection of viewpoints from the literature to enlighten the understanding over the need and challenges of communication. The chapter presents relevant theories, i.e. the essential elements of communication that should be considered in high technology product development projects. The purpose of the theoretical part is to provide different perspectives on the empirical settings. A theory synthesis has been included at the end to highlight the aspects essential for the purpose of this doctoral dissertation.

Chapter 3 discusses the empirical research settings i.e. how the empirical research was conducted in the cases. Also, the chapter presents in detail the methods used for data gathering and analysis.
In Chapter 4, the empirical data and their analysis are described. Firstly, the studied cases – the organizations and the projects – are introduced briefly. Then, for each case separately, the data are described and analyzed. Finally, a cross-case analysis is performed and the results are presented.

Chapter 5 contains a discussion of the main findings, and validity and reliability of the research. Also, directions for future research are defined. The thesis concludes with a short summary of the research and its implications in Chapter 6.
2 Theoretical part

Product development is part of a company’s research and development (R&D) function. The R&D function is typically organized into a matrix organization (Larson & Gobeli 1988): product development is organized into projects which have a limited schedule while the personnel are organized in lines according to technologies, or competencies etc., and allocated to project groups when a project starts up. As a consequence, project groups as organizations are temporary in nature. Typically, the responsibility of human resource (HR) management is within the line organization, while the project organization focuses on finalizing the project on time, budget, and desired outcome.

Project management standards by the International Project Management Association (IPMA) and Project Management Institute (PMI) have identified that for project success, it is advantageous for project managers to be aware of some HR management-related topics (Caupin et al. 2006, Project Management Institute 2004). Communication is included in these standards; however, the standards do not give detailed guidelines how communication should be organized in practice. The purpose of this research is to bring new knowledge especially into project management discipline by studying communication in a high technology project context.

Definitions of communication differ depending on the context. In this study the definition by Galanes et al. (2004: 50) is applied: “Communication is a process in which signals produced by people are received, interpreted, and responded to by other people”. There are two important implications from this definition for this research:

1. communication occurs between people (although may be mediated via different technologies);
2. communication includes personal interpretation of messages sent by other(s) i.e. communication is personal.

The interest in this thesis is on how project personnel – organized into project groups – perceive communication, specifically communication challenges and possible solutions in order to enhance communication in a project context. The theory chapter includes a collection of aspects that influence how an individual experiences communication. Possible solutions are considered to improve effectiveness and efficiency of communication. The theoretical part attempts also to discuss aspects affecting communication effectiveness.
Organizational communication practices & tools and data management systems influence the perceived communication. Personnel’s communication competence related to these affects communication effectiveness. Managers and colleagues, both internal and external to a project, have a central role on how communication is experienced by an individual. In addition, communication audits provide means for developing communication effectiveness.

Chapter 2.1 introduces communication as a multi-faceted process. An individual can be more or less proficient in relation to personal communication competence; hence communication competence is discussed in Chapter 2.2. Communication within an organization and between organizations is disseminated through various channels; hence communication channels are discussed in Chapter 2.3. Literature concerning communication in project groups is discussed in Chapter 2.4, where special attention is paid to a manager’s role in communication, communication culture, and intercultural, virtual & technology aided communication. Aspiration for improvement requires evaluation of current situation; hence communication audits are discussed in Chapter 2.5.

Terms related to organizational communication include e.g. business communication, corporate communication, management communication, organizational communication and public relations (Juholin 1999). In this study, the interest in external organizational communication i.e. communication with the organization’s stakeholders and environment, is limited only to circumstances where they are applicable to project settings (e.g. communication with project customers or suppliers).

There are other research streams of communication relevant to the R&D context that are not covered by this thesis. These excluded streams include public communication (e.g. public speech by an R&D manager), or communication by public speech (e.g. how to prepare a public speech) (Infante et al. 2003). The reason for excluding public speeches is that they are not common to all project members.

Studies on social networks (Wasserman & Faust 1994) are interesting for the settings of this study. However, the studies on social networks go into more detail in clarifying the connections between personnel, which are outside the scope of this study.
Project work is often called team work. According to Lumsden & Lumsden (2000), team work⁴ is more a result of impressive group work rather than a status given above. In this thesis group working and processes are discussed but no special attention is paid to teams or team work alone. Also, the group-forming phases are excluded from the thesis and, thus, it is only acknowledged that all the projects studied were in the execution phase and the project members had already been working together for some time.

Product development projects consist of individuals with specialized knowledge. A challenge is to integrate the knowledge within-persons to be exploited in the project (Enberg 2007) and different means of communication provide ways for this. Thus, perhaps the most interesting research stream excluded from this thesis is knowledge management.

Communication is about sharing information and creating shared meanings which relate also to discussions of organizational learning i.e. how capable the organization is for utilizing the knowledge gained in previous projects. Accordingly, organizational learning is a subset of organizational communication processes (Pace & Faules 1994, Seng et al. 2002). As interesting as the topic is, it is not in the core of this research: organizational learning is more like an outcome of successful communication and thus not within the focus of this study.

Different technical tools are used to promote communication. However, in this thesis the interest in communication technologies and communication media is limited: there is some curiosity on how personnel perceive the practices and media that are present in their everyday work.

Although communication between personnel from different national cultures is more challenging than communication within one nationality, the discussion in this thesis does not target the special characteristics of communication within a certain national culture. Rather, a general approach is adopted and the means to improve international or cross-national communication will be discussed.

2.1 Communication as a multi-faceted process

Communication occurs between people, one cannot communicate alone. If a sent message is not received, communication can hardly be said to have occurred.

---

⁴ A team is “a diverse group of people who share leadership responsibility for creating a group identity in an interconnected effort to achieve mutually defined goals within the context of other groups and systems” (Lumsden & Lumsden 2000: 14).
Communication can be described by the Transactional model of communication (Fig. 3). In the model, a *sender* is a person (or group) with a purpose i.e. a reason for engaging in communication. The sender expresses the purpose for communicating in the form of a *message*. The sender has the role of an *encoder*: the ideas of the source have to be encoded into a form of a message. The *channel* is a medium i.e. a carrier of the message. Choice of the channel affects the effectiveness of communication. The message may be hindered by *noise* related to the channel. The target of the communication is called the *receiver* (individual or group). The receiver needs a *decoder*: the message needs to be decoded into a form that the receiver can use. (Berlo 1960, Andrews et al. 1996). The effects of communication are changes in the receiver’s *knowledge*, *attitudes* or in overt *behavior* (Rogers & Agarwala-Rogers 1976).

Communication is a transactional process. This means that persons involved in communication – encoding and decoding messages – simultaneously affect each other (Wenburg & Wilmot 1973). All parties involved have important roles in the communication process, attempting to gain meanings.

The messages exchanged in communication are composed of signals. Signals may be *verbal* – words spoken and written – or *non-verbal* – such as a tone of voice, or positioning of hands. (Infante et al. 2003, Galanes et al. 2006). Non-verbal communication supplements verbal communication and helps one express feelings (Galanes et al. 2004).

Signals have a symbolic value for the parties involved. For example, a pen is a thing we write with, but will have a different association for each person. Encoding and decoding messages depends on personal attributes (Wenburg & Wilmot 1973) and involves interpretation. In addition, people are different in how they behave in communication situations (e.g. Dugas et al. 2005) and how they process information (Martinsen 1994). Communication as a process, as well as
the outcomes of the communication process for the persons involved, are personal.

Communication is also a social process and involves co-orientation: participants with different associations for communicated issues need to cooperate in order to achieve mutual understanding – communication is an ongoing event and involves gaining shared meaning (Bronn & Bronn 2003, Galanes et al. 2006). All communication is not intentional. People even send signals unconsciously that are interpreted by other people. Interpretation includes the risk that the messages – intentional or unconscious – are interpreted wrongly. For example, crossing arms when speaking, may give an expression of aggression.

Communication is also situational and occurs in a context (e.g. between two people, in a small group, etc). A certain message in one situation may have other meanings in another situation (Hargie 2006). Interactants’ positions within the socio-cultural system – such as the groups that the information source belongs to – impact on the standards one has learned and the values and the world view one has (Epp 2007). Thus, to understand the communication process pertaining to a certain situation it is essential to understand both the communication situation at hand and the (socio-cultural backgrounds of) the persons involved.

2.2 Communication competence

Effectiveness of the communication process is affected by many elements related to the persons involved, including personal communication skills. Communication skills refer to the ability to obtain goals. Important communication skills include empathy (understanding others’ feelings without regarding them as one’s own), adaptation of one’s communication to different situations and interaction management (Payne 2005).

It is important for project group performance that the competence of the group members is relevant for the project work (Thamhain 2004). Communication competence consists of knowledge, motivation and skills (Payne 2005). Rubin (1990: 96) states: “communication competence is knowledge about appropriate and effective communication behaviours, development of a repertoire of skills that encompass both appropriate and effective means of communicating, and motivation to behave in ways that are viewed as both appropriate and effective by interactants”. Thus, in addition to personal communication skills, also personal attitudes towards the persons communicating and the topic communicated influence communication effectiveness. Additionally, personal
knowledge level concerning both the subject matter and communication process in general and the specific context in question affect communication effectiveness.

Parks (1994) highlights that communication competence is a process i.e. continuously changing: when one gets acquainted with the organization, one’s communication competence improves. Payne (2005) claims that high communication competence enhances higher performance of workers: investments in developing personnel communication competence would be beneficial at least when the employee is new in the organization but also continuously. Communication competence is context dependent (Light 1989): it essentially involves understanding communication patterns and technologies of the organization within which one is communicating.

2.3 Communication media

Channels of communication are typically divided into three main categories: face-to-face communication, printed media and electronic media. Printed media refers to documents in a physical form such as newspapers, leaflets etc (Kipphan 2001). Electronic media refer to technology aided communication such as telephone, email, databases (Albarran 2009), groupware (Lumsden & Lumsden 2000) etc. Electronic documents are advantageous for leveraging a long-run organizational memory (Amarni & Beghini 2000).

In a project context, face-to-face communication typically happens in different kinds of meetings: discussion, making decisions or informing (such as in ‘info sessions’). Having lunch and other informal gatherings also belong to this category. One-on-one communication, i.e. when two people are communicating with each other, is the simplest mode of face-to-face communication\(^5\). As one-on-one communication occurs between people, it has been considered as interpersonal. In this context persons communicating perceive more information of the other than in other contexts (rich media) (Wenburg & Wilmot 1973).

Asynchronous communication means that there is a time difference between 1) sent and received messages and 2) sent message and the response (Montoya-Weiss et al. 2001). Use of asynchronous communication is a necessity in the studied context as information is transferred between various actors in different places and time-zones. Asynchronous communication media include email, voice

\(^5\) Communication types one-to-many, many-to-one and many-to-many are out of the scope of this study.
mail, online discussion groups, project management tools, documents and databases. Synchronous communication means communication without time-delay allowing interactively resolving misunderstandings immediately. Synchronous communication media include telephone, audio-conferencing, video-conferencing, application sharing and also face-to-face discussions. (Carmel & Agarwal 2001).

Communication within an organization can also be divided into vertical and horizontal communication. Vertical communication refers to managerial communication and superior-subordinate communication. Horizontal communication, on the other hand, is communication between work colleagues, within one’s personal communication network. An organization’s members are linked in group(s) and the organization is linked via networks: networks are informal patterns so that information flows in an organization (Wasserman & Faust 1994). Each person’s personal network is an important communication channel (Juholin 1999).

An individual may play different roles in the network(s) (Andrews et al. 1996). Typically, a project manager acts as a liaison between project teams, or as a gatekeeper between the project team members and the customer (Fig. 4).

![Fig. 4. Typical communication roles for a project manager.](image)

In a project context, communication can be divided into project internal and project external communication. Lievens & Moenaert (2000) use the terms intra-project and extra-project communication to describe the same. Intra-project communication includes communication flows between members of a project team and extra-project communication includes communication flows between project team members and outside source. Extra-project communication is also called boundary spanning communication: boundary spanners are persons that act as mediators in communication between persons in different organizations (Lievens & Moenaert 2001).

In a project environment there are several different organizational boundaries such as between buyer and seller organizations, and between production and product development units. In addition, organizational boundaries can also be
found between different departments in product development as well as between different projects and project teams.

An organization’s formal structure – e.g. organization chart, job descriptions, and regulations – influences the formation of formal communication channels. Informal communication e.g. rumors, the grapevine, informal workgroups, on the other hand, supplements an official communication system. (Pace & Faules 1994, Rogers & Agarwala-Rogers 1976). Another way to categorize communication, especially in a project context, includes planned vs. ad-hoc communication (Burke 1999). Organizations may have different media and practices for communication even though they may not be planned (Juholin 1999).

Then the question arises, what is transferred? One could easily just answer “information”. However, it is important to distinguish between data and information: data refers to separate objective facts while information refers to data having a purpose and meaning in a certain situation (Davenport & Prusak 1998). Information is data that can be utilized by project personnel.

Information can be divided into oral and documented information. Oral information, i.e. what is spoken, lacks permanence. Documented information is concrete and can be stored in a database. However, although concrete product information can be found in documents, the context information related to it must be found from people. (Hertzum & Pejtersen 2000). Nonaka & Takeuchi (1995) divide these into tacit and explicit knowledge. Explicit knowledge refers to documented information, i.e. which is easy to store in a database, while tacit knowledge is situational and personal.

2.3.1 Information behavior

By communicating people acquire information and knowledge. Pinelli (2003) considers engineering – work by engineers – as an information processing activity: engineering work is about acquisition, producing, using or transferring information or knowledge. In organizations, explicit information is stored in documents and databases. Thus, documents and different information systems serve as essential information sources for project personnel.

Information behavior means all – active and passive – human behavior related to information media and sources, including information seeking and use. Information behavior includes passive reception of an advertisement when one walks by, or face-to-face communication in a meeting. Information seeking behavior refers to behavior where one is purposely looking for information to
Individuals in an organization make choices between possible communication media. Åberg (1979) claims that the choice is made based on a subjective evaluation of the media and information mediated via them. Earlier literature has proposed several aspects which influence the use of certain information sources by engineers:

- one’s work role (Wilson 1981) and career stage (Leckie et al. 1996): personnel with different work roles have different kinds of information needs;
- working environment (Wilson 2006): for example, stratification of resources or political system may restrict use of certain information sources;
- familiarity or perceived credibility (Ong et al. 2004): a person is more likely to use information source that he/she is familiar with, or knows the source is trustworthy;
- self-confidence related to computers by the user (Ong et al. 2004).

The question of selecting a communication media is relevant for this thesis. As stated earlier, face-to-face communication allows the communicators use all senses to perceive the communication process at hand. In addition, in face-to-face communication the parties have a possibility to check, ask another, whether they have understood correctly. (Wenburg & Wilmot 1973).

However, technological advances support communication between personnel working at-distances and in different time-zones (O’Leary & Cummings 2007). Examples of these advances include electronic mail (email), chat rooms, electronic bulletin boards, videoconferencing and other group support systems, intranet, internet etc. Arranging face-to-face meetings is expensive and often not even possible.

Media richness, social presence, and interactivity (Montoya et al. 2009) affect choice of media: which media are appropriate for which purposes. Media richness (Daft et al. 1987, Lengel & Daft 1988) describes the channel’s capacity to convey information through three dimensions: ability to handle multiple information cues simultaneously, ability to facilitate rapid feedback, and ability to establish a personal focus.

For example, a face-to-face meeting is a rich media as it allows communicators to observe a variety of verbal and non-verbal signals related to the communicators and the situation, provide feedback, and personalize the message.

---

6 Group support systems (GSS) have been studied e.g. by Zigurs & Buckland (1998), Zigurs & Munkvold (2006).
7 Taxonomy of internet application for project management, see Giffin (2002).
On the other hand, a written memo of a meeting is a non-rich media allowing very limited signals about the message, slow (if any) feedback to the writer of the document, and typically not much personal focus on the message.

According to Lengel & Daft (1988), in order for communication to be effective there has to be a match between the media richness and the type of message: routine information should be distributed via lean media while non-routine information requires rich media.

Short et al. (1976) and Daft et al. (1987) emphasize the importance of personal immediacy for successful communication. Zack (1993), on the other hand, highlights the interactive capabilities of the media: while face-to-face meetings as interactive are appropriate for when there is a need to build up an atmosphere allowing the sharing of interpretations between the communicators, low-interactive media such as email is appropriate when such an atmosphere already exists.

More recently, research has shown that, newer technologies such as email and voice mail are versatile from the social perspective (Montoya et al. 2009). Burke & Chidambaram (1999) found that using leaner or rich media did not influence the performance of a work group. In addition, Yoo & Alavi (2001) reported that group members’ activeness in engaging group processes is more important than the media capacity of the media.

Furthermore, earlier literature has discussed the role and applicability of documents versus colleagues as an information source. According to Hertzum & Pejtersen (2000), engineering personnel information seeking behavior is directed towards both people and documents: engineers need the exact product information (Allard et al. 2009) call this as technical information) stored in documents but they use people to find the right documents. In addition, people are better sources of information, such as why some solution was selected over another, because this kind of information (which Allard et al. 2009 call as context information) is typically lacking from documents. On the other hand, documents may direct one to finding the right person to address detailed questions concerning context information. Consequently, a lack of systems that support searches for people with specific qualifications (e.g. certain knowledge) leads to decision-making situations with incomplete information (Hertzum & Pejtersen 2000).

Information systems play an integral role in project personnel’s communication. It is essential that systems support the work done in projects. Earlier literature has proposed several aspects influencing the system usability
and thus, the use of certain information system by engineers. These aspects include for example perceived accessibility of the system (Gerstberger & Allen 1968, Fidel & Green 2004), perceived usefulness of the system (Davis 1989), ease of use of the system (Davis 1989, Ong et al. 2004), and system’s technical (Delone & McLean 2003) or perceived quality (Fidel & Green 2004).

A more recent model by Freund et al. (2005) emphasizes the effects of time: time constraint is an essential element in affecting information-seeking behavior. The nature of work and thus information needs change during a project life cycle and, accordingly, the information-seeking behavior changes.

An information system should support the actual work of system users. Ellis & Haugan (1997) have described engineers’ behavior when using information systems in an eight phase process: 1) surveying, 2) chaining, 3) monitoring, 4) browsing, 5) distinguishing, 6) filtering, 7) extracting, and 8) ending.

2.4 Communication in project groups

Much of the work in product development projects is group work. Regardless of one’s role in the project, one’s work is part of a larger entity and one has to work as a part of that entity. Whether the project is large or small, there is a project group or groups. This chapter attempts to present viewpoints on group communication effectiveness as well as aspects that may be considered to influence communication perceived by project group members.

A group is formed for some purposes: the group members work in the group for certain goals, vision, tasks, activities, and desired outcomes. For these purposes, group members are involved in certain processes such as communicating, collaborating, organizing, leading, supporting, developing, analyzing, thinking, and creating. In these processes people in group work are in a relationship to each other: they are interacting, influencing others, sharing resources and thoughts, doing more or less cooperative work, and inter-depending on the members of the group. (Lumsden & Lumsden 2000).

In project organizations, or in R&D function, several kinds of groups may appear. Project groups constitute of people with different backgrounds and skills aiding to accomplish specific tasks. The special characteristics of a project group,

---
8A group performs different processes during the group’s life cycle (forming, storming, norming, performing, adjourning, see Tuckham & Jensen 1977). The project groups studied in this research have been working together already for some time period. Group forming phases are out of the scope of this study.
from the perspective of this dissertation, include a) members may be part of a
group for the whole project duration or a part of it, and b) members may work in
one or several projects at a time. There may also be informal groups that include
friends or people with similar interests. Ad hoc groups are formed for a limited
period of time to deal with specific issues. Focus groups are formed by
representatives of a specific population to discuss a specific question with the
help of a professional facilitator. Management teams consist of managers from
different departments who meet regularly to coordinate their efforts, make
decisions, allocate resources etc. (Lumsden & Lumsden 2000).

Group effectiveness is affected by several variables including those
originating from the environment, such as industry characteristics (Cohen &
Bailey 1997), physical and social environment, parent organization, society and
culture or competing groups (Galanes et al. 2004). Thus, a group needs to be
studied within its environment, not in isolation.

Group performance is also affected by the group members themselves (needs,
motives, attitudes, beliefs and values, skills, and also the number of participants),
and the resources the group has (knowledge, funds, tools, time etc) (Galanes et al.
2004). For project group performance, it is important that the work is
professionally challenging for the group members (Thamhain 2004). The
effectiveness also depends on how well the group members communicate with
each other, their ability to manage conflicts, group cohesiveness (Cohen & Bailey
1997) and job design (Campion et al. 1993). Also, Thamhain (2004) reported that
a group’s ability to solve problems and conflicts is important for successful group
work.

A project group can consist of one group or several smaller groups depending
on the size of the project. A small group is “a collection of at least three and
ordinarily fewer than 20 individuals, who are interdependent, influence each
other over some period of time, share a common goal or purpose, assume
specialized roles, have a sense of mutual belonging, maintain norms and
standards for group membership, and engage in interactive
communication”(Harris & Sherblom 1999: 3).

In small group communication many characteristics of interpersonal
communication are present (Wenburg & Wilmot 1973). Small group
communication is a transactional process between the group members (Harris &
Sherblom 1999): at its best all participants can equally participate and the
communication resembles dialog\(^9\). Small group face-to-face communication is a rich media as all sense modalities are operable and feedback is immediate. Also the correction of messages is possible although not as probable as in interpersonal communication. (Wenburg & Wilmot 1973). Small group communication is embedded within the network of interlocking tasks, roles, and relationships that often include interacting with other work groups and individuals within and/or outside the organization (Greenbaum & Query 1999).

Individuals in the project group may also behave in ways that are not directly pursued for the project task and may even seem irrational. A group member enacting certain behaviors can be said to be playing a role. Beranek \textit{et al.} (2005) divide roles emerging in groups into formal and informal roles. Formal roles relate to the task at hand and follow the assignments from project management. Informal roles are based on group members’ interaction and are affected by personal characteristics.

Groups influence the attitudes and behavior of its members (Myers & Lamm 1976) because the individuals need to belong – general to human beings – and there is a longing for maintaining group united (Infante \textit{et al.} 2003). Consequently, project groups have impact on perceived communication.

The quality of group processes, and decisions made, are dependent on how well the task at hand is understood. However, it is also important that the group is able to identify a range of realistic and acceptable solutions and defining criteria for a high quality solution, and critical analysis of the solutions in order to select the most desirable (Hirokawa 1988).

Hirst \textit{et al.} (2004) reported that task communication, reflexivity, and communication safety enhance R&D team performance. Because the work is for a unique outcome, it is essential that the teams share clarity of objectives – and customer requirements – and constant feedback on achievements. Participative decision-making and open discussion are important for team performance. Also, group’s ability for reflective evaluation of its task and its processes is beneficial for the team performance. (Hirst \textit{et al.} 2004).

---

\(^9\) Dialog is a special kind of communication including giving room, respecting and active listening of others in the situation, but also presenting own point of views openly and honestly. Dialog pursues for gaining shared meaning between the persons communicating. (Isaacs 1999, Isaacs 2001). Dialogic communicator is described as honest, trustworthy, concerned for others, open-minded, emphatic, sincere, direct, non-manipulative, encourages free expression in others, and accepts others as persons of intrinsic worth (Johannesen 1971).
Hirst et al. (2004) argue that power conflicts potentially result in difficulties for group work. Verbal aggression sometimes related to conflicts causes problems for people trying to work together on a problem-solving task. However, conflicts, despite negative connotations, are also a potential for improved group work: defending different positions in the group provides an opportunity for a more detailed analysis and reasoning of the points of view (Nemeth 1986). Consequently, effective communication does not mean avoiding conflicts.

Janis (1982) uses the term group thinking to describe a phenomenon where an extreme desire to avoid conflicts results in insufficient decision-making. Reasons for insufficient decision-making include the group’s desire to stay cohesive, and the pressures of schedules and results. According to Janis (1982), this problem can occur even with the participation of very competent group members.

Trust among group members is crucial as in any kind of group: it makes it easier for people to approach each other. Trust is based on the members of a group behaving in ways expected by other members (Jarvenpaa et al. 1998). Trust develops over time when members of a group have gained experiences in working together (Koskinen et al. 2003). However, in temporary organizations – such as high technology projects – there are limitations on trust developing: such as the different national backgrounds of the members and distant communication instead of physical presence. These settings, according to Meyerson et al. (1996) require a special kind of trust, swift trust, to develop. Swift trust means that personnel involved in working have to dive into trust – express trust and be trustworthy – without a shared working history. Swift trust behavior will, according to Jarvenpaa et al. (1998), enhance task performance, and enable real trust to emerge.

Nevertheless, the longer a project group has worked together – the stability of the group is good – the more it becomes isolated from key information sources both within and outside their organization. Katz (1982) found that a group becoming too isolated in its environment may have a negative influence on the technical performance of the group.

2.4.1 Manager’s role in communication

A project member can simultaneously have several bosses, such as a project manager, program manager, unit or line manager. In this kind of complex organization, communication between managers and their subordinates is challenging.
The concepts of leadership and management are used to describe the versatile role of a manager. It has been argued that management and leadership differ remarkably: management being about controlling, supervising, directing, coping with prevailing circumstances and leadership about influencing, persuasion, and ability to lead to in a given context (Toor & Ofori 2008). In this thesis it is not considered essential to separate managing and leading – rather they both, to some extent – are included in the role of project manager, and the term ‘manager’ is used. This chapter discusses the purposes of managerial work and what kind of behavior and communication by a project manager positively affects project group performance and satisfaction.

A manager’s role is to build a functional unit out of diverse individuals. The manager’s task is to first set values and vision, and then seek consensus. (Fairholm 1994, Cleland 1995). The essential role of the manager is to promote a culture that is suitable in the circumstances of an organization (Amy 2008). The project manager is the social architect and manager of the system but also acts as the chief communicator (Laufer et al. 1996). A manager’s own behavior sets an example (Schein 1992).

Managerial roles include acting as a director, innovator, facilitator, and boundary spanner (Hirst et al. 2004). Managerial work involves helping a group overcome obstacles (Hirokawa 1988, Barge & Hirokawa 1989). Managerial work can be considered as a process or behavior that is aiming at promoting group tasks.

Managerial work occurs through the process of communication. Communication skills are the means used by individuals to lead small groups. (Barge & Hirokawa 1989). Managerial qualities in communication include preparation for a task i.e. doing one’s homework and thus being ready for tasks, e.g. coming to meetings prepared. It also includes credibility meaning how much people perceive a person as competent, objective, trustworthy, co-oriented (perceived similarity), and dynamic. Credibility reflects manager’s ability to get and maintain interests of people. Adaptability means how much a manager can adapt to new situations and to e.g. new groups. In addition, a principled manager operates according to internal ethical standards that help the group work in an ethically sound way. Moreover, strong values bring predictability to a manager’s behavior and increase trust among group members. Also personal involvement i.e. helping the group reach its targets is important. (Lumsden & Lumsden 2000).

How persons perceive a certain message depends on the culture: the effectiveness of communication is culturally dependent (Fu et al. 2004). However,
general characteristics of effective group managers have been identified e.g. by Galanes et al. (2004). These include the following:

1. communicate actively, clearly, and concisely;
2. communicate a good grasp of the group’s tasks;
3. inspire group members’ confidence on themselves;
4. skillfully mediate information and ideas supplied by all members;
5. express their opinions provisionally;
6. express group-centered concern;
7. pursue a collaborative climate by respecting and supporting others;
8. promote celebration of diversity and sensitive diversity management;
9. share rewards and credits with the group.

Henderson (Henderson 2004, Henderson 2008) shows that a project manager’s ability to communicate clearly his/her messages (encoding competence), and listen and understand the project group (decoding competence) positively affects group productivity and group satisfaction with the project manager and group. Brill et al. (2006) highlight the importance of good listening skills by a project manager. Ammeter & Dukerich (2002) emphasize the importance of a project manager in communicating project goals, aligning group member goals with the project goal, fostering a feeling of empowerment among group members and fostering a good work ethic.

A project manager aims for effective and efficient project group work. Thamhain (2007) claimed that the most important drivers for effective group performance are related to work. These include personal interest, pride in the work, and professional work challenge but also accomplishments and recognition. Thus, a project manager should invest in enabling the group for joint achievements. A project manager should also invest in a group’s mutual and individual acknowledgements.

Accordingly, a project manager’s emotional competence (motivation, precision, sensitivity, influence, self-awareness, emotional flexibility, intuitiveness) positively affects a project group’s performance and the project outcome (Müller & Turner 2007). For project group success, it is important that the group is able to trust the project manager in terms of leadership skills and ethical behavior (Sotiriou & Wittmer 2001).

Certain behavior by a project manager enhances group dynamics in a project group. The project manager has to provide and structure the goals for the group work, but leave it to the group to figure out how to get there. Consulting project
group members in decision making (participative leadership style) promotes communication quality within the project group. (Sarin & O'Connor 2009).

A project manager should strive to create a supportive working environment for project group members. This includes arbitrating organizational goals, processes, values etc. to the project group in a way that most suitably supports the project group work. (Thamhain 2007). Also, a project manager should invest in good relations in other functions, other groups and other group managers (Webber 2002). This promotes providing a supportive environment for project group work (Cleland 1995, Thamhain 2007).

Good external relations of a project are necessary because a project manager acts as a gatekeeper between the group and its external information flows. However, even though a project manager acts as a key information medium between the group and the project stakeholders, and the organization, he/she should delimit involvement in the group’s internal communication (Kratzer et al. 2008b).

### 2.4.2 Communication culture

Communication within a project group has the same features as communication in the company overall. For example, project personnel are likely to search for information from company level intranet pages, or use organization level document templates e.g. for meetings. Communication challenges perceived by project members may originate from the organizational level. Thus, this chapter discusses, from organizational level, viewpoints that may affect perceived communication and communication effectiveness.

Communication within any organization is a reflection of the organizational culture. Communication cultures (e.g. Vos et al. 2005, Hofstede & Hofstede 2005 Tukiainen 2001) are unique for every organization and can be seen as a part of the overall organizational culture. Organizational culture, on the other hand, relates to the effectiveness of the organization in patterns of communication, co-operation, commitment, decision-making, and implementation (Sathe 1983). Organizational culture is expressed in a pattern of values, beliefs, symbols (including language), norms, and behaviors that are shared in a group (Schein 1992). Personal communication practices and use of communication media reflect the communication culture in an organization (Tukiainen 2001).

The performance of an organization depends on how well the structure and the management system of the organization match the specific strategic
environment and the competition situation of the organization. In a turbulent environment, as in a high technology business, an organic organization performs better than purely mechanistic (Burns & Stalker 1961). On the other hand, the larger the organization the more there is a need for organized i.e. mechanistic features in management system (Churchill & Lewis 1983). Organization culture is a reflection of how the organization has learned to cope within its environment (Schein 1992).

Thus, there is no one best way to organize communication in organizations – rather it is organizational-specific and depends on the situational operating environment of the organization (Wiio 1978). Organizational communication is affected by the same factors of organizational structures i.e. complexity, formalization, and centralization of the organization (Andrews et al. 1996). Also communication has a contingency nature: as the organization changes, so does the communication (Wiio 1978).

Essential elements of a communication culture include communication system and communication climate. A communication system means the entity consisting of defined communication media, information contents and personal communication patterns. (Juholin 1999, Tukiainen 2001). A communication climate can be considered to be part of larger context of organizational climate (Guzley 1992). A communication climate reflects individual perceptions of communication related issues in his/her work environment (Jablin 1980) including perceptions of vertical and horizontal communication, organization’s rules for communication and quality, quantity and timing of a communication process (Juholin 1999, Tukiainen 2001).

Satisfaction with communication consists of satisfaction with the communication system, interaction, management communication, and possibilities of influencing one’s own work (Juholin 1999, Eisenberg & Goodall 2004). A constructive communication climate positively influences collecting and sharing knowledge, and commitment in work (van den Hooff & Ridder 2004). The author’s understanding of the relation of communication culture and climate is described in Fig. 5.
To enhance personnel working, a communication culture should be open, motivating, supportive and empowering (Eisenberg & Goodall 2004).

There are two aspects to motivation. Intrinsic motivation means being motivated by the characteristics related to the task itself. These include autonomy, deep involvement and personal competence related to the task, but also personal curiosity, enjoyment and interest related to the task. Extrinsic motivation, on the other hand, does not directly relate to the task but rather to concerns with competition, evaluation, recognitions, or tangible incentives. (Amabile et al. 1994).

Several studies have revealed the inter-relationship between communication, motivation and job satisfaction (Trombetta & Rogers 1988). From the point of view of communication, motivation is increased by fulfilling the individual needs for adequate equipment and other essentials required in work (including information sources, communication media and networks), supportive relationships between the members of the work community, and possibilities for personal development in assignments, responsibilities and autonomy (Eisenberg & Goodall 2004). In addition, clearly defined organizational objectives relevant to project work enhance group performance (Thamhain 2004).

A supportive communication climate is also empowering. Messages in supportive communication are problem-centered, congruent, and descriptive but also conjunctive and validating. (Andrews et al. 1996). Supportive communication climate is also straightforward, free of manipulations and non-judgmental for example, personal views are presented without demanding others to comply. The emphasis is on collaborative problem-defining (problem-oriented)
and the interaction is empathic (other employees are respected and there is aspiration to see the world through others’ vantage points), democratic (emphasis is on participative planning) and provisional (for example, viewpoints are presented with tentativeness and flexibility). (Gibb 1961).

Conger & Kanungo (1988: 474) define empowerment “as a process of enhancing feelings of self-efficacy among organizational members through the identification of conditions that foster powerlessness and through their removal by both formal organizational practices and informal techniques of providing efficacy information”. According to them, organizational factors such as organizational climate, communication and networks, and centralization of resources affect empowerment and self-efficacy. In addition, supervisory style (such as emphasis of control, successes/failures, reasoning for actions/consequences) and reward system have a central empowering role. In addition different aspects of job design are important for empowerment, including role clarity, training and technical support, setting realistic goals, task variety, possibilities for participation, number and quality of meetings, appropriate/necessary resources, opportunities for network-forming, rule structure, advancement opportunities, and contacts with senior management.

The process of empowerment by Conger & Kanungo (1988) includes five stages. Stage 1 is a psychological state of powerlessness caused by organizational factors, supervision, reward system, and nature of job. In stage 2 managerial strategies and techniques such as participative management, goal setting, feedback system, modeling, and competence-based rewards are used. In stage 3 self-efficiency information to subordinates on their attainments is provided. Stage 4 is characterized by strengthened belief of personal efficacy and stage 5 by persistent behavior to accomplish task objectives.

2.4.3 Intercultural, virtual and technology-aided communication

The communication context in this study is characterized by intercultural and virtual communication. Communication technologies are typically used to advance communication in these settings. Thus, in this chapter, the aspects that affect communication in intercultural, virtual and technology-aided context are discussed. People from different cultures, to some extent, behave and perceive the world differently. Persons from different cultures may misunderstand each other: one’s behavior although perfectly appropriate in one’s own culture, may be perceived as inappropriate by a person from another culture (Hofstede &
Hofstede 2005). In intercultural communication participants need to be aware of the increased potential for misunderstanding.

Intercultural communication, as understood in this research, means communication situations that involve persons representing more than one socio-culture or subculture of the same socio-culture. In an organization there can be several subcultures (Sackmann 1992). Besides socio-cultural differences, project group members are typically part of different subcultures. Thus, in a new project group there may be communication problems because of differences in languages and expressions in different professions (Koskinen et al. 2003).

According to Matveev & Nelson (2004) cross-cultural communication competence explains 20% of effectiveness of multicultural group performance. Matveev et al. (2001) and Matveev & Nelson (2004) explain effective group membership through certain abilities. These include interpersonal skills such as comfort when communicating with foreign nationals, abilities for dealing with misunderstandings and acknowledging differences in communication. In addition, awareness of your own cultural conditioning and basic knowledge about the country, the culture, and the language of the group members are important. Additionally, group effectiveness is an important ability and it results from abilities of understanding and defining group goals, roles and norms, giving and receiving constructive feedback, discussing and solving problems and dealing with conflicts. Accordingly, group effectiveness is affected by abilities for cooperative working and respecting other group members and a participatory leadership style. The emphasis is also on an ability to manage cultural uncertainty including abilities for dealing with cultural uncertainty, displaying patience, being open to cultural difference and tolerant of ambiguity and uncertainty due to cultural differences. Also, they consider important cultural empathy such as abilities to see and understand the world from others’ cultural perspective, curiousness and openness to other cultures, values, beliefs and communication patterns, and to accept and appreciate dissimilar working styles and ways of doing things.

Intercultural training may promote intercultural communication (Black & Mendenhall 1990). Culture specific training concentrates on the particularities of one culture and how to communicate in these circumstances. On the other hand, culture general training introduces the particularities of one’s own culture and discusses the categories of cross-cultural differences. Therefore, culture general training aims for understanding one’s own culture and typical differences with
other cultures (Infante et al. 2003). Improving one’s inter-cultural competence requires reflecting on one’s own culture (Vuckovic 2008).

Communication between remote colleagues involves extra challenges (at-distance communication). A group with geographically remote members and using different communication technologies is called a virtual work group. A virtual work group is a special kind of group whose operations – cooperation and communication – is based on utilizing variable communication technologies: a virtual work group operates across space, time, and organizational boundaries (Montoya et al. 2009). Virtual working can be considered as a continuum rather than an on-off choice: more virtuality brings more challenges to communication (Gibson & Cohen 2003).

A virtual work group, to its members, represents a significantly different organization form from traditional groups: the logic of working, the meaning of organization, logic of power and control, and expectations for members’ behavior is different from co-located groups (Saari 2005). In virtual work groups, trust is created via communication behavior (Jarvenpaa et al. 1998).

Some research indicates that geographical distance may hinder project group’s productivity (Henderson 2008). However, Lu et al. (2006) found that geographical distance is not the true reason for hindered group productivity, which is rather the disorganization of communication media and practices.

Information richness is interplay between people, tasks, organizational context, and familiarity with the technology in use. Communication in virtual work groups is basically the same as in other circumstances: the difference is that the potential for conflicts is outnumbered while possibilities for overcoming them are remote. (Jarvenpaa et al. 1998). To enhance virtual work group working Jarvenpaa et al. (1998) suggest that there should be a clear definition of roles and responsibilities so that the group members should have a shared meaning for the purpose and outcome of the group. In addition, the emphasis should be on regular communication and there should be guidelines on how often to communicate. Problems, if arising, should be communicated as early as noticed, only between the members that the conflict affects. Lee-Kelley & Sankey (2008) note that in virtual work groups there is a risk of over-communication (too many emails and conference calls). An organization should have a strategy for overcoming problems in remote collaboration (Lee-Kelley & Sankey 2008).

In virtual work groups the managerial communication is much the same as in traditional work groups (Glückler & Schrott 2007). An effective virtual work group manager provides continuous feedback, keeps up regular and prompt
communication, and provides clear and detailed information of the tasks and everyone’s own role and responsibilities (Kayworth & Leidner 2002, Cascio & Shurygailo 2003, Zigurs 2003).

Different technological advances enable group members to operate remotely. Technology-aided communication is essential for remote project work. Communication technologies are used both to effectively implement the technical product development processes (Barczak et al. 2008) and for non-task focused interactions (Qureshi et al. 2006) to enhance socialization.

The use of multiple communication technologies positively affects the perceived group performance. It is important to develop both the technical competences and positive attitudes for using different information and communication technology (ICT). (Montoya et al. 2009). The less personal contacts in the organization, the more the group’s internal trust contributes to project success. (Heinz et al. 2006).

2.5 Auditing organizational communication

This research studies developing organizational communication in the context of high technology product development projects. To direct development efforts, some kind of assessment is required. Organizational communication audits are used for exploring, examining, monitoring, and evaluating communication. Communication audits provide management information concerning organizational communication and its effectiveness. In auditing, communication is considered as a process allowing relating communication to other organizational processes (Downs & Adrian 2004). Communication audit is used to reveal gaps in the communication process and to provide suggestions for improvements (Henderson 2005). This is also an aspiration in this thesis.

Communication audit provides new information of the organization. There are several benefits from assessing organizational communication. First, communication assessments benefit communication practices and training. Communication audit itself can be considered as a communication method: to conduct a communication audit gives the impression that the management is interested in perceptions of the personnel. Focusing attention on communication improves communication practices. For those participating in the auditing process, it also provides an opportunity of influencing one’s own work. The participants involved in the planning and follow-up phases of the auditing process are provided with a comprehensive approach to the whole communication process.
The results of the assessment can be used to develop communication training in general. (Downs & Adrian 2004).

Communication audits emphasize the viewpoint of personnel when developing organizational processes. Assessing organizational communication gives management a means of verifying of personnel perceptions: a communication audit substantiates and checks the accuracy of personnel perceptions. It gives feedback to the management on how the communication process is perceived to be working (Zwijze-Koning & de Jong 2007). In addition, the results of organizational communication assessment – how the personnel view the organization, management and strategic goals – can be used to benefit strategic planning of the organization (Hargie & Tourish 2009).

Communication audits should be conducted regularly. The aim is to provide information on where possible problems are developing before serious problems arise. If conducted regularly, communication assessments also provide information on how the organization is progressing in relation to communication. (Downs & Adrian 2004).

Organizational communication audit can have different focuses. The audit may focus, for example, on how personal tasks affect communication. Akkirman & Harris (2005) studied the difference between communication satisfaction of a virtual office versus traditional office workers. The audit may also focus on formal and informal communication networks. This focus attempts to reveal how the information actually flows within the organization. Another possible focus is adequacy of communication meaning whether the information received timely, what one needs, and adequately loaded (the frequency and amount of information) (e.g. Gray & Laidlaw 2004). Additional focuses are how well employees use communication media (e.g. Hogard & Ellis 2006) or organizational outcomes such as job satisfaction (e.g. Carriere & Bourque 2009).

The focus of a communication audit may also be quality of communication in relationships such as in co-worker relationships, superior-subordinate or other managerial relationships, or at unit relationships (e.g. Gray & Laidlaw 2004) or reviewing the organization as a communication system. In this case the analysis would focus on one or several parts of the organization (e.g. Roberts & O'Reilly 1974). Quality of communication in relationships and reviewing the organization as a communication system are in the focus of this thesis where communication challenges are analyzed by studying project personnel satisfaction for different viewpoints of communication i.e. how satisfied project personnel are towards
certain communication relationships and how they perceive the communication system.

There are different techniques to conduct a communication audit. Previous literature has shown the advantages of both quantitative (Clampitt 2000) and qualitative (Dickson 2000, Millar & Gallagher 2000, Dickson 2009) methods. The most often used include interviews, surveys, focus groups, observations, network analyses, content analyses, communication diaries, and critical incident analyses. Different methods can also supplement each other (Hargie & Tourish 2009), which is also the case in this study. Surveys conducted by other researchers include e.g. Communication Satisfaction Questionnaire (CSQ) focusing on job satisfaction and communication (Downs & Hazen 1977), ICA Audit Survey (Goldhaber & Krivonos 1977, Goldhaber 2002), and LTT audit questionnaire (Wiio & Helsila 1974, Wiio 1977). The topics included in these three earlier surveys are presented in Table 1. This table has been utilized as a base for planning the methods in the empirical part of this study.

Table 1. Themes covered in communication audit surveys by other researchers.

<table>
<thead>
<tr>
<th>CSQ</th>
<th>ICA Audit survey</th>
<th>LTT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication climate</td>
<td>About various topics, the amount of information received versus amount of desired</td>
<td>Overall communication satisfaction</td>
</tr>
<tr>
<td>Relationships with</td>
<td></td>
<td>Amount of information received from different sources (current state and ideal)</td>
</tr>
<tr>
<td>supervisors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organizational integration</td>
<td>About various topics, the amount of information sent versus amount of desired</td>
<td>Amount of information received about certain job items (current state and ideal)</td>
</tr>
<tr>
<td>Media quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal (informal)</td>
<td>Concerning various sources, the amount of information received versus amount of desired</td>
<td>Areas of communication that need improvements</td>
</tr>
<tr>
<td>communication</td>
<td></td>
<td>Job satisfaction</td>
</tr>
<tr>
<td>Organizational perspective</td>
<td>Concerning various channels, the amount of information received versus amount of desired</td>
<td>Availability of computer information systems</td>
</tr>
<tr>
<td>Relationships with</td>
<td></td>
<td>Allocation of time in a working day</td>
</tr>
<tr>
<td>subordinates</td>
<td></td>
<td>Respondent’s general communication behavior</td>
</tr>
<tr>
<td>Personal feedback</td>
<td></td>
<td>Organization-specific communication information-seeking patterns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

45
When developing the questionnaire for the empirical part of this study, the information presented in table 1 was utilized as benchmarks.

2.6 Theory synthesis

The theoretical sub-chapters above attempt to bring forward relevant discussion concerning communication perceived by a sole employee. Relevant stakeholders in working organizations have also been acknowledged. As a conclusion, one can state that persons working for a project have a significant role as information sources to other individuals. Also, in a project, employees close to a person form a sub-organization that provides a possibility for social interaction. However, the role of other personnel must also be recognized. The literature highlights manager’s role being important for communication.

The organization as a whole influences the communication experienced by a project employee. For example, common communication practices and culture have a direct impact on project activities. An organization provides information that enables realizing given tasks and is also an enabler for social integration.

Communication is essentially influenced by data management systems and documents that are used in an organization. These have a central role as an information source from the perspective of a project employee. Figure 6 illustrates the communication environment from the perspective of an individual employee.
The literature has impacts on the empirical part of this thesis. The literature describes that it is vital for an individual to comprehend his own role in the organization. The empirical study clarifies this in more detail. The empirical part also analyses information sources, information accessibility, and media used by a project employee in a true high-tech product development environment. Theoretical discussion has formed the basis for the empirical study.

Also, the literature highlights many aspects of managerial communication, including giving feedback. Communication internal to a group, and communication atmosphere are also addressed by the literature. The empirical part of this thesis further clarifies the impact of these aspects for the communication experience from an individual’s perspective.

As the literature indicates, different organizations represent different cultures and utilize different means to communicate. The empirical part studies relevant practicalities of communication with different project stakeholders.
3 Research process

The practical realization of the research process of this study is described in this chapter. Figure 7 illustrates the research process, the main phases of this study presented in the left (cp. Fig 2, page 19) and practical realization in the right side of the figure.

**Fig. 7. Practical realization of the research process.**

### Phase 2: Case selection

The second step of the research process included selecting the case companies and contacting them. Five different high technology companies operating in the Oulu area were chosen as cases and are called A, B, C, D, and E in this thesis. The cases were chosen based on them being adequately different in size and technology, and so that they would represent high tech product development. All the organizations contacted agreed to participating in the research. Then, a contact person in each case organization was identified. The researcher requested companies to name their contact persons. The contact persons of the cases represented supporting or quality management functions. Together with the contact person, the case project to be studied was chosen.
Although all cases were high technology product development projects, the case companies operated in different kind of business roles. Two of the five projects studied were executed according to a customer order and the companies operated as a project-supplier or a subcontractor. In three of the five case projects the case company was developing its own product, and the company itself may have had some suppliers for its projects.

**Phase 3: Definition of data collection methods**

Phase three of the research process included identifying the data collection process in detail. As stated in Chapter 1, communication in an organization is widely studied area. However, interest for further research remains in the challenging and changing settings that high technology product development provides. The purpose of the thesis is to find versatile information to support high technology organizations to develop their internal processes and practices. The special interest is on how project personnel actually perceive communication in an authentic project environment. Thus, multiple data collection methods were decided to be used:

- thematic semi-structured interviews and documentation by the organizations;
- a web-based survey;
- focus group work.

In this phase, the interviewees and the structure of the interviews were defined. The interviewees included the case contact persons (see Appendix 1). The objectives of the interviews were:

- to familiarize the researcher with essential current project communication practices in each case, for example, how communication aspects are considered in project plans, which communication media is typically utilized;
- to familiarize the researcher with current communication follow-up practices and earlier development actions related to project communication in the organizations;
- to document background information of the studied projects.

The first two objectives were supplemented by studying organization specific internal documentation, such as guides for conducting a project plan, or earlier survey reports.
Additionally, in this phase the survey method was developed. This study utilized literature on communication audits as a basis for formulating the survey questionnaire as both, this study and audits, share a common goal of obtaining information for developing organizations. The survey was decided to be conducted using a web-based questionnaire. There are several advantages for using the tool:

- the questionnaire was easy to develop due to user-friendly user-interface;
- as it was planned that all project personnel were to be invited to participate in the survey, it was important that the questionnaire technology supported the respondents giving replies. With the selected tool the respondents were easy to reach and they could answer the questionnaire whenever it suited them;
- the tool provided data in a form that was easy to analyze.

The purpose of the survey was to reveal how satisfied project personnel were with different communication aspects present in product development. The questionnaire was developed utilizing earlier research of communication audits. In addition, research done by Müller (2003) and the Construction Industry Institute (1996) was used. Some questions were added to the questionnaire based on the interview findings.

The purpose of the survey was to cover the following issues: how an individual experiences horizontal communication (team, other project members, members of other projects, subcontractors, customer) and vertical communication (superior, briefings). In addition, the survey covered the following aspects, how typical communication media are experienced, employee’s own role, personal satisfaction. The items gathered for the questionnaire were roughly divided into eight modules (see Appendix 2). Although the main interest was not in communication contents, the following topics were covered:

- personal feedback to personnel on their contributions in the project;
- the communication of changes;
- how much support individuals get from their superiors or from the organization;
- lessons learned in communication.

The draft of the questionnaire was refined based on the discussions and findings from the interviews. The final questionnaire form included altogether 66

---

10 Questionnaire software was provided by ZEF Solutions Ltd.
questions. However, because the case projects had somewhat different communication media in use, the number of questions for each case organization varied: of the 66 questions 60 concerned case A, 50 case B, 51 case C, 50 case D, and 52 concerned case E (see details in Appendix 2).

The final questionnaire had three kinds of questions:

- questions with multiple choices the respondent could choose from;
- questions with Visual Analogue Scale (VAS) (Metsämuuronen 2001);
- three open-ended questions at the end of the questionnaire.

When answering the multiple choice questions each respondent could only pick up one option. The VAS questions allowed answers to be given on a continuous scale. VAS questions have been used especially in measuring the status of health and quality of life (De Boer et al. 2004). Most of the VAS questions used in the survey had two dimensions: importance and satisfaction (or importance and frequency). For example, if the question was about “communication planning”, the respondent would give his/her answer at the same time to questions “How important is communication planning?”, and “How satisfied are you with communication planning in your project?” (see Fig. 8). Thus, the respondents gave their answers to both dimensions at the same time.

![Communication planning:](image)

**Fig. 8.** An example of a VAS-scaled question with two dimensions.

The extreme positions for the VAS questions were:
In this phase the focus group work was planned in more detail. The researcher decided that the focus group would consist of a smaller group of people than the one that participated in the survey, and that the participants would represent different roles from the project: designers and other engineering personnel, supporting functions, and project management. The focus group participants were named by the researcher and the company representatives together. The agenda of the focus groups were defined to include two main steps:

1. identification of topics that focus group participants considered requiring improvement actions the most;
2. generation of ideas on how to develop each topic named in the first part of the focus group working.

The interest in the working of the focus groups was twofold: a) in phase one, it would be interesting to note whether focus group participants would choose the same topics that were highlighted in the survey results, and b) as a result of phase two, new ideas on how to develop project communication would emerge.

**Phase 4: Data collection**

The case specific data collection and related analyses were partly conducted in a parallel manner. Empirical data was collected during the first half of 2005. In each case, the following phases were conducted: interviews, studying organizations’ internal documents, surveys of project personnel and focus group work.

The interviews took from one to two hours. During the interviews, it was also decided what organization specific documents were to be studied further. After the interviews, the researcher became acquainted with case specific documents and wrote a summative case-specific report using relevant information gathered during the interviews and from the documents. Attention was especially on project communication practices in each case, for example, how communication aspects were considered in project plans and which communication media was typically utilized. In addition, the interest was on current communication follow-up practices and earlier development actions related to project communication in
the organizations. The case-specific report was inspected by the case contact person, and changes were made based on the feedback.

After that, all the members of the case project were invited to answer the web-based questionnaire. The project members were sent an email requesting them to answer the questionnaire within two weeks (see appendix 2). The survey results were first analyzed by the researcher, and then the results were discussed with the contact person of each case organization.

The set-up on focus group sessions resembled a workshop. The typical duration of focus group sessions was four hours. The sessions started with a presentation of the survey results to the participants. After that, the focus group members identified communication-related topics that they considered the most important development targets. This was accomplished by using a simple technique: each participant was asked to identify the five topics needing improvement actions the most, each on a separate sheet of paper. Then, all the information from the sheets was grouped, and the participants were asked to vote which of these groups were the most important ones. In voting every participant had five points to give to the groups, and the five groups with most points were selected for discussion in later parts of the session.

After that, for each category, ideas on how to improve the problem related to the category were covered. Again, the same technique was used: the participants were asked to identify the five ideas for improving the problem related to the category. Each idea was documented on a separate sheet of paper. Then, the sheets were introduced to and discussed with other participants in the focus group.

The results of focus groups were documented as idea-maps\textsuperscript{11} (see Appendix 4). The idea maps describe the challenges experienced by the participants, and development ideas for each identified challenge. A case-specific report on the focus group session and its results was generated by the researcher, and inspected by each case contact person. Changes were made to the report based on the feedback.

In the focus groups, the role of the researcher was to provide the settings for the work, keeping on schedule, and directing the process, but not to participate in the discussions by the participants: the intention was to have no impact on the contents of the categories or development ideas the participants identified. However, the focus group sessions involved significant informal discussion which

\textsuperscript{11} In this documentation MindManager was used.
also provided the researcher with the possibility of raising specific questions about the reasons and backgrounds of the studied phenomena.

**Phase 5: Data analysis**

After data gathering within each case, the material was analyzed and a report written by the researcher and inspected by the case representative. A report was written and feedback requested after every data collection phase (interviews & organizations’ internal documents, surveys of project personnel and focus group work). Based on the feedback by company representatives, the researcher corrected any identified logic mistakes.

When analyzing the data from the interviews and the organizations’ internal documents, special attention was paid to compare the information gained by these two means: whether the information supported or contrasted each other. This was done to clarify whether the employees follow given instructions in practice. Later, this comparison was continued with the data gained from the survey and focus group data.

When analyzing the survey results concerning the VAS questions, the respondents who had answered less than 50% of the questions were excluded from the data. After that, any remaining empty cells were replaced by the mean value of other respondents. This was done to make the analysis of the data easier. Because the analysis concerned mainly mean values, it was considered that adding mean value to an empty cell would not affect the analysis. When interpreting the results of VAS questions, the results were scaled from 1 to 7. In this scaling each response was given a numerical value. This allowed a statistical analysis of the results.

In the analysis of the survey results, the two-dimensional VAS-questions were analyzed to reveal communication challenges and best-functioning practices. In this analysis, the mean values for “importance” and “satisfaction” were compared in following way:

- the top ten largest differences of the mean values of “importance” and “satisfaction” represented the top ten communication challenges;
- the top ten smallest differences of mean values of “importance” and “satisfaction” represented the top ten best-functioning practices.
To make the analysis easier, the number of categories was reduced. The answers to certain multiple-choice questions were categorized into groups as presented in Table 2.

Table 2. Groups of categorized questions.

<table>
<thead>
<tr>
<th>Original classes</th>
<th>The new classes after grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program manager,</td>
<td>Project management</td>
</tr>
<tr>
<td>Project manager</td>
<td>(questions B2, B7, B8)</td>
</tr>
<tr>
<td>SW/DSP engineer,</td>
<td>Engineering personnel</td>
</tr>
<tr>
<td>HW/RF/Mechanics</td>
<td>(questions B2, B7, B8)</td>
</tr>
<tr>
<td>Testing engineer,</td>
<td></td>
</tr>
<tr>
<td>System engineer,</td>
<td></td>
</tr>
<tr>
<td>Supporting personnel,</td>
<td>Other (questions B2, B7, B8)</td>
</tr>
<tr>
<td>Line manager,</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Colleagues,</td>
<td>Persons</td>
</tr>
<tr>
<td>Project manager</td>
<td>(question E13)</td>
</tr>
<tr>
<td>Project meetings,</td>
<td>Meetings &amp; infos</td>
</tr>
<tr>
<td>Project info sessions,</td>
<td></td>
</tr>
<tr>
<td>Program info sessions</td>
<td></td>
</tr>
<tr>
<td>Document management system,</td>
<td>Data management systems (question E13)</td>
</tr>
<tr>
<td>Project intranet pages,</td>
<td></td>
</tr>
<tr>
<td>Program intranet pages</td>
<td></td>
</tr>
<tr>
<td>Different projects,</td>
<td>Different projects/programs (question D8)</td>
</tr>
<tr>
<td>Different programs,</td>
<td></td>
</tr>
<tr>
<td>Team and project manager,</td>
<td>Team and project management (question D8)</td>
</tr>
<tr>
<td>Team and program manager</td>
<td></td>
</tr>
</tbody>
</table>

After the case specific analyses, cross-case analysis was conducted to enable conclusions on similarities and differences. In the cross-case analysis the case specific reports and findings were compared to each other.

**Phase 6: Drawing conclusions from the empirical data**

The case-specific data and analyses are documented in chapters from 4.1 to 4.5. After this, the researcher made a cross-case analysis (Chapter 4.6) by summarizing the results from mainly the case surveys and focus groups. The role of the interviews and organizational documents was to support the analysis. Then
the researcher selected the topics that would aid in answering the research questions (Chapter 4.7).

Phase 7: Research implications

The researcher presents the answers to the research questions in Chapter 5.1. The theoretical implications are discussed by comparing the results with existing literature describing to what extent they confirm or contradict the findings of other researchers, and what is totally new (Chapter 5.2). In addition, managerial implications are discussed by presenting recommendations for companies and their managers how to improve communication (Chapter 5.3).
4 Empirical analysis on project communication

In this chapter, the cases are first briefly introduced. Then, a more detailed description of each case and the related data are presented.

All the studied five case projects were selected from high technology companies operating in the Oulu area. All of the case companies had well-documented project management practices. However, only in case A there were development activities related specifically to project communication (see Table 3). Information presented in the table has been obtained through the interviews.

Table 3. Case organizations.

<table>
<thead>
<tr>
<th>Industry sector / % of R&amp;D personnel</th>
<th>Organization structure</th>
<th>Project management practices</th>
<th>Project communication development</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Telecommunication / 65%</td>
<td>Matrix: project personnel allocated to programs and projects from competence pools, line and project organization are partly integrated</td>
<td>Documented and well-established</td>
<td>Several communication-specific actions</td>
</tr>
<tr>
<td>B Electronics / 90%</td>
<td>Matrix</td>
<td>Documented and well-established</td>
<td>Developed together with other development activities</td>
</tr>
<tr>
<td>C Software industry / 90%</td>
<td>A business sector specific units are owners of everything (inc. Personnel, customers and projects), units are grouped and each group has several customers and projects</td>
<td>Documented and well-established</td>
<td>Developed together with other development activities</td>
</tr>
<tr>
<td>D Electronics / 30%</td>
<td>Matrix</td>
<td>Documented and well-established</td>
<td>Developed together with other development activities</td>
</tr>
<tr>
<td>E Telecommunication / 70%</td>
<td>Mixed matrix organization: project organization includes only project management and supporting personnel, while engineering personnel are in line organization, lines are responsible for customer projects and HR-management</td>
<td>Documented and well-established</td>
<td>Developed together with other development activities</td>
</tr>
</tbody>
</table>
As was mentioned earlier in chapters 1 and 3, it was considered important that each case project would represent a typical project for the company in question. The studied projects included both large and small projects and they were all conducted under very complex circumstances (see Table 4). Two of the five case projects were conducted according to a specific customer order (the company was operating as a project subcontractor). The project personnel of the studied projects were located in one or several locations. Communication in the studied projects involved persons from different national backgrounds. Information presented in the table has been obtained through the interviews.

Table 4. Case projects.

<table>
<thead>
<tr>
<th>Type of contract</th>
<th>Size:</th>
<th>Complexity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniqueness</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Size:</td>
<td>Duration in years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Size in man-years</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Persons involved</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. Own product
- SW
- Typical program and project to the organization: although the end product has unique features it is improvement version of an existing product
- 2 years
- 150 man-years
- 270 persons
- Multicultural project environment
- Many companies (subcontractors)
- Personnel in many locations in Finland
- Most are working also for other projects at the same time

B. Organization is operating as a subcontractor
- Typical project to the organization: unique end product
- Electro-mechanics, HW
- 2 years
- 20 man-years
- 26 persons
- All personnel are Finnish
- Project has subcontractors
- Personnel in one location in Finland
- Some of the personnel are working also for other projects at the same time

C. The case company has two kinds of business areas: project business (e.g. the case C project) and product business
- Typical to the business unit: the end product is unique but based on customer specifications
- SW
- 0.5 years
- 5 man-years
- 15 persons
- Multicultural project environment
- Project has no subcontractors, the project itself is a part of larger R&D project by the customer
- Two: one location in Finland and one elsewhere in Europe
- Personnel is working only for the case project
4.1 Case A

The case A organization operates in the telecommunication industry. The organization has over twenty years experience of project work and consequently project management methods can be considered mature. 65% of the personnel are working in R&D. The organization structure is a typical matrix: project personnel are allocated into programs and projects from competence pools. The line and project organizations are partly integrated.

The projects in the case organization are typically very complex, as is the case project too. In general, the case project is a large product development project but due to its large size, it is called a program. The case program is a release development i.e. the outcome has unique features but actually is an improved version of an existing product.

The case program is a large software project, including specification, testing, and project integration. The total duration of the program is two years and the size is about 150 man-years. Altogether 270 persons are involved in the program, although most of them are working in other projects too at the same time. The program personnel are working in many locations in Finland and abroad: the program is very multi-cultural. The project involves many other companies, mainly subcontractors. The case program organization is detailed in Fig. 9 and

<table>
<thead>
<tr>
<th>Type of contract</th>
<th>Size:</th>
<th>Complexity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies</td>
<td></td>
<td>Cultures</td>
</tr>
<tr>
<td>Uniqueness</td>
<td></td>
<td>Network</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Locations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Personnel</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th>Own products</th>
<th>1</th>
<th>Multicultural project environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical project to the organization:</td>
<td>0.5</td>
<td>Project has subcontractors</td>
</tr>
<tr>
<td></td>
<td>although the end product has unique features it is improvement version of an existing product</td>
<td>20</td>
<td>Four: two in Finland, one in elsewhere in Europe and one in Asia</td>
</tr>
<tr>
<td></td>
<td>Electronics, mechanics, software</td>
<td></td>
<td>Some of the personnel are working also for other projects at the same time</td>
</tr>
<tr>
<td>E</td>
<td>Own products, although sometimes there are some customer specific specifications</td>
<td>1</td>
<td>Multicultural project environment</td>
</tr>
<tr>
<td></td>
<td>Typical project to the organization:</td>
<td>50</td>
<td>Project has both internal and external subcontractors</td>
</tr>
<tr>
<td></td>
<td>the end product in totally new but utilizes earlier development results</td>
<td>130</td>
<td>Most persons in one place in Finland</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Most are working also for other projects at the same time</td>
</tr>
<tr>
<td></td>
<td>Mechanics, HW, RF, SW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.1 Case A
includes a manager, management team, assistant and advisor. The program has identified supporting personnel. The program is divided into projects which are further divided into sub-projects. The projects and sub-projects use support functions identified at the program level. An example of a supporting function is a team specialized to provide document management services. The projects have their own assistants.

![Program organization diagram]

**4.1.1 Current communication practices**

This chapter describes the current communication practices in case A based on the interviews and the organization’s internal documents.

According to the interviewees, the case program defines intranet pages as the main communication media, but also emails and telephones are commonly used. There is a document management system for documents management. Other generally used communication media include program newsletter published once a month, and regularly hold different meetings (project team meetings, project meetings, program ‘infos’, and program management team meetings). There is also an application for questions and answers on the intranet. Team building activities may be organized at program and/or project level.

As stated by the interviewees, the organization has recently developed and implemented general data management guidelines concerning data management tools and their usage. The guidelines are used by every program. The case program uses a special program data management system for managing all program documents. This data management system is used by every program. In
addition, there is a specific data management system for managing SW codes used by all SW programs.

According to the interviewees, there has been a relatively high number of project communication development activities in the case A organization. For more than five years the company has had documents which define:

- what is meant by project communication;
- why special attention to project communication is important;
- the different roles and information needs in project communication;
- difficulties in project communication;
- guidelines for communication in different project situations.

The organization’s internal documents reveal that, currently, there is a process description and guidelines for project communication management. The description of project communication process includes tasks for communicating previous lessons learned, nominating responsible persons, planning communication solutions, implementing project concepts, implementing communication solutions, monitoring communication, updating the communication plan, planning communication handovers, ensuring information reuse and traceability, and collecting end-user feedback.

The organization’s internal documents show that guidelines for project communication management are extensive concerning external communication, information management system, communication plan, roles in communication, special communication situations, and use of communication media, tools and methods such as communication matrix, e-mail, intranet, extranet, meeting practices, project starting and info sessions, virtual meetings, coffee room culture, following team spirit, and measuring communication effectiveness. In the guidelines, informal communication is considered e.g. by highlighting the importance of coffee room culture (including visualizing all relevant information).

In addition, the documents show that a project communication plan is recommended in every project. Due to tight schedules, prioritized requirements, and due to the fact that a communication plan is not required, the communication plan is often not implemented or it is not used actively. In the case program, the communication plan was drawn up according to the guidelines mentioned earlier and communication key messages, target groups, sources, media, and frequencies are defined in the communication matrix. There is also a separate plan for communication with the program stakeholders.
According to the interviewees there has been a channel for feedback and questions for the case project personnel via the project internet pages. Project personnel could send questions about project work and decisions to the project management and the answers were published on the internet pages. This practice was stopped because after some time no more questions were being asked.

The case organization has had a number of project communication improvement actions and has also clear project communication planning and management guidelines and documented processes. However, according to the interviewees, the implementation of guidelines depends on the persons in question and may be hindered by other more important requirements. For example, emails and different kind of meetings are all vital for the organization to perform but they exceed the personnel’s capacity. Thus, the organization has developed instructions e.g. for effective email and meeting practices. Despite the instructions, not everyone is following them, and not everyone acknowledges that such instructions even exist.

**Project communication follow-up**

This chapter describes what type of follow-up practices the organization used concerning communication in projects. The information presented is based on the interviews and the organization’s internal documents.

Based on the interviewees and the documents, in the case organization there are different kinds of surveys and questionnaires, some of which are regular and established practices throughout the whole organization while some are for a project or project manager to utilize when needed. Different surveys and questionnaires are authorized by different departments, and typically the surveys or their results are not compared with each other unless a project manager does so. The most important regular survey for the whole organization covers, among other things, the following topics:

- receiving feedback;
- clarity of work responsibilities and roles, goals and objectives related to work;
- work satisfaction and motivation;
- abilities to affect decisions related to one’s own work;
- teamwork and cooperation;
- communication and obtaining information.
The interviewees revealed that the results of the survey explained above are analyzed by every unit and project, and they are used as a basis for development. The results are also compared against earlier data (history) and in wider contexts.

In addition the interviewees showed that there is another typical survey in the case organization conducted when needed for specified projects. The results can be analyzed at the level of a single sub-project team. This questionnaire covers topics much the same as the questionnaire in this research project, e.g. understanding goals, project team intra and extra communication and cooperation, team spirit, atmosphere, possibilities of impact on decisions, and management and team members’ support.

In the case organization, according to the interviewees, there are also other surveys with the target groups of certain projects such as the one studied in this research. Based on the survey analysis corrective actions are taken and followed. A recent large questionnaire focused on communication media, internal and external information, product data management, document creation and control, tool support, training services, and other services. A small survey, also carried out recently, concerned the project plan, intranet pages, and information sources. There are also surveys at the business unit level about internal communication in general, managerial communication, and informing about e.g. market situation, customer feedback, achievements, milestones, decisions etc.

4.1.2 Communication challenges and best-functioning practices

Communication challenges and best-functioning practices were studied by using a web-based survey open to personnel of the selected case program. In case A the questionnaire was sent to 269 case program members, and the outcome was 116 answered questionnaires (response rate 43%). Most of the respondents were engineering personnel (SW/DSP engineers 38.6%, testing engineers 13.9%, systems engineers 11.9%, N=101, Fig. 10).
Fig. 10. Roles of the respondents in case A questionnaire (N=101).

Clearly, the primary information source in case A is the personnel (Fig. 11).

Fig. 11. Primary information sources in case A (N=98).

Survey results indicate that communication problems most often occur between persons from different sites. Information sharing between projects is the second largest source of communication problems. Communication between different professions is also seen as problematic. (see Fig. 12).
In this chapter, only highlights of the survey data are presented. In addition to the above mentioned, the survey results in Appendix 3 show that only 41% (N=100) of the case A program personnel knew that there was a communication plan in the program.

The answers to the two-dimensional VAS-scaled questions of the questionnaire were used to define the best-functioning communication practices and most important communication challenges. The best-functioning communication practices were those with the smallest difference of mean values between “importance” and “satisfaction”. The top ten best-functioning communication practices in case A based on the survey are presented in Table 5\textsuperscript{12}.

\textsuperscript{12} A detailed list of all the differences is presented in Appendix 3.
Table 5. The best-functioning communication practices in case A.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “Importance” and “Satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5</td>
<td>Understanding what is expected of you</td>
</tr>
<tr>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>C6</td>
<td>Understanding your roles and responsibilities</td>
</tr>
<tr>
<td></td>
<td>0.41</td>
</tr>
<tr>
<td>E12</td>
<td>Communication by phone</td>
</tr>
<tr>
<td></td>
<td>0.51</td>
</tr>
<tr>
<td>E3</td>
<td>Program intranet pages</td>
</tr>
<tr>
<td></td>
<td>0.51</td>
</tr>
<tr>
<td>F8</td>
<td>Knowing how the job affects the project success</td>
</tr>
<tr>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>E9</td>
<td>Program info sessions</td>
</tr>
<tr>
<td></td>
<td>0.59</td>
</tr>
<tr>
<td>E4</td>
<td>Project intranet pages</td>
</tr>
<tr>
<td></td>
<td>0.60</td>
</tr>
<tr>
<td>F6</td>
<td>Team spirit in the team</td>
</tr>
<tr>
<td></td>
<td>0.64</td>
</tr>
<tr>
<td>F5</td>
<td>Communication between the team and the program manager</td>
</tr>
<tr>
<td></td>
<td>0.72</td>
</tr>
<tr>
<td>C4</td>
<td>Communication planning</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
</tr>
</tbody>
</table>

The survey results indicate that in case A the personnel are well aware of one’s own role in the project (C6, F8) and the team spirit (F6) is good. Also program level information media (program intranet pages, program info sessions, and communication with program manager) are working well. The survey respondents are also satisfied to communication planning in the project, although majority of the respondents (59%, N=100, see Appendix 3) did not know that there is a communication plan conducted in the program.

The topics with the largest difference in mean values for “importance” and “satisfaction” can be considered as the most important challenges. The most important communication challenges, according to the survey results, in case A are presented in Table 6.

Table 6. The most important communication challenges in case A.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “Importance” and “Satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3</td>
<td>Training of personal communication skills</td>
</tr>
<tr>
<td></td>
<td>1.77</td>
</tr>
<tr>
<td>G4</td>
<td>Receiving feedback on contributions to the project</td>
</tr>
<tr>
<td></td>
<td>1.65</td>
</tr>
<tr>
<td>E2</td>
<td>Document management system</td>
</tr>
<tr>
<td></td>
<td>1.57</td>
</tr>
<tr>
<td>F10</td>
<td>Open and honest communication</td>
</tr>
<tr>
<td></td>
<td>1.44</td>
</tr>
<tr>
<td>C11</td>
<td>Being kept up-to-date with changes</td>
</tr>
<tr>
<td></td>
<td>1.44</td>
</tr>
<tr>
<td>F3</td>
<td>Communication between teams</td>
</tr>
<tr>
<td></td>
<td>1.30</td>
</tr>
<tr>
<td>G6</td>
<td>Meeting the program manager</td>
</tr>
<tr>
<td></td>
<td>1.24</td>
</tr>
<tr>
<td>F7</td>
<td>Team building</td>
</tr>
<tr>
<td></td>
<td>1.21</td>
</tr>
<tr>
<td>D4</td>
<td>Communication with other projects</td>
</tr>
<tr>
<td></td>
<td>1.17</td>
</tr>
<tr>
<td>D6</td>
<td>Communication with the program customer</td>
</tr>
<tr>
<td></td>
<td>1.16</td>
</tr>
</tbody>
</table>
The survey results (Table 6) indicate that, according to the project personnel, the most important challenge is training of communication skills (G3). This means that they perceive that there are too little possibilities for developing one’s communication skills.

Although program level media are working well (Table 5), the document management system (E2) is perceived as one of the challenges in case A. Additionally, although team spirit is good and project personnel are aware of their roles in the project (Table 5), Table 6 shows that receiving feedback (G4), open and honest communication (F10) and team building (F7) are considered challenging. This means that the respondents perceived that there is not frequent enough feedback and team building activities, and that the communication climate could be more open. Additionally, survey respondents considered as challenging to follow frequent changes in project work (C11), and that they did not meet frequently enough the program manager (G6).

In addition, communication with other teams (F3) and projects (D4) and with the program customer (D6) is considered as challenging. These results mean that communication over different organizational boundaries is perceived challenging.

### 4.1.3 Development targets

The focus group work was arranged to define the themes or topics of communication that the representatives of the case in question would identify as the development targets. The focus group in case A had 16 participants representing different roles in the case project (management, engineering and supporting functions).

The results of the survey were the starting point for the focus group work. The focus group work started by identifying the topics that according to the participants, needed improvement action the most. Then, the topics were categorized, and each category was discussed separately to define possible improvement actions. In case A, five categories of development targets, and the improvement actions for them were identified by the focus group participants, and are listed below (in detail in Appendix 4):

1. **Communication of changes**\(^{13}\). Decisions on what and how to communicate in a constantly changing environment is an especially problematic issue. The

---

\(^{13}\) During the focus group working the participants identified communication on changes as one of the most critical development targets. The focus group participants used the term ‘change’ to refer to all
quality of information is most important and should be: right, concrete, clear and well-defined information to the right persons. The focus group participants agreed that information should be shared quickly but only after the decision is made (to avoid needless rumors). Communication on changes should be planned and further actions clarified. The focus group participants agreed that the consequences of the changes should be discussed in-person with the persons involved. In-person discussions were considered preferable as they allow giving feedback. Depending on the significance of the change, different media should be used: face-to-face discussion with the foreman e.g. in team meetings, sharing meeting minutes, or via email or intranet. Some kind of road map for future changes with defined responsible informants and target groups are recommended by the participants. The participants hoped that a project plan would be prepared so carefully that changes could be prevented;

2. Communication plan and tools. Special targets for improvements include a communication plan, its creation and implementation. According to the focus group participants, there should be a description of the communication plan process including clear responsibilities. The participants proposed that there should be enough time for documenting the project communication plan. Training project personnel in using the project communication plan would support its active use. The contents of the plan should include instructions for how communication is defined and what the targets of communication are, how to find information (provide e.g. links to intranet and document management systems), how to transmit information (guidelines for different media involved in the project communication and communication matrix: what, when, who, how, to whom), how to operate in certain situations, and where to find support on project communication;

3. Boundary spanning communication. The focus group participants identified communication between persons from different sites, and between different teams having different functional roles, as especially problematic areas. Different interfaces of the project and communication practices across them should be identified. A stakeholder communication plan should be shared with everyone. Identified means for more effective communication between teams included co-location of teams, identified contact persons per team or kinds of changes that they face during a project life cycle, both organizational and project & product scope related changes.
per developed feature, consideration of which teams should be communicating to whom, cross-participation in meetings and different kind of events in other teams, and other ways of supporting personal relationships. Another point of view which arose was that supporting good communication practices in boundary spanning communication is everyone’s responsibility. Based on the focus group discussions the case organization representatives decided to share an example of a good meeting agenda and minutes to be used as a template (includes memo distribution principles);

4. **Data management systems.** The participants stated that the current network of systems is too complicated. The system and the processes related to it could be more user-friendly regarding organizing documents, helpdesk, versioning of documents, and giving rights to systems. There should be a list of all tools or systems used in project work and training of purpose, use and rules of systems;

5. **Open and honest communication.** According to the focus group participants, an especially problematic issue is the communication with collaborators i.e. the persons who are working in the same premises but who are employees of other companies. Participants stated that the current rules are too tight or that not everybody understands them. Extranet could be much more supportive regarding communication with these collaborators. The participants agreed that all company information should be shared with the company’s own personnel especially information on program success. Open and honest sharing of information requires face-to-face meetings. A communication plan that includes methods, clear responsibilities, and distribution lists would support open and honest communication.

### 4.1.4 Main findings from case A

In this chapter, the researcher attempts to draw case-specific conclusions based on the results from the interviews, the organization’s internal documents, survey and the focus group. In addition, these findings are discussed in relation to relevant theories.

The case A organization, and its business, are extremely complex. Based on the interviews, to cope with this extreme complexity, case A organization has invested in developing project communication practices. The case has some very effective practices e.g. meeting practices, different instructions and guidelines for project communication, detailed process descriptions, as explained in Chapter
4.1.1. Although project management standards (see e.g. Project Management Institute 2004) recommend project communication plan to be accomplished, earlier research does not emphasize the importance of it as much as the case A personnel. The case A has also invested in good working conditions: there are a number of different activities for enhancing a good team spirit among the project personnel as well as the personnel across departments. Nevertheless, there is no specific follow-up system to regularly steer project communication performance aiding systematic project communication development. However, other organization’s internal surveys contain some communication aspects.

The huge complexity present in the case A organization causes some problems. As explained in Chapter 4.1.1, different departments may pursue the same tasks at the same time (e.g. certain surveys and development actions). Different departments are responsible for different guidelines, which make it difficult for the personnel to source instructions etc. Again, the same information may be in different guides. Clearly, in a large organization communication between different departments is extremely challenging.

Based on the survey results, other persons are the most important source of information for project personnel. A person’s own personal network, i.e. who the person knows, affects what information the person receives.

The complexity of the business shows also in the complexity of the data management systems, document management, process descriptions and instructions. For example, based on the interviews in the case A program, the intranet is one of the official information sources, but only 7% (N=101, see Appendix 3) of respondents named it as their main information source. One of the problems of intranet is that it is system-oriented and very complex, too. In addition, according to the interviews, the structure is changing fast because the organization changes fast.

Another problem related to data management systems is that the systems are not designed from the perspective of project engineering personnel but rather from the perspective of the system itself. For example, focus group discussions reveal that, when the same document is used in several projects, the document has to be updated and saved again for the new project, too. The project personnel hoped that the different parts of the overall data management system in the organization would better support data transfer. Also, the data management system and processes related to it could better support collaborative work: for example, getting user rights for the system is not as easy as it could be and still,
collaborators do not have access to all the files that would help them to do their job.

The organization has attempted to address this problem of complexity by e.g. creating a document describing the roles of different data management systems, as was revealed during the focus group discussions. However, too few people know that this kind of guide exists. During the research process, several improvement ideas were suggested for inclusion in the guide for certain practices, but after some discussion it was noticed that it already existed. In case A there are a number of excellent instructions, guides, process descriptions etc. The problem is the lack of awareness of these: the implementation of these to support everyday work has not been very effective.

Poor implementation is not due to a lack of training. Based on the interviewees, there are number of trainings available. In spite of the training, the purpose and how to use certain system, process, or instruction etc. is too often forgotten. One might conclude that the training is not effective, but it is more likely that the organization as a system simply is too complex for the personnel to digest everything.

The communication of changes was one of the areas that the focus group participants considered as an important development target. Theoretical part of this dissertation (see e.g. Järvenpää et al. 1998), highlights that it is important for project personnel to have a common understanding of the goal and clarity of roles & responsibilities in the project. Continuously coming changes make it very challenging to gain and sustain this understanding. In addition to effectively communicating the goals, roles and responsibilities at the beginning of a project, these should be effectively communicated whenever changes occur during the project life cycle.

Another problem related to the communication of changes is that although management decisions are communicated, people do not recognize or do not remember the shared information. For example, important information is send in an email and two weeks after the person the information involved does not remember having ever heard about it. One explanation for this comes from the survey results: people have different preferences for primary communication media (Fig. 11). Only 24% (N=98) of respondents named data management systems as their primary information source. Important information should be shared via different media. Moreover, as explained in 2.3.1, the more significant the change (related to personnel, organization, or the project itself) the richer the media used should be.
In the case A focus group, boundary spanning communication meant communication between different organizations or sub-organizations such as between teams, projects, programs etc. Having a dependency chart open to all project personnel would enhance the understanding of boundaries in the project in question. The most obvious problem, communication with persons from different sites, can be addressed by means of virtual communication, as presented in Chapter 2.4.3.

One of the difficulties identified in the case A focus group was the confusion about whose responsibility it is to inform about which issues. It can be a challenge for a project manager to decide what information should be shared with the group. It was noticed that a project manager does not necessarily realize that project personnel would like to receive business level information concerning e.g. project success or about competitors. This kind of information can motivate project personnel and help them better understand their role in the work, as stated also in theoretical part, Chapter 2.4.2. A communication matrix (see Chapter 4.1.1) basically describes the communication responsibilities at a certain level, but it cannot be very detailed, and so does not solve this problem. Consequently, other means have to be used to increase project managers’ understanding of the perspective of the engineering personnel.

Based on the survey data, it can be concluded that the concept of project communication and the meaning of a project communication plan are not clear to everyone in the organization: only 41% (N=100, Appendix 3) of the respondents knew that a communication plan had been conducted. Thus, special attention should be paid to implementing a communication plan and providing training related to it: employees who know about the communication plan make better use of the different communication media in the organization.

In the case organization, based on the interviews, drawing up a project specific communication plan was outsourced. One can easily outsource e.g. updating internet pages but drawing up a communication plan is much more important. As the communication and information gathering and sharing are the main tasks of the project manager, their planning should not be outsourced. A better solution would be to make a plan template which is simple enough that project management personnel have time to complete it.

In general, during the interviews it was indicated that although certain practices are documented in great detail, the real problem is insufficient implementation. It seems that the problem is not related to how well the practices
have been identified in process descriptions etc. but how well they are implemented (including effective training) in such a large company.

Many of the communication challenges faced by the case A personnel originate from the enormous complexity of the organization and the business. Managerial implications from case A are as follows:

- systemize everything possible;
- for every action or process, consider whether it is absolutely necessary or not, and what would be a better way of organizing it;
- create enough rules and guidelines to support the work of the personnel;
- involve everybody who needs to be involved;
- make information available;
- invest in a good team spirit.

### 4.2 Case B

Case B company operates as a product development subcontractor in the electronics industry. The case project belongs to a unit, which has been involved in projects for over five years. The number of R&D personnel of the unit is 90%. Project management practices are documented and well-established. The case project is a typical project in the organization: the case project is part of a much larger project managed by the customer. As a subcontractor the case organization has agreed to go along with change requests coming from the customer.

The project takes about two years, the size is 20 man-years and the number of personnel is 26. Half of the personnel are working in other projects too. The project personnel are working in one location in Finland, all the personnel are Finnish. The case project has subcontractors. The technologies used are electromechanics and electronics hardware.

The projects in the organization are owned by sales while the project personnel are allocated to projects from competence pools (matrix organization). The case project organization is set out in Fig. 13.
4.2.1 Current communication practices

This chapter describes the current communication practices in case B based on the interviews and the organization’s internal documents.

According to the interviewees, telephone and email are the most common communication media in the project. Basically the communication practices are project specific: only a project kick-off is a recommended practice for all projects. Internal project reporting is managed via intranet. Reporting and document management related to customers (i.e. almost all the documents) are managed via customers’ data management systems. Regular meetings are held at the level of the project steering group, project management team and project personnel. Project ‘infos’ are run together with team building events held about twice a year.

As stated by the interviewees, project communication practices have been developed together with project management processes in general. There has been no special attention to project communication alone. There are no project communication specific guidelines or project communication plans in use; all the documents are from the general project management point of view. However, the organization’s internal documents reveal that project communication is at least partially included in the project management processes. For example, project organization (including also customer organization contact persons), roles and responsibilities, meeting practices and frequencies, roles and responsibilities in document management, information management tools, and other document management practices are defined in the project plan.
The interviews and organization’s internal documents show that the case organization has a considerable number of follow-up practices. First of all, there are two kinds of surveys used during a project life cycle: an intra-project survey and customer survey. Both are carried out approximately twice a year for every project. The customer questionnaire is short including only 10 questions about e.g. the general quality of the work being done but also the communication and working atmosphere. The project internal questionnaire is more extensive concerning e.g. cooperation and quality of information flows in the project group and between stakeholders, and receiving feedback and other issues related to job motivation. Depending on the project, the survey data are discussed in a project meeting, project steering group meeting or in the project closing session.

In addition to the mentioned surveys, according to the interviewees, there is a survey for the whole personnel concerning the general atmosphere in the organization. Also, there are surveys concerning special issues such as working ability.

4.2.2 Communication challenges and best-functioning practices

Communication challenges and best-functioning practices were studied by distributing a web-based survey to case project personnel. In case B the questionnaire was sent to 24 respondents, 16 of whom gave their answers (response rate 66.7%). Most of the respondents were engineering personnel (3 (23%) were test engineers and 4 (31%) HW/RF/mechanical engineers, Fig. 14).

![Fig. 14. Roles of respondents in case B (N=13).](image-url)
Special to case B was that the primary information source for the case project personnel was different kinds of meetings and info sessions (see Fig. 15). Surprisingly 0% of the respondents named colleagues or the project manager as their primary information source. Considering reasons for this it should be noted that in the project there is strong emphasis on different kinds of weekly and monthly meetings. In addition, the project personnel are heavily dependent of the customer’s data management systems.

![Fig. 15. Primary information source in case B are meetings info sessions (N=13).](image)

Based on the survey results, communication problems most often occur between the teams and the program manager, or between different projects or programs (Fig. 16). The case company itself has no programs but the projects are part of customers’ programs. Also, all the project personnel are working in one location (except the customer’s personnel). The conclusion is that most of the data in Fig. 16 refer to the case company’s role as a subcontractor. Much of the communication problems are related to communication with the customer.
Fig. 16. Typical communication problems in case B (N=13).

The answers to the two-dimensional VAS-scaled questions in the questionnaire were used to define the best-functioning communication practices and the most important communication challenges. The best-functioning communication practices were those with the smallest difference between the mean values of “importance” and “satisfaction”. The top ten best-functioning communication practices in case B are presented in Table 7.

Table 7. The best-functioning practices in case B.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “importance” and “satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>C6 Understanding roles and responsibilities</td>
<td>0.00</td>
</tr>
<tr>
<td>E10 Project info sessions</td>
<td>0.20</td>
</tr>
<tr>
<td>E12 Communication by phone</td>
<td>0.24</td>
</tr>
<tr>
<td>F9 Knowing how the project affects the overall business</td>
<td>0.28</td>
</tr>
<tr>
<td>G5 Meeting the project manager</td>
<td>0.32</td>
</tr>
<tr>
<td>E11 Communication by email</td>
<td>0.37</td>
</tr>
<tr>
<td>F8 Knowing how the job affects the project success</td>
<td>0.59</td>
</tr>
<tr>
<td>E4 Project intranet pages</td>
<td>0.6</td>
</tr>
<tr>
<td>F4 Communication between the team and the project manager</td>
<td>0.68</td>
</tr>
<tr>
<td>E7 Project meetings</td>
<td>0.73</td>
</tr>
</tbody>
</table>

14 A detailed list of all differences is presented in Appendix 3.
Based on the results, the project personnel’s general understanding of the project (F9 & F8) and their own roles (C6) in it were clear. The project manager (G5 & F4) was available frequently enough and the most general communication media (E12 telephone, E11 email, E4 intranet, E7 meetings and E10 ‘infos’) were functioning well.

The topics in the survey results with the largest difference in the mean values of “importance” and “satisfaction” are considered as the most important challenges. The ten most important communication challenges in case B are presented in Table 8.

**Table 8. Most important communication challenges in case B.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “importance” and “satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3    Training of personal communication skills</td>
<td>2.33</td>
</tr>
<tr>
<td>E2    Document management system</td>
<td>2.14</td>
</tr>
<tr>
<td>G4    Receiving feedback on contributions to the project</td>
<td>2.08</td>
</tr>
<tr>
<td>C2    Project communication in general</td>
<td>1.88</td>
</tr>
<tr>
<td>C7    Introduction to communication methods and tools</td>
<td>1.81</td>
</tr>
<tr>
<td>F10   Open and honest communication</td>
<td>1.61</td>
</tr>
<tr>
<td>F3    Communication between teams</td>
<td>1.31</td>
</tr>
<tr>
<td>F2    Communication inside the project team</td>
<td>1.27</td>
</tr>
<tr>
<td>C11   Being kept up-to-date with changes</td>
<td>1.25</td>
</tr>
<tr>
<td>F6    Team spirit in the team</td>
<td>1.05</td>
</tr>
</tbody>
</table>

In comparing the best-functioning practices and communication challenges, there are some surprises. First, although project personnel understood their roles and responsibilities at the project well (Table 7), project communication in general (C2) was named as a challenge. In addition, although the project personnel met the project manager frequently enough (Table 7), the team spirit (F6) and communication within the team (F2) were seen as problematic. Moreover, receiving feedback (G4) and open and honest communication (F10) are on the list of communication challenges. These may indicate that there are inconveniences inside the project team.

Secondly, although the most often used communication media were seen to work well (Table 7), introductions to communication methods and tools (C7) and training of communication skills (G3) were considered as challenges. Additionally, the document management system (E2) was on the list of communication
challenges. These indicate difficulties because of the subcontractor role of the company but also due to insufficient communication competences.

4.2.3 Development targets

To define themes or topics that the case representatives would name as future development actions, the focus group work was arranged. The focus group in case B had 9 participants representing different roles in the case project (engineering personnel, management, and supporting personnel).

The results of the survey were the starting point for the focus group work. The focus group work started by identifying the topics that according to the participants, needed improvement action the most. In general, the issues discussed in the first part were wide ranging (Appendix 4). The themes were then categorized, and in the second part of the focus group work the participants identified development ideas for each category. The development ideas were documented into the following six categories:

1. Data management systems. In general, the participants would prefer to use only one system for all document and data management (vs. now they have to use both the company’s internal database and the customer’s database). Document numbering should be simple and automatic (between organizations). Due to the role of the company, document management between two parties, e.g. customer and supplier, was seen as too complex: the participants would prefer clearer and simpler data transfer practices and clarity of roles (e.g. what information, which place, when, users, etc). A less bureaucratic document management system and more openness by the customer would benefit the daily work. As the supplier has to use customer systems, clear guidelines and user rights should be easily available;

2. Communication planning. The participants were very interested in communication planning. In general, they agreed that a communication process should be identified, planned, documented and communicated to the personnel. At the project level communication planning includes the identification of roles and responsibilities (project personnel, suppliers, customer contact persons), when, what and how to share information, and procedures such as project meetings, review and check lists, informing about the overall picture of the project, etc. The intranet should be updated frequently and used for internal information about a project;
3. *Project in its context.* Understanding the overall picture is very important and motivating for project personnel. There are two key points of views: knowing the customer and knowing the meaning of the project for the case company. Knowing the customer includes sharing customer feedback and information in project team meetings together with customers’ visits to project team meetings. Required information consists of customer needs, market information, volumes, and other ongoing projects. Moreover, it would be fruitful for project team members to participate in the customer’s ‘infos’ etc. Informal happenings such as evening gatherings support close and trusting relationships also between personnel from different companies;

4. *Project-specific intranet pages.* The case company has currently intranet pages but the focus group participants agreed that the content should be improved to a certain extent. For example, the intranet should include information on available training, tools and systems used and links to them. Also the intranet should include a menu with a choice of project specific intranet pages. Project-specific intranet pages should include information on project resources, schedules, status, dates, product, delivery lists, contact persons, and links to a document management system. The intranet should be regularly updated;

5. *Feedback.* The participants agreed that there should be feedback from the customer but also to the customer. Again, feedback from the customer’s customer would be useful. Feedback should be given to the person(s) whom it concerns. For internal feedback there could be a channel via the intranet. In general, feedback should be collected and shared at different phases of the project;

6. *Personal communication skills.* The participants agreed that there should be training of personal communication skills such as presentation skills. It is also important to support practical communication experience. Communication competence necessitates knowledge of communication processes and media.

### 4.2.4 Main findings from case B

In this chapter, the researcher draws case-specific conclusions based on the results from the interviews, organization’s internal documents, survey and focus group. In addition, these findings are discussed in relation to relevant theories.

Due to the nature of its business, the case B organization is relatively flexible in its practices. Case B project personnel are used to adopting different practices
with different customers: for example, different data management systems are
used with different customers.

Based on the focus group discussions, information gathering and sharing in
the organization is well-organized and effective. The organization’s internal
documents reveal that the variety of surveys ensures wide-ranging information.
There are also many and varied occasions for information sharing. In addition,
business level information is shared during info days. Effective communication
practices in the case organization include e.g. a resource management database,
intranet pages (although some improvements could be useful), and a number of
different kinds of follow-up surveys for the personnel. Although, there is no
specific survey for project communication; these aspects are covered in other
surveys. This has led to efficient internal practices. However, the identified
problems relate to ineffective communication between certain customers.

Based on the organization’s internal documents and focus group participants,
the number and variety of activities enhancing a good working atmosphere seems
to be in balance with the challenges of the organization. The instructions and
processes that the organization has are not allowed to hinder operations: customer
orientation is present in every practice.

There are two data management aspects in case B. Based on the focus group
participants, case B internal data management was working well. The other
viewpoint is management of data with customers. The case B internal data
management systems vary to some extent. For example, according to the focus
group participants, although the intranet pages are currently rather good, there is
still room for some improvements. The focus group participants suggested
creating project-specific intranet pages. As a non-rich media (Daft et al. 1987,
Lengel & Daft 1988) intranet could well support communication in the project as
there already were extensive regular meeting practices. The intranet should,
however, not duplicate other databases.

As a subcontractor, case B has agreed, and is used, to utilize the systems
provided by the customer. For example, project personnel use customers’
document management systems and as all the customers have different practices
this could make data management an uphill struggle. Still, according to the focus
group participants, the project personnel had communication difficulties only with
certain customers.

According to the focus group discussions, the case personnel experienced
open communication with certain customers especially as problematic. They felt
that although they were very motivated to serve the customer, they still did not get
the openness and trust that they felt they deserved. Moreover, the client’s data management systems and their management were considered very complex: it was hard to get access to a certain system which was essential in order to accomplish the job. In the theoretical part of this dissertation (see e.g. Ong et al. 2004) it was stated that perceived usability of systems is important. The usability analyses of systems should also include perceived usability by external users.

In an effort to overcome the problem the case organization can try to enhance communication between the organizations. However, its possibilities are limited as the customer has the dominating position in the relationship. Furthermore, it may be difficult for the customer to understand the reality perceived by the subcontractor’s personnel – such as problems caused by complex management of user rights and document numbering. The case B organization can try to encourage open discussion between the organizations. According to the focus group participants, there should be a regular two-way feedback practices between the companies involved in a business relationship.

According to the focus group participants, understanding the overall picture in the project is motivating, as emphasized also in the literature (e.g. Amabile et al. 1994). Lack of overall understanding is for the most due to the case company’s role as a subcontractor. It is of key importance to know the customer and understand the customer needs better. For the customer it must be difficult to understand the subcontractor’s point of view of.

In case B, the focus group participants discussed feedback at project or organizational level. The focus group participants agreed that, in order to improve project performance, there should be feedback from the customer and from the customer’s customer to the project. In addition, project level performance was considered to be improved by providing feedback, also to customer.

The importance of communication planning was emphasized by the focus group participants. Communication planning is not widely highlighted in the earlier research, although project management standards (see e.g. Project Management Institute 2004) consider this viewpoint.

Interestingly the focus group participants agreed that, in addition to training in communication skills, training in the “basics of people skills” such as self-knowledge, or knowledge of human nature, especially of personal differences, would be beneficial to support working in a complex environment. The focus group participants also emphasized the importance of practical communication experience, which is in line with the theory of communication competence by Rubin (1990).
Managerial implications from case B include:

- the business environment has a significant effect on how to organize processes inside a company: it may limit the possibilities for organizational development;
- “being near” to the customer, a typical situation for a subcontractor means – at least in this special case – adaptation and deep integration in the different processes of different customers, and an outlook on everyday operations which is very different to that of a large company with its own products. The positive effect of “being near” to a customer is that everyone in the company knows what the goals of their work are.

4.3 Case C

The case C company operates in the software industry and has very mature project management processes and practices having conducted projects for approximately 20 years. The proportion of R&D personnel is 90% of the whole personnel. In the organization, a specific group of the personnel is responsible for certain customers and certain projects.

The type and size of projects vary between the business units in the case organization. The case project is typical project for the business unit in question. The end product of the case project is based on customer specifications. The project does not have any subcontractors. The duration of the project is 0.5 years including 5 man-years of work and involving 15 persons. The project personnel are working in one location in Finland and in one location elsewhere in Europe. The project personnel represent many cultures. The case project organization is rather simple including a project manager, two teams and a project steering group. The case project organization is visualized in Fig. 17.
4.3.1 Current communication practices

This chapter describes the current communication practices in case C based on the interviews and the organization’s internal documents.

According to the interviewees, the company’s internal information is realized via the intranet while the main communication media in the case project is a document management system: it includes all project specific documents and templates. Email and telephone are constantly in use. Different kinds of regular meetings are held which include project steering group meeting, project reviews (to review the project by a quality officer), project meetings, and technical meetings with customers to agree on certain technical issues. The participants in technical meetings are those persons whose work the issue concerns. ‘Infos’ are held when needed, at project level usually they coincide with team building events. At the project level the purpose of team building is to improve team spirit. Human resource management happens at the unit level, and there are also unit level team building activities three times a year.

As stated by the interviewees, project communication practices have been developed together with project management processes in general. There has been no special attention to project communication alone. There are no project communication specific guidelines; all the documents are from the project management point of view.

According to the interviewees, the organization has no specific project communication guidelines or distinct project communication plan. However, project management processes are defined and strictly followed. The
organization’s internal documents reveal that project management processes include also project communication the following aspects:

- in order to prepare a project plan, a report plan (internal and external reporting) and a communication plan concerning both internal communication (e.g. meetings and unofficial communication) and external communication (e.g. contact person information, communication media and data transfer practices) are also drawn up. In addition, meeting practices and documents are defined and project documentation management and personnel management are planned;
- in the project plan, internal and external project communication and reporting practices, contact information, meeting practices of different meetings, document management processes and practices, and used document standards and files are described;
- in a guideline for managing multisite projects, different communicational aspects are included such as the organization structure in a multisite project, consideration on different languages, communication media and tools, document management practices, communication responsibilities, training, and meeting practices.

The organization’s internal documents show that there are three types of surveys including communicational aspects in the case organization. A company level internal customer satisfaction survey for all the personnel concerns different aspects of personnel management and quality unit services e.g. organization atmosphere, setting up and following objectives, supervision and guidance, giving and receiving feedback, supporting project work, training, meetings, informing, and communication. This survey is conducted once a year.

Another company level survey is a well-being survey addressing different aspects of human well-being. The organization’s internal documents reveal that this survey is rather unique and highlights the importance of the entire human being and not just that of an employee. The topics of the survey include e.g. the possibilities of getting and giving feedback, clarity of work objectives, relationships with co-workers, experiences of support and influencing, attitude towards work and changes but also health and personal life. This survey is conducted once a year.

In addition, the organization’s internal documents show that there are also project specific job satisfaction surveys concerning e.g. satisfaction with one’s role, atmosphere in the project, personal development possibilities in the project,
project management in general, project status and project quality, customer satisfaction and co-operation between projects. According to the interviewees, the frequency of the project specific surveys is usually four times a year but it varies between projects.

4.3.2 Communication challenges and best-functioning practices

Communication challenges and best-functioning practices were studied by using a web-based survey sent to the case project personnel. In case C the questionnaire was sent to 15 respondents of which 14 gave their answers (response rate 93.3%). Most of the respondents were engineering personnel (5 (39%) test engineers and 5 (39%) SW/DSP engineers, Fig. 18).

![Bar chart showing roles of respondents in case C (N=13).](chart.png)

According to the interviews, in case C the document management system is in a very elevated position in the information sharing process. Nonetheless, the personnel are the primary information source for the largest proportion of the respondents (Fig. 19).
According to the survey results, communication problems most often occur between personnel working in different locations or with the customer (see Fig. 20). Based on the results in Fig. 20, communication problems in case C are strongly two-folded.

The answers to the two-dimensional VAS-scaled questions of the questionnaire were used to define best-functioning communication practices. The best-functioning communication practices were those with the smallest difference...
between mean values of “importance” and “satisfaction”. The top ten best-functioning practices in case C are presented in Table 9. 15

Table 9. The best-functioning communication practices in case C.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “importance” and “satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>G5 Meeting the project manager</td>
<td>-0.34</td>
</tr>
<tr>
<td>F8 Knowing how the job affects the project success</td>
<td>-0.06</td>
</tr>
<tr>
<td>E6 Project reviews</td>
<td>0.37</td>
</tr>
<tr>
<td>E12 Communication by phone</td>
<td>0.64</td>
</tr>
<tr>
<td>D2 Communication with other projects</td>
<td>0.65</td>
</tr>
<tr>
<td>G2 Informal and ad-hoc meetings</td>
<td>0.65</td>
</tr>
<tr>
<td>E10 Project info sessions</td>
<td>0.81</td>
</tr>
<tr>
<td>E7 Projects meetings</td>
<td>0.82</td>
</tr>
<tr>
<td>C5 Understanding what is expected from you</td>
<td>0.93</td>
</tr>
<tr>
<td>F6 Team spirit in the team</td>
<td>0.94</td>
</tr>
</tbody>
</table>

According to the survey results, the project personnel meet the project manager (G5) frequently enough. Project personnel are also satisfied with the phone use (E12). Different kind of meetings (E6 project reviews, E10 info sessions, G2 ad-hoc meetings and E7 project meetings) are working well. The personnel know their own role (F6 & C5) in the project. Communication with other projects (D2) is working well and the team spirit (F6) is good.

The topics with the largest difference between mean values for “importance” and “satisfaction” were named as the most important communication challenges. The most important communication challenges based on the survey results are presented in Table 10.

15 A detailed list of all differences is presented in Appendix 3.
Table 10. Most important communication challenges in case C.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “importance” and “satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>G2 Training of personal communication skills</td>
<td>2.75</td>
</tr>
<tr>
<td>G4 Receiving feedback on contributions to the project</td>
<td>2.52</td>
</tr>
<tr>
<td>D6 Communication with the project customer</td>
<td>2.36</td>
</tr>
<tr>
<td>F3 Communication between teams</td>
<td>1.99</td>
</tr>
<tr>
<td>C2 Project communication in general</td>
<td>1.87</td>
</tr>
<tr>
<td>C11 Being kept up-to-date with changes</td>
<td>1.60</td>
</tr>
<tr>
<td>F10 Open and honest communication</td>
<td>1.58</td>
</tr>
<tr>
<td>F9 Knowing how the project affects the overall business</td>
<td>1.52</td>
</tr>
<tr>
<td>E2 Document management system</td>
<td>1.51</td>
</tr>
<tr>
<td>C4 Communication planning</td>
<td>1.48</td>
</tr>
</tbody>
</table>

Although the best-functioning practices indicated that the project personnel know what their role in the project is (Table 9), project communication in general (C2), open and honest communication (F10), communication of changes (C11), receiving feedback (G4), and knowing how the project affects the overall business (F9) are on the list of communication challenges. In addition, the challenges of boundary spanning communication are emphasized in case C as communication with the customer (D6) and between teams (F3) is seen as challenging. The results indicate also challenges in communication planning (C4) and related to document management system (E2). In addition, training communication skills was seen as a challenge (G2).

4.3.3 Development targets

To define themes or topics that the case representatives would name as future development actions, the focus group work was arranged. The focus group in case C involved 6 persons representing different roles of the project (project management and engineering personnel).

The results of the survey were the starting point for the focus group work. The focus group work started by identifying the topics that according to the participants, needed improvement action the most (Appendix 4). Then, the topics were categorized and each category was discussed separately to define improvement actions. The improvement ideas identified by the participants were categorized into five categories as follows:
1. **Communication between teams** (in the same project). The focus group participants highlighted the importance of different face-to-face communication situations for improving communication between teams. If it is not possible to locate teams in the same premises, visits to other teams should be supported, and at least at the beginning of the project there should be a kick-off meeting where all teams participate. Also, different free-time activities and team building, and lunches or dinners together were favored by the participants. An awareness of cultural differences helps communication with team members from other cultures. Different kinds of technologies assist in communicating at a distance, e.g. email, teleconferences, and instant messaging. Defining contact persons in teams and agreeing on communication practices are useful. Also, a review of other teams’ weekly memos would help to keep in touch with other teams’ work. Investing in communication between team managers would be beneficial;

2. **Communication planning.** The focus group participants agreed that at the beginning of a project a communication plan should be drawn up. It should include a common agreement among the project personnel on roles and responsibilities (also in information sharing) and practices such as meeting practices (for different kind of meetings), document management practices, and telephone and email practices. A project communication plan should include a graphical approach e.g. for describing roles and responsibilities. The participants were not fully pleased with the database in use: they agreed that the structure should be re-planned and everyone should have access to necessary information;

3. **Training of personal communication skills.** Communication skills that the participants would like to improve in training include interpersonal communication skills (e.g. basics of “people” skills), English language skills, knowledge of different cultures, and communication processes and media used in the organization. The task of writing meeting memos should be shared among team members;

4. **Communication with other projects.** The focus group participants agreed that effective communication between projects would benefit project work (e.g. sharing info on how certain technical problems have been approached in other projects) but it is often limited by restrictive non-disclosure agreements
(NDAs\textsuperscript{16}). However, communication between projects with the same NDA should be supported e.g. by arranging meetings and social occasions, hobbies or competitions between projects. Moreover, sharing the brief info of projects and use of a lessons learned database should be supported;

5. **Feedback and lessons learned.** The focus group participants would like to have feedback from the project manager in face-to-face discussion at least twice during the project. Interestingly, some of the participants also wanted to get some feedback from their team members. According to the participants, lessons learned should be documented at least twice during a project, if possible briefly and incrementally. Lessons learned should be published in an edited form (i.e. consisting of processed information).

### 4.3.4 Main findings from case C

In this chapter, the researcher draws case-specific conclusions based on the results from the interviews, organization’s internal documents, survey and focus group. In addition, these findings are discussed in relation to relevant theories.

The organization’s internal documents show that the organization has many instructions and detailed process descriptions. The complexity of the business is addressed by being systematic. This show from organization’s internal documents and, for example, when starting a meeting: case C personnel were the only ones among the studied cases who were present exactly when the meeting was supposed to start.

The organization’s internal documents show that project management guidelines included many essential communication planning aspects. Still, communication planning was on the list of challenges and was also discussed in the focus group. Communication planning has also been considered in project management standards (e.g. Project Management Institute 2004) but not widely emphasized in earlier research. According to focus group participants project communication planning and plans should be tailored to the needs of the organization in question.

The organization’s internal documents show that there is no special practice to follow-up project communication, but the viewpoint is considered in other

\textsuperscript{16} During the focus group discussions, it was revealed that in case C the customer projects are typically realized under tight NDAs, which hinder communication and sharing lessons learned between projects.
organizational surveys which allow regular follow-up and development of project communication.

According to the survey results, team spirit was good (Table 9) but communication between teams (Table 10) was challenging. The challenge of communication between teams was highlighted also in focus group discussions. These results are in line with the theoretical part of this dissertation (see e.g. Gibson & Cohen 2003). However, focus group participants named several practices which could help in overcoming these challenges, as explained in Chapter 4.3.3.

The focus group participants agreed that the organization should define what the needed communication skills are. They also named a number of communication skills they considered enhancing communication in their project, as explained in Chapter 4.3.3.

Communication within the project team was working well (Table 9). However, open and honest communication was on the list of communication challenges. In focus group work it was clarified that, because of the nature of the business, compared to other cases, case C personnel were given very little information on other projects. Sharing knowledge and learnings between ongoing and coming projects, in the case C, can be challenging because of the classified nature of some projects. NDAs hinder open communication between projects. This indicates that the nature of the business limits how the company can develop its internal processes.

According to the interviews, there were not many evening gatherings during a project life cycle: rather other practices ensured a good working atmosphere. Among the project personnel the team spirit was good and communication was open. The focus group participants showed uninhibited innovativeness during the research process, which gave the sense of successful empowerment. In case C, although information sharing between product development personnel was partly limited, the team spirit in the case project was good. It seems that discussions and informal ad hoc meetings have a relatively significant role in the organization. Personal needs of the project personnel were respected: for example, although for team internal communication being near to each other is important, it was acknowledged that some persons need more privacy for their work than an open-plan office offers.

On the other hand, communication between teams at different locations was not very active. The focus group participants raised the idea of investing in communication between team managers. Moreover, investing in communication
between project managers would be beneficial: it both supports information sharing and provides a peer group in which to share ideas and problems related to a manager’s job.

To a certain extent, communication between the case project and its customer could be better. However, as a subcontractor the company had only limited possibilities for developing communication with the customer.

Case C representatives proposed that, as much as possible, practices, e.g. even the database structure, should be agreed on together by the team at the beginning of the project. This depends of course on the size of the project: the bigger the project the less the chance of creating a fruitful discussion between the project members. On the other hand, if efficient project communication planning practices have been defined in an organization, they should be used in every project. This reduces time-wasting at the beginning of a project. The background for the proposition is the role of the case organization: usually it operates as a supplier and thus project personnel use the customer’s processes instead of the case company’s own. If the processes used in the project are not already familiar to the project personnel, a common understanding of them should be provided at the beginning of the project.

According to the interviews, the case organization significantly invests in training the personnel. In the training both technical and human aspects are considered. However, training communication skills was listed as a challenge. It seems that there is a need for more and expanded contents of trainings. As discussed in the focus groups, the case project participants had understanding that knowledge of human nature increases the potential of successful communication. In addition, training in other cultures involved in the project work further increases the potential of successful communication: it is easier to trust a person if you know something about them, even if this knowledge may be a stereotype and not always accurate.

According to the focus group participants, the case company had in use a functional database for lessons learned. This is important as it enhances information-sharing between projects. The focus group participants agreed that, as any other project-specific follow-up activity, documenting lessons learned should be done as the project proceeds, e.g. according to milestones or increments. As enhancing communication between projects is otherwise very difficult, a database for lessons learned and updated according to milestones would further improve information sharing between projects and teams. Such database would make learning during project life cycle documented, allow searching for
personnel with relevant knowledge and enhance organizational and individual learning. Although organizational learning is a very close topic to communication, it is out of scope of this dissertation.

The importance of receiving feedback was also highlighted in this case, as well as in the theoretical part of this dissertation (see e.g. Thamhain 2007). However, some focus group participants proposed feedback from team members too, not only from the project manager. It should be noticed that only if you have a trusting relationship is it possible to give and receive feedback also from team members. For very open communication, a high level of the team’s internal security is required.

Managerial implications from case C are as follows:
- a strong customer-orientation in the company gives a clear direction for the personnel;
- besides evening social gatherings, there are plenty of ways of enhancing a good working climate;
- the operating environment – the business – delimits the possibilities the company has for developing its internal processes.

4.4 Case D

The case D organization operates in the electronics industry. The organization has been involved in projects for over 10 years and can be considered to have mature project management processes. Compared to the other case organizations, the case D organization has a relatively low number of R&D personnel (30%) as the production is mostly owned by the case organization, too.

The case project is typical in the organization. Although the end product has unique features, it is an improvement version of an existing product involving electronics, mechanics, and software technologies. The total duration of the project is 1 year and total number of personnel is 20. The project includes subcontractors. Project personnel are working in four locations: two in Finland, one elsewhere in Europe and one in Asia. Thus, the cultural backgrounds of the project personnel vary. Some of the project personnel are working in other projects too. R&D personnel are organized as a matrix. The case project personnel are divided into five teams (Fig. 21).
4.4.1 Current communication practices

This chapter describes the current communication practices in case D based on the interviews and the organization’s internal documents.

According to the interviewees, emails and telephones are the most common communication media. There are regular meetings for the whole project and separate ones for each project team. There are also project info sessions together with team building activities held in the beginning and at the end of projects. Team building activities are also held at team level about once a month. Two or three times a year, an information day is organized for all R&D personnel about ongoing projects.

In addition, according to the interviewees, project communication practices have been developed together with the general project management processes. There has been no special attention on project communication. There are neither project communication specific guidelines nor separate project communication plans; all the documents are from the project management point of view. However, the organization’s internal documents reveal that the project plans include also project communication related issues e.g. a description of the project organization, roles and responsibilities, stakeholders and their contact information, document tools, responsibilities of internal and external communication, and project internal communication such as document management and meetings practices.

According to the interviewees, the case organization conducts a work satisfaction survey once a year. The organization’s internal documents show that
the survey focuses on e.g. clarity of responsibilities and job objectives, receiving feedback, skills development, receiving and sharing information and team spirit. At the project level there is a lessons learned survey including project communication related issues at the end of the project. There are no other surveys at project level.

4.4.2 Communication challenges and best-functioning practices

Communication challenges and best-functioning practices were studied by using a web-based survey open to the personnel of the case project. In case D the questionnaire was sent to 51 respondents, 30 of whom responded to the questionnaire (response rate 58.8%). In contrast to the other cases, the proportion of engineering personnel was small whereas the largest group (9 persons i.e. 35%) of the respondents named “Other” as their role. Also, the proportion of supporting personnel (5 persons i.e. 19%) was high compared to other cases. (Fig. 22).

![Fig. 22. Roles of the survey respondents in case D (N=26).](image)

According to the survey results, in case D the personnel are the most important communication source for the respondents (Fig. 23). About one third of the survey respondents name meetings and infos as their primary information source, while only for 20% of the respondents name data management systems as the most important information source.
According to the survey results, communication problems most often occur between persons from different sites. The next categories include problems between different professions and different projects. (see Fig. 24).

The answers to the two-dimensional VAS-scaled questions of the questionnaire were used to define best-functioning practices and most important communication challenges. The items of the questionnaire with the smallest difference between mean values of “importance” and “satisfaction” were considered as the best-
functioning communication practices. The top ten best-functioning communication practices in case D are presented in Table 11\textsuperscript{17}.

**Table 11. The best-functioning communication practices in case D.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values for “importance” and “satisfaction”</th>
</tr>
</thead>
<tbody>
<tr>
<td>F8 Knowing how the job affects the project success</td>
<td>0.44</td>
</tr>
<tr>
<td>C6 Understanding roles and responsibilities</td>
<td>0.45</td>
</tr>
<tr>
<td>G5 Meeting the project manager</td>
<td>0.68</td>
</tr>
<tr>
<td>G2 Informal and ad-hoc meetings</td>
<td>0.72</td>
</tr>
<tr>
<td>E12 Communication by phone</td>
<td>0.74</td>
</tr>
<tr>
<td>F9 Knowing how the project affects the overall business</td>
<td>0.76</td>
</tr>
<tr>
<td>C5 Understanding what is expected from you</td>
<td>0.76</td>
</tr>
<tr>
<td>E10 Project info sessions</td>
<td>0.83</td>
</tr>
<tr>
<td>C7 Introduction to communication methods and tools</td>
<td>0.92</td>
</tr>
<tr>
<td>F6 Team spirit in the team</td>
<td>1.11</td>
</tr>
</tbody>
</table>

According to the survey results, the project personnel are aware of their role in the project (F8, C6, F9 & C5). The team spirit (F6) is sufficient and project manager (G5) is accessible enough for project personnel. Survey respondents are also satisfied with introductions to communication methods and tools (C7) as well as with certain generally used media (E12 phone, E10 project info sessions, G2 ad hoc meetings).

The topics from the survey with the largest difference of mean values between “importance” and “satisfaction” were named as the most important communication challenges. The most important communication challenges in case D based on the survey are presented in Table 12.

\textsuperscript{17} A detailed list of all differences is presented in Appendix 3.
Table 12. Most important communication challenges in case D.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values of &quot;importance&quot; and &quot;satisfaction&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4 Communication planning</td>
<td>2.30</td>
</tr>
<tr>
<td>G3 Training of personal communication skills</td>
<td>2.25</td>
</tr>
<tr>
<td>F3 Communication between teams</td>
<td>2.10</td>
</tr>
<tr>
<td>C2 Project communication in general</td>
<td>1.91</td>
</tr>
<tr>
<td>C11 Being kept up-to-date with changes</td>
<td>1.90</td>
</tr>
<tr>
<td>F10 Open and honest communication</td>
<td>1.88</td>
</tr>
<tr>
<td>G4 Receiving feedback on contributions to the project</td>
<td>1.80</td>
</tr>
<tr>
<td>E2 Document management system</td>
<td>1.68</td>
</tr>
<tr>
<td>E8 Project team meetings</td>
<td>1.58</td>
</tr>
<tr>
<td>F7 Team building</td>
<td>1.54</td>
</tr>
</tbody>
</table>

According to the survey results, communication planning (C4) was the most important communication challenge in case D. In addition, communication in general (C2) was on the list of challenges.

The survey results also show some contradicting findings. Although respondents were satisfied with some media (Table 11), the survey results show that team meetings (E8) were considered challenging. Additionally, although team spirit was experienced as good (Table 11), the respondents were not satisfied with team building (F7). Furthermore, communication between teams (F3) is not considered to work well. Also, although project personnel are satisfied with how well they understand their role in the project (Table 11), but the survey results show that receiving feedback (G4), open and honest communication (F10) and being kept up-to-date with changes (C11) are considered challenging.

Somewhat contradicting findings include the respondents being satisfied with introductions to communication methods and tools (Table 11) but not on training of communication skills (G3). Communication skills, according to the respondents, possibly refer to other skills than being able to use communication technologies.

4.4.3 Development targets

To define themes or topics that the case representatives would name as future development actions, the focus group work was arranged. The focus group in case
D included 11 persons representing different roles of the project (engineering personnel, management, and supporting personnel).

The results of the survey were the starting point for the focus group work. The focus group work started by identifying the topics that according to the participants, needed improvement action the most. The most important topic discussed in the focus group was assigning and taking responsibility. Related to this topic, another relevant topic was the lack of common processes and practices. These and other important issues were categorized. Then, improvement ideas by the focus group participants were discussed for each category at a time. There were seven categories as follows (in detail in Appendix 4):

1. **Assigning of responsibilities.** The focus group participants agreed that there should be more clear rules on how to assign and communicate about responsibilities in project work. Problematic areas are change management, a lack of clarity of roles and responsibilities in a project, a lack of feedback on mistakes, email discussions where nobody really takes responsibility. Moreover, true goals, objectives and schedules are not disclosed to project members. The participants suggested the use of project communication plans (including communication matrix) and project intranet pages (including project schedule, status, and organization chart) to be used;

2. **Communication planning.** The focus group participants were very interested in communication planning. They regarded defining and implementing common processes, practices and templates in project communication as fundamental. According to the participants a project communication plan should be part of the project plan and should include identification of communication roles and responsibilities e.g. in communication matrix, communication tools and practices used in the project, information contents, frequencies, stakeholders, and plan for increasing personnel commitment. Participants agreed that it is important to meet persons connected or affected by their job (also from other teams);

3. **Change management.** The focus group participants agreed that change decisions should be made in meetings. Changes should be well-reasoned (based on a careful evaluation of field feedback) and schedules defined. The participants felt that currently nobody really takes responsibility for changes being made: whether a change is justified or not;

4. **Email.** The focus group participants agreed that current email practices need improvement. The participants suggest using mailing lists, addressing one
question in one email, having formal job titles in emails, providing discussion groups e.g. on the internet, and stopping the email chain by having a meeting (with responsible persons). Also, email discussions could be summarized in e.g. team meetings;

5. **Feedback.** The participants divided feedback into field feedback and personal feedback. Field feedback relates to change management. The participants felt that there is a lack of personal feedback. Positive feedback can be given in public while negative should be given privately. However, the participants saw that corrective feedback is also necessary, as long as it is given in a proper way and for a reason. Receiving feedback is not easy. Participants suggested giving rewards based on project outcomes;

6. **Open communication.** The focus group participants had several suggestions for more open communication: a project information center on the intranet i.e. project web pages, informing all relevant stakeholders and not hiding information (e.g. use of mailing lists), documented justifications of changes;

7. **Meeting culture.** The participants agree that different meetings should be separated: in workshops brainstorming is acceptable but in decisions-making meetings the approach should be more disciplined. According to the participants, meeting practices and templates common to the whole organization should be defined. Good meeting practices were identified as follows:

   - prepare for the meeting:
     i. define the meeting goal, purposes, agenda and participants,
     ii. assign responsibilities, and
     iii. provide a meeting invitation on time, early enough;

   - be on time for meetings;
   - nominate a meeting chair;
   - provide meeting minutes which include at least the participants, date and assigned tasks / decisions made and their justification.

**4.4.4 Main findings from case D**

In this chapter, the researcher draws case-specific conclusions based on the results from the interviews, organization’s internal documents, survey and focus group. In addition, these findings are discussed in relation to relevant theories.
The organization’s internal documents reveal that the case D organization had the most essential instructions such as a guide for a project plan. According to the focus group participants investments on communication planning are, however, needed. The organization’s internal documents reveal that there are no specific guidelines for project communication, although some aspects of communication are included in the project plan template. According to the interviews, the template is not punctually followed. Also, project management standards (e.g. Project Management Institute 2004) emphasize the importance of communication planning. The organization has regular personnel surveys including some aspects of communication, but there are no project-level follow-up practices for communication.

According to the focus group participants, although the employees were given autonomy in processing their everyday work, the personnel had the feeling that their work was not appreciated as a) all the changes (from the marketing department) are not justified and there are re-changes, and b) they were asked to hurry up even though the real schedules were not disclosed. The focus group participants agreed that systematic change management would mean careful evaluation and prioritization of user needs or other requirements for changes. In addition, disclosing real schedules would stabilize the designers’ workload, prevent completed work from becoming obsolete and make it easier to commit to targets.

The focus group participants stated that there is a need for improved practices relating to change management, as described above and in Chapter 4.4.3. The focus group discussions related to change management indicated lack of empowerment as stated by Conger & Kanungo (1988) in the theoretical part of this dissertation.

Based on the focus group discussions, in the case organization the purpose of a meeting is too often unclear. In addition, the focus group participants considered meeting practices not being very efficient. There is a need to better categorize different kind of meetings. This is supported also in the theoretical part of this dissertation (see e.g. Lumsden & Lumsden 2000). Defining common meeting practices and providing document templates could enhance meeting efficiency.

The case D had some contradicting results. Although survey results show (Table 11) that the respondents are satisfied with knowing their role in the project, focus group participants name assigning responsibilities as the most critical development target. The theoretical part of this dissertation also discusses the importance of understanding both roles and responsibilities (e.g. Ammeter
&Dukerich 2002, Thamhain 2007, Sarin & O'Connor 2009). This result may indicate that the project personnel know their own role but not the roles and responsibilities of others: for example, when they need certain information, who is the right persons to ask? As it was stated in the theoretical part of this dissertation, engineering personnel seek for persons to find the right documents and information they need (Hertzum and Pejtersen 2000).

In general, the focus group participants were not very satisfied with some aspects of the management system. This was shown in several ways during the focus group discussions. There was a lack of clarity about roles and responsibilities in the organization. Some had difficulties in understanding the purpose of certain roles (the roles were enacted differently in different teams). There was also dissatisfaction with decision-making and change management. In addition, there also seemed to be a lack of feedback: mistakes were not exactly hidden but action for handling them was not taken effectively. The organization should closely define what the responsibilities and authorities are at different organization levels.

According to the focus group participants, special problems related to emails include long email chains with no real contribution. There is a clear need for a more disciplined approach to emails: someone needs to take responsibility for the issue and, if necessary, call a meeting. Efficient email practices would be facilitated by designating clear responsibility areas. It seems that there is a need to agree on communication rules and practices in the case D.

According to the interviews and focus group participants, the implementation of the organization’s internal instructions was not punctilious (e.g. conducting a project plan according to the guide). In addition, the organization’s internal documents reveal that certain essential instructions or agreements at company level are missing: there are e.g. unambiguous role descriptions and a lack of certain process descriptions. A lack of a systematic approach showed also in certain organizational practices: according to the focus group participants, for example, decision-making should be done at meetings, which was currently not the case, and meetings should follow basic principles essential for an effective meeting.

Open and honest communication was on the list of communication challenges (Table 12). In addition, focus group participants named it as one of the most critical development areas. Also, the theoretical part of this dissertation supports positive and democratic communication (see e.g. Gibb 1961, van den Hooff & Ridder 2004). There are many aspects that could enhance open communication.
According to the focus group participants, these include investing in systematic and better documented change management processes and enhanced information sharing in projects, such as defining meeting practices and use of intranet and mailing lists.

Receiving feedback was on the list of communication challenges (Table 12). Also, the focus group participants named feedback as one of development targets. The focus group participants divided feedback into two categories. First, they required feedback concerning project outcome and performance. Secondly, they required personal feedback concerning how a person working in a project has accomplished his/her duties. This means that there is a need for feedback information concerning both individual and project group level performance.

The focus group participants proposed compensation if project targets are met or exceeded. However, compensation may have drawbacks: a) if rewarding is given e.g. for completing a project in a shorter time than planned it may encourage setting longer schedules for projects, and b) the real challenge is not that project is not reaching the target but that the project personnel do not know the real targets.

Interestingly, team building was identified as a challenge (Table 12) although the number of activities aimed at enhancing the working climate was the highest of all the studied cases, and the case project personnel seem to know each other very well. However, at the same time, the variety of activities was not very high: consisting mainly of evening social gatherings (typically weekly). Thus, it can be concluded that evening gatherings may not be the best team building activities but something else is required to give the participants experience of succeeding together. It is also possible that there were even too many evening gatherings in the case D.

In general, almost all the identified shortfalls were identified during the focus group work, although they were given different significance. The only one not really discussed in the focus group was communication skills. Considering the discussions it may not be the first topic to be dealt with although it was estimated as the most important shortfall.

Managerial implications from case D are as follows:

- project communication practices (such as email) reflect the overall organizational culture;
- evening gatherings are not the best or even adequate way of team building.
4.5 Case E

The case E organization operates in the telecommunications business. The organization has been involved in projects for over 20 years. The proportion of R&D personnel is 70\% in the company. The project aims are to develop the company’s own products although sometimes there are some customer-specific specifications. The R&D personnel are organized as a mixed matrix organization: the project organization includes only project management and supporting personnel, while the engineering personnel are in the line organization. The lines are responsible for customer projects and HR-management. Generally, product development projects use ready-made technical components which have been developed in other, more research oriented projects.

The case project is typical in the case organization: the outcome of the project is totally new but it utilizes some earlier developments. The project involves mechanics, HW, RF, and SW. The project has both internal and external suppliers. The total duration of the project is about one year and the size is approximately 50 man-years involving 130 persons in total. Most of the personnel are working in one location in Finland but the cultural background of them is variable. Most of the project personnel are working in other projects too.

The case project has a manager, management team, assistant and advisor (Fig. 25). Project has also identified supporting personnel. The project is divided into sub-projects which are further divided into sub-projects. The project and its sub-projects are using support functions identified at the project level. An example of a supporting function is a team specialized in providing document management services. The sub-projects have their own assistants.
4.5.1 Current communication practices

This chapter describes the current communication practices in case E based on the interviews and the organization’s internal documents.

According to the interviewees, project communication practices have been developed together with general project management processes. There has been no special attention to project communication alone. There are no project communication specific guidelines; all the documents are from the project management point of view. There is no project communication plan in use. However, the organization’s internal documents reveal that project management processes include project communication aspects such as information management systems and processes, project communication in general, meetings, communication follow-up practices, and training practices and policies are defined in project plan.

As stated by the interviewees, the main communication medium in the project is email. The telephone is widely used and a project-specific newsletter is published once a month. Project meetings, project team meetings and project info sessions are held regularly. The nature and frequency of team building activities vary. There are at least kick-off events, evening gatherings, and milestone celebrations. In addition, the line organization has its own team building events. The organization has a document management system for managing project documents and another for managing SW codes.

The organization’s internal documents show that in the case organization there are a number of surveys carried out which include also the topic of
communication. A regular survey for the whole organization focuses among other things on the following topics:

- receiving and giving feedback;
- clarity of goals and objectives, and roles and responsibilities at work;
- motivation and work satisfaction;
- effect on one’s own job;
- teamwork and cooperation;
- communication and receiving information.

According to the interviewees, the survey results are analyzed regularly and, at least partially, used for development at different organizational, or project, levels. The results are also compared against earlier data (history) and in wider contexts.

### 4.5.2 Communication challenges and best-functioning practices

Communication challenges and best-functioning practices were studied by using a web-based survey to the case project personnel. In case E the questionnaire was sent to 178 persons, of which 78 answered (response rate 43.8%). Most of the respondents were engineering personnel (see Fig. 26).

![Fig. 26. Roles of the survey respondents in case E (N=59).](image)

According to the survey results, the primary information source for the project personnel in case E are “meetings and infos”, although “personnel” have almost as high a score in the answers (Fig. 27).
Based on the survey results, communication problems most often occur between persons from different sites. The second largest proportion is between different functional roles, and the third team and project manager. (Fig. 28).

The topics of the survey with the largest difference in values of “importance” and “satisfaction” questions were considered as the most important communication challenges. The best-functioning communication practices were those with the smallest difference in the values of “importance” and “satisfaction” questions. The top ten best-functioning practices are presented in Table 13\textsuperscript{18}.

\textsuperscript{18} A detailed list of all differences is presented in Appendix 3.
Table 13. The best-functioning communication practices in case E.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values of &quot;importance&quot; and &quot;satisfaction&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>E12 Communication by phone</td>
<td>0.37</td>
</tr>
<tr>
<td>C6 Understanding roles and responsibilities</td>
<td>0.38</td>
</tr>
<tr>
<td>E2 Document management system</td>
<td>0.43</td>
</tr>
<tr>
<td>E10 Project info sessions</td>
<td>0.43</td>
</tr>
<tr>
<td>C5 Understanding what is expected from you</td>
<td>0.44</td>
</tr>
<tr>
<td>F8 Knowing how the job affects the project success</td>
<td>0.52</td>
</tr>
<tr>
<td>E11 Communication by email</td>
<td>0.55</td>
</tr>
<tr>
<td>G2 Informal and ad-hoc meetings</td>
<td>0.65</td>
</tr>
<tr>
<td>E8 Project team meetings</td>
<td>0.69</td>
</tr>
<tr>
<td>C7 Introduction to communication methods and tools</td>
<td>0.69</td>
</tr>
</tbody>
</table>

According to the survey results, the project personnel in case E are very aware of each one’s role in the project (C6, C5 & F8). In addition, the survey respondents are satisfied with the use of typical media (E12 telephone, E11 email, E8 project team meetings, G2 ad hoc meetings, and E10 info sessions). Additionally, the survey respondents are satisfied with the document management system (E2) and introductions to communication methods and tools (C7).

The most important communication challenges in case E are presented in Table 14.

Table 14. The most important communication challenges in case E.

<table>
<thead>
<tr>
<th>Question</th>
<th>Difference between mean values of &quot;importance&quot; and &quot;satisfaction&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3 Receiving feedback on contributions to the project</td>
<td>1.79</td>
</tr>
<tr>
<td>C2 Project communication in general</td>
<td>1.57</td>
</tr>
<tr>
<td>G3 Training of personal communication skills</td>
<td>1.49</td>
</tr>
<tr>
<td>F7 Team building</td>
<td>1.39</td>
</tr>
<tr>
<td>F3 Communication between teams</td>
<td>1.37</td>
</tr>
<tr>
<td>C4 Communication planning</td>
<td>1.31</td>
</tr>
<tr>
<td>F10 Open and honest communication</td>
<td>1.26</td>
</tr>
<tr>
<td>F2 Communication inside the project team</td>
<td>1.16</td>
</tr>
<tr>
<td>F9 Knowing how the project affects the overall business</td>
<td>1.10</td>
</tr>
<tr>
<td>D6 Communication with the program customer</td>
<td>1.09</td>
</tr>
</tbody>
</table>
According to the survey results, project communication in general (C2) and communication planning (C4) are considered challenging. Additionally, communication with the customer (D6) is experienced challenging.

The survey results had some contradicting results. Although personnel were satisfied with introductions to communication tools (Table 13), training of communication skills was considered as a challenge. Also, although survey respondents knew their own role in the project, they still considered open and honest communication (F10) as a challenge and felt that they receive inadequate feedback (G3) and business level information (F9).

In addition, although team meetings were considered to work well (Table 13), communication inside the project team (F2) and between teams (F3), as well as team building (F7), were considered challenging.

4.5.3 Development targets

To define themes or topics that the case representatives would name as future development actions, the focus group work was arranged. The focus group in case E involved 9 persons representing different roles in the project (engineering personnel, management, and supporting personnel).

The results of the survey were the starting point for the focus group work. The focus group work started by identifying the topics that according to the participants, needed improvement action the most (Appendix 4). A large proportion of them relate to interaction: communication between sites, communication between teams in the same and in different projects, team building, feedback, communication skills, open and honest communication etc. Moreover, one of the most popular topics was communication planning and the communication plan. Information on customer and overall business was identified as one topic potential for development. Additionally, communication of changes and timing of information were defined as important.

Then, the topics were categorized. Improvement ideas by the participants were discussed for each category. The five categories and the improvement ideas identified by the focus group participants are as follows:

1. Communication between teams. The focus group participants highlighted the importance of communication between teams. This includes both teams in the same and other projects as well as possible supplier’s teams. They named a number of activities for more effective communication between teams:
creating uniformity e.g. norms and having shared goals, rearranging some working habits (e.g. cross-participation to meetings, job rotation), shared events and hobbies, understanding different roles, co-location of teams or visiting other sites, and sharing information of e.g. info letters or info sessions. According to the focus group participants, and important aspect was management commitment for enhanced communication between teams;

2. *Communication skills.* The focus group participants agreed that it is better to communicate too much rather than too little. They stated that an open communication culture should be supported (management sets the example). Training in communication skills should include presentation skills and how to express oneself, negotiations skills, personal communication and listening skills, giving feedback, foreign language skills, and cultural differences. The participants considered it important that, in addition to traditional training, learning by doing should be supported e.g. by creating presentation situations in meetings or ‘infos’. Moreover, regular rounds of feedback should be arranged;

3. *Communication planning.* The focus group participants agreed that there should be more effort put into communication planning. Once the communication plan has been created there should also be training on how to utilize it. The communication plan should be a framework-like checklist to be used in every project after it has been tested in pilot projects. The communication plan should include definitions on to whom, how, and when to share information, interfaces, roles and responsibilities related to the project (including different stakeholders), and definition of communication practices in general such as meeting practices and reports. Communication might include a communication map;

4. *Understanding of customers and business.* In general, the participants agreed that understanding the overall picture motivates project personnel. The participants’ suggested business training on all levels and customer visits (to or by the customer) and presentations. Customer and business info should be shared at ‘infos’ and should include the overall picture and reasoning why your job is important, the project mission, customer needs, business effect of not achieving the plan, road maps, feedback from other sites and customers. Moreover, the most important requirements should be clearly communicated to suppliers;

5. *Timely communication.* The participants considered communication at the right time as difficult: if it was too early there might still be changes and if
too late this might cause rumors. This problem should be addressed in the project communication plan. Good media for timely communication are info sessions and info letters.

4.5.4 Main findings from case E

In this chapter, the researcher draws case-specific conclusions based on the results from the interviews, organization’s internal documents, survey and focus group. In addition, these findings are discussed in relation to relevant theories.

Based on the organization’s internal documents, despite the large size of the company and the complexity of its business, the number of documented guidelines, templates, and instructions was relatively low. For example, it turned out that during the interviews it was challenging, almost impossible to draw an organization chart of the project. The organization seemed so complex that even the interviewed personnel could not describe the organization structure in detail. Still, this did not bother them: rather they were amused by this. The principle seemed to be that everyone knows the persons they should know in order to perform their job. It seemed that the complexity of the business has not been addressed by tightening rules but by being open and flexible. However, according to the interviews, those documented guidelines that existed were also effectively implemented and followed by the personnel.

According to the organization’s internal documents, the case had no specific project communication plan template in use. However, communication and communication follow-up were considered in project management documents. Based on the discussions in the focus group, the case E personnel appreciated investing also in drawing up a project communication plan template, but they wanted to keep it as simple as possible. A checklist-type communication plan template could be suitable for use in the case E organization. Although project management standards consider this viewpoint (see e.g. Project Management Institute 2004), there is little earlier research concerning project communication planning.

In case E, the focus group participants stated that it would be motivating to receive more e.g. business level information or information about other projects. This is also supported by the survey results, see Table 14. Sharing this kind of information was considered as a motivating opportunity. Also, in the theoretical part of this dissertation it is stated that deep involvement increases motivation at work (Amabile et al. 1994).
According to the survey results and focus group discussions, communication between teams was one of the key challenges. As explained in the theoretical part of this dissertation, different teams represent different sub-cultures (see e.g. Sakmann 1992) and may also be geographically distant to each other (Gibson & Cohen 2003). Case E focus group participants named some interesting ideas how to enhance communication between teams, as explained in Chapter 4.5.3.

The survey results show that training of personal communication skills was one of the key challenges (Table 14). This challenge was also discussed in the focus group. In addition to the communication skills essential in project work identified in other cases (see previous chapters), the ability to be a good listener was highlighted in case E. According to the focus group participants, it is easy to present your ideas but how to ensure that you will be heard? By creating a culture of listening. To develop different communication skills, the case E participants emphasized the “learning by doing” attitude: give personnel possibilities for learning while working (e.g. how to prepare meeting minutes, or short presentations). In addition, organizational knowledge and sharing good working practices is promoted by job rotation, as suggested by the case E personnel. The outlook of the case E focus group participants supports the concept of overall communication competence as stated by Rubin (1990) and as described in the theoretical part of this dissertation.

According to the survey results, receiving feedback on personal accomplishments was considered as a challenge (Table 14). The topic was also discussed in the focus group. However, the outlook was different: the participants emphasized the importance of learning to give and receive feedback. Receiving feedback – especially corrective feedback – is not easy.

Team building was listed as a communication challenge (Table 14). However, during the interviews it was revealed that there were rather many and varied efforts for implementing a good working atmosphere. In certain positions, the number of possible events is so high that one even may have to choose in which events to participate. The variety of activities aimed at building a good team spirit included also other ways than just evening gatherings.

Timely communication was one of the development targets discussed by the focus group participants. Providing accurate information in complex continuously changing high tech project environment is not as easy as one would hope. However, investing in systematic communication planning may enhance addressing this problem.
In general, the focus group participants’ ideas were innovative and not bureaucratic: e.g. job rotation, shared working teams with members from different teams and/or projects, and a communication plan as a checklist. It was obvious that the participants tried to come up with easy and workable solutions to the problems. Even if they identified the importance of management commitment, they did not pass the responsibility of doing things right to some other party. The personnel felt positively towards their job and its development.

Managerial implications from case E are as following:

– project communication practices reflect the overall organizational culture;
– documentation and instructions in project communication planning practices should be considered in relation to other organizational practices.

4.6 Cross-case analysis

In this chapter, the data from the studied cases are summarized and compared. First, current project communication practices in all the cases are presented based on the interviews and organizations’ internal documents. Then, primary information sources and typical communication problems obtained from the case surveys are presented. After that, communication challenges are identified by comparing the mean values of VAS questions of these surveys. In addition, development targets identified by the focus groups are presented. For each of the viewpoints mentioned above, the raw data are first presented, then the researcher analyzes and discusses the data.

4.6.1 Current project communication practices

Organizational internal documents reveal that in all other cases, except case A, there were no special guidelines or specific documents for project communication. In the case A, there was a project communication process described and a project communication plan accomplished including e.g. definition of communication roles and responsibilities, guidelines for communication in different situations, media and information management systems. However, in other cases at least some communication aspects were considered in other project management guidelines. It was typical that guides for project management plans included e.g. meeting practices and frequencies (case B, C, D, E), information management
tools and documents used in the project (case B, C, D, E), a report plan (C), contact/responsible persons defined (C, D), or communication follow-up (E).

Communication follow-up practices were rare in the studied cases. In case E project management processes included project communication follow-up practices. In case A, project communication process description included communication monitoring, but evidence of conducting this was lacking. However, in all of the studied cases communication was typically considered in other organizational level surveys.

In addition, only in case A there had been earlier development efforts concerning specifically project communication. In the other cases, communication had not been considered or the topic had been considered as part of other development efforts.

The aspects of planning and monitoring communication have been acknowledged in project management standards (see e.g. Project Management Institute 2004). Results of this study show that, in the studied high technology companies, there are deficiencies in implementing these in practice.

The research results of the empirical part of this thesis show that the most often used media (see Appendix 1) in product development project include phone, email, different kinds of meetings (at different organization levels), intranet, and electronic data management systems. Research concerning groups with remote members (see Chapter 2.4.3) highlights that technological advancements enhance communication in such a context. However, results of this study show that, regardless of the high technology environment involving communication at-distance, the traditional media – telephone, email, and meetings – still have essential roles.

4.6.2 Information sources

The survey results show (Fig. 29) that the personnel in studied cases have differences in what they consider as their primary information source. In addition, profiles of primary information sources vary between the cases, and there are surprisingly large differences between the cases.
Analysis of the data

Considering the survey results for primary information sources in the cases (Fig. 29), it seems that personnel have an essential role. Especially in the cases A, C, and D personnel are the most cited primary information source. In case E, personnel have a significant role, but meetings and ‘infos’ are cited in an even larger proportion of the answers. It can be concluded that personal networks play an important role in how and what information a person receives.

In contrast, in case B none of the survey respondents named personnel as their primary information source. Instead, meetings and ‘infos’ were the most cited primary information source. An explanation could come from the context of the business role of the company B: the B organization operates as a subcontractor, and a large part of relevant and important information relates to the customer and is shared especially in meetings. The essential information needs related to the customer are better supported by meetings and infos than by a personal network within the case B company.

In case A, the results from the interviews and organization’s internal documents highlighted that the case organization has significantly invested in...
documenting process descriptions and different guidelines. The results also emphasized the essential role of the intranet. However, in the survey results, instead of the intranet or data management systems, personal networks were most often cited as the primary information source. Official and actual practices seemed to be at variance.

The role of the data management system as a primary information source is emphasized in case C. Case C is also, as seen earlier in this chapter in Table 3 & Table 4, the only case operating in the SW industry and C is the only project that involves software development solely. Developing software differs from other development: in software development the product itself is an electronic document that needs to be stored in a database. Software developers are used to practices required for proper documentation. In other cases the product is a physical element, and information related to it is in the form of documents that are stored in printed form or in databases. Again, a possible explanation for primary information source may come from the business of the organization.

The survey findings of this study suggest that personnel have an essential role for primary information sources in the studied cases. However, also data management systems are utilized. This finding of this research supports the statement by Hertzum & Pejtersen (2000) that engineering personnel use both personnel and documents to satisfy their information needs.

4.6.3 Typical communication problems

The survey results show that the personnel in the studied cases consider typical communication problems differently (Fig. 30). There are also large differences between the cases. However, communication problems between different sites seem to play central role in all of the cases. Especially in cases A, D and E, communication between different sites is the most often cited source of typical communication problems.
Analysis of the data

Communication between different sites seems to be an important source of communication problems in all of the studied cases (Fig. 30). In case A, the largest proportion of the answers identify communication between different sites as the most typical source of communication problems. In the case A program the personnel has many locations in Finland and internationally (see Table 4).

In case A, the second largest proportion of the answers – communication between different projects/programs – may refer to communication problems
because of organizational boundaries. In addition, it is typical that there are several projects with similar objectives run at different times. Sharing information between these projects may have been a reason for the problems indicated in the survey results.

From Fig. 30 it seems that, in case B, the team and project management are the most cited source of typical communication problems. However, a closer analysis of the answers in Table 23 in Appendix 3 shows that the problems are mainly experienced between the team and the program manager. An explanation may come from the fact that case B is a subcontractor. There is a project/team manager within the case B organization and a program manager within the customer organization. The case B project is part of the customer’s larger program. Possibly, the problem indicated in the results refers to problematic communication between the team and the program manager of the customer.

Moreover, the second – communication between different projects/programs – and the third – communication between persons from different sites – largest proportions of the responses may refer to the same problem: problematic communication between the case B project personnel and the customer.

The case C organization has the same type of role in the business as the case B: the project is conducted due to specific order by the customer. The typical communication problems are the same as in case B. Communication problems are most often seen to occur between the project and the customer. The second largest proportion of typical communication problems occur between persons from different sites, which may refer to communication between the teams within the project, or communication between the project personnel and the customer.

In case D, the most cited typical communication problems are said to occur between persons from different sites. However, also the next three – between project and the customer, between different projects, and between different professions – have gained almost as large a proportion from the respondents.

In case E, the largest proportion of the answers to typical communication problems refer to those with persons from different sites. Furthermore, communication between different professions and team and project management represent a majority of the answers.

The analysis of the results reveals that the most cited communication problems are somehow related to boundary spanning communication. The boundaries may be physical (between different sites) or organizational (between different teams or projects). These results support earlier literature on communication challenges. E.g. Allen (1970) emphasizes that physical
boundaries are a reason for communication challenges in both project internal and external communication. However, communication problems between different projects, as identified in this research, may also be due to projects/sub-projects being run at different times.

### 4.6.4 Communication challenges

The top ten most important communication challenges in the cases were identified by comparing the mean values of VAS questions of the surveys (see Table 15). Four challenges were identified as highly important in all of the cases. These were a) training of personal communication skills, b) receiving feedback on one’s contributions to the project, c) communication between teams, and, d) open and honest communication.

#### Table 15. Summary of the top ten communication challenges.

<table>
<thead>
<tr>
<th>Communication challenge</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3 Training of personal communication skills</td>
<td>A,B,C,D,E</td>
</tr>
<tr>
<td>G4 Receiving feedback on contributions to the project</td>
<td>A,B,C,D,E</td>
</tr>
<tr>
<td>F3 Communication between teams</td>
<td>A,B,C,D,E</td>
</tr>
<tr>
<td>F10 Open and honest communication</td>
<td>A,B,C,D,E</td>
</tr>
<tr>
<td>C11 Being kept up-to-date with changes</td>
<td>A,B,C,D</td>
</tr>
<tr>
<td>E2 Document management system</td>
<td>A,B,C,D</td>
</tr>
<tr>
<td>C2 Project communication in general</td>
<td>B,C,D,E</td>
</tr>
<tr>
<td>D6 Communication with the program/project customer</td>
<td>A,C,E</td>
</tr>
<tr>
<td>F7 Team building</td>
<td>A,D,E</td>
</tr>
<tr>
<td>C4 Communication planning</td>
<td>C,D,E</td>
</tr>
</tbody>
</table>

#### Analysis of the data

Four of the communication challenges (Table 15) have an important role in all of the cases. The challenges present in each of the five cases include: training of personal communication skills, receiving feedback, communication between teams, and open and honest communication.

Training of personal communication skills, according to the survey results, was the most important challenge in the cases. However, in the focus groups it was revealed that it is unclear what is meant by communication skills.

Receiving feedback was also an important challenge in all of the cases. Based on the focus group findings, feedback can be considered in many ways.
related feedback can be gained from the customer and refers to all change requests and other feedback on how the product operates. Process feedback refers to how well the operations – like certain project management practices – are working, and is typically gained from the customer. However, process related feedback can be given also to a customer, especially when both parties involved have an interest in improving the performance of the relationship.

In contrast to the earlier mentioned, personal feedback refers to how well one has accomplished a job, and comes typically from the foreman. In addition, workmates can serve as a source of personal feedback.

Communication between teams was also one of the top ten challenges in the cases. This may refer to communication between teams located in different sites (discussed earlier in this chapter), or to communication between persons representing different work roles (professions). Open and honest communication refers to a desire for a supportive climate, which is promoted by adequate feedback.

Keeping up-to-date with changes and document management system were not among the top ten challenges in case E. These two may be related to each other, as detailed change information is essentially in documents and databases.

Project communication in general is on the list of top ten communication challenges in all other cases except case A. Based on the interviews and organization’s internal documents, case A had had the largest investments in project communication development.

Surprisingly, the challenge of communication with the project customer is present in cases A, C, and E, but not on case B, although communication with the project customer got the second largest proportion of the answers to typical communication problems in case B.

Team building is seen as a challenge in the cases A, D, and E. In the cases A and E, organizing team building activities is more challenging than in other cases due to the large organizations. The results from the interviews indicated that, in a large organization, there sometimes are even too many team building activities as one person may simultaneously have numerous projects, contacts, and interfaces. On the other hand, in case D evening gatherings were held most often of all the cases. Seemingly, evening gatherings are not the best way for team building.

Communication planning was a challenge in cases C, D, and E. In case A, relatively many actions had been taken for improving project communication. The case B is a relatively small organization which may affect why communication planning is not seen as an important challenge. In addition,
because case B operates as a subcontractor and a part of a larger project by the customer, the emphasis on project communication management is more on the customer side. In cases C, D, and E, earlier efforts on developing project communication have been minor. One reason for this in cases C and D may be the relatively small size of the companies.

### 4.6.5 Development targets

The focus group work was arranged to identify what communication issues the studied cases would select for further development. A summary, presented in Table 16, reveals that only some of the topics are the same as the survey results indicate. The first development target varies among the cases. The second development target in the cases related to communication planning (in case E the third).

#### Table 16. Development targets by focus group participants.

<table>
<thead>
<tr>
<th>Nro</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Communication of changes</td>
<td>Document management system</td>
<td>Communication between teams (in a same project)</td>
<td>Assignment of responsibilities</td>
<td>Communication between teams</td>
</tr>
<tr>
<td>2</td>
<td>Communication plan and tools</td>
<td>Communication planning</td>
<td>Communication planning</td>
<td>Communication planning skills</td>
<td>Communication planning</td>
</tr>
<tr>
<td>3</td>
<td>Boundary spanning communication</td>
<td>Understanding the business context of the project</td>
<td>Communication skills</td>
<td>Change management</td>
<td>Communication planning</td>
</tr>
<tr>
<td>4</td>
<td>Document management system</td>
<td>Project specific intranet pages</td>
<td>Communication with other projects</td>
<td>Email practices</td>
<td>Understanding of customer and business</td>
</tr>
<tr>
<td>5</td>
<td>Open and honest communication</td>
<td>Feedback</td>
<td>Feedback and lessons learned</td>
<td>Feedback</td>
<td>Timely communicating</td>
</tr>
<tr>
<td>6</td>
<td>Communication skills</td>
<td>Open communication</td>
<td>Meeting culture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Analysis of the data

Only some of the development targets (Table 16) named by the focus groups were the same as the survey results indicated. One explanation for this may be that
possibly the focus group participants did not have any influence on certain issues highlighted in the survey results and thus these topics were ignored during the focus group work.

The first development target varies among the cases. The second development target in all of the cases seems to be related to communication planning (in case E the third).

In case A, the complex project environment includes a significant amount of change requests. Detailed information on these is in documents and databases. As the earlier results show, data management systems are not the most important information sources for the case A personnel, which may have an effect on the choice of communication of changes being the first on the list of development targets.

In high technology product development projects there are constant changes in project and product scope, as may be the case also in the organization. As suggested in the theoretical part of this dissertation (see e.g. Amabile et al. 1994, Ammeter & Dukerich 2002, Thamhain 2007, Sarin & O’Connor 2009), deep involvement and understanding roles & responsibilities is important for project personnel. Based on the empirical findings of this study, high technology product development as a working environment with constant changes brings extra challenges for communicating up-to-date information concerning roles, responsibilities, and tasks at hand.

In case B, as earlier data shows, communication problems mostly relate to communication with the customer. One of the difficulties, identified in the focus group, was that the case project personnel had to use the customer’s database, which, with certain customers, brought extra challenges to document management and organizing the process (e.g. getting the user rights). Thus, the document management system was named as the first development target. It seems that with certain customers, case B organization did not have two-way symmetrical communication, as proposed by Grunig & Dozier (2002).

In case C, the project personnel was organized into two teams which were located in different parts of Europe. Improving the communication between these two teams was identified as the first development target. This finding supports earlier literature that communication at-distance is challenging (Gibson & Cohen 2003).

In case D focus group, a new problem not noticed from earlier data (the interview, the organization’s internal documents, and the survey) was identified. Among the project personnel, there was a lack of information and implementation
of roles and responsibilities related to these roles. The focus group participants were, to some degree, frustrated as too often the responsibilities were unclear. Thus, the assignment of responsibilities was listed as the first development target in case D. As stated in the theoretical part, it is important for personnel to be aware of roles and responsibilities related to the task at hand (e.g. Ammeter & Dukerich 2002, Thamhain 2007, Sarin & O'Connor 2009).

In case E, communication between teams was listed as the first development target. In a large project with several teams, improving communication between the teams could be considered beneficial. Each team represents different subculture (Sakmann 1992).

The second development target in the cases related to communication planning (in case E the third). In case A, after some earlier development actions had been carried out, a more detailed development target was named: communication plan and tools. During the focus group work, the participants realized that communication is a matter that needs to be planned – just as the outcome, schedules, risks, etc. Communication planning is considered also in project management standards (see e.g. Project Management Institute 2004).

Other development targets in case A are in line with the survey results. In a very large and complex organization, as the case A is, there are plenty of organizational (different projects/project teams) and physical (different locations) boundaries, bringing extra challenge for managing communication beyond the boundaries. These are also emphasized as challenging for communication in theory (see e.g. Allen 1970, Gibson & Cohen 2003). Management of data systems was also on the list of top ten communication challenges in case A. The focus group participants argued that, the current network of databases and its management are too complicated. Also, earlier literature (see Chapter 2.3.1) suggest that data management systems should support the user needs. Open and honest communication was problematic due to the project having a number of external personnel (workers from other companies): the focus group participants stated that sometimes it is unsure about what information can be shared with them.

The third development target in case B concerns understanding the business context of the project. There are two points of views: 1) information about the project customer and customer feedback, and 2) understanding the business importance of the project in question. Sharing this kind of information would motivate project personnel, as suggested also in earlier theory (see e.g. Amabile et al. 1994).
The fourth development target in case B is creating project specific intranet pages. The fifth development target is feedback. In case B, this referred mostly to product and process related feedback. The Case B focus group participants needed more and more frequent feedback from the customer, and emphasized the importance of giving feedback also to the customer.

Compared to other cases, case B had less emphasis on internal training. Thus, the sixth development target was training communication skills.

Also case C personnel listed developing communication skills as one of the development targets. However, in case C, the focus group participants were able to identify in more detail what skills this would mean. In case B the need was on improving presentation skills and understanding the overall project communication process, whereas in case C the need was on improving interpersonal skills, skills in English, knowledge of other cultures (relevant to the case personnel), writing meeting memos, and also knowledge of the overall communication process and tools.

The fourth development target was listed as improving communication between projects. In case C, communication between projects was partially limited by NDAs, which also hindered sharing e.g. technical information between the projects: for example, a certain technical problem could be solved in a number of projects while the organization would be more efficient if the information of how to solve the problem would be shared among other projects.

The fifth development target in case C was identified as feedback and lessons learned. In case C, the feedback referred more to personal feedback. As proposed in the theoretical part of this dissertation (see e.g. Thamhain 2007), personal feedback concerning your contributions from the foreman is considered important.

Although emphasized in the survey results, communication with the customer was not selected on the list of development targets by the case B and C focus group participants. An explanation for this could be that the focus group participants did not have any real influence on developing that issue. What the participants could do is to invest in the organization’s internal communication and present suggestions to customers on how to improve communication between the companies.

The third development target in case D was named as change management. Case D focus group participants, especially engineering personnel, felt that all change requests were not justified and carefully considered. This is related to the first development target, assign of responsibilities: if clear roles and
responsibilities would exit, it would be easier to give reasons and authority for changes.

In case D, the fourth development target concerned email practices. There was a lack of competence for using email effectively and efficiently. Feedback, the fifth development target, concerned both product feedback from the customers (e.g. change request) and personal feedback. In case D, feedback from the customer and personal feedback needed better organization.

The sixth development target in case D, open communication concerned improving organizing project-related information. This is also supported by the literature (see e.g. van den Hooff & Riddet 2004) presented in the theoretical part of this dissertation. The seventh development target, meeting culture, concerned developing good meeting practices common to the whole organization.

In case E, communication skills were named as the second development target. The focus group participants in the case named a number of important skills to be emphasized in the organization. These included presentation skills, interpersonal skills, listening skills, and skills in giving feedback, expressing oneself, and training about foreign cultures and languages. In addition, it was argued that competence development would be enhanced if certain responsibilities, e.g. creating a meeting memo, or presenting team outcomes, would be rotated from one person to another. These findings support earlier literature (see e.g. Rubin 1990) emphasizing developing overall communication competence.

The fourth and fifth development targets by case E focus group participants were identified as “nice to have” and included understanding the customer and the business and timely communication. Although optimum for these it is difficult to define, and some improvement is always possible.
5 Discussion

This chapter begins with a presentation of the answers to the research questions after which it discusses theoretical and managerial implications of this dissertation. The theoretical implications document the results of this thesis comparing them with existing literature describing to what extent the results confirm or contradict the findings of other researchers, and what is totally new. The managerial implications describe the results by presenting recommendations for companies and their managers how to improve communication within the organization. Then, critical evaluation of the research is presented i.e. validity and reliability of the research is considered. Finally, possible routes for future research are suggested.

5.1 Answering the research questions

The overall aim of this research is to provide further information on how to manage and improve communication in high technology product development projects. This research has focused on finding answers to the following two research questions:

RQ1: What type of communication challenges are encountered in high technology product development projects as perceived by personnel?

RQ2: What are the possible solutions for addressing communication challenges encountered in product development projects?

Answering RQ1

To answer research question one it is concluded that challenges for communication originate from a variety of sources. Based on the results of this study, the communication challenges facing companies are strongly affected by the business role of the company and other current realities. For example, due to its strong dependence on the client, a subcontractor faces different communication challenges compared to a company with own products.

According to the results, especially the cases concerning subcontractors emphasized that communication with the customer was one of the main sources of communication problems. It seems that in a business relation with more or less co-organized product development, the challenges for communication increase.
These challenges are because of the physical distance, and organizational and cultural (ways of conducting certain practices) boundaries.

By the time research data were gathered from the cases, the case organizations had had only limited efforts for developing project communication. Only one of the cases had put considerable efforts into developing communication. In other cases project communication had been considered as part of other activities, for example a project plan could include a description of communication responsibilities. Much of the communication challenges are due to companies not recognizing the importance of investing in communication. Thus, a challenge is to understand advantages of putting efforts on project communication development. The business role of companies also limits the possibilities of developing their internal practices. Consequently, challenges are company dependent and development actions need to be case-specific.

However, some challenges common to all the studied cases were identified in the empirical part of this dissertation. The most important is how to organize project communication in general. This includes the challenge of preparing more detailed communication planning with tangible instructions on roles and responsibilities. In most of the studied cases there was a lack of investment in communication planning.

In addition, the results of this study show that different kinds of boundaries influence the appearance of communication problems. Physical boundaries refer to communication between persons located geographically dispersed. Organizational boundaries may be within a company (between different units or projects) or between companies. In addition, different teams within a project may consist of persons with different technical competences bringing extra challenge for organizing communication between different professions.

In modern high technology product development with complicated products and development networks, in addition to personal networks, the essential role of different data management systems as information sources was highlighted in this thesis. In addition to product and project related information, process descriptions and other information on organizational practices are typically available in databases. Based on the results of this research, data systems are of great importance as information sources for R&D engineers. However, existing data systems have too often been constructed from the technical (or managerial) rather than the user point of view. It is challenging for companies to develop user friendly data systems that would support practical work, especially the work of
engineering personnel. Additional challenges come from tailoring the systems to different user groups.

*Open and honest communication* was on the list of top ten challenges (Table 15). In the focus groups (cases A&D) it was found that, within a case, problems with open and honest communication were not related to a lack of trust. The real problem was not that the communication climate would be bad but, rather the result originated from unclear rules for communication. These may be related to unclear responsibilities – whose responsibility it is for each communication task such as making certain decisions – or to unclear purposes of communication, such as what can be communicated to external personnel. It seems that product development and project work essentially means a systematic way of planning and conducting the work and tasks desired. The research results indicate that many practices could be improved simply by organizing and executing the practice in a more systematic way.

In addition, the results indicate a challenge of managing and organizing communication related to *change management*. In modern high technology product development, there are frequent changes in the scope of projects, product specifications, but also in personnel and even in the organization.

With regard to *communication skills*, the research results emphasize two different challenges. On the one hand, one challenge is to identify company specific relevant communication competences. On the other hand, the challenge is to invest in overall competence, especially motivation, which affects one’s behavior. The empirical part of this research revealed that while companies typically invest in different type of personnel training, the motivation aspect is too often ignored.

**Answering RQ2**

The purpose of research question two was to clarify how companies could enhance communication in product development projects. However, earlier in this chapter, it was concluded that the communication challenges depend on the business role and other current realities of a company. Similarly, the results of this study indicate that the company needs to define its *project communication development targets and actions considering the business role of the company* and possibly other current realities. For example, due to its business role, a subcontractor typically faces a challenge in communication with its client, and it may have only limited means of affecting the practices related to communication
with the client. Thus, communication development should not be considered separately but rather in close connection with the business and the role the company has in it.

Thus, based on the results of this study, it seems that instead of presenting detailed answers of how to organize communication in projects, it is more important to present alternatives to be implemented within the organizational realities. These alternatives are presented in the next paragraphs.

The results of this research highlight the importance of investing in communication planning and development. Based on the results, a company should have guidelines and/or templates for project communication planning. Communication planning should assist project personnel to accomplish project tasks by providing information concerning roles, responsibilities, practices and technologies related to project communication. Planning can be documented in the form of a project communication plan, which would include, for example, instructions on:

- the purposes of the document;
- how to find information (provide e.g. links to intranet and document management systems);
- how to transmit information i.e. guidelines for most typical (or recommended) media for project communication, and a communication matrix including the following aspects: what information, when, whose responsibility, how, and to whom;
- how to operate in certain situations;
- where to find support concerning project communication.

Project communication development should be based on an analysis of the effectiveness of current communication. Companies should have a follow-up system for project communication. Based on the results of this dissertation, there are different ways to perform this type of follow-ups. One way is to follow communication effectiveness in a project e.g. according to milestones. Another way is to organize regular communication audits. Auditing can be done either at project or organizational level, and may also be integrated into other personnel surveys. Both communication planning and development, as any other practices, should be adapted to the organization in question.

High technology product development projects typically involve a network of companies. Development work requires in-depth co-operation between the parties involved. Based on the results, companies – especially the client-companies –
should invest more in communication and trust building between the network companies. Because of its role, the subcontractor is typically very customer-oriented. However, when developing certain practices between organizations, it could be beneficial if the customer would also consider the point of view of subcontractors. Developing the business relationship together may be profitable for the both parties. A practical means of achieving this are cross-participation in meetings, and to provide feedback on communication effectiveness between the parties involved.

By studying the perceived communication, this research acknowledges the viewpoint of the project personnel. The empirical results show that company data management systems should be organized in consideration of the actual work done in projects and the information flows related to product development. In addition, change communication should be integrated into other processes of the organization. The results of this study indicate that change management could be improved by emphasizing clear rules, roles, and practices which will clarify who assesses and makes decisions about changes, and where the information related to change is stored.

Based on the empirical part of this dissertation, two kinds of challenges were identified concerning communication skills. First, companies may not be aware what kind of communication skills are needed by the project personnel. Secondly, training of the needed competences may not always be effective. The results of this research indicate that companies should invest in developing the communication competences of the project personnel. A company should define what the most important communication competences needed by the personnel are and provide training based on this analysis. However, it is not realistic to expect all personnel to participate in all the training. In addition, it should be noted that in practice competences also develop on-the-job. It could also be beneficial for the project personnel to pursue different skill profiles. However, some general skills important in high technology product development can be identified:

- skills in speech communication, especially presentation skills and skills in how to express oneself;

19 In the empirical part of this dissertation, the focus groups participants (cases A&D) identified communication of changes as one of the most critical development targets. In this discussion the respondents referred the term ‘changes’ to all kind of changes that they face during a project life cycle, both organizational and project & product scope related changes.
– interpersonal skills including at least the skills of listening, and giving and receiving feedback;
– negotiation skills;
– skills related to other cultures relevant to the organization including language and knowledge of culture specific practices;
– skills related to essential communication media and tools, as well as the overall communication processes in the organization.

A skill means an ability to obtain a goal, and, as explained in the theoretical part of this dissertation (see Payne 2005), is only one part of a larger concept, competence. Competence includes also the aspects of knowledge, e.g. of organization specific issues, and motivation, which directs one’s performance. Thus, companies should invest in overall project communication competence development. This would include:

– knowledge, concerning especially a) specialties of project working, b) organization specific communication rules and guidelines, c) the organization in general (to support personal network) and its practices;
– motivation behaving appropriately concerning communication aspects and for following disciplined project management;
– skills in relevant communication media and contexts, as mentioned above.

The results of this study show that telephone, email, meetings, and different documents are essential media in project work. Project personnel should have competence at least in these and specific tools related to them: for example, knowledge about when email is appropriate, motivation for using it properly, and skills such as stating the title clearly. Or, as another example, basic competence related to meetings would include at least knowledge of purposes of different kind of meetings, motivation to enhance meetings with proper preparation, and skills in expressing oneself properly in a meeting.

Feedback on how well one has accomplished one’s job – personal feedback – is given usually by the line manager. However, the results of this research suggest that there is also a need for the project manager to provide adequate personal feedback regularly concerning the project work.

The empirical part of this dissertation identifies numerous functional ways of organizing team building to enhance communication within and between teams. Sauna parties and evening gatherings are traditional for Finnish people, but they are not necessarily the best solutions. Instead, other activities such as social
events, shared hobbies, or competitions should be promoted. These kinds of activities would also serve as possible solutions for improving communication between projects.

The empirical results of this dissertation emphasize also other possible solutions for overcoming problems related to boundary spanning communication. At an organizational level, these include rotation of work roles and responsibilities and sharing communication lessons learned. Sharing lessons learned can be realized by providing a suitable database for this purpose. Project level solutions include sharing meeting minutes with relevant stakeholders and arranging kick-off meetings at the beginning of projects (especially if the project is physically dispersed).

The communication challenges from the survey results (Tables 6, 8, 10, 12 and 14) were only partly the same as the development targets identified by the focus groups (Table 16). This means that surveys as a method for information gathering provides different kind of information than focus group working. A survey is easy and time saving for both the researcher and respondents. However, focus group discussions provide more information and deeper analysis of problems. It seems that, in the development of practices and processes, some kind of workshops are needed to discuss the survey results in conjunction with other realities (e.g. resources, strategy) of the organization in question.

5.2 Theoretical implications

This study aims to deepen the existing literature from the perspective of communication in high technology product development. The empirical findings from this study emphasize that a company’s business role affects both the communication challenges and development possibilities the company has. Earlier research (Tukiainen 2001, Vos et al. 2005) points out that each organization has a specific communication culture. The findings of this research complement earlier research by emphasizing that communication challenges are company specific. Furthermore, Wiio (1978) states that general best practices for communication cannot be identified but that practices are rather organization-specific. Similarly, in this research it was showed that communication development actions are company-specific.

Earlier research on communication development has focused on an organization’s internal (Downs & Hazen 1977, Goldhaber & Krivonos 1977) or external (Ryder 1998) communication, while this research is carried out on the
understanding that these two aspects are closely interrelated. The challenges – and especially development – for internal communication, that has been the focus of this study, are affected by the challenges originating from the company’s external factors. Thus, contradicting the earlier literature, this study indicates that a company’s external realities set the scope also for a company’s internal communication development. This research emphasizes the importance of factors external to a company – such as business environment – for the development activities.

The research results of this study highlight the importance of systematic planning and organization of project communication. This should include a clear description of communication roles, responsibilities and practices. These findings are supported also by the previous literature (e.g. Caupin et al. 2006, Project Management Institute 2004). In addition, for example Lee-Kelley and Sankey (2008) note that the potential for project success is increased if the project has a strategy for overcoming problems related to at-distance communication. In addition, for virtual work groups, Montoya et al. (2009) suggest agreeing on basic ground rules of communication, such as how soon emails will be answered. This can be accomplished in a project communication plan and/or matrix, as proposed by the empirical findings of this study.

The results of this research show that one of the essential challenges of communication in R&D projects relates to communication between buyer and seller companies. The results support the findings of earlier research documenting the challenges managing the everyday interaction in a buyer-seller relationship (Lakemond et al. 2006, Wagner & Hoegl 2006, Wynstra et al. 2001, Ragatz et al. 1997). The earlier literature has at least two viewpoints on the challenge. One is that the challenge can be due to physical boundaries: e.g. Allen (1970) highlights physical boundaries as a source of communication challenges in both project internal and external communication. Another consists of considering the problem as originating from the companies having different ways of organizing communication. For example, Grunig & Dozier (2002) emphasize that the parties in a buyer-seller relationship should invest in two-way symmetrical communication meaning that the communication between the parties should involve dialog and willingness to adapt to the other organization’s practices. In addition, the empirical findings of this study propose that feedback should be provided between the parties involved. To enhance project communication between the client and the subcontractor, investments in trust between the parties involved are supported. The results support the findings of earlier studies.
indicating that both physical and organizational boundaries are sources of communication challenges. Ganesan et al. (2005) states that it is more important to create a good relationship between the parties than to be located next to each other. For example, blended teams increase a client’s trust, which in turn will increase a team’s internal trust, cohesion, and performance (Webber 2008).

It seems that in a business relation with a co-organized product the development challenges for communication increase. However, this research also highlighted that, besides physical and organizational boundaries between the companies involved, different kinds of inter-organizational boundaries – units, projects, teams – bring challenges for communication.

The results of this study highlight the essential role of data management systems as information sources in high technology product development. The challenge is to organize the systems to support the actual work and information flows within the projects conducted. These findings are supported by earlier researchers (e.g. Ebert & Man 2008, Sharma 2005). Also, Ameri & Dutta (2005) highlight that modern IT solutions should integrate people, processes and information. However, contrary to the suggestion by Ngai et al. 20 (2008), the results of this study suggests that, instead of having several systems, it seems even more important that the systems and the network of systems are easy to use and support practical work.

Scientific literature on communication often emphasizes the role of personal communication networks. For example, Glückler & Schrott (2007) report that successful project managers and teams have a more central role in the communication network within the organization. Whereas Kratzer et al. (2008a) found out that communication in an informal situation – within one’s social network – enhances creativity but possibly lessens productivity of work. While this research confirms the importance of personal contacts, it also highlights the role of data management systems in high technology product development communication.

High technology product development typically involves communication between geographically dispersed persons possibly even in different time-zones. O’Leary and Cummings (2007) state that technological advances support communicating at-distance and over different time-zones. However, the results of this study propose that the most typical media used in the studied projects are the

---

20 Ngai et al. (2008) claimed that it would be beneficial to have several data management systems for knowledge to accumulate.
traditional ones: phone, electronic mail and different kind of face-to-face meetings. Technological advances are to assist communication, but not in a central role.

The findings of this research support earlier literature documented by Ibbs et al. (2001) and Griffith-Cooper & King (2007) that communication related to change management is challenging. Detailed information concerning changes is provided essentially in documents and databases. The results of this study encourage promoting systematic change management, as suggested also by the earlier literature (Steffens et al. 2007), and clear documentation of roles and responsibilities related to change management and integrating change management into other project (and organizational) practices.

Regarding communication skills, the results of this research support the findings by den Otter & Emmitt (2007) that investments in communication competence are needed: it is important to focus on overall communication competence that includes the aspects of knowledge, skills, and particularly motivation. However, the findings of this study propose that organizations should also define what the essential communication competences in that particular organization are. This dissertation highlights the importance of motivation – as a crucial element of communication competence – of different actors to behave appropriately. Payne (2005) also notes that high job performers have a higher motivation and ability to adapt their communication according to actual situations.

The research results indicate that personal feedback should be provided regularly by the project manager. Moreover, Ángel & Sánchez (2009) highlight the importance of the R&D manager’s human resource management responsibilities, especially in managerial support among other aspects.

This research utilized the communication audit method. The findings suggest that it is beneficial to use multiple data collection methods, as proposed also by Downs and Adrian (2004). The literature emphasizes the importance of conducting audits regularly (Hargie & Tourish 2009). In addition, the findings of this study propose that communication follow-up should be arranged regularly also at project level.

---

21 In a case study from Netherlands documented by den Otter & Emmitt (2007), the author studied communication in design teams and found out that there was a lack of framework, and understanding – due to lack of training and management stimulation for usage – of electronic tools usage in team communication and collaboration (den Otter & Emmitt 2007).
5.3 Managerial implications

This research focuses on communication and its development in high technology product development projects. Such projects can be considered very complex as they typically are multi-technical, multicultural, geographically dispersed and usually involve more than one organization. In addition, there typically are several ongoing projects within the R&D unit. These settings bring special requirements for managing communication.

Such projects involve work by highly specialized personnel with different backgrounds and competences. The personnel in high technology companies – as the ones studied in this research – are competent and motivated to use different types of communication technology advancements. However, companies should understand that the traditional phone, email, documents and different kinds of meetings are still the most important media.

In addition, it is recommendable that the organization management acknowledges the status on communication within the organization. Management should have some kind of follow up system for communication in general. When developing communication, the process used in this thesis has proved functional: analyzing a project personnel’s satisfaction with the communication system and climate gives hints about what kind of interventions should be made in the communication system. However, it is essential that the results of the analysis are aligned with the other realities of the organization: a company needs to define communication development targets and actions by considering the business realities. In this research this was performed in workshops with organization specific focus groups.

Focus group work as conducted in this research is advantageous also because, during the work, the participants learn from the topic – project communication – and have a chance to consider how the project communication practices should be organized and managed within one’s organization. In addition, in this research the results of the focus group work – practical solutions on how to develop project communication – were shared with other cases providing a benchmarking opportunity for the organizations.

Seemingly, the organization’s role in the business (and the product) notably affects the operations and culture within a company. Moreover, it seems that the way the organization has learned to cope with its environment directs the way the organization develops its internal processes and practices. In this research an attempt was made to define possible solutions for how to develop project
communication. These identified solutions can be used as inspiration in inter-organizational communication development efforts, although the implementation has to consider the organization specifically.

It seems that essentially product development and project work means a systematic way of planning and conducting the work and tasks desired. The research results indicate that many practices could be improved simply by organizing and executing the practice in a more systematic way. Additionally, the results highlight the essence of communication planning and clear articulation of communication roles, responsibilities and rules. It would be beneficial to agree on these matters at a project level, and describe them in a communication plan or matrix. A project communication plan could include the following aspects:

- the purposes of the document;
- how to find information (provide e.g. links to intranet and document management systems);
- how to transmit information i.e. guidelines for most typical (or recommended) media for project communication, and a communication matrix including the following aspects: what information, when, whose responsibility, how, and to whom;
- how to operate in certain situations;
- where to find support about project communication.

The importance of developing the communication competence of project personnel was highlighted from the results of this research. Managers should pay attention to the development of overall competence including motivation rather than just certain skills of their personnel. The cases in this study show that communication competence relevant to product development work depends on the individual work role and organization specific realities. It is not realistic that everyone in the R&D organization goes through the same training but project personnel could have different kind of communication competence profiles.

In the empirical part of this study, from the subcontractor point of view, the problems in communication with the customer were emphasized. To enhance the relationship investment in communication between the parties are supportive. For example, it is typical that the seller follows up customer satisfaction by surveys etc, but there could also be a survey from the seller viewpoint studying what aspects could be improved to help the seller serve the client better.

This research highlights the integral role of data management systems in product development. However, it is important that the personnel are capable and
motivated to use the systems as they are planned to be used. In addition, the systems – and especially the network of systems that the personnel use – should be designed to support the work of project personnel as it has a significant impact on personnel motivation. In addition, special attention should be paid on how the systems support work if the project involves personnel from more than one company.

In product development, changes for project and product come frequently. The results indicate that change management could be improved by emphasizing clear rules, roles, and practices – which would clarify who assess and makes decisions of changes –, and where the information related to change is stored. In addition, it is important to integrate change communication into a project life cycle, possibly forthcoming development projects and product development in general. One possibility, as reported by Augustine et al. (2005), is to apply agile project management methods that provide practical solutions for the project group to track changing circumstances, such as accomplishments, customer requirements and how these two meet, continuously and faster (in shorter time cycles).

The empirical part of the research addressed some simple possibilities for improving communication between teams. At a project level these included sharing meeting minutes with relevant stakeholders, and arranging a kick off meeting at the beginning of the project (especially if the project is physically disperse). On the level of a product development unit the rotation of work roles and responsibilities could be considered, or promoting sharing communication lessons learned e.g. by providing a suitable database for lessons learned to be stored and processed for utilizing and updating the database.

The results of this study indicate that company management should develop a supportive communication culture that the project personnel perceive as open and fair. It is important for the project personnel to feel their efforts being appreciated. A project manager should provide feedback for the project personnel adequately. In a supportive communication climate, the project members can provide a source of personal feedback.

In addition to databases, project members’ personal networks are in a central role for members to acquire information. The personnel should be encouraged to develop personal networks. Project management could also invest in arranging a kick-off meeting at the beginning of a project with an informative part on the project desired outcomes, tasks, resources, schedules etc., and another part for
project members to get familiar with each other, and for team members to discuss and agree on the organization of practical work.

5.4 Evaluating the research

In this chapter validity and reliability of the study are discussed. Construct validity means establishing correct measures for the concepts being studied. Internal validity means evaluating whether the presented causal relationship, whereby certain conditions are shown to lead to other conditions, truly exists. External validity means identifying the domain to which the findings can be generalized. When assessing reliability one is interested in whether the operations of the study can be repeated, with the same results. (Yin 2003, Saunders et al. 2007).

Construct validity

Construct validity is an evaluation of whether the research settings are suitable to study the concepts selected to be studied. According to Yin (2003) two steps have to be covered:

- select the specific types of changes that are to be studied (and relate them to the original objectives of the study);
- demonstrate that the selected measures of these changes do indeed reflect the specific types that have been selected.

Typically a case study strategy provides a broad view of the phenomena (compared e.g. to a survey) and thus has naturally good construct validity. Tactics to meet these requirements include using multiple sources of evidence, establishing chain of evidence, and having key informants review a draft of a case study report (Yin 2003).

In this research multiple types of data were used for gaining the empirical evidence. Both quantitative and qualitative data were used. The research process within each case had the following phases: interviews, studying the organization’s internal documents, a survey of the project personnel using a web-based questionnaire, and focus group work. Each phase was documented by the researcher and the documentation was inspected by the case representatives.

The purpose of this dissertation was to reveal the perceptions of people working in high technology product development projects relating to
communication challenges and possible solutions. Based on this information, this dissertation proposes directions for developing organizational practices. It can be concluded that by the research process with multiple data collection methods this kind of information is possible to gain. However, there are number of shortcomings. For example, for the survey respondents, answering two-dimensional VAS-questions can be difficult. It was not tested, whether the answers would be the same, if VAS-questions were divided into two more traditional Likert-type questions. In addition, the survey was created based on earlier literature and interviews. The conducted survey was considerably different from other earlier surveys (e.g. sentence structures of the questions). The survey validity was not tested, which can be considered as one of the main challenges of this study.

Insufficiencies related to focus group working include that the focus groups involved only a limited number of persons. Additionally, as it was the purpose to obtain the perceptions of project personnel, most of the participants were engineers. However, compared to managers, project personnel have different viewpoint on organizational management and development. This gives a reason to question whether possible solution ideas discussed in focus groups can really be implemented. Also, although the researcher attempted not to influence the contents of the focus group discussions, it is still questionable how much influence she had on the gained results.

Internal validity

Internal validity is an evaluation of whether the causal relationship professed truly exists, or could it be by coincidence. This study has attempted to identify, based on project personnel’s perceptions, communication challenges faced in high technology product development projects and identify solutions to develop communication in such projects. Communication challenges were first studied by using a survey among project personnel, and then again in focus groups. The focus group work provided support and more in-depth explanation for challenges identified in the survey.

This research has a strong emphasis on perceptions by personnel working in the studied organizations. This can be considered as a weakness. For example, interviews that provided information on typical communication media, involved only very limited proportion of personnel. In addition, the interviewees had a strong influence on which internal documents were provided for closer analysis.
Additionally, the validity of the survey was not tested. Also, possible solutions were identified based on the discussions with each case focus group members. It was not tested in this study whether the identified solutions really work in practices: the implementation of the identified solutions was left to the case organization’s responsibility. However, these shortcomings in internal validity have been attempted to overcome by using multiple data collection methods.

**External validity**

External validity describes the extent to which the results are generalizable. The case study approach has been a target of criticism because the challenge of generalizing the results (Hamel et al. 1993). In this study, the empirical material is from high technology organizations operating in the Oulu area: the material collected is from a very limited geographical area and thus generalizing results can be criticized. If some generalization is to be made, the discussion of project communication presented in this thesis can be considered relevant for high technology product development projects. For other types of projects, like construction projects, the discussion may have a different emphasis.

For qualitative studies, it is often argued that external validity is not relevant or even reasonable to argue. Nonetheless, Schofield (2002) emphasizes the importance of considering external validity i.e. the generalizability of a qualitative research, too. Schofield (2002) argues that certain choices made in defining the empirical research settings can enhance the external validity of a qualitative study. First, if one studies a typical case, it is more likely that the results are applicable to a larger group. Secondly, if one selects very different types of cases and makes the same kind of conclusions about them, the results may be considered more significant.

In this study, the case selection followed a process, starting with the selection of five typical high technology companies operating in the Oulu area. It is typical for the area that there are only a few large companies and number of smaller and younger companies. This aspect was considered by selecting two large companies (and large projects of them), and three medium size companies one of which operated as supplier and one had its own product, and one had both businesses.

In addition, the projects chosen to be studied within the selected case companies were identified as typical for the case company. Although the projects studied were typical of the case organization, they were very different from each
other: two of the five case projects were large product development projects while the other three were considerably smaller.

The empirical material for the research was gathered from five product development projects from the different high technology companies. All the companies operate in the Oulu area but have offices also elsewhere in Finland and in other countries. All the case companies were from the electronics or telecommunication industries. The case companies were selected so that they would well-represent the high technology industry in the Oulu area. However, this selection of case companies potentially limits some of the results due to the dominance of the Finnish national culture and local habits in the Oulu area.

**Reliability**

Traditionally, in qualitative research, the concept of reliability refers to if the same research were to be repeated, the results would be the same. Reliability in general can be considered as one of the weaknesses of this study. The purpose of this research is to support organizational development. If the same research would be conducted again in the studied organizations, the results would probably be different, because, hopefully, there would have been efforts to overcome the identified challenges. On the other hand, as stated in the theoretical part and in findings of this dissertation, communication and related challenges are very much organization dependent. Thus, conducting the same research process in other companies would probably provide at least slightly different results.

However, Gummeson (2000) has suggested that in qualitative research the emphasis on reliability is more on the research report: reliability is evaluated based on whether the research reported in a manner based on which it is possible to follow the logic of the research process and how the researcher has made conclusions in the study. To increase the reliability of this research, the researcher has written the thesis considering the requirements mentioned by Gummeson. The research objectives are presented in Chapter 1.2 and the main phases of the research process in Chapter 1.3. In addition, in Chapter 3, Research realization, describes the data collection phases and methods as well as the empirical data analysis in detail. Additionally, the effort has focused on describing the empirical material and analysis in Chapter 4 carefully.
5.5 Further studies

During this research, a number of topics of interest for future research emerged. First, this research has not extensively addressed the communication contents i.e. what is being communicated. An interesting area for further study would involve more detailed research on how the content being communicated affects, for example, communication practices and technologies.

In addition, more knowledge is needed concerning communication in different phases of the project life cycle: the emphasis on different communication contents and technologies may be different at different phases of a project, as suggested also by Montoya et al. (2009). Thus, questions for future research would be as follows: What are the special characteristics of communication at the different phases of a project? How to assess project communication during the project life cycle?

Additionally, during the early phases of a project, roles and practices concerning the project work and communication are formed and agreed. If it is not possible to organize a face-to-face meeting, much more emphasis has to be on creating a shared understanding of the project by other means. Another topic for future research would be what specific means, at the early phases of a project, enhance project work when a face-to-face project startup meeting may not be possible to organize.

Furthermore, high technology projects are facing constant changes in product and project requirements, but also in (project) organizations. An interesting question for future research could be: how to organize these changes and manage the information related to them during the project life cycle? It does not seem sufficient that project personnel understand the overall picture of the project at the beginning: they also need to be aware of the impacts of constant changes.

This research has studied perceived communication among high technology product development project personnel. Another topic for further research would be to study whether the perceptions at the different organizational levels of projects differ or not. For example, do project personnel perceive communication differently than the project manager(s).

High technology organizations typically operate in an intensive network of companies. Product development projects involve persons from a number of companies. Persons from different companies represent also different communication cultures. A project may have subcontractors’ personnel working within the same facilities. More knowledge is needed concerning how to promote an integrated communication culture in networked high technology product development.
6 Summary

Product development plays a crucial role for a high technology company to survive in business. This research focused on communication and its development in high technology product development projects. These multi-technical, multicultural, geographically dispersed and networked projects pose special requirements for managing communication.

This research is a qualitative multiple-case study. In the empirical part of the research, communication was studied from five case projects in high technology companies operating in the Oulu area. Multiple data collection methods were used: interviews, studying the organization’s internal documents, a survey among project personnel using a web-based questionnaire, and focus group work. Each phase was documented by the researcher and the documentation was inspected by the case representatives. After research within each five cases, a cross-case analysis was conducted by the researcher. This covered an analysis of primary information sources, typical communication problems, communication challenges and communication development targets.

The empirical analysis was summarized based on both theoretical and empirical material and answers to research questions were presented. The summary of answers to research questions is presented in Table 17.
Table 17. Summary of answers to the research questions.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answers</th>
</tr>
</thead>
</table>
| RQ1: What type of communication challenges are encountered in high technology product development projects as perceived by personnel? | Communication challenges depend on the business role and the history of the company  
Generic challenges:  
Lack of communication planning  
Physical and organizational boundaries:  
Communication with customer  
Communication within an organization  
Data management systems  
Communication of changes  
Lack of overall communication competence                                                                                                                                                                                                                                           |
| RQ2: What are the possible solutions for addressing communication challenges encountered in product development projects?                      | Defining communication development targets and actions considering the business realities of the company  
Developing communication based on an internal analysis of communication system and climate  
Planning and organizing communication including description of communication roles, responsibilities and practices  
Data management systems to enhance actual information flows  
Systematic change communication  
Developing communication competences  
Personal feedback  
Trust building by providing feedback between the companies involved in the product development network                                                                                                                                                                                                 |

There are several implications to be drawn from this research. First, it was shown that the business role of the organization significantly affects the communication practices and development possibilities of high technology companies. For example, communication development possibilities in a company operating as a subcontractor are different to those in companies with own products.

In addition, although this research has attempted to propose some directions for how to address communication challenges, the implementation has to be considered in respect to the organizational realities and the business of the company. At project level, it is important to consider project organization related issues such as project size, location, organizational structure, execution procedures, and team experience.
Based on the findings of this research, obstacles of communication are typically caused by physical and organizational boundaries. The main implications of this research include that project communication, as well as any other process in a project work, has to be well-organized, planned, documented and communicated to the project personnel. Additionally, there should be regular feedback mechanism to track communication effectiveness in product development and in projects. To define a communication action plan, companies can utilize the process applied in this research: a personnel communication survey and focus group work.

This research has identified the importance of both personnel and data management systems as information sources for personnel working in product development projects. However, it was pointed out that more emphasis should be put into organizing the data management systems to support the practical work done and the information flows in projects.

A critical evaluation of the research shows limitations of this study. The empirical data was gathered from only five product development projects. Those case projects represented different high technology companies operating in the Oulu area. The researcher followed the norms defined for qualitative case research. However, generalizing the results wider, outside high technology product development projects, is of questionable value. In addition, the possible solutions for developing project communication proposed in this research are based on project personnel perceptions, and have not been proved to be effective in practice.

The research has proposed several interesting directions for future research such as the following: how to develop communication in a high technology buyer-seller relationship, or in a networked product development? What emphasis do the project life cycle phases have on communication contents, practices, and technologies used? At the early phases of a project, how to enhance development of the project team and supportive communication climate? How communication is perceived at different organizational levels in the project?
References


OECD Organization for economic co-operation and development. 2009(9/21).


Appendix 1

The interviews in the case A concerned four people of which two represented supporting functions and two the actual project. The interviews in the case B concerned two people of which one represented supporting functions and one product development management. The interviews in the case C concerned one person representing supporting functions. The interviews in the case D concerned two people, one of which represented the project and the other one product development management. The interviews in the case E concerned two people, one of which represented the project and the other one supporting functions. The interviewees in all the cases included the contact persons and people named by them, all the interviews were conducted by the researcher.

The interviews in all the cases were theme interviews covering the following:

- What kinds of practices are used for project management and project communication management? How project communication is covered in project management guides/document templates?
- What are the most typical communication media used by the project personnel?
- How communication is addressed in organizational surveys and what kind of results have been gained earlier?
- What kind of development efforts have been conducted in relation to project communication?
- What is the industry sector of the organization and how is product development organized?
- Is the developed product for the company or for someone else?
- Description of the case project: organizational chart, size of the project, communication media and practices used, technologies involved, and other complexity contingencies.

Table 18 presents the typical communication media in the studied cases according to the interviews.
Table 18. The most typical communication media in the studied cases according to the interviewees.

<table>
<thead>
<tr>
<th>Media</th>
<th>Case A</th>
<th>Case B</th>
<th>Case C</th>
<th>Case D</th>
<th>Case E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
</tr>
<tr>
<td>Email</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
<td>Widely and frequently used</td>
</tr>
<tr>
<td>Intranet</td>
<td>One of the main media.</td>
<td>Project internal reporting is managed via intranet although there are no project specific intranet pages.</td>
<td>All company internal informing in general in intranet</td>
<td>Company internal informing in intranet</td>
<td></td>
</tr>
<tr>
<td>Newsletter</td>
<td>Published in intranet monthly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Info (for R&amp;D, project or program) / once a month</td>
<td>Program info when needed</td>
<td>Not regularly. There has been starting info. Basically infos are held together with team building happenings.</td>
<td>Varies according to the level info is kept, e.g. a single project, a certain customer, a certain group, the whole personnel. At group level is usually done together with team building events.</td>
<td>Project info at the beginning and at the end of the project.</td>
<td>Project info sessions once a month</td>
</tr>
<tr>
<td>Project meeting project specific</td>
<td>Weekly. The purpose is to provide forum for whole project personnel for all topics current at the project.</td>
<td>Weekly</td>
<td>Monthly</td>
<td>Weekly</td>
<td></td>
</tr>
<tr>
<td>Project team meetings project specific</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media</td>
<td>Case A</td>
<td>Case B</td>
<td>Case C</td>
<td>Case D</td>
<td>Case E</td>
</tr>
<tr>
<td>-------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Program / project management team meeting</td>
<td>Formal project technical steering meeting organized weekly. Participants include representatives from all areas of the project.</td>
<td></td>
<td></td>
<td></td>
<td>Weekly</td>
</tr>
<tr>
<td>Project steering group (includes customer’s representatives)</td>
<td>Monthly, project scope and contractual follow-up</td>
<td>Monthly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project review (internal quality audit)</td>
<td>Is tailored to project specific needs. In this project once a month</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical meetings with customer</td>
<td></td>
<td>Weekly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team building</td>
<td>About twice a year. Team building happenings may include other activities too, e.g. project planning working or customer’s representatives’ presentations.</td>
<td>At project level varies between projects, there is at least project closing session. At a group level three times a year.</td>
<td>In the project only kick-off (formal part including definition of goals, roles and responsibilities plus informal part) and ending meeting. In teams occasionally about once a month</td>
<td>The nature and frequency varies. There are at least kick-off, evening gatherings, and milestone celebrations. Plus to these, the line organization has its’ own team building events.</td>
<td></td>
</tr>
<tr>
<td>Feedback via intranet</td>
<td>Questions and answers intranet page</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2

The questionnaire respondents were given following instructions:

Dear [name of the project] project member,

You have received an email from [name of the project manager] concerning research on Project Communication. This is an invitation for you to fulfill survey related to the research. Filling in the survey takes few minutes of your time.

Enter the questionnaire form (open until January 28th, 2005)
[link to the questionnaire]
The query number is: [questionnaire identification number]
Your personal password is: [personal password]

All the questions consider YOUR OPINIONS of issues affecting [name of the project] success.

- Notice that answers to open-ended questions need to be saved after responding!
- You will find more instructions by clicking the question mark (?) in the ZEF-form.
- It is recommended to use new versions of MS-IE, Netscape in PC with Windows 2000 or more recent version. The ZEF-program checks whether your browser uses Java-support or not. If not, we highly recommend you to install it by using given instructions. Otherwise, you can use HTML-form, which is a bit slower and less graphical, however operates in most computers.

Thank you for your input!

With best regards,

Mirja Peltoniemi (mirja.peltoniemi@oulu.fi)
Researcher
Oulu University

Questions used in the survey questionnaire are presented in table 19. Other similar surveys have been used as a reference when formulating the questionnaire. The table presents also these references. Some of the questions were formed based on the findings from the case specific interviews. This is also shown in the table.
Table 19. The survey questionnaire.

<table>
<thead>
<tr>
<th>Module</th>
<th>Question</th>
<th>Case 2</th>
<th>VAS</th>
<th>2D3</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>A</td>
<td>1. In which site is your workplace located?</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Organization you belong to</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1. What is your role in this program?</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. What is your role in this project?</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>3. How well do you know the top five formal objectives of your program?</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>4. How well do you know the top five formal objectives of your project?</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>5. Success of the program</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Success of the project</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Communicating with persons from other programs</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Communicating with persons from other projects</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1. Program communication in general</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Project communication in general</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. Communication plan: Is there a communication plan in the project/program?</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Communication planning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Understanding what is expected from you</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Understanding roles and responsibilities</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Introduction to communication methods and tools</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8. Knowing where or from whom to get information you need</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9. Access to people with information necessary to you</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Access to information necessary to you</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11. Being kept up-to-date with changes</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1. How well do you understand how your project affects other projects?</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Communication with other projects</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. How well do you understand how your program affects on other programs?</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. Communication with other programs</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module</td>
<td>Question</td>
<td>Case</td>
<td>VAS</td>
<td>ZD</td>
<td>Reference</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------------------------------------------------------</td>
<td>------</td>
<td>-----</td>
<td>----</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>5. Project/program customer: How well do you know the project/program</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>customer?</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>6. Communication with the project/program customer</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>7. Communication with external project personnel</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>8. Communication problems: at what level do you think communication</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>problems mainly occur?</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>E 1. Project follow-up: How important are visual control practices like</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>schedule at white board?</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>2. Document management system</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>3. Program intranet pages</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>4. Project intranet pages</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>5. Info email / Project newsletter</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>6. Project reviews</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>7. Project meetings</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>8. Project team meetings</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>9. Program info sessions</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>10. Project info sessions</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>11. Communication by email</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>12. Communication by phone</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>13. Primary information source</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>F</td>
<td>1. Your experience in project work</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>2. Communication inside the project team</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>3. Communication between teams</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>4. Communication between the team and the project manager</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>5. Communication between the team and the program manager</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>6. Team spirit in the team</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>7. Team building</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>8. Knowing how the job affects the project success</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>9. Knowing how the project affects the overall business</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>10. Open and honest communication</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Module</td>
<td>Question</td>
<td>Case</td>
<td>VAS</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>------</td>
<td>-----</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Downs &amp; COMPASS</td>
<td>Müller</td>
<td>Wiio</td>
<td>Interviews</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11. Managing with conflicts</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12. Considering your reporting to project management</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>1. Working hours allocated to this project</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Informal and ad-hoc meetings</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Training of personal communication skills</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Receiving feedback on contributions to the project</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Meeting the project manager</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Meeting the program manager</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Communication lessons learned</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8. Receiving conflicting instructions</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>1. Current good practices in project communication?</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. What communication practices should be avoided?</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. How could communication be improved?</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Your age</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

1 Modules: A General questions 1, B General questions 2, C Communication in your program, D Communication with project & program stakeholders, E Information management, F Leadership 1, G Leadership 2, H Improving communication. All cases except B had personnel working in more than one location. However, module A was used only in case C and E because it was not considered necessary in other cases.

2 Total number of questions in each case: A 60, B 50, C 51, D 50, E 52.

3 2D: the question had two dimensions: satisfaction & importance or satisfaction & frequency.
Appendix 3

Appendix 3 presents the survey results in detail in Tables 20, 21, 22, 23 and 24.

Table 20. Survey results: case-specific demographic data.

<table>
<thead>
<tr>
<th>Question</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3</td>
<td>N=100</td>
<td>N=13</td>
<td>N=13</td>
<td>N=26</td>
<td>N=61</td>
</tr>
<tr>
<td>Is there a communication plan in the project/program?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>41%</td>
<td>31%</td>
<td>15%</td>
<td>35%</td>
<td>10%</td>
</tr>
<tr>
<td>No</td>
<td>8%</td>
<td>8%</td>
<td>46%</td>
<td>19%</td>
<td>21%</td>
</tr>
<tr>
<td>I do not know</td>
<td>51%</td>
<td>62%</td>
<td>38%</td>
<td>46%</td>
<td>69%</td>
</tr>
<tr>
<td>F1</td>
<td>N=99</td>
<td>N=13</td>
<td>N=13</td>
<td>N=26</td>
<td>N=57</td>
</tr>
<tr>
<td>Respondents experience of project work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 2 years</td>
<td>0%</td>
<td>38%</td>
<td>23%</td>
<td>12%</td>
<td>18%</td>
</tr>
<tr>
<td>2–5 years</td>
<td>4%</td>
<td>31%</td>
<td>46%</td>
<td>40%</td>
<td>33%</td>
</tr>
<tr>
<td>5–10 years</td>
<td>49%</td>
<td>23%</td>
<td>31%</td>
<td>36%</td>
<td>39%</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>38%</td>
<td>8%</td>
<td>0%</td>
<td>16%</td>
<td>11%</td>
</tr>
<tr>
<td>G1</td>
<td>N=95</td>
<td>N=13</td>
<td>N=13</td>
<td>N=25</td>
<td>N=57</td>
</tr>
<tr>
<td>Working hours allocated to this project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80–100%</td>
<td>35%</td>
<td>46%</td>
<td>100%</td>
<td>20%</td>
<td>39%</td>
</tr>
<tr>
<td>50–80%</td>
<td>16%</td>
<td>15%</td>
<td>0%</td>
<td>20%</td>
<td>16%</td>
</tr>
<tr>
<td>About 50%</td>
<td>7%</td>
<td>15%</td>
<td>0%</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>25–50%</td>
<td>15%</td>
<td>15%</td>
<td>0%</td>
<td>12%</td>
<td>19%</td>
</tr>
<tr>
<td>Less than 25%</td>
<td>27%</td>
<td>8%</td>
<td>0%</td>
<td>44%</td>
<td>21%</td>
</tr>
<tr>
<td>H1</td>
<td>N=96</td>
<td>N=13</td>
<td>N=13</td>
<td>N=26</td>
<td>N=56</td>
</tr>
<tr>
<td>Age of respondents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 20 years</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>20–25</td>
<td>4%</td>
<td>15%</td>
<td>23%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>26–35</td>
<td>49%</td>
<td>62%</td>
<td>69%</td>
<td>62%</td>
<td>64%</td>
</tr>
<tr>
<td>36–45</td>
<td>38%</td>
<td>15%</td>
<td>8%</td>
<td>31%</td>
<td>29%</td>
</tr>
<tr>
<td>46–55</td>
<td>9%</td>
<td>8%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Over 56</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Table 21. Survey results: roles of the respondents.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Program manager</td>
<td>1.0%</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Project manager</td>
<td>6.9%</td>
<td>7.7%</td>
<td>15.4%</td>
<td>7.7%</td>
<td>13.6%</td>
</tr>
<tr>
<td>SW/DSP engineer</td>
<td>38.6%</td>
<td>0.0%</td>
<td>38.5%</td>
<td>3.8%</td>
<td>13.6%</td>
</tr>
<tr>
<td>HW/RF/Mechanical engineer</td>
<td>0.0%</td>
<td>30.8%</td>
<td>–</td>
<td>15.4%</td>
<td>16.9%</td>
</tr>
<tr>
<td>Test engineer</td>
<td>13.9%</td>
<td>23.1%</td>
<td>38.5%</td>
<td>11.5%</td>
<td>11.9%</td>
</tr>
<tr>
<td>System engineer</td>
<td>11.9%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>3.4%</td>
</tr>
<tr>
<td>External personnel</td>
<td>6.9%</td>
<td>15.4%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>16.9%</td>
</tr>
<tr>
<td>Supporting personnel</td>
<td>9.9%</td>
<td>7.7%</td>
<td>0.0%</td>
<td>19.2%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Line manager</td>
<td>7.9%</td>
<td>7.7%</td>
<td>0.0%</td>
<td>7.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Other</td>
<td>3.3%</td>
<td>7.7%</td>
<td>7.7%</td>
<td>34.6%</td>
<td>13.6%</td>
</tr>
</tbody>
</table>

Table 22. Survey results: primary information sources.

<table>
<thead>
<tr>
<th>Primary information source</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document management system</td>
<td>17%</td>
<td>8%</td>
<td>38%</td>
<td>12%</td>
<td>7%</td>
</tr>
<tr>
<td>Project intranet pages</td>
<td>1%</td>
<td>8%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Program intranet pages</td>
<td>6%</td>
<td>15%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Project meetings</td>
<td>18%</td>
<td>0%</td>
<td>8%</td>
<td>32%</td>
<td>41%</td>
</tr>
<tr>
<td>Project reviews</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Info email/Newsletter</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>Project info sessions</td>
<td>2%</td>
<td>54%</td>
<td>8%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Program info sessions</td>
<td>2%</td>
<td>15%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Colleagues</td>
<td>41%</td>
<td>0%</td>
<td>31%</td>
<td>32%</td>
<td>33%</td>
</tr>
<tr>
<td>Project manager</td>
<td>11%</td>
<td>0%</td>
<td>15%</td>
<td>16%</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Table 23. Survey results: typical communication problems.

<table>
<thead>
<tr>
<th>Typical communication problems occur between…</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team members</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Team and project manager</td>
<td>10%</td>
<td>0%</td>
<td>8%</td>
<td>8%</td>
<td>15%</td>
</tr>
<tr>
<td>Team and program manager</td>
<td>3%</td>
<td>38%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Persons from different sites</td>
<td>37%</td>
<td>15%</td>
<td>38%</td>
<td>31%</td>
<td>25%</td>
</tr>
<tr>
<td>Different professions</td>
<td>17%</td>
<td>8%</td>
<td>–</td>
<td>23%</td>
<td>20%</td>
</tr>
<tr>
<td>Different projects</td>
<td>19%</td>
<td>15%</td>
<td>0%</td>
<td>23%</td>
<td>12%</td>
</tr>
<tr>
<td>Different programs</td>
<td>6%</td>
<td>15%</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Program and business mgmt</td>
<td>3%</td>
<td>8%</td>
<td>–</td>
<td>8%</td>
<td>10%</td>
</tr>
<tr>
<td>Project and the customer</td>
<td>–</td>
<td>-</td>
<td>46%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
</tr>
</tbody>
</table>
Table 24. Survey results: summary of challenges and best-functioning practices\textsuperscript{22}.

<table>
<thead>
<tr>
<th>Question</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 Program communication in general</td>
<td>0.87</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C11 Being kept up-to-date with changes</td>
<td>1.44</td>
<td>1.25</td>
<td>1.60</td>
<td>1.90</td>
<td>1.09</td>
</tr>
<tr>
<td>C2 Project communication in general</td>
<td>1.08</td>
<td>1.88</td>
<td>1.87</td>
<td>1.91</td>
<td>1.57</td>
</tr>
<tr>
<td>C4 Communication planning</td>
<td>0.75</td>
<td>1.02</td>
<td>1.48</td>
<td>2.30</td>
<td>1.31</td>
</tr>
<tr>
<td>C5 Understanding what is expected from you</td>
<td>0.35</td>
<td>0.83</td>
<td>0.93</td>
<td>0.78</td>
<td>0.44</td>
</tr>
<tr>
<td>C6 Understanding roles and responsibilities</td>
<td>0.41</td>
<td>0.00</td>
<td>1.09</td>
<td>0.45</td>
<td>0.38</td>
</tr>
<tr>
<td>C7 Introduction to communication methods and tools</td>
<td>0.83</td>
<td>1.81</td>
<td>1.07</td>
<td>0.92</td>
<td>0.69</td>
</tr>
<tr>
<td>D2 Communication with other projects</td>
<td>1.09</td>
<td>0.96</td>
<td>0.65</td>
<td>1.40</td>
<td>0.85</td>
</tr>
<tr>
<td>D4 Communication with other programs</td>
<td>1.17</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>D6 Communication with the program customer</td>
<td>1.16</td>
<td>0.84</td>
<td>2.36</td>
<td>1.36</td>
<td>1.09</td>
</tr>
<tr>
<td>E10 Project info sessions</td>
<td>0.83</td>
<td>0.20</td>
<td>0.81</td>
<td>0.83</td>
<td>0.43</td>
</tr>
<tr>
<td>E11 Communication by email</td>
<td>0.80</td>
<td>0.37</td>
<td>1.14</td>
<td>1.31</td>
<td>0.55</td>
</tr>
<tr>
<td>E12 Communication by phone</td>
<td>0.51</td>
<td>0.24</td>
<td>0.64</td>
<td>0.74</td>
<td>0.37</td>
</tr>
<tr>
<td>E2 Document management system</td>
<td>1.57</td>
<td>2.14</td>
<td>1.51</td>
<td>1.68</td>
<td>0.43</td>
</tr>
<tr>
<td>E3 Program intranet pages</td>
<td>0.51</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E4 Project intranet pages</td>
<td>0.60</td>
<td>0.60</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E7 Project meetings</td>
<td>0.97</td>
<td>0.73</td>
<td>0.82</td>
<td>1.37</td>
<td>0.84</td>
</tr>
<tr>
<td>E9 Program info sessions</td>
<td>0.59</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E5 Info email / Project newsletter</td>
<td>–</td>
<td>–</td>
<td>1.28</td>
<td>0.90</td>
<td>–</td>
</tr>
<tr>
<td>E6 Project reviews</td>
<td>–</td>
<td>–</td>
<td>0.37</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E8 Project team meetings</td>
<td>–</td>
<td>–</td>
<td>1.58</td>
<td>0.69</td>
<td>–</td>
</tr>
<tr>
<td>F10 Open and honest communication</td>
<td>1.44</td>
<td>1.61</td>
<td>1.58</td>
<td>1.88</td>
<td>1.26</td>
</tr>
<tr>
<td>F2 Communication inside the project team</td>
<td>1.00</td>
<td>1.27</td>
<td>1.17</td>
<td>1.41</td>
<td>1.16</td>
</tr>
<tr>
<td>F3 Communication between teams</td>
<td>1.30</td>
<td>1.31</td>
<td>2.00</td>
<td>2.06</td>
<td>1.37</td>
</tr>
<tr>
<td>F4 Communication between the team and the project manager</td>
<td>1.04</td>
<td>0.68</td>
<td>1.16</td>
<td>1.51</td>
<td>0.98</td>
</tr>
<tr>
<td>F5 Communication between the team and the program manager</td>
<td>0.72</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>F6 Team spirit in the team</td>
<td>0.64</td>
<td>1.05</td>
<td>0.94</td>
<td>1.11</td>
<td>1.09</td>
</tr>
<tr>
<td>F7 Team building</td>
<td>1.21</td>
<td>0.98</td>
<td>1.31</td>
<td>1.54</td>
<td>1.39</td>
</tr>
<tr>
<td>F8 Knowing how the job affects the project success</td>
<td>0.53</td>
<td>0.59</td>
<td>–0.06</td>
<td>0.44</td>
<td>0.52</td>
</tr>
<tr>
<td>F9 Knowing how the project affects the overall business</td>
<td>0.82</td>
<td>0.28</td>
<td>1.52</td>
<td>0.76</td>
<td>1.10</td>
</tr>
<tr>
<td>G2 Informal and ad hoc meetings</td>
<td>0.88</td>
<td>0.87</td>
<td>0.65</td>
<td>0.72</td>
<td>0.65</td>
</tr>
<tr>
<td>G3 Training of personal communication skills</td>
<td>1.77</td>
<td>2.33</td>
<td>2.75</td>
<td>2.25</td>
<td>1.49</td>
</tr>
<tr>
<td>G4 Receiving feedback on contributions to the project</td>
<td>1.65</td>
<td>2.08</td>
<td>2.52</td>
<td>1.80</td>
<td>1.79</td>
</tr>
<tr>
<td>G5 Meeting the project manager</td>
<td>0.92</td>
<td>0.32</td>
<td>–0.34</td>
<td>0.68</td>
<td>0.87</td>
</tr>
<tr>
<td>G6 Meeting the program manager</td>
<td>1.24</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

\textsuperscript{22} The table includes all the two-dimensional VAS-questions. The number in the columns represent case-specific differences of means of “importance” and “satisfaction”.

174
Appendix 4

In this appendix the mind maps documented during the focus groups in each case are presented. Of each of the five cases, it is first described on one mind map what do the focus group participants identify as themes that need development efforts. Then, possible solutions for how to develop communication related to each identified theme is documented on a separate mind map.

First, the participants named topics that they considered the most problematic. These topics were categorized and presented as the first figure of each case figures. Then, the participants gave points to the named topics i.e. voted which of them were the most critical. Each participant had three points to give and he/she could divide them between one or several topics. The points given have been documented in first figure of each case (e.g. communication plan 5p means that the special topic of communication plan were given altogether 5 points by the participants). Five topics with the most votes were selected for the second part of the working.

After this, participants named solution ideas for the topics identified problematic. These solution ideas for each topic were also categorized and documented each topic on separate idea map. The figures representing these idea maps are also presented in this appendix.

The figures presented in this appendix are summaries of discussions and findings from the focus groups.
Fig. 31. Case A: Ideas on development ideas defined by individuals and groups.
Fig. 32. Case A: Ideas on topic ‘Communication of changes’ defined by individuals and groups.
Fig. 33. Case A: Ideas on topic ‘Communication plan and tools’ defined by individuals and groups.
Fig. 34. Case A: Ideas on topic 'Boundary spanning communication' defined by individuals and groups.
Fig. 35. Case A: Ideas on topic ‘Document management system’ defined by individuals and groups.
Fig. 36. Case A: Ideas on topic ‘Open and honest communication’ defined by individuals and groups.
Case B

Fig. 37. Case B: Ideas on development ideas defined by individuals and groups.
Fig. 38. Case B: Ideas on topic 'Document management system' defined by individuals and groups.
Fig. 39. Case B: Ideas on topic ‘Communication planning’ defined by individuals and groups.
Fig. 40. Case B: Ideas on topic 'Project in its context' defined by individuals and groups.
Fig. 41. Case B: Ideas on topic 'Intranet pages' defined by individuals and groups.
Fig. 42. Case B: Ideas on topic 'Feedback' defined by individuals and groups.
Fig. 43. Case B: Ideas on topic 'Personal communication skills' defined by individuals and groups.
Case C

Fig. 44. Case C: Ideas on development ideas defined by individuals and groups.
Fig. 45. Case C: Ideas on topic ‘Communication between teams in a project’ defined by individuals and groups.
Fig. 46. Case C: Ideas on topic ‘Project communication planning’ defined by individuals and groups.
Fig. 47. Case C: Ideas on topic ‘Training of communication skills’ defined by individuals and groups.
Fig. 48. Case C: Ideas on topic ‘Communication with other projects’ defined by individuals and groups.
Fig. 49. Case C: Ideas on topic 'Feedback and lessons learned' defined by individuals and groups.
Fig. 50. Case D: Ideas on development ideas defined by individuals and groups.
Fig. 51. Case D: Ideas on topic 'Assign of responsibilities' defined by individuals and groups.
Fig. 52. Case D: Ideas on topic ‘Communication planning’ defined by individuals and groups.
Fig. 53. Case D: Ideas on topic ‘Change management’ defined by individuals and groups.
Fig. 54. Case D: Ideas on topic 'Email' defined by individuals and groups.

- Guidelines
  - one question in one e-mail
  - save emails with decision to PDM
  - Use of mailing lists (1p.)
  - have formal e-mail title

- E-mail
  - summarize e-mail discussions in meetings
    - arrange a meeting when there is a large e-mail chain (1p.)
    - provide project specific discussions groups

- Management
  - guidelines on email usage
Fig. 55. Case D: Ideas on topic 'Feedback' defined by individuals and groups.
Fig. 56. Case D: Ideas on topic ‘Open communication’ defined by individuals and groups.
Fig. 57. Case D: Ideas on topic 'Meeting culture' defined by individuals and groups.
Case E

Fig. 58. Case E: Ideas on development ideas defined by individuals and groups.
Fig. 59. Case E: Ideas on topic ‘Communication between teams’ defined by individuals and groups.
Fig. 60. Case E: Ideas on topic 'Communication skills' defined by individuals and groups.
Fig. 61. Case E: Ideas on topic ‘Communication planning’ defined by individuals and groups.
Fig. 62. Case E: Ideas on topic 'Customer & business understanding' defined by individuals and groups.
Fig. 63. Case E: Ideas on topic ‘Communication at right time’ defined by individuals and groups.
348. Leiviskä, Tiina (2009) Coagulation and size fractionation studies on pulp and paper mill process and wastewater streams


358. Ylioinas, Jari (2010) Iterative detection, decoding, and channel estimation in MIMO-OFDM

359. Tervonen, Pekka (2010) Integrated ESSQ management. As a part of excellent operational and business management—a framework, integration and maturity


Book orders:
Granum: Virtual book store
http://granum.uta.fi/granum/
COMMUNICATION IN HIGH TECHNOLOGY PRODUCT DEVELOPMENT PROJECTS

PROJECT PERSONNEL’S VIEWPOINT FOR IMPROVEMENT

Mirja Väänänen