



TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

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REARRANGEMENT OF TECHNICAL DOCUMENTATION IN AN
INDUSTRIAL ENTERPRISE

Master of Science Thesis

Examiner: Professor Mika Hannula
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ABSTRACT

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In the challenging business environment of today companies need to strive for excellence in every business area including technical documentation in order to remain competitive. Consequently, organizations often outsource non-core business functions which can possibly be better conducted by external professionals. As a support task, also technical documentation can be considered for outsourcing. In this research the structural arrangements of technical documentation were inspected. The aim of the study was to find out, how technical documentation should be organized in an industrial enterprise.

The research consisted of a literature review and a single case study. In the literature review background theory of both outsourcing and technical documentation was gathered. Special attention was given to different outsourcing and documentation arrangements and management approaches. The data collection technique used in the case study was semi-structured interview. The objective of the case study was to evaluate the current arrangement of technical documentation and consider the possibilities for rearrangement.

On the basis of the case study, eight alternatives for the rearrangement of technical documentation were formed. One main separator of the arrangements was the scope of outsourcing. In the analysis of the arrangements it turned out that purchasing documentation services from the current service provider or the formation of a centralized documentation department would best support the business needs of the case company.

The results of the study show that there are many ways to organize technical documentation successfully in an organization. Even though on the basis of the research it was not seen as possible to define one right way for the arrangement, it was noted that successful arrangements often reflect the same principles. It was concluded that there exists certain limitations in regard to the outsourcing of technical documentation. First, it was noted that it is important that technical writers and designers work geographically close by. Second, full outsourcing of technical documentation may not be wise in high-technology industries where the products and services are complex and dynamic.

TIIVISTELMÄ

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Nykyisessä vaativassa liiketoimintaympäristössä yritysten on kilpailukykyänsä säilyttääkseen pyrittävä täydellisyyteen jokaisella liiketoiminta-alueellaan tekninen dokumentointi mukaan lukien. Tämän seurauksena yritykset usein ulkoistavat ydinliiketoimintaansa kuulumattomia tehtäviä, jotka ulkopuoliset ammattilaiset pystyvät mahdollisesti tekemään paremmin. Koska teknistä dokumentointia voidaan pitää yritysten tukitoimintona, myös sen ulkoistamista voidaan harkita. Tässä tutkimuksessa tarkasteltiin teknisen dokumentoinnin rakenteellisia järjestelyjä. Tutkimuksen tarkoituksena oli selvittää, miten tekninen dokumentointi kannattaa järjestää teollisuusyrityksessä.

Tutkimus koostui kirjallisuuskatsauksesta ja yksittäisestä tapaustutkimuksesta. Kirjallisuuskatsauksessa tutustuttiin sekä ulkoistamiseen että teknisen dokumentoinnin taustateoriaan. Huomion kohteena kirjallisuuskatsauksessa olivat erityisesti erilaiset ulkoistamisen ja dokumentoinnin järjestelyt ja johtamistavat. Tapaustutkimuksessa datan keräysmenetelmänä käytettiin puolistrukturoitua haastattelua. Tapaustutkimuksen tarkoituksena oli arvioida kohdeyrityksen nykyinen teknisen dokumentoinnin järjestely ja pohtia mahdollisuuksia uudelleenjärjestämiseen.

Tapaustutkimuksen kautta muodostettiin yhteensä kahdeksan vaihtoehtoa teknisen dokumentoinnin uudelleenjärjestämiseksi. Yksi merkittävä erottava tekijä eri vaihtoehtojen välillä oli ulkoistamisen laajuus. Vaihtoehtojen analyysissä paljastui, että dokumentointipalvelujen ostaminen nykyiseltä palveluntarjoajalta tai keskitetyn dokumentointiosaston muodostaminen tukisivat parhaiten kohdeyrityksen liiketoimintatarpeita.

Tutkimuksen tulokset näyttävät, että on olemassa monia hyviä tapoja järjestää tekninen dokumentointi yrityksessä. Vaikka yhden oikean järjestelytavan määrittelemine ei tutkimuksen perusteella koettu olevan mahdollista, huomattiin, että onnistuneet järjestelmät heijastavat usein samoja periaatteita. Tutkimuksessa tultiin siihen lopputulokseen, että teknisen dokumentoinnin ulkoistamiselle on olemassa tiettyjä rajoitteita. Ensinnäkin todettiin, että teknisten kirjoittajien ja suunnittelijoiden maantieteellinen läheisyys on tärkeää. Toiseksi, teknisen dokumentoinnin kokonaisvaltainen ulkoistaminen ei välttämättä ole kannattavaa korkean teknologian aloilla, joissa tuotteet ja palvelut ovat monimutkaisia ja nopeasti muuttuvia.

PREFACE

Writing this thesis has in many respects been an interesting and rewarding process. It was a learning experience that taught me a lot more than only facts of the research topic. So far it has also been the most challenging and demanding process during my studies. Now that it is over, I feel more prepared for the future after student life.

This thesis would not have been possible without the help, support and encouragement that I have gotten during the whole process. First, I would like to thank Sandvik for giving me this amazing chance to do my thesis on this particular topic. I am especially grateful to Marko Sormunen, who gave me helpful advice always when I needed it and was strongly involved in initiating this research. Second, I want to thank all the people who participated in the interviews. I was very delighted to notice that the research was welcomed by all and everybody I asked wanted to take part in the study. I also want to express my gratitude towards the supervisor of this thesis, Mika Hannula, for guiding me in the right direction and bringing up new perspectives on the research topic that I had not thought of.

I want to thank all my fellow students who gave me feedback on the thesis. Last but not least, I would like to address special thanks to my friends and family, who encouraged and supported me throughout the process and ensured that I have life outside the thesis as well.

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TABLE OF CONTENTS

Abstract	i
Tiivistelmä	ii
Preface.....	iii
Key terms and abbreviations	vi
1 Background	1
1.1 Research problem and research questions.....	1
1.2 Scope and limitations	2
1.3 Research methodology	3
1.3.1 Research philosophy	4
1.3.2 Research approach	5
1.3.3 Research methods	7
1.3.4 Data collection and analysis	9
1.4 Structure of the thesis.....	11
2 Outsourcing	13
2.1 Motivations and opportunities	13
2.2 Reasons for failure and their avoidance	16
2.3 Outsourcing strategies and arrangements.....	19
2.3.1 Outsourcing strategies	19
2.3.2 Location of outsourcing.....	22
2.3.3 Scope of outsourcing	24
2.4 Management of outsourcing.....	26
2.4.1 Relationship management.....	27
2.4.2 Organizational control in outsourcing	31
2.4.3 Evaluation of outsourcing arrangement.....	33
3 Technical documentation	38
3.1 Background of technical documentation	38
3.2 Product documentation	41
3.3 Documentation processes and arrangements	46
3.3.1 Documentation processes	47
3.3.2 Documentation arrangements	51
3.3.3 Improving efficiency of documentation	55
3.4 Evaluation and management of documentation	57
4 Empirical case study	62
4.1 Case company and background of the study.....	62
4.2 Data gathering	65
4.3 Data analysis	68

5	Results	70
5.1	Present state of documentation in the case company	70
5.2	Challenges related to documentation	75
5.3	Rearrangement of documentation	80
5.3.1	Starting point for analysis	80
5.3.2	Documentation arrangement alternatives	83
5.3.3	Synthesis	93
6	Discussion	95
6.1	Summary of the results.....	95
6.2	Discussion and implications.....	101
6.3	Evaluation of the study and suggestions for future research.....	103
	References	105
	Appendix 1: Interview frame	112

KEY TERMS AND ABBREVIATIONS

Backsourcing	Bringing previously outsourced business activities back in-house.
BOM	Bill of Material. A design document of the end product's structure.
CM	Configuration Management. Establishing and maintaining consistency of a product's performance, functional and physical attributes, design and operational information throughout the product life cycle (ANSI/EIA-649 1998, p. 3).
CMS	Content Management System. A system of methods and techniques aimed at collecting, managing and publishing content in a company (Benevolo & Negri 2007, p. 10; Boiko 2001, p. 8).
CPE	Current Product Engineering. The development of products that are already in production.
Documentation	A collection of documents that addresses a specific topic and the activities related to developing documents (IEC 61082-1 1991, cited in SFS 2006, p. 35; Albing 1996, p. 67). Here: see technical documentation.
EC	Engineering Change. An alteration made to a product's parts, drawings or software that have already been released during the design process (Jarrat et al. 2004, p. 268, cited in Hamraz et al. 2013, p. 474).
ECM	Engineering Change Management. The process of handling Engineering Changes (see EC).
ECMS	Enterprise Content Management System. An integrated approach to managing all enterprise information (Benevolo & Negri 2007, p. 12). See CMS.

ECO	Engineering Change Order. A standalone document that documents an Engineering Change (see EC) and can be related to one part or document or a collection of them (Pikosz & Malmqvist 1998, p. 9; Watts 2012, p. 26).
ECR	Engineering Change Request. A request for Engineering Change (see EC).
Manual	Here: the end product of product support documentation. See Product support documentation.
NPD	New Product Development. The development of a new product. Usually handled as a project.
Offshoring	Outsourcing across national borders using either internal or external resources (Bengtsson et al. 2009, p. 36; Corbett 2004, p. 39). See Outsourcing.
Outsourcing	The use of external resources to carry out an activity that has previously been performed in-house (Hätönen 2008, p. 42).
Outsourcing arrangement	The form of outsourcing that can be classified, for instance, according to scale, scope, complexity, location, type of contract, form of relationship, criticality of the outsourced business activity and number of service providers (e.g. Hätönen 2008, p. 63; Lee et al. 2004). See Outsourcing.
Outsourcing strategy	The logic underlying a firm's outsourcing decisions (Lee et al. 2004, p. 112). See Outsourcing.
Opportunism	Self-interest seeking with guile (Williamson 1985, p. 47).
PDM	Product Data Management. An information tool that helps in managing the vast product data in every step of the product life cycle (Philpotts 1996, p. 12).
PDMS	Product Data Management System. An information system for Product Data Management (see PDM).

Product support documentation	A part of technical documentation that is focused on developing user and instruction manuals of a product to support the installation, operation and maintenance of a product.
Product documentation	Includes technical information of a product from all aspects during the product life cycle. Can be divided into design, support and manufacturing documents. (Hsu et al. 1999, p. 11; Watts 2012, p. 44.)
Technical documentation	Handling information about technical subjects and developing product manuals, reports, descriptions, instructions, websites, marketing material or other publications (Markel 2012, pp. 4, 581–598; Albing 1996, p. 67). Here: The development of product manuals. See Product support documentation.
Technical communication	Here: an overarching term that describes the academic field of technical documentation. See Technical documentation.
WCMS	Web Content Management System. An information system for managing the multi-format content on the Web (Benevolo & Negri 2007, p. 12). See CMS.

1 BACKGROUND

Technical documentation can in many ways be regarded as one critical corner stone of manufacturing enterprises. It is needed to define the critical elements of products and processes and instructions to install, use and maintain products (Watts 2012, p. 44). Thus it plays a major role in the success of a project or product (see Whitaker & Mancini 2013, p. 1). Technical documents codify the mental work of engineers and help transfer knowledge from subject matter experts to those who need it (Hameri & Nihtilä 1998, p. 196; Hackos 1994, p. 9). Additionally, user manuals constitute an important part of the end user's perceived quality of the product (Wingkvist et al. 2010, p. 476).

Documentation managers are currently confronted with constant pressure to reduce the costs and length of projects, achieve more with fewer resources and increase the overall value of technical documentation (Hackos 2007, p. 31). As a consequence, new solutions are sought in order to adapt to the tough requirements of the business environment. To reduce the costs of technical documentation, documentation managers are increasingly relying on outsourcing (Hackos 2007, p. 53). Outsourcing is often seen as a worthy alternative for answering the changing demands of the marketplace by making economic activities better, faster and cheaper and the organization more flexible (Hätönen 2008, p. 22). It has become a standard business procedure in many business areas. However, surprisingly little research exists on the suitability of technical documentation for outsourcing (Padmanabhan 2007, p. 109).

This master's thesis is made in cooperation with Sandvik Mining and Construction. The aim of the study is to explore technical documentation as a structural arrangement and find out different ways in which technical documentation can be organized.

1.1 Research problem and research questions

The research question this research aims to answer is: *How technical documentation should be organized in an industrial enterprise*. In order to answer this question background theory of technical documentation is needed. This includes information about the definitions, processes and management of technical documentation. Further, the case company of this research has outsourced its technical product documentation, which is why some basic understanding of outsourcing is required to find out what opportunities outsourcing can in general bring to technical documentation. In this research it is especially important to consider, what can be achieved with outsourcing, and gather background information on outsourcing challenges, engagements and management. In the empirical part of this research, the objective is to conduct an analysis of the present state

of technical documentation in the case company, recognize possible challenges, make proposals for the rearrangement of documentation and analyse the appropriateness of the arrangement alternatives. Hence, the research question can further be divided into the following sub-questions:

- How can technical documentation be managed and controlled?
- How can outsourcing be exploited in technical documentation?
- What kind of alternatives are there to arrange technical product documentation in the case company?
- How should the case company arrange technical product documentation on a long-term basis?

The first two questions are mainly examined in the theoretical part of this research and the last two questions relate to the empirical part of the research. Finally, by combining the results of the two parts of the study, the main research question can be answered.

1.2 Scope and limitations

This research is a single case study which brings some limitations. When dealing with one case and a singular phenomenon, it is not necessarily possible to gain generalizable results (Gummesson 2000, p. 88). Therefore, this research is to some extent limited due to the unique character of the case company and its technical documentation. Nevertheless, by combining and comparing the results of the empirical study with theory and previous studies of the subject it is possible to reflect the results also at a general level.

Documentation is a broad term that can be viewed from different perspectives. In this case study, documentation is examined in the context of technical product documentation. This narrows down the viewpoint to technical documentation and more precisely to product support documentation. As design documents are the cornerstone of product support documentation, the processes and outcomes related to them are also an essential part of the research. However, the rearrangement of design documentation is out of scope of the case study. Thus, any other aspects of documentation, such as technical process documentation, are in the case study ignored and the entire attention is given to documentation in the context of product manuals.

Processes are in the case study examined as a whole in order to develop an overall framework for product support documentation. Even though information systems are an essential part of technical documentation, the objective in this research is not to study different technical solutions for documentation. This is partly because the case company has already implemented global product data management and content management systems and made future plans concerning their development. The objects of interest are

more or less non-technological factors of documentation such as processes, resources, management, control, communication and quality.

Besides technical documentation, outsourcing is another subject of interest in this study. In this research, outsourcing is examined from the client organization's perspective. Also the case study reflects this point of view and only the processes of the client and those that are visible to the client are examined. Further, outsourcing is in this research related to outsourcing of services. Thus, the focus of interest is not for example outsourcing the manufacture of products or subcontracting.

1.3 Research methodology

Before the actual research and analysis can be conducted, many important choices about the design and strategy of the research need to be made. These concern methodological choices of different levels as illustrated by the research "onion" in Figure 1. The figure is not to be seen as a comprehensive description of research methodology but as an illustration of the most essential alternatives concerning the context of this research. By understanding first the research philosophies and approaches, appropriate research methods and data collection and analysis techniques can be selected. There are no best strategies that fit all purposes of research. That is why the choices need to be made according to the research objective and problem.

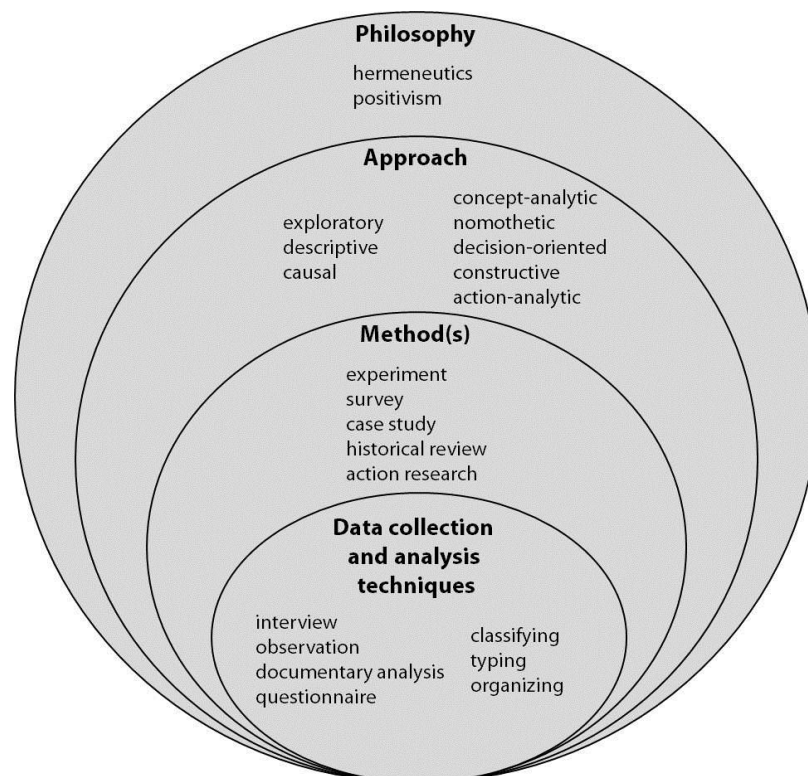


Figure 1. The levels of the methodological choices in research (modified from Saunders et al. 2009, p. 108).

Next, the methodology of this research is presented in a descending order of abstraction as suggested by Figure 1. First, the decision between hermeneutics and positivism is reflected. Second, an appropriate combination of the different research approaches presented in Figure 1 is formed. On the basis of these methodological choices the most practical research methods are examined and one method selected. Finally, it is considered what the most suitable data collection and analysis techniques for this research are.

1.3.1 Research philosophy

The first step in the examination of research methodology is the understanding of research philosophy, which is an umbrella term relating to the development of knowledge and the nature of that knowledge. Research philosophies represent different views of the interaction between knowledge and the process by which it is developed. (Saunders et al. 2009, pp. 106–108.) No matter what type of research is conducted, it is always based on some hidden assumptions. When these are understood, the methodological choices can more easily be made and justified. (Hirsjärvi et al. 2005, p. 125.)

Saunders et al. (2009, p. 108) divide research philosophies into positivism, realism, interpretivism and pragmatism. The underlying thought of positivism is that credible data has to be based on observable phenomena. In positivist research, existing theory is used to develop hypotheses which are tested and either confirmed or rejected. Positivist research relies to a great extent on quantitative research methods and statistical analysis. (Saunders et al. 2009, pp. 113–114.) Interpretivism, in turn, comprises a quite different view of the world than positivism. According to this research philosophy, humans need to be understood as social actors with different roles rather than as objects. One interpretive approach (Heracleous 2004, p. 180) that beside positivism is usually regarded as one of the main research philosophies is hermeneutics (Olkkonen 1994, p. 26). As these two are generally considered the main philosophical orientations, it is next considered, how this research is positioned between them. From this basis, other methodological choices can be made and this is why it is not necessary in this context to further examine the other philosophies.

Positivist and hermeneutic philosophies differ in many respects. First, the question of repeatability is treated differently. In positivism it is presumed that different researchers will end up in similar results when using the same data and the same research methods. In hermeneutics the emphasis is on understanding the phenomenon and the data used is usually qualitative. That is why it cannot be verified that different researchers would understand similarly the data and the phenomenon it represents. (Olkkonen 1994, p. 35.) In this respect, this research complies with hermeneutic philosophy, since the aim is to gain understanding which requires power of reasoning and may decrease repeatability. The second difference of the two philosophies is the verifiability of the results. Generally speaking, the reliability of the results is usually lower in hermeneutic research (Olk-

konen 1994, p. 36). In this research, it cannot be scientifically determined, how valid the results are. Further, the conclusions are likely to be at least to some extent subjective even though the aim is to remain as objective as possible.

Whereas positivism utilizes large amounts of quantitative data, hermeneutic research aims to develop new knowledge out of empirical data with the help of induction and a limited number of cases (Olkkonen 1994, p. 37). From this angle, this research is clearly of a hermeneutic nature. The empirical data is restricted to one organization, which enables deep but not statistical analysis. The next defining feature of the philosophies is the nature of the research targets. Positivist research tends to handle structured research problems while hermeneutics focuses on unstructured problems that have not necessarily been previously widely studied. (Olkkonen 1994, p. 37). In this regard, the decision between positivism and hermeneutics is not that obvious. The research problem cannot be regarded as new, since structural rearrangements have been widely studied at a general level. Nevertheless, for the case company it is relatively unstructured and new. Thus, the context brings some challenges to the structuring of the research problem.

The goal of positivist research is to explain and describe dependencies between variables whereas hermeneutics usually results in explorative insights that add understanding of the phenomenon (Olkkonen 1994, p. 38). As already mentioned, this research resembles the latter approach. All in all, according to this examination, there seems to be few features of positivist philosophy in this research. So, it can be concluded that this research is hermeneutic.

1.3.2 Research approach

There are different kinds of research areas and problems in business studies. Therefore, it is obvious that one research approach does not suit them all in the best possible way. That is why different approaches are applied according to what kind of problem is in question, what the level of the knowledge is at the beginning of the study, what kind of data is available and what the objective of the research is. (Olkkonen 1994, p. 59.)

One important consideration of the research approach is the way in which theory is handled in the research project (Saunders et al. 2009, p. 124). The two alternative approaches to establishing what is true or false and to drawing conclusions are deduction and induction. In deductive research, conclusions are drawn through logical reasoning. Existing knowledge is used in order to deduce hypotheses which are then tested and, finally, either accepted or rejected. (Ghauri & Grønhaug 2005, p. 15.) Further, facts are measured quantitatively by using large sample sizes to ensure generalization of the results (Saunders et al. 2009, pp. 124–125). In inductive research, however, general conclusions are drawn from empirical observations (Ghauri & Grønhaug 2005, p. 15). Induction is often associated with qualitative research where a small sample of subjects is

under observation and a common objective of interest is to find out why something is happening. When attached to research philosophies, deduction owes more to positivism and induction to hermeneutics. (Saunders et al 2009, pp. 124–126.) As this research is hermeneutic and includes only one case company, this study is clearly mostly inductive.

Based on the problem structure and the purpose of the research, three main classes of research design can be distinguished. These are exploratory, descriptive and causal. (Ghauri & Grønhaug 2005, p. 58; Saunders et al. 2009, p. 138.) Exploratory research is especially useful to clarify the understanding of the research problem. Key characteristics of exploratory research are flexibility and adaptability to change. That is why the focus of this type of study usually is broad at the beginning and becomes narrower, as the project proceeds. (Saunders et al. 2009, p. 140.) Descriptive research is characterized by structure and precise rules and procedures. It can be a part of exploratory or causal research since before the data collection a clear picture of the phenomenon needs to be formed. Causal or explanatory research, in turn, is focused on cause-and-effect problems. (Ghauri & Grønhaug 2005, p. 59; Saunders et al. 2009, p. 140.) This research is mostly exploratory, since the purpose is to gain understanding of technical documentation and explore the different ways in which it can be arranged. However, there are descriptive features as well especially in the theoretical part of the research where the most important concepts are defined and examined in order to get the needed understanding and tools for the empirical part of the research.

To take a closer look at research approaches or strategies often used in business studies, the classification of Neilimo & Näsi (1980) is practical. They divide research approaches into four dimensions: the concept-analytic, nomothetic, decision-oriented and action-analytic approach. Constructive approach has been added by Kasanen et al. (1991) to the categorization. (see Olkkonen 1994, pp. 60–61.) The research approaches are illustrated in Figure 2.

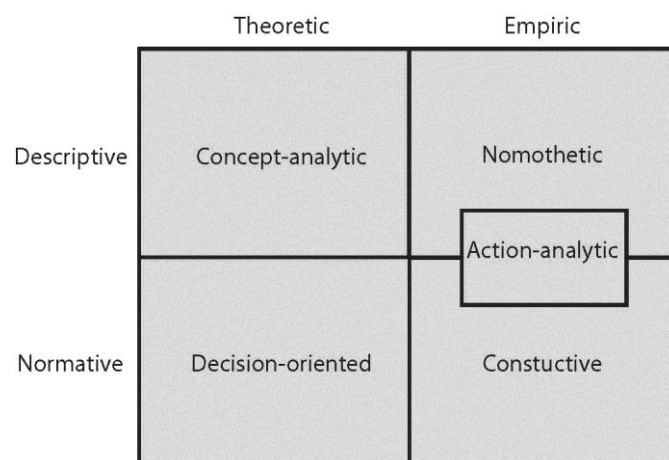


Figure 2. The relative positions of the research approaches in business studies (adapted from Kasanen et al. 1991, cited in Olkkonen 1994, p. 78).

Even though hermeneutics and positivism are not clearly visible in the division of the approaches, they serve as meaningful principles in the background. Induction is most apparent in the nomothetic approach in which the dependencies between concepts are the object of interest. Positivism is strongly present also in the decision-oriented approach, in which mathematic methods are applied in order to develop tools for organizational decision making. (Olkkonen 1994, pp. 60–70.) Since this research does not operate in the positivist philosophy, these two approaches cannot be applied.

This research fits action analytic approach that is based on hermeneutics and usually covers topics from organization's internal environment, such as management, problem solving and change processes (see Olkkonen 1994, pp. 72–73). Typical for action-analytic research is that external and objective observation is not possible, since the subject matter cannot be measured as a natural phenomenon. Further, the interpretations are usually based on the researcher's understanding. (Olkkonen 1994, p. 73.) The mentioned characteristics depict the nature of this research well. Close to action analysis is constructive approach and some features of it can also be seen in this study. In constructive approach, the purpose is to develop managerial problem solving methods through creativity, innovation and heuristics. In the action-analytic approach the understanding of the phenomenon is the core of the research, whereas in the constructive approach the initiative for research derives from a problem to be solved. (Olkkonen 1994, p. 75.) In this research both objectives are present but the latter stands out, since the understanding of the phenomenon on its own is not enough to answer the research question. Thus, the purpose is to present different alternatives that can be applied to solve the problem.

In concept-analytic approach the focus is on building a conceptual system. This is necessary for example when a new phenomenon is recognized and described. (Olkkonen 1994, p. 65.) The theoretical part of this research can be seen to reflect this type of approach since in it a conceptual system is developed. To sum up, this research is deductive and exploratory and it takes a constructive action-analytic approach with concept-analytics as the starting point.

1.3.3 Research methods

According to Saunders et al. (2009, p. 141) the choice of a research method is guided by research questions and objectives, the extent of existing knowledge, available resources and philosophical foundation. Ghauri & Grønhaug (2005, p. 40) define methods as tools or ways of proceeding to solve problems. According to them, methods act as a way of reasoning and provide rules for communication and of intersubjectivity. Research methods are typically divided into quantitative and qualitative. The main difference between these two relates to the research practices and principles. However, they should not be seen as opposites and especially not as exclusive, since they can both be applied within the limits of one research. (Hirsjärvi et al. 2005, pp. 132–135.)

Quantitative methods are usually based on logical reasoning. It is typical for them that concepts are operationalized and quantified in order to conduct statistical analysis. Qualitative research, in turn, focuses on understanding and takes a holistic perspective on the research problem. Typical characteristics of qualitative research are that analysis is inductive and objectivism is not possible due to the effect of the researcher's own values. (Hirsjärvi et al. 2005, pp. 157–160.) According to Ghauri & Grønhaug (2005, pp. 111–112) qualitative methods are most useful for inductive and exploratory research as well as in-depth studies. Since this research is both exploratory, inductive and an in-depth study, the choice of qualitative methods is obvious.

Robson (1995, p. 40, cited in Hirsjärvi et al. 2005, p. 130) separates three traditional research methods: experiment, survey and case study. Other methods that could possibly be used in this research are historical review and action research. Experiment is the most quantitative alternative of the above mentioned methods and Saunders et al. (2009, p. 143) note, that it is usually not a practical method in solving business and management research problems. Therefore, it can be excluded from closer examination regarding the execution of this research. Survey, however, is a common method applied in business studies (Saunders et al. 2009, p. 143). It usually involves the collection of data in a standardized form from a group of people (Hirsjärvi et al. 2005, p. 130). Survey is an especially useful method for exploratory and descriptive research where deduction is adapted. One disadvantage of surveys is that the data collected can be quite narrow in comparison with other methods. (Saunders et al. 2009, p. 144.) As the objective of this study demands in-depth insight into the phenomenon, survey is not the optimal method to answer the research problem.

When the phenomenon under investigation is difficult to study outside its natural setting, case study can be the right method for research. The purpose of case study is to describe the phenomenon, which is usually a management situation. (Ghauri & Grønhaug 2005, pp. 114–115.) Case study is useful for inductive theory building and theory testing and it is typically used in causal and exploratory research. It is similar to historical review, which is focused on past events by studying administrative records and documents. (Ghauri & Grønhaug 2005, pp. 114–116; Saunders et al. 2009, pp. 146–150.) However, in historical review, direct observation and interaction are not possible in the same way as in case study (Ghauri & Grønhaug 2005, p. 116). Historical review is not suitable for this research, since the aim is not to focus on the past but instead to look at the future. Further, to conduct a historical review, the case organization needs to have proper documentation and well-organized records (Gummesson 2000, p. 104). This cannot be guaranteed in the context of the research.

In action research the researcher takes on the role of a consultant and influences actively the process under study (Gummesson 2000, p. 3). It is a demanding method, since it requires the total involvement of the researcher and an organizational problem that “al-

lows to go in and act’’. It can be applied in research in which the problem concerns understanding, planning and implementing change in organizations. (Gummesson 2000, pp. 116–124.) Even though action research could fit the nature of this research, this method would probably be too challenging due to limited resources and understanding of the phenomenon. When compared with action research, traditional case studies can usually be to some extent conducted according to the researcher’s wishes (Gummesson 2000, p. 124). All in all, case study is clearly the most appropriate method for this study.

According to Gummesson (2000, p. 84) there are two types of case studies. The first attempts to derive generalizable conclusions out of analysis of a limited number of cases. The other searches for specific conclusions regarding one particular case. This research is mostly of the latter type. Yin (2003, p. 39) distinguishes two dimensions of case studies, which are:

- single v. multiple case and
- holistic v. embedded case.

These dimensions form four different case research strategies. This study is a single embedded case study. According to Ghauri & Grønhaug (2005, p. 115) a single case is used to identify factors that relate to certain behaviour or aspect of an organization or smaller unit of analysis. A holistic case study is concerned with the organization as a whole whereas an embedded case study covers several units of analysis which are some sub-units of the organization, such as departments or work groups (Yin 2003, pp. 42–43). This study cannot be regarded as holistic, since it does not operate at the organizational level but more on a departmental level. Moreover, it affects employees from different departments, which owes more to embedded case design.

1.3.4 Data collection and analysis

There are several data collection techniques that can be applied in case studies, such as interviews, observations, documentary analysis and questionnaires (Saunders et al. 2009, p. 146). Even though both qualitative and quantitative data collection techniques can be used, the latter usually predominates (Gummesson 2000, p. 3). As already mentioned, this research is strongly qualitative, which is why qualitative data collection techniques are applied.

Questionnaires are the main data collection technique in survey research. They enable the collection of a large body of data from many respondents. Both the collection and analysis of data is efficient, since respondents are reached indirectly and closed-ended questions enable mechanical analysis. However, questionnaires are not that suitable a technique, if a lot of open-ended and multiple choice questions need to be asked. (Hirsjärvi et al. 2005, pp. 186–193.) Observation, in turn, is a good data collection tech-

nique to find out, how people really behave and if this is in line with what they themselves say. The main advantage of observation is that direct first-hand information can be collected. However, it is a demanding technique, which is why questionnaires and interviews have partly replaced it. (Hirsjärvi et al. 2005, pp. 207–208; Ghauri & Grønhaug 2005, pp. 120–121.) These methods are not applied in this research because the phenomenon under interest is not easily observable and in-depth information is required.

Interview is probably the most popular data collection technique in qualitative research (see e.g. Hirsjärvi et al. 2005, p. 200; Koskinen et al. 2005 p. 105). It is especially suitable for exploratory and inductive research (Ghauri & Grønhaug 2005, p. 133) when the research problem is poorly understood and it is hard to determine the direction of the answers beforehand. Interviewing is a more flexible data collection technique than questionnaires, since it involves direct verbal interaction with the respondent which allows a different kind of control as well as deepening and clarifying of answers. However, conducting interviews takes more time than questionnaires. (Hirsjärvi et al. 2005, pp. 199–201.) In this research, interviews are the main data collection technique. This way rich data can be gathered and views of people from different job positions found out.

There are three types of interviews: structured, semi-structured and unstructured or in-depth interviews. Structured interviews resemble questionnaires, since the questions and their order are predetermined. Usually, the response categories or expected answers are identified and defined as well prior to the data collection. In semi-structured interviews the researcher has more freedom to guide the interview, since only a list of themes and questions to be covered is used as an interview framework. (Saunders et al. 2009, p. 320; Koskinen et al. 2005, p. 104). In this type of interview, the questions asked and the overall content of the interview may vary from one interview to another. This applies also to unstructured interviews, in which the interview does not follow any kind of predetermined list of questions (Saunders et al. 2009, p. 321). In that case, the interview acts more as a discussion and it requires skills from the interviewer to capture all the essential information regarding the research problem (Hirsjärvi et al. 2005, p. 204).

Interviews can be conducted as one-to-one, pair or group interviews. Group interview can be regarded as an efficient data collection technique, since information from several respondents can be gathered simultaneously. On the other hand, the impact of group dynamics on the respondents' answers needs to be carefully considered and controlled in group interviews, which can cause challenges. (Hirsjärvi et al. 2005, pp. 204–205.) In this research, semi-structured one-to-one interviews are applied in the data collection. A non-standardized type of interview allows asking additional questions and adapting them to the interview situation. Group interviews could be a potential alternative as well, but they are not applied in this research because of the uncertainty of the quality of the data and the inexperience of the researcher.

As already noted, the data collected in this research is analysed qualitatively. In qualitative analysis, data collection and analysis are interrelated processes which are usually performed iteratively (Saunders et al. 2009, p. 488). There are many types of analytical activities that can be performed in qualitative analysis. According to Saunders et al. (2009, p. 490) these can be grouped into three main categories, which are processes of summarizing, categorization and structuring. Tuomi & Sarajärvi (2009, pp. 92–93) note that techniques such as classifying, typing and organizing the data in themes are usually understood as actual data analysis but these activities are not possible without preparation of data. This includes deciding on what is interesting in the data and separating the objects of interest from other data that are then left out of the analysis. In this research, the data is prepared in the above mentioned way and analysed especially by organizing it in themes. Organizing can basically resemble classifying but the emphasis is more on what has been said about each theme than on quantitative analysis of the occurrence of the classes in the data. It deals with dividing and categorizing the data into different topics. (Tuomi & Sarajärvi 2009, p. 93.) A summary of the research methodology applied in this research is illustrated in Figure 3.

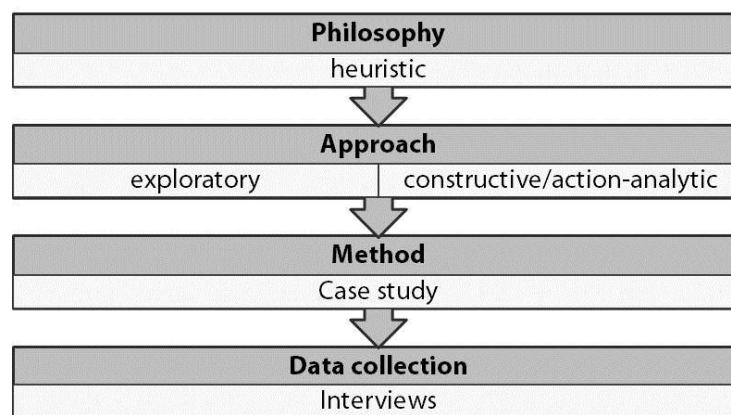


Figure 3. Research methodology at a general level.

It was concluded that this research reflects the heuristic research philosophy. Features from exploratory, constructive and action-analytic research approach were identified. For the purpose of the research, case study was regarded as the right research method. The data is collected by interviews and analysed mostly by organizing it in themes.

1.4 Structure of the thesis

This thesis is divided into six chapters. First, Chapter 1 acts as an introduction to the research. In this chapter, the research field, problem and scope are presented and the execution of the research is examined from a methodological viewpoint. The theoretical part of this research is divided into two sections: outsourcing and technical documentation. The overall structure and content of the theoretical part of the research is illustrated

in Figure 4. In Chapter 2, the first theoretical part of the research, outsourcing, is covered and the issues listed in Figure 4 are discussed. In the next chapter, background knowledge of technical documentation is presented covering the topics mentioned in Figure 4.

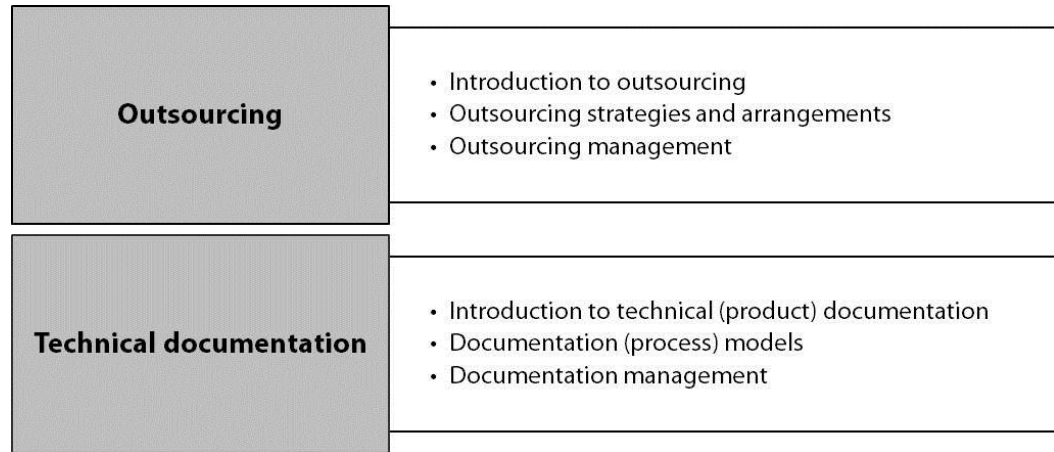


Figure 4. The theoretical part of the research.

After the most essential theories of the research have been presented, the focus switches to the empirical part of the research. In Chapter 4, the execution of the empirical research is discussed. This includes the presentation of the case company and the problem field as well as the application of the data collection and analysis techniques. In Chapter 5, the results of the research are revealed. The chapter is organized as follows: first the results of the analysis of the present state of documentation in the case company are discussed, then the uncovered challenges treated and finally, the documentation rearrangement alternatives presented and analysed. In the last chapter of this thesis, the main results of the research are summed up and general conclusions are drawn. Finally, the reliability of the results of the study is assessed and the prospects of future research are considered.

2 OUTSOURCING

Outsourcing is usually defined as the use of external resources to carry out an activity that has previously been performed in-house (Hätönen 2008, p. 42; Hätönen & Eriksson 2009, p. 146; Varadarajan 2009, p. 1165; Lacity & Hirschheim 1993, p. 74; Morgan 2003, p. 36). As other examples, Barthélemy (2003a, p. 67) defines outsourcing simply as “turning over all or part of an organizational activity to an outside vendor” and Kakabadse & Kakabadse (2002, p. 189) note that outsourcing was previously termed as contracting out. A common denominator of the slightly varying definitions of outsourcing is that the ownership of an activity is to some extent transferred (Hätönen & Eriksson 2009, p. 146). In today’s hypercompetitive and constantly changing business environment, a traditional self-sufficient and vertically integrated organization is no longer a desirable structure. The ever greater demand for performance, effective cost management and differentiation has nurtured the emergence of new business principles that are focused on vertical disintegration and specialization. (Kakabadse & Kakabadse 2002, p. 190; Corbett 2004, pp. 4–5.) Consequently, alternative forms and features of outsourcing and hybrid organizations have become popular, which has led to current times being referred to as the “outsourcing economy” (Kakabadse & Kakabadse 2002, p. 190; Hätönen 2008, p. 21).

Outsourcing entails a wide range of opportunities as well as risks. These are further discussed in Chapters 2.1 and 2.2. In making the decision on outsourcing, different aspects need to be considered. The decision is based on the organization’s outsourcing strategy which should reflect the overall strategy of the company. The different strategies are presented in Chapter 2.3.1. There are many forms of outsourcing, and the engagements can be classified according to location and scope. These classifications are discussed in Chapters 2.3.2 and 2.3.3. It has been recognized that inadequate management is a primary reason for outsourcing failure. Thus, issues related to outsourcing management are examined in Chapter 2.4. The chapter is divided into three sections: relationship management, control mechanisms and outsourcing evaluation.

2.1 Motivations and opportunities

Outsourcing is by no means a new phenomenon, since the idea of it dates back to the early dates of industrialization. The term was first used by manufacturer executives in 1970’s. (Hätönen 2008, p. 17.) However, it can be claimed that outsourcing has already been practised long before the official introduction of the concept, since for example explorers, traders and mercenaries can be seen as early examples of outsourcing. (Corbett 2004, p. xiii.) But it was not until 1980’s that outsourcing gained popularity and

became a viable strategy of organizations (see Lacity & Hirschheim 1993, p. 73). By the turn of the millennium, it already grew into a standard business procedure (Lawton & Michaels 2001, p. 104, cited in Hätönen 2008, p. 18). Besides the role of outsourcing, the related practises have developed during this evolution. For instance, the scope, strategic importance and management of outsourcing have experienced a huge turn from their early dates to their present state (Hätönen 2008, p. 41). Nowadays, entire service industries are based on the concept of outsourcing and the supply of different services is extensive. As Corbett (2004, xiii) states, it would be difficult to find an organization that is not outsourcing in just about every part of its operation.

To have gained such popularity and a steady role in business, outsourcing must be considered as advantageous by organizations. But why do organizations outsource and what do they achieve by it? The traditional reason for outsourcing is to reduce costs (Power et al. 2006, p. 8; Corbett 2004, p. 11). According to most studies, the financial motivation is still considered as a primary reason for outsourcing (Lehikoinen & Töyrylä 2013, p. 21, Lacity & Willcocks 1998, p. 367; Hätönen 2008, p. 67 and the references mentioned there; Kakabadse & Kakabadse 2002, p. 191). Cost reduction can be accomplished by moving work to low-cost locations (Power et al. 2006, p. 8) or to a service provider that can conduct the work more efficiently because of expertise, well-suited equipment or scale benefits. The underlying theory of this kind of traditional outsourcing is Williamson's (1985) transaction cost theory, which is very commonly cited in the outsourcing literature (e.g. Murray & Kotabe 1999, p. 793; Hui & Tsang 2004, p. 91; Lee et al. 2004, p. 112; Barthélemy 2003a, p. 93; Hätönen 2008, p. 40). According to it, the alternative that minimizes the total cost of ownership should be selected (Williamson 1985). Nevertheless, organizations have over the years realized that outsourcing can also bring about other possibilities than merely cost efficiency.

Besides cost reduction, outsourcing motives include for example the following:

- focus on core competencies
- access to resources, knowledge and capabilities
- changing of costs from fixed to variable
- quality or service improvement
- process improvement
- innovation
- access to new technology
- reduction of time-to-market
- flexibility (Corbett 2004, pp. 11–15; Power et al. 2006 pp. 6–10; Leavy 2004, p. 20; Jennings 2002, pp. 26–27; Hätönen & Eriksson 2009, p. 146).

As can be seen from the list, reasons behind outsourcing are several and they differ from one organization and one business function to another. The outsourcing strategy determines what the organization wants to accomplish with outsourcing initiatives (see Chapter 2.3.1). During the first wave of outsourcing, outsourcing was mainly concerned with basic support tasks (Hätönen 2008, p. 17) and the concept of core competencies started to affect the outsourcing decisions strongly. According to it, an organization should focus on business operations that create its competitive advantage and, this way, differentiate itself from other actors in the marketplace (Corbett 2004, p. 8). Any other business processes can then be considered for outsourcing by putting them in competition with the external service market (Corbett 2004, p. 6; Quinn & Hilmer 1994, cited in Barthélemy 2003a, p. 87). Still today, the definition of core competencies is considered as one precondition for outsourcing success (Barthélemy 2003a, p. 88). Yet, outsourcing is becoming more and more strategically driven; instead of purely lowering the costs, organizations are seeking capabilities and competencies from the outsourcing market (Power et al. 2006, pp. 5–6). Moreover, as the supply of the external service market and the experience of organizations in outsourcing have developed, also more strategically important business operations are outsourced (Jennings 2002, p. 26). Hence, outsourcing is regarded as one of the most important strategic management tools (Rigby & Bilo-deau 2009, p. 3).

According to Corbett (2004, pp. 91–94) the most mature outsourcing markets are in the physical part of business operations. These include activities, such as facility services and maintenance, manufacturing and warehousing. Considering that organizations have extensive experience in purchasing these activities and the available services and their providers are highly developed, outsourcing is a natural choice that is often settled on. What Corbett (2004) refers to as the second wave of outsourcing, is the specialist areas of business, which include services, such as IT, payroll and travel services. The third wave is the transactional part, which represent repeatable and routine tasks, such as telemarketing and customer order processing. Varadarajan (2009, p. 1165) concludes that outsourcing is a standard business process in, for example, accounting, IT, human resources management, facilities services and maintenance, logistics and supply chain management, manufacturing and marketing. According to Lehtikoinen & Töyrylä (2013, p. 18) outsourcing market in Finland is quite mature and new service providers bring healthy competition to the established market. Although outsourcing is already a common way of doing business, many scholars share the vision that it is even going to expand in the future (e.g. Corbett 2004, p. xiv; Lehtikoinen & Töyrylä 2013, p. 28).

According to Corbett (2004, pp. xiv–xvii) outsourcing makes firms more competitive and productive and economies and businesses stronger and better. Further, it helps organizations to rearrange their operations in a more effective manner, make the organizational structure more flexible and innovate. Outsourcing can improve an organization's efficiency, since tasks can be conducted by experts at lower costs (Power et al. 2006,

pp. 1–2). In short, outsourcing can help organizations create and sustain business value in the global marketplace (Power et al. 2004, p. 37). Despite the fact that outsourcing is generally considered a powerful tool for managing costs and improving performance, outsourcing arrangements do not usually succeed in meeting the management’s expectations (Barthélemy 2003a, p. 87). If not carefully planned and managed, all the opportunities and benefits of outsourcing can quickly turn into hindrances. This is further discussed in the next chapter.

2.2 Reasons for failure and their avoidance

Outsourcing is a complex process which requires understanding of common practises of outsourcing and of the related business processes, careful planning, sufficient resources and management of all the different parts of the process (Power et al. 2004; Hätönen 2008, p. 86). Even when these are taken into account and invested in, it is unlikely that everything goes as planned. In his research, Barthélemy (2003) has identified seven key reasons behind outsourcing failure. Next, these are introduced and reflected. At the end of the chapter the interconnectivity and the impact of the risks are considered.

The first reason for failure Barthélemy (2003) mentions is to outsource activities that should not be outsourced. To avoid this trap, an organization needs to consider what its core competencies are and what constitutes its competitive edge. Activities that directly contribute to these should not be outsourced (Barthélemy 2003a, p. 88; Sanders et al. 2007, p. 11). Sanders et al. (2007, p. 11) add that also activities that cannot be separated from core competencies should be outsourced only with extreme caution. Nevertheless, as noted in the previous chapter, besides support tasks, more business critical activities are currently considered for outsourcing. According to Jennings (2002, p. 26) any part of the value chain can in theory be outsourced but the decision implies that the internal operation does not bring any unique value for the company. As Hätönen (2008, p. 64) notes, the strategic nature affects especially the management needs and the relationship type with the service provider. The more critical the outsourced activity is, the more management and careful planning are needed and the deeper relationship is usually sought to build in order to decrease the higher risk level.

The second “deadly sin” of outsourcing, as Barthélemy (2003a) terms them, is selecting the wrong vendor. Vendor choice should be based on several criteria that correspond to the organization’s objective of outsourcing, perceived cultural and strategic fit and the required capabilities of the vendor. Thus, in the vendor assessment both task-related and strategic compatibility issues should be taken into account. (Hätönen 2008, pp. 80–81.) The third possible reason for failure is writing a poor contract. The contract serves in many ways as the foundation of the outsourcing implementation, which is why it should be carefully drafted. A good contract determines expectations and goals as well as provides safety for both parties. (Barthélemy 2003a, p. 90.) According to Barthélemy

(2003a, p. 90) a well-formulated contract is precise, complete, incentive based, balanced and flexible.

Overlooking personnel issues is the fourth key reason behind outsourcing failures. If the outsourcing communications plan is lacking, outsourcing rumours can harm the organizational atmosphere and productivity at all levels even before the actual outsourcing decision has been made. Fearing for changes and even losing their jobs, employees may become less productive and insecure. Even though employees could keep their positions, outsourcing impacts job security and loyalty negatively. That is why key personnel who possesses important tacit knowledge need to be recognized and motivated to stay in the company. (Barthélemy 2003a, p. 91; Power et al. 2004, p. 38.) The next deadly sin Barthélemy (2003a, p. 92) mentions is loss of control, which typically leads to increased costs and lower performance. This in addition to writing a poor contract was discovered to have the largest impact on the outcome of outsourcing. According to Sanders et al. (2007, p. 10) the ability to retain control of the outsourced activity decreases as the scope of the arrangement increases. Losing control can stem from either insufficient skills to manage the service provider or lack of active management (Barthélemy 2003a, p. 92). In order to prevent this risk factor from realizing, organizations apply different control and management mechanisms (Kang et al. 2012, p. 1200) that are further discussed in Chapter 2.4.

Also the next reason for failure, overlooking the hidden costs of outsourcing, can lead to a substantial increase in cost level. Tasks, such as searching for an appropriate vendor, contracting and managing outsourcing are costly but essential procedures in order for outsourcing to succeed. Thus, they need to be included in the cost analysis. (Barthélemy 2003a, pp. 93–94; Jennings 2002, p. 27.) Considering that this failure ultimately results from inadequate assessment of the total costs of outsourcing, it may be worthwhile to acquire outside experts, such as technical or legal experts, to assist in the matter (Barthélemy 2003a, p. 94). Service providers are experienced negotiators and some may even mislead the client to an arrangement which focuses more on maximizing the profits of the service provider than reflecting the real business needs of the client. In other words, outside outsourcing professionals who are familiar with the most important pitfalls can help avoid other failure factors than only hidden costs, such as selecting the wrong vendor. That is why relying only on internal resources in outsourcing decision making may be dangerous (Power et al. 2004, p. 39).

Finally, the seventh key reason for failure is failing to plan an exit strategy. According to Barthélemy (2003a, p. 94) many managers are not willing to think about the end of the contract, which can eventually lead in a lock-in situation. As a result, changing service provider and reintegrating the activities would require so much effort that managers are reluctant to make this decision even if outsourcing had failed in terms of costs and performance. If the possible termination of the contract is not considered at an early

stage of the outsourcing process, the contract may be missing important clauses, such as material and human reversibility clauses which strengthen the power base of the client in case there is a need to exit the relationship (Barthélemy 2003a, p. 94; Bahli & Rivard 2003, p. 214.) According to Bahli & Rivard (2003, pp. 213–214) also asset specificity and a restricted number of suppliers may expose an organization to a lock-in situation. Asset specificity refers to “the extent to which the production activity is dependent on the current environment and resources for completion” (Williamson 1975, cited in Hätönen 2008, p. 64). When asset specificity is high, the assets are valuable only in the specific context and they cannot be easily transferred somewhere else.

Power et al. (2004) have also identified reasons why outsourcing typically fails. These reflect the seven deadly sins of Barthélemy (2003a) quite well, though some other reasons are mentioned as well. For example, Power et al. (2004) point out, that lack of management commitment can lead to a situation, in which outsourcing goes on a wrong track right from the beginning. Also wrong human resources, lack and transfer of knowledge, haste and ignoring important aspects of outsourcing, such as cultural differences, can have a negative impact on outsourcing success. Considering the different failure factors, it can easily be concluded that they are not exclusive. In contrast, they are very much interconnected, so failing in one of them can lead to failures in other aspects as well. (Barthélemy 2003a, p. 88.) For example, if a company fails in defining its core competencies and outsources something that should not be outsourced, not even appropriate vendor selection or management can restore the initial mistake (Hätönen 2008, p. 86). As another example, poor contracting often leads to hidden costs (Sanders et al. 2007, p. 12).

Outsourcing challenges can at worst lead to the failure of the outsourcing arrangement. As a consequence, organizations may terminate the contract, switch the service provider and repeat the same mistakes. (Power et al. 2006, p. 19). In Finland, the experiences of organizations in outsourcing have not always been very positive. Some companies have already collaborated with multiple service providers and some have in the end decided to bring the operation back in-house. (Lehikoinen & Töyrylä 2013, p. 18.) This counter phenomenon of outsourcing is not only bound to Finland, since also Power et al. (2006) among others mention it. For example in the IT field, studies have according to Preston (2004, p. 14) shown that half of the organizations that outsource IT functions finally end up bringing them back in-house. Nevertheless, according to Barthélemy (2003a, p. 95) outsourcing can still succeed even if one or two mistakes are made.

All in all, the failure factors mentioned above seem to reflect some joint root causes for failure. One of them is undoubtedly the fact that organizations do not succeed in taking into account every aspect of outsourcing. This, in turn, can result from inadequate planning, which also seems to lead to many of the above mentioned risk scenarios. A third root cause for failure relates to the management of outsourcing. Organizations that fail

in outsourcing have not necessarily put enough effort in making it work (Hui & Tsang 2004, p. 86). In fact, inadequate management is often labelled as the primary reason for outsourcing failure (Hätönen 2008, p. 86; Sanders et al. 2007, p. 12). Outsourcing engagement requires effort from the client in every step of the process. As Corbett (2004, pp. 16–17) puts it: “when it comes to outsourcing, the particular areas of hard work and planning are: choosing the right opportunities for outsourcing; setting realistic expectations; choosing the right providers; crafting a balanced relationship that offers sustainable benefit to customer and provider, alike; properly managing outsourcing’s organizational impacts; and managing the ongoing relationship”.

2.3 Outsourcing strategies and arrangements

The outsourcing decision is not easy to make, since many variations of outsourcing arrangements exist and they have been classified according to a variety of different schema (Kang et al. 2012, p. 1196; Sanders et al. 2007, p. 4). The arrangements differ significantly in scale, scope and complexity (Hätönen 2008, p. 63). Additionally, making the right decisions requires a lot of knowledge and understanding for example of the potential engagement options, risks and benefits and the strategic fit of the different arrangements to business objectives (Sanders et al. 2007, p. 4). Not only a wide range of contextual factors but also their longer-term development needs to be taken into account (Jennings 2002, p. 31). In this chapter, outsourcing strategies and arrangements are presented and their compatibility considered. According to Handley & Benton (2013, pp. 112–113) defining the content and scope of the work to be outsourced and determining where the work should be performed are two fundamental outsourcing decisions. In this respect, the types of arrangements are in this research categorized according to the location and scope of outsourcing. Also other factors, such as the type of the contract, the length and form of the relationship, the nature of the activities to be outsourced and the number of service providers (see Lee et al. 2004) could be used in classifying different arrangements but these are excluded from this research.

2.3.1 Outsourcing strategies

The outsourcing strategy can be seen as the logic underlying a firm’s outsourcing decisions (Lee et al. 2004, p. 112). It regards outsourcing as an organization-wide and long-term strategic decision which aims to ensure sustainable competitive advantage (Kang et al. 2012 p. 1196; Jennings 2002). Größler et al. (2013, p. 297) conceptualize outsourcing strategy as consisting of two sets of decisions. The first is the main objective for outsourcing and the second the geographic location where outsourcing is allocated. The outsourcing strategy defines the core activities that need to be retained by the company as well as the activities that can be considered for outsourcing. Additionally, the general objectives of outsourcing are determined. Besides corporate level, the outsourc-

ing strategy can be written at divisional or functional level. (Lehikoinen & Töyrylä 2013, pp. 43–46.)

As concluded in Chapter 2.1, an organization can pursue a variety of different net gains with outsourcing. The motivation for outsourcing is the primary determining factor of the outsourcing strategy. According to Hätönen (2008, pp. 16–18) outsourcing has developed from pure traditional or transactional outsourcing to strategic outsourcing and finally to a new buzzword of transformational outsourcing. Traditional outsourcing focuses on purely cutting operational costs by shifting non-core business functions to external service providers. In strategic outsourcing, in turn, organizations turn to outsourcing in order to gain new skills, competences and knowledge by handing over more complex and business critical processes to outside partners. (Hätönen 2008, pp. 17–18.) Finally, transformational outsourcing goes even further in exploring the possibilities of outsourcing, since the aim of this strategy is to change the entire industry by creating radical new business models (Engardio et al. 2006, cited in Hätönen 2008, p. 18). Hence, as organizations' experience in outsourcing increases, the awareness of the potential also grows. As a consequence, more complex strategies and outsourcing arrangements are dared to pursue. (see Leavy 2004, p. 20.)

Based on motives, Hätönen (2008, p. 67) divides current outsourcing strategies into three categories: transactional, resource-seeking and transformational outsourcing. An organization following resource-seeking strategy outsources processes to acquire resources and capabilities or competencies outside the organizational boundaries. Therefore, this strategy clearly resembles strategic outsourcing mentioned above. With this strategy the organization can compensate lack of expertise, which enables process improvement (Sanders et al. 2007, p. 9). In resource-seeking strategy, outsourcing often aims at innovation (Hätönen 2008, p. 73). Sanders et al. (2007, pp. 9–10) use a similar trisection of strategies, which they term financial, resource-based and strategic outsourcing. As can be seen, resource-based and strategic outsourcing are in this classification separated from each other. They define that the aim of strategic outsourcing is to achieve competitive differentiation with outside expertise. Hence, the two strategies have clearly a lot of in common.

Leavy (2004) presents four promising strategies of outsourcing, which are focus, scale without mass, disruptive innovation and strategic repositioning. First, the strategy of focus sees outsourcing as a way to hand over non-core business processes to experts on that field and move own resources to the key activities that bring competitive advantage. In order to follow this strategy successfully, the organization needs to determine which value driver to focus on; is it customer intimacy, product leadership or operational excellence. Secondly, outsourcing offers a great opportunity to organizational growth without expansion in the size of the organization. Scale without mass is an especially useful strategy for rapidly growing new companies. (Leavy 2004, pp. 20–21.) Leavy's

(2004, p. 22) disruptive innovation strategy resembles transformational outsourcing of Engardio et al. (2006), since the aim is equally to develop an innovative business model which may even change the entire industry. Finally, in strategic repositioning the aim is to change the entire strategic course of the organization (Leavy 2004, pp. 22–23).

Other scholars (e.g. Kang et al. 2012; Bengtsson et al. 2009) consider two distinct strategies of outsourcing that are efficiency-seeking and innovation-seeking outsourcing. These can be seen to represent two end points of a continuum, on which the other outsourcing strategies can be placed. In Figure 5 it is shown how the strategies presented in this chapter could be positioned in this kind of continuum. The end on the left represents efficiency-seeking strategy, while the one on the right represents innovation-seeking. To begin with, traditional and transactional outsourcing are clearly the most financial-oriented strategies and they are placed at the very left end of the continuum. Leavy's (2004) scale without mass and focus strategies have already other motives than purely cost reduction, but innovation is still mainly sought with rearrangements inside the company which is allowed by outsourcing mostly non-core business processes. Strategic repositioning aims at a major change in business, but the change is mostly internal to the company and outsourcing strategy is refined as a consequence of a redefinition of core competencies. Resource-seeking and strategic outsourcing are the first strategies that clearly move down the continuum towards innovation-seeking strategy. In these strategies, the costs are only a by-product of outsourcing that is aimed at bringing certain value for the client. Finally, disruptive innovation and transformational outsourcing represent the right end of the outsourcing strategy continuum.

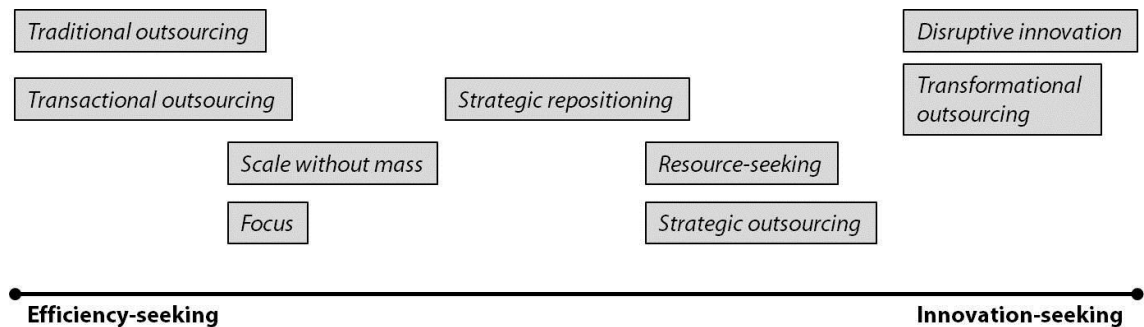


Figure 5. *The outsourcing strategy continuum.*

Different outsourcing strategies require different types of outsourcing arrangements and control measures in order to achieve desired goals (Kang et al. 2012 p. 1201; Hui & Tsang 2004). Outsourcing arrangements are examined in more detail in the following chapters and control measures later in Chapter 2.4.2. In order to make the right outsourcing decision, many considerations besides the purpose of outsourcing need to be considered. These include the location and scope of outsourcing which are treated in the next two chapters.

2.3.2 Location of outsourcing

Outsourcing types can be grouped by using different kind of criteria. One typical classification of outsourcing arrangements is based on the location of outsourcing. Handley & Benton (2013) identify three location-specific attributes that are geographic distance, cultural distance and geographic dispersion. These significantly contribute to the complexity of the outsourcing arrangement. Considering the geographic distance, a distinction between on-site and off-site outsourcing can be made. In on-site outsourcing, the employees of the service provider work in the premises of the client organization while in off-site outsourcing the external employees work outside the client organization in the service provider's premises. Off-site work can further be divided into onshore, nearshore and offshore outsourcing. (Power et al. 2006, p. 12.)

In onshore outsourcing the service is conducted within the same country in which the client organization is located. In nearshore arrangements, in turn, the service is shifted to some neighbouring country. For example, US companies have moved some operations to Canada and organizations of the West European countries to Russia or East Europe. (Power et al. 2006, p. 13.) The most popular nearshore outsourcing locations of Finnish organizations are Estonia, Latvia, Poland, the Czech Republic, Hungary and Romania (Lehikoinen & Töyrylä 2013, p. 30). Finally, a business operation can be shifted to a more distant location as well. Especially India is one country that is usually mentioned in the context of offshore outsourcing, since it has become the dominant country for outsourcing of software work. (Lehikoinen & Töyrylä 2013, p. 30; Power et al. 2006, p. 13.) The term offshoring is sometimes used as a synonym for offshore outsourcing but a distinction between these two can be made. Some authors (e.g. Bengtsson et al. 2009, p. 36; Corbett 2004, p. 39) define offshoring as outsourcing across national borders using either internal (e.g. a subsidiary) or external resources. Others (e.g. Varadarajan 2009, p. 1165), however, outline that in offshoring only internal resources are used. In this thesis the former definition is applied.

Low costs of labour combined with talented workforce are usually the striving motive for offshore outsourcing. Nevertheless, costs may be significantly reduced also in onshore arrangements, especially if the client organization seeks a service provider outside the major cities, since these organizations can price their services lower due to lower costs of labour and living. (Lehikoinen & Töyrylä 2013, pp. 29–30; Power et al. 2006, p. 13.) An onshore arrangement can be considered as less risky, since there are fewer issues to deal with concerning for instance laws, governmental issues as well as language and cultural issues (see Größler et al. 2013, p. 309). The advantages of nearshore outsourcing include geographical proximity, cultural similarities and no major time differences (Lehikoinen & Töyrylä 2013, p. 30). In other words, both the geographical and cultural distance is smaller, which reduces the complexity of the arrangement.

The terms global and international sourcing both of which indicate offshoring are often mentioned in the context of outsourcing strategies. According to Petersen et al. (2000, p. 29), in international sourcing the decisions are made locally and there is no clear coordination of outsourcing practises between different business units. Global sourcing is generally seen to go beyond this meaning that outsourcing activities and requirements are coordinated and integrated at a corporate group level across worldwide business units to create a common set of items, processes, technologies and service providers. By moving towards global sourcing strategy, purchasing and sourcing decisions become more strategic in comparison with international sourcing in which they tend to be made according to tactical or operational justifications. In their study, Trent & Monczka (2003) found out that firms that engage in global sourcing generally experience greater and more diverse benefits than those that rely on more locally coordinated international sourcing. However, they note that the transition to global sourcing progresses through many stages making it a complex transition process.

The location decision is significantly affected by the outsourcing strategy of the organization. When following efficiency-seeking strategy, organizations often outsource internationally. This way costs can be reduced due to more favourable cost structures in other countries, though more potential risks are involved as well. (Größler et al. 2013, pp. 309–310.) In addition, as the geographic distance increases, usually more coordination and control are needed, which needs to be taken into account in the financial analysis. At worst, the accumulated costs associated with control and coordination can nullify the benefits of low labour costs. (Handley & Benton 2013, p. 124.) Innovation-seeking outsourcing does not tend to exclude international partners either, since it would be naive to count on the innovation capability of only one country in pursuing new ground breaking ideas. In contrast, onshore outsourcing is usually preferred when aiming to achieve flexibility related to capacity. This can be explained by the fact that onshore resources are easier to reach. Additionally, it should be easier to cooperate with organizations from the same country especially in situations where ad hoc solutions are needed. (Größler et al. 2013, pp. 309–310.) According to Hui & Tsang (2004, p. 88) outsourcing for capability is an appropriate strategy for non-critical tasks that are being sourced in order to maintain or develop capability. Outsourcing for capability can be seen to reflect the resource-seeking strategy defined in the previous chapter.

According to Hätönen (2008, pp. 70–72) factors that influence the outsourcing location decision and the choice of the partner include situational, external, locational and internal factors. The outsourcing strategy is one of the internal factors together with experience. For example, the threshold to offshore outsourcing is much lower if the organization has prior experience in it. Moreover, previous research has suggested that outsourcing is a learning cycle which starts from nearshore locations and non-strategic activities and incrementally proceeds towards strategic offshore outsourcing (Hätönen 2008, p. 70 and the references mentioned there). Considering that offshoring has in recent years

captured the attention of outsourcing researchers and become one of the primary literary streams of the field, it can be claimed that organizations are beginning to be relatively experienced in outsourcing and interested in more complex strategies and arrangements.

2.3.3 Scope of outsourcing

Outsourcing is not an all-or-nothing decision. Instead, there is a wide range of alternatives from outsourcing the operative execution of a singular task to handing over the total responsibility of an entire department or process to an external service provider. Therefore, scope of outsourcing, which can also be understood as the degree of responsibility assigned to the service provider, is one important dimension of outsourcing. (Sanders et al. 2007, pp. 4, 7.) According to Handley & Benton (2013, pp. 113–114) scope or breadth of the task, as they term it, is one critical task-specific characteristic that contributes to the complexity of the outsourcing arrangement. They define breadth of the task as the number of activities involved in the outsourcing service. Besides scope, also scale of the service and level of customization are task-specific characters that affect the complexity of the arrangement.

Sanders et al. (2007, p. 7) have identified four distinct categories of outsourcing arrangements from the viewpoint of scope. These are:

- out-tasking
- co-managed services
- managed services
- full outsourcing.

First, out-tasking is the simplest form of outsourcing, where only a specific task or one aspect of a function is assigned to an outside service provider (Hui & Tsang 2004, p. 86). In this kind of arrangement the responsibility of the service provider is small and specific. Second, in co-managed services, an organization transfers a larger scoped task or function to a third-party service provider but keeps the management partly in-house. This means that both parties share responsibility for the performance of the tasks, which usually requires collaboration. Typically, the tasks outsourced as co-managed services have little strategic significance but not always. Third, managed services refer to an arrangement, in which the outside service provider usually designs, implements and manages an entire end-to-end solution of a function for the client organization. As can be noted, the responsibility of the service provider is here relatively strong and comprises all aspects of the function. Even greater is the responsibility of the service provider in full outsourcing. In this arrangement, also the strategic direction of the outsourced activity is usually in the hands of the service provider. (Sanders et al. 2007, p. 7.)

The strategic significance of the activity to be outsourced has a great impact on the appropriateness of the different outsourcing arrangements. According to Sanders et al. (2007, p. 8) out-tasking is usually applied for tactical tasks and functions whereas full outsourcing engagement generally involves a shift of a more business critical process or operation. Also the outsourcing strategy affects the decision on scope. Out-tasking and co-managed services operate at a more tactical level of outsourcing and are generally intended to meet financial or resource-based objectives. The two more comprehensive arrangements, instead, are usually applied when seeking deeper and longer-term strategic advantages. The more comprehensive the arrangement is and the more critical the task to be outsourced, the deeper form of relationship is usually searched for. In complex arrangements partnerships or even strategic alliances are often formed (Sanders et al. 2007, pp. 8–10.) Thus, the appropriate level of involvement depends strongly on the scope and business nature of the outsourcing arrangement. When following efficiency-seeking strategy, simple forms of outsourcing are most likely preferred, whereas commitment to a more extensive arrangement requires strategic justifications that represent innovation-seeking.

Lacity et al. (1996) distinct two levels of outsourcing: total and selective. In total outsourcing an organization transfers at least 80 per cent of the function's budget to an external service provider while in selective outsourcing 20 to 80 per cent of the budget is allocated to internal use. Selective strategy may include a single vendor or multiple service providers. (Lacity et al. 1996, pp. 14–15; Lacity & Willcocks 1998, p. 370.) According to Lacity et al. (1996, pp. 14, 24) the most successful approach to outsourcing is reasoned, incremental and selective. With selective outsourcing an organization can maintain the control of the core activities and at the same time take advantage of outside expertise. Further, this strategy diminishes the associated risks, because the client is not dependent on a single service provider and the client maintains knowledge of the function in-house. One fundamental risk of selective outsourcing is to make a wrong decision on which services to outsource and what to retain in-house. That is why it is extremely important to consider the matter carefully and examine the interdependencies between processes (Power et al. 2006, p. 78). Lacity et al. (1996, p. 15) argue that total outsourcing usually leads to great difficulties in a few years. Moreover, ignoring the external service market and maintaining functions in-house has its risks as well. In their research, using internal resources turned out to be successful only after when placed in competition with the external service market.

Speaking of the scope of outsourcing, one of the latest trends in the field is business process outsourcing (BPO). It refers to handing over an entire business process to an external service provider. (Halvey & Melby 2007, p. 3.) It takes a process-centric approach to outsourcing where the current process is examined closely and reengineered with the service provider who then takes on the management of the process (Corbett 2004, p. 28). Additionally, BPO usually involves some level of risk sharing. For exam-

ple, the fees of the service provider can depend on the success of the arrangement which can be measured as the increase in the profit of the client organization. (Kakabadse & Kakabadse 2002, p. 191.) In this sense, BPO is an extensive form of outsourcing, since the responsibility of the service provider is high and close cooperation between the two parties is usually required.

The scope of outsourcing may change over time. For example, outsourcing may start as out-tasking and evolve into full outsourcing (Hätönen 2008, p. 75). Hence, smaller arrangements in scope are a good way to test the capability of the service provider. If successful, more responsibility can incrementally be given out. This kind of an approach to outsourcing can be considered as less risky than directly handing over all responsibility outside. The decision about the most appropriate outsourcing arrangement needs to be considered from many perspectives. It is worth careful planning, since poor arrangements may harm client organizations in many ways. Most importantly, they may cost organizations a lot, since renegotiating the contract or switching the vendor are both expensive procedures. The different outsourcing arrangements presented in this research are illustrated in Figure 6. By combining the arrangements of scope with different locations of outsourcing, multiple arrangement alternatives are formed.

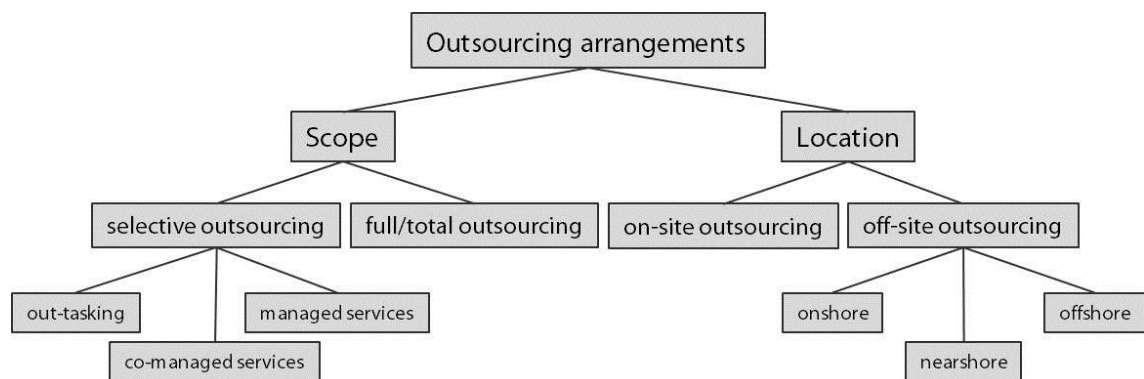


Figure 6. *Outsourcing arrangements.*

No matter what arrangement is chosen, at least some management of outsourcing is needed in order for outsourcing to be successful (see Sanders et al. 2007, p. 11). Management and control of outsourcing is further discussed in the next chapter.

2.4 Management of outsourcing

Management and evaluation of outsourcing can be seen as one stage of the outsourcing process, which follows after the planning, implementation and transition phase (see Power et al. 2006, p. 32; Hätönen 2008, p. 55; Hui & Tsang 2004, p. 87). This stage has been reached when all the initial difficulties have been resolved and the process has reached a level of normality and the service provider conducts work for the client in the agreed manner (Power et al. 2006, p. 153). In fact, it has been recognized that building

relationships and managing the day-to-day operations are one of the main factors behind successful outsourcing (Morgan 2003, p. 44). That is why management of the collaborative work should be an integral part of the decision making throughout the process (Corbett 2004, p. 178). However, managing the outsourced activities seems to be a considerable challenge in organizations. As concluded in Chapter 2.2, it is one of the most important reasons for outsourcing failure.

In the next two chapters, management and control of outsourcing are examined in more detail. In this context, relationship management is understood as an overarching term for the nurturing of interfirm relations, whereas control focuses more on tools that client organization uses in order to affect the service provider. According to Chen et al. (2009, p. 1134) control is in some cases paralleled by the term governance, since both indicate one party's influence on another. Not even proper management is usually enough to ensure the long-term success of outsourcing, since the business environment constantly changes. That is why organizations and their value networks need to change as well in order to adapt to the dynamic business and remain competitive. Thus, an organization needs to reassess the engagement and its suitability for the current and future business requirements from time to time. This calls for evaluation of outsourcing, which leads to continuing, modifying or terminating the contract (Power et al. 2006, p. 163). This is treated in the final chapter of this section.

2.4.1 Relationship management

According to the survey results from the 2004 Outsourcing World Summit, organizations are not getting the maximal contract's value due to poor working relationships between the client and the service provider (see Corbett 2004, p. 177). There are several reasons which can explain this. First, since organizations often outsource because of financial reasons, putting effort on management is not necessarily encouraged. Second, organizations may have insufficient knowledge of how to manage interfirm relationships and activities, because little is known about which management practises yield the best results. (Corbett 2004, p. 177.) Further, they might not have the skills needed, since managers may be more used to managing internal teams than a complex value network. Hence, managing the relationship is clearly a challenge in outsourcing that requires closer investigation.

Even though management can be regarded as a hidden cost of outsourcing, it is worth investing in, since it has been discovered that it enhances outsourcing performance and usually separates successful outsourcing arrangements from failures (Barthélemy 2003a, pp. 93–94; Barthélemy 2003b, p. 539). With appropriate management, the client organization can extract the optimal value of the arrangement as well as manage the related risks (Hätönen 2008, p. 73). Further, by managing the relationship properly, early signals of incoming issues may be spotted and dealt with before they become serious prob-

lems (Power et al. 2006, p. 154). Management is also the key to prevent opportunism of the service provider (Barthélemy 2003a, pp. 92–93). According to Williamson’s (1985, p. 47) definition, opportunism refers to “self-interest seeking with guile”. In short, most of the reasons for failure mentioned in Chapter 2.2 could be prevented with proper management, which is why management should not be overlooked even if the outsourced activity is purely a support task.

When the outsourcing initiative has been implemented, it has to be monitored that the terms of the contract realize in practise (Power et al. 2006, p. 153). This requires negotiating skills and management of the relationship. Power et al. (2006, p. 153) define that relationship management involves continuous monitoring of the outsourcing arrangement as well as conducting routine audits to ensure that the expected levels of operation are being met. Nevertheless, relationship management is a lot more than just managing the day-to-day operations of outsourcing. Besides work administration, also communication, knowledge, personnel and financial management need to be paid attention to. (Power et al. 2006, pp. 153–154.) In addition, management should occur at operational, tactical and strategic level (Corbett 2004, p. 179; Lehikoinen & Töyrylä 2013, p. 113). The multilevel governance model is illustrated in Figure 7. According to Hätönen (2008, p. 73) the governance model is the key to achieve the goals of outsourcing and it needs to be included in the decision making. He adds that choosing the wrong model is one of the key reasons for outsourcing failure.

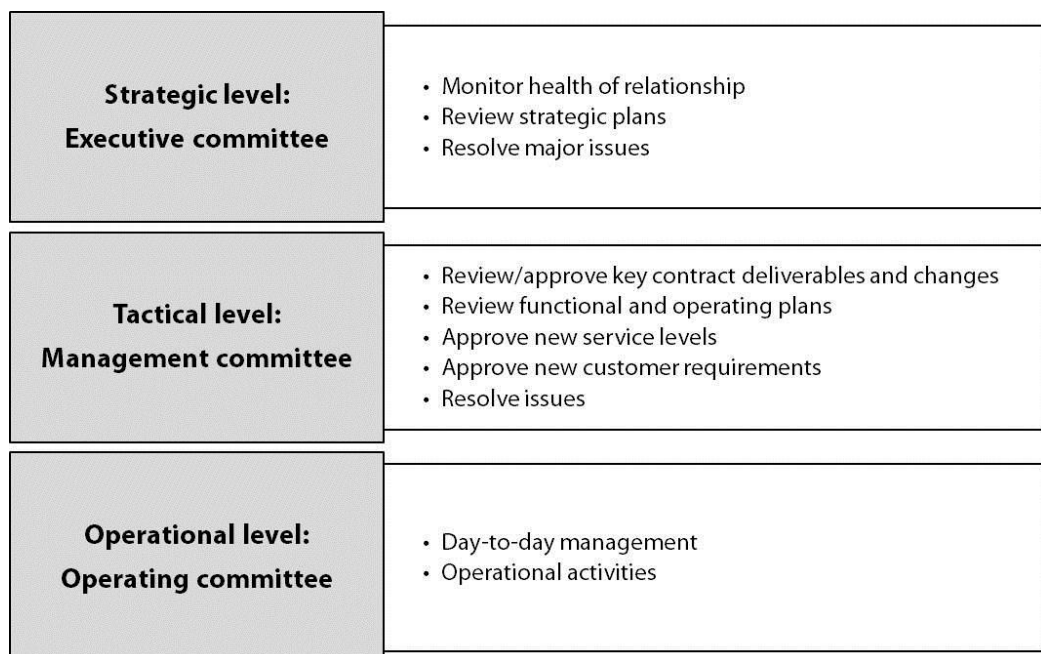


Figure 7. The multilevel governance model (modified from Corbett 2004, p. 180).

The principle of the multilevel governance model is that the client organization and the service provider define own management teams for each layer. The team members

should represent all disciplines and interests that are affected by the outsourcing arrangement. When planning the governance model, it is essential to take into account the information flows between the layers in order to ensure that issues recognized at a lower level are brought for resolution to a higher level of management when needed. (Lehikoinen & Töyrylä 2013, p. 112; Corbett 2004, p. 179.) The continuous flow of information can be ensured by positioning at least one person at multiple levels of management. Outsourcing can well be managed with small teams if the contract is carefully drawn up and team members have the demanded skills. A three-level governance model is not obligatory, since the strategic and tactical level may be combined if the outsourced activity is not of strategic nature. (Lehikoinen & Töyrylä 2013, pp. 112–116.)

At the operational layer, managers are concerned with day-to-day operations and tasks that include settling the demand and supply of services, assessing quality, constant development of services and cost control (Lehikoinen & Töyrylä 2013, p. 117). The tactical management team, in turn, ensures that both parties have a common perception of the current performance and fulfilment of expectations. Also any changes in the scope or outputs of outsourcing have to be approved by it. Finally, the strategic management team has the overall strategic responsibility of the arrangement. (Corbett 2004, p. 179.) This team is tasked with resolving any major issues that may arise, such as a change in the client's business or a substantial volume change (Lehikoinen & Töyrylä 2013, p. 116). Considering that the precise definition of people and system interfaces, data flows and reporting capabilities including their number and location is a precondition for successful relationship management (Corbett 2004, p. 178), applying the multilevel governance model can help in the definition effort. This way a solid foundation for achieving the desired goals is formed.

The objective of work administration is to ensure that the service provider conducts the work according to the operating principles outlined in the contract (Power et al. 2006, p. 154). According to Power et al. (2006) work administration involves looking at resource consumption, managing roles and responsibilities and evaluating outputs. This way the service provider knows what is expected from it and its members, which facilitates the successful completion of tasks. In order to evaluate the quality of the outputs, the client organization may apply key quality measures, such as customer satisfaction or the number of defects and their origin. (Power et al. 2006, pp. 154–156.) If the terms of the contract are not being met, the client organization should apply appointed penalties. Nevertheless, rewarding the service provider's employees for good results and applying incentives that motivate to pursuit the goals are as important in ensuring the ongoing success of the arrangement. (Corbett 2004, p. 183.)

Communication is nowadays usually handled by using different information tools. The development of technology has opened up a whole range of tools that facilitate efficient and continuous communication in interfirm relations. The Internet, voice mail, telecon-

ferencing, extranets, e-mail, discussion groups, instant messaging and online collaboration tools are all well taken advantage of in organizations. (Power et al. 2006, p. 158; Corbett 2004, p. 181.) In addition, advanced information systems with real-time data and analysis tools can be developed in strategic relationships. Communication management should ensure that proper tools are available and the involved individuals are aware of the ways they can and should be used (Power et al. 2006, p. 158). This and effective communication in general requires a joint communication plan (Sanders et al. 2007, p. 12). Despite the advantages of IT, the value of regular goal-oriented meetings should not be underestimated, since face-to-face meetings can still be in many ways seen as the cornerstone of communication management (Power et al. 2006, p. 158; Corbett 2004, p. 181). Communication management can be perceived as one part of knowledge management. Transferring and sharing information is one critical success factor of outsourcing, which can be encouraged with different communication tools but needs proper management as well. Busi & McIvor (2008, p. 193) conclude that applying technics known in knowledge management to the outsourcing context is one of the most important research topics that require further investigation.

Financial management focuses on money transactions between the client organization and the service provider (Power et al. 2006, p. 160). According to Lehtikoinen & Töyrylä (2013, p. 168) the portion of service providers that over-invoice is remarkable. They state that the results of audits show that as much as 25–50 per cent of service providers are over-invoicing. There is plenitude of ways that service providers use to charge clients some extra. These are partly depended on the pricing model applied. To mention a few examples, working hours are rounded up or exaggerated and they include non-chargeable time, unnecessary tools are used or reported to have been used in case the client organization pays for them, more outputs are reported than actually finished, unnecessary work is done and unrelated expenses are invoiced. (Lehtikoinen & Töyrylä 2013, p. 168.) Clearly, the client organization can in many cases save a lot of money with adequate financial management. This calls for assessment of the appropriate pricing model and the needed accounting information, careful invoice verification and a precise contract that defines the invoicing principles (Lehtikoinen & Töyrylä 2013, pp. 169–170). Further, budget realization needs to be monitored regularly. (Power et al. 2006, p. 161.)

Management can be focused on hard or soft factors or include both. The former refers to contract-based management practises while the latter is more concerned with developing the relationship based on trust. (Barthélemy 2003b, pp. 539–540.) According to Barthélemy (2003b) a soft approach enhances especially the performance dimension, while hard management results in performing well on the cost dimension. In the combined management mode, trust supplements the contract, which is a powerful management approach especially in complex arrangements. In simple outsourcing engagements, hard side of management may be sufficient. (Barthélemy 2003b.) There is no one

best management model, since the nature of the outsourced activity, strategy, motives, location and transactional operational models all influence the management needs. The more knowledge intensive, complex and strategically important the outsourced activity is, the more management and control are needed. (Hätönen 2008, pp. 73–84.) In addition, also geographic distance and the scope and scale of the arrangement all positively correlate with the costs associated with coordination (Handley & Benton 2013, p. 124). That is why before engaging in more encompassing outsourcing engagements and strategic relationships, the organization needs to determine if it possesses the required relationship management skills (Sanders et al. 2007, p. 12).

2.4.2 Organizational control in outsourcing

According to Das & Teng (2001, p. 258) control is generally viewed as “a process of regulating and monitoring for the achievement of organizational goals”. Kirsch (1996, p. 1) perceives control as a set of mechanisms that are needed to motivate individuals to work in a way that ensures the achievement of goals. By using different control mechanisms, the client organization monitors the service provider’s performance and ensures that it follows the outsourcing strategy (see Chen et al. 2009, pp. 1196–1197 and the references mentioned there). Besides achieving desired goals, control is also needed for mitigating opportunistic behaviour of the service provider (Eisenhardt 1989, cited in Chen et al. 2009, p. 1142). Especially if the goals of the service provider are clearly incongruent with those of the client, the need for control in opportunism mitigation increases (Chen et al. 2009, p. 1142). As mentioned in Chapter 2.2, lack of control is one of the key factors that often lead to outsourcing failure. That is why proper control mechanisms are needed to prevent a net loss in the client organization’s competitive advantage (Kang et al. 2012, p. 1197).

In organizational control literature, control is most often divided into formal and informal or social control. Additionally, formal control is further divided into output and process or behavioural control. This trisection and framework of organizational control is widely used and accepted by the control and outsourcing researchers (e.g. Chen et al. 2009; Das & Teng 2001; Kang et al. 2012). That is why it is also presented in this research. Some researchers (e.g. Kirsch et al. 2002; Kirsch 1996) recognize also different modes of social control, such as self-control and clan control. The latter is sometimes used as a synonym for social control (Das & Teng 2001, p. 259), whereas self-control, in other words motivating and relying on self-management of the service provider’s employees (see Kirsch et al. 2002, p. 486), is more seldom dealt with. Hence, in this research, social control is examined as one distinct control type.

In formal control, the client organization monitors and rewards desirable performance by using formal rules, procedures and policies (Das & Teng 2001, p. 259). The first mode of formal control, namely process control, refers to the evaluation of the service

provider's performance according to its adherence to defined steps and procedures (Kirsch et al. 2002, p. 485). According to Power et al. (2006, p. 190) it is common to measure attributes, such as the time taken to complete the process and the amount of critical issues that arise during process execution. Second, in output control, the performance is measured through the final outcomes by evaluating how specific outcome targets are being met (Kang et al. 2012, p. 1196). According to Sanders et al. (2007, p. 10) identifying key outsourcing performance metrics and their values is challenging especially if the output is intangible and therefore difficult to quantify. In formal control, the degree to which the service provider meets the defined service levels (SLA) can be seen as the minimum performance criteria. In addition, situation dependent key performance indicators (KPIs) are often used in the measurement. (Hätönen 2008, p. 85.) Social control, in turn, focuses on people-based control modes, organizational norms, common values, culture and shared goals to motivate desirable behaviour and outcome (Das & Teng 2001, p. 258). In other words, social control can be considered as indirect control.

There are many factors that affect the choice and appropriateness of control modes. These should all be considered when deciding which control mechanisms to apply. First of all, several researches show that client organization's knowledge and understanding of the outsourced activity has a significant impact on the control mechanisms chosen (e.g. Kirsch 1996; Kirsch et al. 2002; Kang et al. 2012). Generally speaking, formal control measures are usually applied when understanding of the processes is high, whereas social control is a more attractive alternative when this kind of knowledge is not possessed. For example, in order to conduct process control, the client organization needs to be able to define the exact process and formal measures based on the process description. Without this kind of relatively deep understanding, social control may be more appropriate than formal control. Through active participation in meetings and other formal and informal channels, the client can enhance its knowledge and develop "cognitive frames of understanding" which can eventually work as a framework to evaluate the progress and performance of the service provider. (Kirsch et al. 2002, p. 494.) In addition, social control has been recognized to have a positive effect on trust among the partners. In informal control, socialization, communication, participation and interaction between partners are emphasized, which enhances mutual and shared understanding as well as trust. (Das & Teng 2001, p. 264.)

On one hand, prevailing trust affects the choice and effectiveness of control measures. Kang et al. (2012, p. 1200) found out in their research that organizations did not apply strict process control with service providers whose capabilities and performance were trusted in but, instead, focused merely on output control. In contrast, the service providers deemed not that reliable were placed under continuous process control to ensure the expected level of performance. Additionally, Das & Teng's (2001, p. 265) integrated framework of trust, control and risk propose that trust enhances the effectiveness of all control types. On the other hand, the cause-and-effect relationship of control and trust

may as well be examined from the opposite direction, since control measures have been noted to affect the development of trust in the relationship. Formal control may undermine trust, since the controlees may perceive strict rules and frequent measuring and evaluation as a sign of mistrust. Moreover, if the processes are strictly specified in the partnership, the controlees may think that they are not trusted to conduct work in their own way. (Das & Teng 2001, p. 263.) As already mentioned, social control tends to have the opposite effect on trust.

Different outsourcing strategies require different types of control mechanisms. The research of Kang et al. (2012, p. 1199) shows that efficiency-seeking outsourcing is primarily concerned with formal control while social control is required by innovation-seeking strategy. In addition, Chen et al. (2009) report similar findings. Hence, too strict control measures and rules may inhibit the innovation capabilities of service providers. Furthermore, the measurability of the processes and outcomes may be low in this kind of knowledge work, which makes the application of formal control challenging. On the other hand, if outsourcing is more financially motivated, social control may require too much involvement in relation to the net gains. Also the location and scope of the outsourcing arrangement affect the need for control. Handley & Benton (2013, pp. 123–124) suggest that as the geographic distance and the scope of the arrangement increase, the associated control costs become greater. Complex arrangements increase the involved uncertainty and make it difficult to develop and maintain a complete contract, which is why the client organization needs to invest more heavily in control mechanism systems. Thus, formal control based on contractual agreements is usually sufficient in out-tasking but more comprehensive arrangements require more diverse forms of organizational control (Sanders et al. 2007, p. 12).

All in all, the more measurable the outsourcing activity is, the more formal control mechanisms are used. On the other hand, the more tacit the activity is, the more social control has to be involved. (Chen et al. 2009, p. 1149.) Process control is appropriate, when behaviour is observable and sufficient knowledge of the processes is available. Output control, in turn, can best be applied when measurability is high and behavioural observability low. Finally, social control fits to arrangements where behaviours and outputs are not specified. (Kirsch et al. 2002, pp. 493–494; Das & Teng 2001, p. 259.) Kang et al. (2012, p. 1199) point out that successful outsourcing usually involves using several different control mechanisms. As the relationship develops, the control mechanisms need to be updated accordingly.

2.4.3 Evaluation of outsourcing arrangement

From time to time client organization needs to pause and evaluate the net gains from the outsourcing arrangement and how well they fit the current business needs and the situation in the marketplace. If no major changes concerning the business environment have emerged and the service provider has been delivering at the agreed service level, there is

no need to modify the contract let alone terminate it. However, even in this kind of desirable situation, the client organization needs to evaluate the past and future development of the relationship. In other words, it is worthwhile to consider, what the situation is compared to the time before the service provider and where the relationship is heading. (Power et al. 2006, pp. 163–164.) Danger signals that implicate a need for evaluation include the following:

- expected service levels and targets are continuously not being met
- the service provider is not communicating to the assigned people but may be using other channels
- internal employees are increasingly conducting the work of the service provider
- internal hostility towards the service provider is increasing
- customer satisfaction is decreasing
- the service provider is more concerned of revenues than quality (Power et al. 2006, p. 154).

According to Power et al. (2006, p. 165) the reasons that call for evaluation of the outsourcing arrangement can be segmented into three categories: internal and external events and changes to the vendor's business. Internal events imply some change in the client's business, such as structure changes due to alliance termination or mergers and acquisitions, product and services changes or redefinition of core competencies. External events are especially critical in offshore outsourcing, since for example the political and economic environment of the service provider may be unstable. Additionally, if there are some signs that the service provider is losing market share and not doing well financially, its ability to operate successfully also in the future needs to be considered. Also a change of senior executives and close cooperation with client organization's competitors may affect the relationship negatively. (Power et al. 2006, pp. 165–170.) The latter can expose the client organization to proprietary risk, which refers to information leakage to a rival. The likelihood of proprietary risk needs to be evaluated especially if the relationship is of a strategic nature and sensitive information is shared. (Sanders et al. 2007, p. 11.)

In the assessment of the current outsourcing arrangement, the client organization can consider several alternatives for the future of the outsourced service. First, in case no major danger signals are recognized, the client can decide to continue with the current service provider and renegotiate the terms of the contract if necessary. Secondly, if the current arrangement and the service provider do not for some reason meet the expectations well enough the client organization can consider terminating the contract and transferring the service to a new vendor. As a third option, it can also give up outsourcing and bring the function back in-house (later referred to as back-sourcing). (Lehikoinen & Töyrylä 2013, p. 172; Veltri et al. 2008, p. 52.)

A decision tree model that is illustrated in Figure 8 can be used in the decision making. According to it, the organization begins assessment by defining the opportunities and problems in the light of the current arrangement. After that the capability of the service provider to solve the problem or exploit the opportunity is considered. If it is concluded that it has the required capabilities, the situation can be rectified in cooperation with it. On the other hand, if the service provider does not have the capabilities, the organization needs to decide whether or not it wants to address the problem or leverage the opportunity. If it decides to take action, the contract with the current provider is terminated and the organization engages in a new make-or-buy decision. It can either backsource part or all of the previously outsourced services or re-outsource them to another provider that has the needed capabilities. When new problems or opportunities emerge, the arrangement needs to be re-evaluated from the beginning. (Veltri et al. 2008, p. 65.)

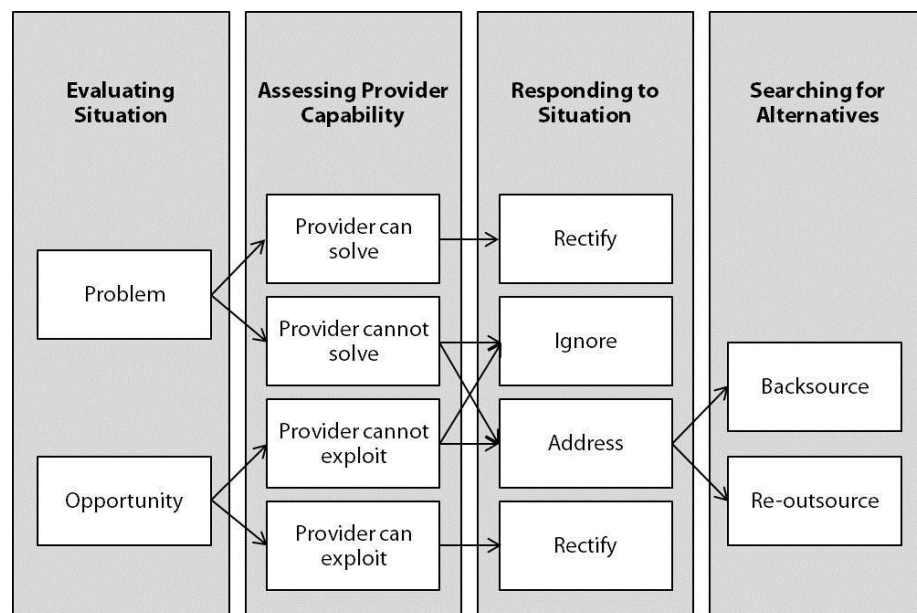


Figure 8. Outsourcing arrangement evaluation: Decision tree (modified from Veltri et al. 2008, p. 64).

Usually the costs related to the termination of the contract are so high that the service is continued even if the client is not satisfied with it (Lehikoinen & Töyrylä 2013, p. 172). On the other hand, it is also common that both parties get frustrated with the relationship for trivial reasons, which easily makes any new proposal seem like a better alternative. However, vendor switch requires reinvestments of time and effort, acquainting a new service provider as well as dedicating oneself to a new learning period that may cause disruptions to business operations. (Power et al. 2006, pp. 164–174.) Backsourcing, in turn, entails recovering skills and resources lost during outsourcing, which can also be an expensive and long process (Veltri et al. 2008, p. 69). That is why these options should only be used if the present service provider is clearly underperforming and there is something seriously wrong with the relationship. In short, modifying an existing

contract makes usually more sense than trying to solve minor dilemmas with a new service provider. Conditions related to the pricing, service delivery, number of transactions, customer support and fees among other things may be renegotiated and trimmed. (Power et al. 2006, pp. 164–174.) Contract modifications are inevitable as business changes (Sanders et al. 2007, p. 13). However, according to Lehtikoinen & Töyrylä (2013, p. 165) the initial contract is seldom updated.

Even though the associated costs can be significant, evidence suggests that at least in the IT-front switching vendors and back-sourcing are becoming increasingly common (Whitten & Leidner 2006, p. 605). As visible in the introduced decision tree model, organizations end up rearranging previously outsourced activities either to correct existing problems or harvest new opportunities arising from internal or external changes (Wong 2008, p. 106; Veltri et al. 2008, pp. 51–53). One important predetermining factor in the make-or-buy decision is if the organization maintains trust in the suitability of outsourcing. Whitten & Leidner (2006, pp. 614–615) found that one main reason why organizations decided to switch vendors was poor relationships with the current service provider. In contrast, the organizations that decided to back-source had usually experienced poor product and service quality and, consequently, lost trust in the suitability of outsourcing. The reason for back-sourcing can also stem from reconsidering the strategic position of the outsourced activity. Something that was previously considered as a commodity, such as IT in many organizations, can in a reassessment be seen as a strategic resource. In addition, cost savings in outsourcing are often exaggerated, which is why expectations may not be met. This can also result in the decision to back-source the services. (Wong 2008, pp. 102–104; Veltri et al. 2008, p. 67.)

Since the decision to end the current arrangement is a very costly one, making the decision is usually affected by a combination of different motivating factors rather than only one reason (Wong 2008, p. 106; Veltri et al. 2008, p. 61). Just as outsourcing arrangements, also back-sourcing may differ in scale and scope. It can range from back-sourcing only one function to taking over all parts of the outsourced service. (Wong 2008, p. 103.) Thus, back-sourcing can be either selective or total in the same manner as outsourcing (see Chapter 2.3.3). In case total back-sourcing is not possible for business limitations, selective back-sourcing may be a viable strategy. This way the organization can take over those activities that are newly defined as core or can better be managed in-house while maintaining good relations with the service provider for certain products or services. Whatever strategy is chosen, it is vital that a detailed transition plan is formed. (Veltri et al. 2008, pp. 68–72.) Even if no rearrangement is planned to be executed, the organization should prepare for any unexpected events by revising the exit strategy in the evaluation phase (see Morgan 2003, p. 48).

The objective of the exit strategy is to ensure the continuance of the client's business by preparing for situations, such as the service provider going out of business or suffering

from temporary malfunction. It concerns exiting the relationship and continuing operations in some other way as fluently as possible. (Power et al. 2006, p. 177.) There are some structural arrangements that can facilitate the transfer of operations. First, standardized services decrease the dependency on the service provider whereas highly customized and integrated arrangements are risky in terms of exit barriers (Lehikoinen & Töyrylä 2013, p. 174; Sanders et al. 2007, p. 11). Secondly, the ownership of the premises is essential in arrangements in which the location plays a vital role. Thirdly, the ownership of the information systems facilitates the transfer as well especially in combination with tailored services. (Lehikoinen & Töyrylä 2013, p. 174.) Finally, the exit strategy is easier to realize if multiple service providers are responsible for the same function, since this divides the risks concerned in outsourcing. In a single service provider arrangement, the risk of opportunism is greater which may show as disadvantageous terms of the contract and unwillingness to renegotiate them. This, in turn, easily results in high exit barriers. (Power et al. 2006, p. 175.)

To sum up the outsourcing related issues presented in this research, it can be concluded that outsourcing is a complex process which encompasses several different possibilities in terms of value, reasons for outsourcing, the intensity of the relationship and the arrangement, geographical location and management mode. Being a complex business process, outsourcing entails many pitfalls as well. However, when these are understood, they can also be avoided. In the outsourcing life cycle the first questions that need to be answered are why outsourcing is considered in the first place and what are the benefits that the organization could get from it. Second, an important consideration is whether the process or operation is suitable for outsourcing. From this basis, it should be possible to define what kind of arrangement best fits the purposes of the organization and what level of management is needed. In case outsourcing is considered as superior to conducting the work internally, it is worth applying. According to Morgan (2003, p. 37) the decision on whether or not to outsource is nowadays becoming irrelevant; rather one should ask the extent to which one outsources. However, the built arrangement is not permanent and outsourcing may in some point come to an end. Thus, continuous assessment of the arrangement is necessary to ensure ongoing success and recognize possible needs for rearrangement (see Veltri et al. 2008, p. 71).

3 TECHNICAL DOCUMENTATION

Technical documentation can be understood as the process of finding, making and sharing information and as the end products of the process. It involves handling information on technical subjects and developing product manuals, reports, descriptions, instructions, websites, marketing material or other publications. (Markel 2012, pp. 4, 581–598; Albing 1996, p. 67.) The terms and their definitions in this broad field are varied, partly because its professionals have different functions, roles and specialization in different kinds of organizations resulting in various approaches and points of view. In this research the term technical communication is understood as an overarching term describing the academic field. Technical documentation, in turn, is used in the above mentioned meaning with the addition that the focus in this research is the development of product manuals. Even though the term technical communicator is widely accepted and preferred in the field, the term technical writer is used in this research for clarification and accuracy, since this research deals with activities in which the end product is written documentation (see McGee 2000, p. 35).

This section is organized as follows. First, Chapter 3.1 acts as an introduction to the subject covering areas, such as definitions and the role and development of technical documentation and communication. Next, a closer look into product documentation is taken in Chapter 3.2. The most important product documentation types for this research are design and support documentation, which are the main focus of the inspection. Additionally, some information systems used in managing product data and creating content are shortly introduced. In Chapter 3.3, it is discussed, how technical documentation is practised and arranged in organizations. First, different process models of documentation are presented in Chapter 3.3.1 and then the organizational arrangements of documentation are reflected in Chapter 3.3.2. In the next chapter it is considered, how the efficiency of documentation can be enhanced. Finally, in Chapter 3.4 the evaluation and management of technical documentation is discussed.

3.1 Background of technical documentation and communication

Anttila (2001, p. 1) describes document as a set of information meant for human inspection. In ISO/IEC 8613-1 (1994) standard, in turn, document is described as a set of structured information that is meant for human understanding and can be exchanged as one entity between humans and systems (SFS 2006, p. 35). From a corporate perspective, Albing (1996, p. 67) defines document as “any contained set of information that serves the purpose of assisting the user in performing a function related to the enter-

prise”. Nevertheless, an individual file saved on a computer’s hard drive does not constitute a document if it is not known what the file deals with. That is why meta-data is a fixed part of a document, since it relates the document to its real-world counterpart. (Anttila 2001, p. 1.) Meta-data stores relevant information about the document, such as changes, release levels, approval authorizations and other data controls that can be tracked and audited. In addition, it is also used to create relations to other documents. (Philpotts 1996, p. 13.) A collection of documents addressing a specific topic can be perceived as documentation (IEC 61082-1 1991, cited in SFS 2006, p. 35). As already mentioned, this term can also be used to describe the activities related to developing documents (Albing 1996, p. 67). Technical documentation narrows down the context of documentation to technical subjects. From now on, the term documentation is used in this particular meaning of technical documentation.

According to Markel (2012, p. 3) technical documents help users learn, carry out tasks, make decisions and solve problems. They are especially focused on audience and purpose addressing particular readers and specific topics (Markel 2012, pp. 5–8). Proper and well-planned documentation brings many kinds of advantages for an organization and adds value to products, processes and ideas. It helps customers understand a product and perform processes effectively in addition to serving as one communication channel to share ideas on. (Hackos 1994, p. 9.) Thus, most of the mental work related to design and engineering is bound to documentation (Hameri & Nihtilä 1998, p. 196). Additionally, documentation helps transfer knowledge from subject matter experts to those who need it (Hackos 1994, p. 9). Hence, technical documentation is obviously a valuable asset for any organization dealing with and selling technological products or services. For manufacturing enterprises, it is especially critical. For instance, without design documents (see next chapter), it would be very challenging or even impossible to produce high-quality products (Watts 2012, p. 1). Nevertheless, the role of technical documentation is unfortunately often underestimated in organizations and unrecognized by the general public (Spilka 2002, pp. 98–99).

Technical documentation plays a major role in the success of a project or product (see Whitaker & Mancini 2013, p. 1). For example, support documentation in the form of user manuals constitutes an important part of the end user’s perceived quality of the product. Users often first turn to user manuals when they have encountered problems with the product itself or with their ability to operate with it. In this sense, documentation must be trustworthy and include the information required by the users. (Wingkvist et al. 2010, p. 476.) If they cannot find the needed information easily, they will most likely frustrate, which decreases customer satisfaction. Furthermore, the number and length of expensive calls to technical support increase, since customers need to contact it in order to get the information (Hackos 2007, p. 21; Markel 2012, p. 13). From this point of view, well-constructed manuals can result in substantial cost savings, since service requests are usually strongly affected by the quality of the manuals (Hackos 2007,

p. 21; Markel 2012, p. 13). Furthermore, high-quality manuals may increase customer loyalty, since the perceived quality of the product is positively affected and satisfied customers are more likely to stay loyal to the organization also in the future.

The field that examines technical documentation has been called by various titles, of which the most common are technical writing, technical communication, document design and information design. However, the term technical writing has been for the most part abandoned by the specialists of the field and replaced by technical communication, which according to Spilka (2002, p. 101) reflects the emerging dominance of online documentation and the fact that the field involves a lot more than only writing. (Spilka 2002, pp. 99–101.) Thus, the discipline is nowadays widely called as technical communication and the professionals of it technical communicators (McGee 2000, p. 35). This is partly due to the fact that the term is included in the name of the field's largest organization, i. e. Society for Technical Communication (STC), and has also given name to the industry-leading publication *Technical Communication* published by STC (see Spilka 2002, p. 102). STC (2014) defines technical communication to be characterized by communicating about technical or specialized topics by using technology and providing instructions about how to conduct a technical or non-technical task. According to the organization, technical communication makes information usable and accessible to those who need it and that way advances the goals of the organization. Consistent with this description, technical writers have traditionally seen their role as transferors of information (Hughes 2002, p. 275).

Most of technical documentation is currently produced and distributed in electronic format, which has many advantages compared to the traditional printed paper versions. To begin with, modern documentation tools enhance availability and accessibility, since the same content can be displayed in several formats, such as HTML, PDF, online help integrated in the product or printed book. (Wingkvist et al. 2011, p. 150.) Additionally, electronic documents can also increase the usability of manuals (Whitaker & Mancini 2013, p. 15). Since the technological complexity of products constantly increases, a greater amount of technical documentation is required to describe the product (Hameri & Nihtilä 1998, p. 196). In many cases the volume of the documentation makes the utilization and storage of printed books simply unpractical. Further, electronic documentation can be grouped meaningfully and accompanied by extra information, such as maintenance notes, update files, common configurations and license keys to form a value-adding complex of information. (Whitaker & Mancini 2013, p. 15.)

Electronic documentation makes the maintenance of documentation easier on one hand and more complex on the other. It simplifies the process of keeping documentation up to date and correct, but there might be many versions of the same content and thus, more documentation to manage. (Wingkvist et al. 2011, p. 150.) New technologies enable the increase of quality and the decrease of documentation development costs simul-

taneously. With modern technology, technical writers can focus more on value-adding tasks, since some aspects of documentation, such as formatting, can be automated. (Hackos 2007, p. xxi.) However, software programs are merely tools to work with and they on their own are not to be seen as an off-the-shelf solution to efficient documentation. In order to take advantage of information systems and documentation software, one needs to understand the documentation processes and activities of the organization first. (Watts 2012, p. 6.) These are described in Chapter 3.3.1.

New documentation methods and delivery media, faster product development and globalization among other factors have radically changed the field of technical communication (Rauch et al. 2010, p. 297). These trends have affected the role of documentation transforming it from pure information transfer and tasks, such as writing and editing, towards knowledge creation and more demanding and diverse work assignments. This, in turn, requires new skills from technical writers. (Rauch et al. 2010; Hughes 2002; Wick 2000.) Technical documentation in terms of practice is an old phenomenon, but as a field technical communication is relatively new and not yet entirely professionalized (Spilka 2002; Albing 1996, p. 67). However, in recent years there have been many efforts of making the field a profession. For example, *Technical Communication* published a Special Issues of the professionalization of technical communication in November 2011 and February 2012. Additionally, the publication's Special Issue in November 2013 dealt with developing a body of knowledge for technical communication. In general, body of knowledge defines a profession or a disciplinary field (Hart & Baehr 2013, p. 260). Thus, many of the currently most important themes of the field seem to be closely connected to professionalization; the recognition, value and strategic position of the field and the new roles of technical writers as knowledge creators.

3.2 Product documentation

Product documentation includes technical information of a product from all aspects during the product life cycle. Product documentation can include a variety of different media and information types, such as text, schematic diagrams, CAD drawings, images and photos of machine parts as well as video. Due to the technological complexity of the current products, product documentation is a necessity to support the whole life cycle of the product from design and production to operation and maintenance. (Hsu et al. 1999, pp. 11–12.) Additionally, in order to manage the vast product data and documentation, advanced technical solutions are needed (Hameri & Nihtilä 1998, p. 203; Pikosz & Malmqvist 1998, p. 1).

Products are often arranged in product families in which the related products to a great extent share same components and parts. Thus, technical documentation does not need to be written from scratch for every new product, since the available component and other documentation can be reused if the product structure allows for it. (Hsu et al.

1999, pp. 11–12.) Supported by XML tools and content management systems (CMSs), a topic-based architecture, where a document consists of a hierarchy of topics, allows for the same content to be referenced in different contexts (Hackos 2007, pp. xx-xxi, 61). Before writing new content, all related component documents in the document database should be checked to identify those that can be reused in the new document with very little or no modification (Hsu et al. 1999, p. 30). If the new product has same or similar components as former products and the purpose of the use is similar through the whole product family, it is likely that many parts of the documentation can for the most part be obtained from the database. Additionally, by altering the document structures the same topics may also be referenced in different product manuals (Hsu et al 1999, pp. 12–14). By avoiding duplicates and the excess work they cause, product documentation can be made more efficient. However, reuse to occur and even be possible, decent amount of planning is required (Hackos 2007, p. 61).

Watts (2012, p. 44) divides product documentation into three categories that are design, support and manufacturing documents. Design documents define the critical elements of a product or process, while support documents are created in order to support the operation and maintenance of a product. Manufacturing documents, in turn, define the manufacturing process or routing. In this research, manufacturing documentation is not examined in more detail, since the focus of the study is support documentation. However, support documentation is for the most part created by modifying and applying design documentation, which makes this category an important aspect for this research. Thus, the main characteristics of design documentation are next shortly presented. This creates a basis for understanding support documentation which is discussed afterwards. At the end of this chapter, some tools to manage product documentation are shortly introduced.

Design documents include different types of drawings, specifications and lists, such as product, design, process and materials specifications, part and assemble drawings as well as assembly parts lists. Product specifications define the critical physical and functional characteristics of the product, and they are in general often regarded as the most important design document. Even though codifying knowledge by creating design documents help design engineers in the product development effort, they are not the primary users of the documents. Consequently, design documentation is mostly dedicated to manufacturing, suppliers, field service and the company's customers. (Watts 2012, pp. 5, 39–45.) However, customers do not usually have access to design documentation, but they are served with support documents that are especially created for their requirements. Watts (2012, p. 5) concludes that though the end customer must be paramount, most design documents are prepared for the other three groups of users mentioned above.

Regardless of their size, all design documents should have a common pre-determined format. Additionally, they need to be formulated in respect of the processes of the or-

ganization. For example, if an organization treats parts and assemblies differently, a clear definitions standard is essential. (Watts 2012, pp. 22–25.) Watts (2012, p. 25) states that the difference between an assembly and a part is that the former has a parts list and the latter does not. The general terms item and component, however, may refer to both of them. In order to keep design documents up to date and as a coherent complex, a fair amount of controlling and monitoring is needed (see Watts 2012, p. 12). Further, design changes often result in changes in manufacturing and support documentation (Watts 2012, p. 46). Since these different documentation types are strongly inter-linked with each other, documentation cannot be viewed from one single aspect. In contrast, an organization needs to regard product documentation as a whole and ensure that changes made in design documents are transferred to other documents as well. This can be accomplished by an overall configuration management system approach.

Design documentation is usually conceived as a part of configuration management (CM). Watts (2012, p. 6) defines that CM is a process approach to planning, identifying, controlling and tracking a product's configuration throughout the product life cycle. It deals with establishing and maintaining consistency of a product's performance, functional and physical attributes, design and operational information (ANSI/EIA-649 1998, p. 3). The product's configuration refers to the technical description and combination of parts and materials in a way that fulfils the requirements of the related pre-determining specifications (Watts 2012, p. 6). According to Watts (2012, p. 6) CM system constitutes of four major processes, namely document release, Bill of Material (BOM), change and design processes. As can be noted from these processes, CM is strongly linked with documentation. For example, always when an engineering change (EC) is initiated and implemented, the changes need to be documented and when necessary all the related existing documentation updated in a controlled fashion. The EC-related processes are more closely examined in Chapter 3.3.1.

In contrast to design documentation, support documents do not define the product, they define instructions to install, use or maintain the product. Typically these are referred to as service manuals or publications. (Watts 2012, p. 44.) They are usually created by technical documentation specialists who in this research are called technical writers. In general, as the name already indicates, support documents are meant to support customers in using the product safely, correctly and efficiently. Further, support documents are especially critical in failure recognition, maintenance and repair work (Hsu et al. 1999, p. 11). Due to the technological complexity of the modern products, extensive documentation providing the reader with instructions and relevant technical information for operation and maintenance has become an essential part of the product (Hsu et al. 1999, p. 11).

According to Watts (2012, p. 45) support documents include the following:

- field instruction/bulletin/kit
- illustrated parts catalogue
- product description manual
- maintenance manual
- spare parts list
- spares kits
- installation instructions.

These documents are released as a result of a product design release and changed according to product design changes. That is why an overall CM system approach is needed. (Watts 2012, p. 46.) According to Watts (2012, p. 46) the control of support documentation is similar to design documentation but probably not so strict. In many industries and countries user manuals are not voluntary; they are often governed by laws, regulations, standards and different kinds of industrial rules (see Tukes 2012). In Finland, the content and language requirements of user instructions are regulated in different laws and regulations, such as:

- Consumer Safety Act (920/2011)
- Government Decree on Information to be Supplied in Respect of Consumer Products and Services (613/2004)
- Consumer Protection Act (38/1978)
- Act on the Conformity of Certain Technical Devices to Relevant Requirements (1016/2004)
- Government Decree on the Safety of Machinery (400/2008)
- Government Decree on Regulations for Personal Protective Equipment Intended for Consumer Use (1101/2009)
- Government Decision on Personal Protective Equipment (1406/1993)
- Language Act (423/2003) (Tukes 2012, p. 4; Finlex).

These acts and decrees state that the required information and instructions for the safe usage of a product are to be delivered with the product to prevent any hazards to health or property. The information has to be given in a clear and understandable way, both in Finnish and Swedish. Further, the manufacturer of a machine for professional use is required to draw up appropriate operation and other instructions. The requirements of the acts and decrees are unambiguous and binding for manufacturers and market importers in regard to accessibility, content and language of user manuals. (Tukes 2012, p. 4.) When products are exported to other countries, also international and local legislation have to be taken into consideration. For example, in order to get a CE mark required for many products, the product needs to fulfil the requirements set by the Euro-

pean Union. In addition to laws and regulations, also different uniform standards depict the content of manuals. Standards are either related to a particular machine or written at a general level. (Tukes 2012, p. 5.) It can be concluded that the minimum requirements for product manuals are quite extensive in Finland and there is a lot of guidance available on what to include in them and how to structure them.

To keep the expanding documentation up to date with the corresponding physical products that are more and more complex and dynamic, organizations need advanced technical solutions (Hameri & Nihtilä 1998, p. 203; Pikosz & Malmqvist 1998, p. 1). Product data management (PDM) is one popular information tool that is intended to help in managing the vast product data in every step of the product life cycle (Philpotts 1996, p. 12). It offers valuable information for many purposes and it is often used throughout the organization. PDM systems (PDMS) typically include all essential information related to products, such as product configurations, part definitions, design data, product specifications, CAD drawings, manufacturing process plans, product structures and BOMs. Typical users of PDM include design, manufacturing and operations engineers, project managers, administrators and purchasing agents. (Philpotts 1996, pp. 11–12.) Some of them act as creators and editors of content while others may only have access to view the data or some part of it.

According to Philpotts (1996, p. 12) PDM improves the whole process of product management making it more efficient, which saves time and money and can result in better quality of the products. The system has slightly different roles in every step of the product life cycle. First, in the conceptual phase, where the main technical specifications of the product are prepared, PDMS serves as a tool for managing the product structure. Secondly, in the design phase, PDMS is mainly used for accumulating design documentation and controlling the changes to the designs. Thirdly, when the product is ready for manufacturing, the usage of PDMS turns into material management. Finally, in the operation phase, the focus of PDMS shifts to inter-organizational communication in order to serve the customer, support the maintenance of the product and get customer feedback. (Hameri & Nihtilä 1998, pp. 199–202.) Among other functionalities, PDM includes document management. Besides storing sheer data, PDM enables to manage workflows and processes related to documentation. For example, an approval process for the release and publication of a product manual can be determined. (Philpotts 1996, p. 13.) Processes related to documentation are examined more closely in Chapter 3.3.1.

Another important and popular information system that can be used in the development of product documentation is content management system (CMS). It is a system of methods and techniques aimed at collecting, managing and publishing content in a company (Benevolo & Negri 2007, p. 10; Boiko 2001, p. 8). When collecting content, information is either created or required from an existing source. The acquired information can be edited, segmented into chunks and supplemented with meta-data. In man-

agement, a repository of database records, content components and administrative data is created. Finally, in publishing, the content is made available by extracting components from the repository and constructing targeted publications such as websites or printable documents. (Boiko 2001, p. 8.) Thus, CMS supports the whole process of document development. CMSs emerged to answer the challenge of managing the exponential proliferation of documents and information that have come with the Internet (Benevolo & Negri 2007, p. 10). According to Boiko (2001, p. 8) content management is a necessity for organizations producing multiple publications. The two current trends in the field of content management are Web CMSs (WCMS) and Enterprise CMSs (ECMS) (see Boiko 2001). The former is focused on managing the multi-format content on the Web while the latter is an integrated approach to managing all enterprise information and can be seen as a fusion of different information systems (Benevolo & Negri 2007, p. 12).

The hard competition on the marketplace requires fast adaption to customer needs, which places ever increasing challenges to product development in terms of product specifications, quality, performance, price and lead-time of the projects. That is why the traditional sequential way of performing product development is no longer a working method to stay competitive. Product development is moving towards production of customer variants and the product development cycles have become shorter. As a result, technical writers have less time to develop product documentation. (Pikosz & Malmqvist 1998, p. 1; Rauch et al. 2010, p. 305.) Advanced information systems, such as PDMSs and CMSs, can help answer this challenge, but the starting point for any development needs to be an assessment of the efficiency of the current processes. That is why one needs to understand the processes and documentation in the organization before implementing tools that support them (Watts 2012, p. 6). Thus, the documentation processes and the way documentation is usually organized in organizations are dealt with in the following chapter.

3.3 Documentation processes and arrangements

Documentation processes can be examined from different perspectives. First of all, they can be examined from a pure book-centric approach; how one manual is created from a recognized need to a published book. However, this process description alone serves only as a one-viewed perspective of documentation and, thus, it needs to be supplemented with other process approaches in order to form a more thorough picture of documentation. Another model that can be reflected is the life cycle of a document. Third, especially the maintenance and updating of manuals can be examined as a side product of enterprise change management (ECM) process. These are all dealt with in the next chapter.

Naturally, the appropriate arrangement of documentation is dependent on the needs and characteristics of organization. According to the size of the company, different amount of resources is needed – some organizations have only one technical writer or a few writers, whereas others have an entire central documentation department (Carliner 2012, p. 125). Different internal arrangements of documentation and the possibilities for outsourcing are considered in Chapter 3.3.2. Finally, when the main processes and arrangements have been introduced, it is reflected in the last chapter of this section, how the maturity of these can be defined and improved in order to make documentation more efficient. This is examined on the basis of the Information Process Maturity Model (IPMM) of Hackos (1994, 2007).

3.3.1 Documentation processes

Even though information tools and delivery media of documentation have developed during the last few decades, Hackos (2007, p. xix) argues that in regard to processes little has changed since the introduction of his book “Managing Your Documentation Projects” in 1994. He explains this by stating that the processes he describes in his book represent the basics of project management techniques. At the time when he wrote an updated version of the book in 2007, according to him, the basics of documentation plans and project estimates, schedules, tracking and completion had not substantially changed. This can be illustrated by comparing two documentation process descriptions: the one defined by Hackos (2007) and another that Strassmann introduced in 1988.

Hackos (2007, p. 318) sees documentation to include five different phases, that he refers to as planning, design, development, production and evaluation. Strassmann (1988, p. 26), in turn, identifies an eight-stage documentation process. These stages are plan, design, document, produce, distribute, train, use and value. As can be seen, the first two stages of both processes are exactly the same. Though named a bit differently, also the third step (development/document) depicts in both the stage in which the actual content of the manual is created. The production phase that includes activities that turn the content into a final deliverable includes in the model of Hackos (2007) also distribution, which Strassmann (1988) has separated as its own stage. The both processes end in evaluation of the document. However, before evaluation, Strassmann (1988) identifies two additional steps that are not included in the model of Hackos (2007). These are train and use, which depict the ability of the reader to use the document efficiently and the actual “operation” of the document (Strassmann 1988, p. 27). As can be seen, the basic structure of the process has not changed; the process steps have only been defined and named in a slightly different way. Nevertheless, the work routines and tasks performed in each step have naturally changed, as the technology and delivery format of documents have dramatically developed.

Similarly, when comparing the documentation process Hackos (1994) introduced to the updated version (2007) it can be seen that, at a general level, the only difference is that the stages have been renamed. Thus, the five documentation steps of Hackos (1994, p. 29) are information planning, content specification, implementation, production and evaluation. The process of documentation, as defined in this research from the basis of the three process descriptions mentioned above, is illustrated in Figure 9.



Figure 9. Documentation process (modified from Hackos 2007, p. 318).

In the first phase, namely planning, a documentation plan (also termed as information plan) is prepared. It includes details about the project, the processes and the design of documentation (Hackos 2007, p. 61). In the planning phase, the needs of readers and all other requirements of the project are investigated and converted into a documentation plan (Strassmann 1988, p. 25). The second deliverable of this phase, the project plan, determines the schedule, milestones, resources and risk factors related to the project. The two plans are often combined into a single document. In the design step, the plans are brought to a more detailed level and the content of the final outputs are specified. To be able to define the content, technical writers need to develop a deep understanding of the product, its operation and the audience of the manual. (Hackos 1994, pp. 29–34.) According to Strassmann (1988, pp. 25–26) the design phase is the most critical step in regard to the success of the project. The assumptions and decisions made in this stage affect the total cost and effectiveness of the project. Thus, poor productivity usually results from inadequate planning and design.

Next, the actual technical publication is developed. Development is the most time consuming phase of the process. The content is created in various cycles resulting in a number of draft versions before the final book. Each draft is reviewed after which corrections are made until the content meets the requirements and pre-determined specifications. When the final content is approved, the book is prepared for distribution. When dealing with paper manuals, this includes activities such as translating, printing, collating, binding, packaging, assembling and preparing all other forms for delivery. (Hackos 1994, pp. 29–36.) However, due to modern technology publications are more and more delivered in electronic format, which simplifies production and distribution. For example, only brief installing instructions may be delivered with the product as a printed booklet, while the complete manuals are made available online. In most cases, outside services are used in the completion of the production phase (Hackos 1994, p. 36). Finally, the manual is published and delivered to the customer physically or electronically. The evaluation of documentation is examined in Chapter 3.4.

As already mentioned, in the current hectic, fast changing and extremely competitive business environment, products are more and more tailored according to customer needs or updated and changed rapidly every time a new innovation, need or improvement emerges. That is why documentation is rather a continuous process instead of a linear one (see Wingkvist et al. 2011, p. 150). Hence it is no wonder that constant change and last minute changes are regarded to cause frustration for technical writers (Jayaprakash 2008, p. 7). After completing the first published version, the manual is revised every time a major engineering change (EC) is implemented or a mistake or a shortcoming in the documentation is noticed. An EC involves an alteration made to a product's parts, drawings or software that have already been released during the design process (Jarrat et al. 2004, p. 268, cited in Hamraz et al. 2013, p. 474). The model of the life cycle of a document described by Anttila (2001, p. 5) illustrates well this continuous nature of documentation. It is depicted in Figure 10. When the product is withdrawn from production and selection of goods, no more modifications to the publications are made and after a certain amount of time the manuals can be archived.

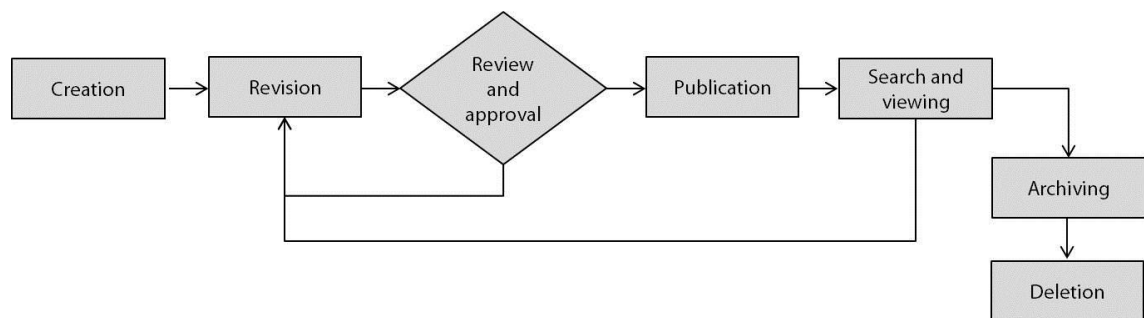


Figure 10. The life cycle of a document (adapted from Anttila 2001, p. 5).

There are several reasons why documentation may need to be revised. For instance, parts of the product can be withdrawn and replaced with new parts, the application of a part can be changed, or spotted errors in the documentation may need to be corrected (ISO 11442-6 1996, cited in Pikosz & Malmqvist 1998, p. 2). Although unnecessary changes to the product should be avoided, ECs are often advantageous (Lee et al. 2006, p. 376). They can also be necessary if there are difficulties in parts fabrication or assembly, quality problems with components or design failures. Even if the product meets the basic requirements, it can always be developed for future product revisions. When changing approved documents, many companies follow a formal engineering change management (ECM) process. It is one of the core processes of configuration management (CM), since each change to product or its corresponding documents implies a change of the product configuration. (Pikosz & Malmqvist 1998, pp. 1–3.) According to Hamraz et al. (2013, p. 476) “the goals of ECM are to avoid or reduce the number of engineering change requests (ECRs) before they occur, to select their implementation effectively when they occur, to implement required ECs efficiently, and to learn from implemented ECs”.

Based on a holistic literature review of 427 ECM publications, Hamraz et al. (2013, p. 474) conclude that the vast majority of design is evolutionary, meaning that the product is developed by modifying an existing one and, thus, initiated by ECs. Additionally, also original design projects, where a new product is designed from scratch, are usually affected by ECs during the product development and throughout their lifecycle. ECs are considered inevitable especially when dealing with complex products that take a long time to develop and require intensive collaboration of designers and engineers who might be geographically distributed (Huang et al. 2003, p. 484). In this sense, it is no wonder that the interdisciplinary topic of ECM has increasingly gained attention by researchers. (Hamraz et al. 2013, pp. 473–474). From the viewpoint of documentation, it is important that the process is managed effectively in order that the documents are not left behind in the ever shorter cycles of ECs. Currently, the pressure for quick EC processes is enormous and the processes need to be fluent (Watts 2012, pp. xv–xvi; Pikosz & Malmqvist 1998, p. 1). When products change often, obtaining and verifying information becomes a continuous process that requiring constant effort from the technical writer (McGee 2000, p. 36). Considering also the exponential proliferation of data, documentation encounters new challenges caused by somewhat contradictory trends; one should create and manage more documentation in less time. Hence, technical writers need to come up with new processes to assure high-quality products in the tightened time constraints (Rauch et al. 2010, p. 305).

Several EC processes of different levels of abstraction have been proposed (see Hamraz et al. 2013, p. 476). In this research the EC process is seen to compose of four stages that are:

1. Initiating an ECR
2. Evaluating the ECR
3. Issuing engineering change orders (ECOs) to relevant participants
4. Storing and analysing the ECOs for management purposes (Lee et al. 2006, pp. 376–377).

When an ECR is received, it is divided into several sub-requests, which are distributed to different departments for evaluation. If the ECR is approved by the project leader and the EC board, ECOs that document the change are created. An ECO is a stand-alone document that can be related to one part or document or several one of them. Afterwards, EC action is taken and the related documents are updated according to the ECOs. The impact of the change needs to be investigated carefully in order to recognize all the documents (e. g. design, support and manufacturing documents) that are affected by the change. Thus, the process requires extensive document management as well as communication between different departments. (Peng & Trappey 1998, p. 102; Pikosz & Malmqvist 1998, pp. 1–9; Watts 2012, p. 26.) In the complete formal process, the EC has to be analysed and approved by several authorities before it can be introduced. Nat-

urally, the complex approval process takes time and delays the implementation of changes. That is why the application of a simplified EC process is worthwhile when dealing with minor changes. (Pikosz & Malmqvist 1998, p. 2.) Changes may be classified according to the complexity and the importance and, in consequence, treated with different processes (Huang et al. 2003, p. 484).

In order to fully understand the manual development related to new products and, thus, product development projects, some basic knowledge of project management and product development processes would be valuable. However, in this research they are not exclusively dealt with. The good practises of document management are based on the principles of project management (see Hackos 2007, p. xix) and it is regarded as sufficient that this is recognized. Similarly, it suffices for the purpose of this research that it is acknowledged that documentation often is a “side product” of product development processes. However, different documentation arrangements are a corner stone of this research and they are examined in the next chapter.

3.3.2 Documentation arrangements

Documentation arrangements vary from company to another depending on the documentation needs and maturity of the processes (see next chapter). It can be controlled by different departments, funded in various ways and conducted with inner or external resources. According to Watts (2012, p. 18) technical documentation should be controlled by the department which authorizes it meaning that several document control functions would exist. In this sense, engineering would for example be responsible for design documents and manufacturing of process documents. This requires that the responsibilities for all the technical documents are agreed upon. Nevertheless, the control functions must work in close connections with each other so that an overall CM system is formed. On the other hand, Watts (2012, p. 46) admits that the separation of the responsibilities does not often realize in small companies, since one person can be in charge of all technical documentation including design, support and maintenance documents.

It is often debated where documentation groups or departments should be placed in the organizational structure. Examples of placement options include marketing, product development, operations and technical support. (Carliner 2012, p. 142; Wishbow 1999, pp. 28–31.) Thus, it is common that documentation managers report to people in job functions that are only marginally related to technical documentation. The location of the documentation group or department can greatly affect, for instance, information transfer and the perceived status of technical writers. If technical writers are located physically far from design engineers, exchange of information becomes more difficult, since the possibility for face-to-face discussions is limited. (Wishbow 1999, pp. 28–29.) Face-to-face interaction is a powerful and rich form of communication that is still

strongly preferred in technical documentation especially at the beginning of a project (Wishbow 1999, p. 29; McGee 2000, p. 47).

According to Wishbow (1999, pp. 29–31) technical writers are typically placed within a sub-group of engineering or business units. This can lower the status and role of technical documentation, which may result in low negotiating power. As mentioned earlier, the low status of technical documentation is a common challenge in the field. Hence, it could be argued that, since technical documentation is usually undervalued in organizations, it is not placed on equal footing with other departments, which lowers its status even more. Albing (1996, p. 68) argues that keeping technical documentation under departments, such as marketing or engineering, inhibits the proper and effective performance of processes that should be organization-wide and reflect the goals of more than one department. While no organizational structure is ideal, a good starting point is to consider the goals of various departments in relation to the objectives of technical documentation (Wishbow 1999, p. 30).

According to Carliner (2012, p. 142) the answer to the question of the best location of technical documentation depends on the business model under which documentation operates. In other words, different business models benefit from different placements in the organization (see Wishbow 1999, p. 31). Adapting to the changing market by reshaping the business model can be a key to survival in the technical industry (Thayer 2005, p. 573). Carliner (2012) has defined different business models that describe how documentation is in practice arranged in organizations. The fundamental basis of business models is funding, since it is assumed that the way an organization receives money affects all of its operations (Carliner 2012, p. 128). According to Carliner (2012, p. 124) most technical documentation groups operate under the Development Shop, Technical Support or Contractor Models. Additionally, mixed methods are also applied. Next, these three business models are shortly described.

The Development Shop model describes technical documentation groups that “support a strategic effort by developing help, user’s guides, reference manuals and similar product information” (Carliner 2012, p. 124). In addition, the group may develop tutorials, project documentation and other information, such as technical support websites and materials for user meetings. In this model, documentation is funded on an apportionment basis, which means that it receives its funding for the fiscal year as a lump sum, the amount of which depends on the defined budget. As documentation is in the Development Shop model seen as a non-strategic support task, technical writers do not have a lot of influence in the larger organization. Likewise, the information created by groups operating under the Technical Support Model is typically of a supporting nature. In addition, these groups receive their funding according to a similar procedure. They develop materials related to technical services for mainly internal use. In contrast to Devel-

opment Shop Model, these groups have higher power in the organization. (Carliner 2012, pp. 135–137.)

The third business model, Contractor Model, describes a documentation group that focuses on both maintaining existing documentation and developing new documentation for products and services that have long life cycles. This model is particularly used among the manufacture of heavy equipment, military, space technology and development of computer systems. These groups may consist of either internal resources or external contractors. Their responsibility is to ensure completeness and accuracy of the documentation but they do not usually get to contribute to the actual content, since it is specified by subject matter experts. The funding is received either for time and materials or, depending on the resources, on a project or apportionment basis. The former is used when dealing with external contractors and the latter for internal arrangements. (Carliner 2012, p. 138.)

As evident in the Contractor Model, documentation can be considered for outsourcing. However, little research about the suitability of technical documentation for outsourcing exists, even though outsourcing is a timely trend in general and also in the field of documentation (Padmanabhan 2007, p. 109). Nevertheless, according to Hackos (2007, p. 53) documentation managers are increasingly relying on outsourcing and especially offshoring in order to reduce the costs of documentation. The results of a McKinsey and Gartner research indicate that onshore outsourcing is the most preferred outsourcing arrangement in technical documentation (Farrell et al 2005, cited in Padmanabhan 2007, p. 110). The different outsourcing arrangements were presented in Chapters 2.3.2 and 2.3.3. However, offshoring has most likely increased its popularity in the past decade, as the research predicted, but onshore outsourcing is not yet threatened by it due to quality and innovation benefits, since technical documentation is a well-established profession in developed countries and a new one in emerging economies (Padmanabhan 2007, p. 110). Additionally, some tasks of documentation may need to be kept geographically near the organization, which brings some limitations to offshoring technical documentation services.

Documentation activities that are offshored to low-cost countries are mostly the ones that do not require direct interaction with customers. Technical documentation can be regarded as this kind of activity. (Padmanabhan 2007, p. 114.) The president and Chief Operating Officer of Sakson & Taylor, Inc., which is a corporate leader in the areas of technical communication staffing and consulting, see that offshore outsourcing currently impacts the routine types of tasks, but tasks that involve content analysis cannot yet be offshored (Thayer 2005, p. 569). Padmanabhan (2007, pp. 118–119) is of the same opinion stating that some routine-like and uncomplicated tasks can be offshored but some tasks should be kept in-house, since they may require face-to-face cooperation with subject matter experts or something similar that can not necessarily be guaranteed

in an outsourcing arrangement. Thus, it can be concluded that the most appropriate form of offshoring in the field of technical documentation is out-tasking, which calls for dividing documentation into parts and deciding on what needs to be kept onshore and what parts can be considered for offshoring (see Thayer 2005, p. 569).

Hackos (2007, p. 53) claims that the expected savings of offshoring do not usually realize and the results can even be very disappointing due to language and cultural problems and the immaturity of the field in emerging countries. These problems may at worst result in major quality reductions. Nevertheless, even if the targets are not fully met, offshoring can result in significant cost reductions in the context of technical documentation (Hackos 2007, p. xxii). As discussed in Chapter 2.3.2, offshore outsourcing is especially risky, which is why it needs to be considered, planned and controlled carefully. This requires certain skills from the client organization. Hence, it should itself have fairly mature processes in order to be able to communicate with the service provider and most likely untrained employees as well as manage remote documentation groups (Hackos 2007, p. 53). In order to offshore documentation, the organization needs to have clear rules, structures and standards in place. The more mature the business processes are, the higher the level of standardization is and the more opportunities an organization has also in regard to outsourcing and offshoring. (Thayer 2005, p. 569.)

As already mentioned, document managers are under constant pressure to reduce the costs and improve the efficiency of documentation. According to Wishbow (1999, p. 33) outsourcing can be “the most economically rewarding position”, if market conditions are favourable, and bring technical writers greater control of their work. However, it may not be possible to fully integrate documentation with the larger organization and documentation may not be seen as a critical activity, if it is outsourced. As one possible consequence, technical writers may be brought in at a late stage of projects, which complicates the development of high-quality manuals. (Wishbow 1999, p. 33.) On the other hand, this has also been regarded as a general challenge of documentation (Jayaprakash 2008, p. 7). Whatever documentation task is considered for outsourcing, the adequacy of the capabilities of the potential service provider needs to be evaluated carefully. It should have a multi-disciplinary talent pool with expertise in areas, such as user assistance, usability testing, content management, indexing, single-source publishing and XML-based authoring. A good way to evaluate an outsourcing partner is track record; if the service provider has an extensive client base it is a substantially more trustworthy selection than one without such connections (Padmanabhan 2007, pp. 109–111, 115.)

Outsourcing can offer one solution to the development of documentation but in many cases it may not be the best alternative for efficiency enhancement. As discussed at the beginning of this chapter, also internal rearrangements may result in better performance, since documentation may be better supported and valued in a new location or under a

different business model. One broad approach to evaluating and improving the processes and arrangements of documentation is illustrated in the following chapter.

3.3.3 Improving efficiency of documentation

A precondition for improving the efficiency of documentation is a close inspection of the current situation. A helpful tool to consider the sophistication of the current processes is the Information Process Maturity Model (IPMM) of Hackos (1994). According to Hackos (2007, p. 31) this tool was developed in order to make it possible for organizations to compare their documentation processes with the leaders in the field. He continues that this is essential to improve productivity and quality as well as to reduce costs. IPMM describes the practices that make documentation successful. It was first introduced in 1992 and since that has continuously been updated (Hackos 2007, p. 32).

IPMM is based on maturity levels that describe documentation processes and give basic recommendations for what an organization needs to do for the transition to the next level. There are five primary maturity levels and one additional level, level zero, where technical information is developed in the organization but not by professional technical writers. (Hackos 2007, pp. 34–38.) The main features of the five primary maturity levels as well as action proposals for the transition to the next level are described in Table 1.

Table 1. The Five Levels of Process Maturity (modified from Hackos 2007, pp. 35–37).

IPMM Level	Description	Transition to the Next Level
<i>Level 1: Ad hoc</i>	<ul style="list-style-type: none"> • lack of structure and uniform practices • technical writers work alone • managed by someone from another field • no quality assurance activities 	<ul style="list-style-type: none"> • build cooperation among staff • create a management position • organize a department
<i>Level 2: Rudimentary</i>	<ul style="list-style-type: none"> • structures, standards and quality assurance practices being instituted • some collaboration among staff • can be a difficult transition period 	<ul style="list-style-type: none"> • establish a firm commitment to following the processes/standards • templates, style guide, project workflow and sound processes needed
<i>Level 3: Organized and Repeatable</i>	<ul style="list-style-type: none"> • uniform processes/standards • strong leader, vision for future • planning/quality assurance in projects • qualified individuals hired and educated 	<ul style="list-style-type: none"> • boost the commitment to high-quality practices, not only within the organization but also in relationship with peer organizations
<i>Level 4: Managed and Sustainable</i>	<ul style="list-style-type: none"> • customer needs assessed via customer studies/usability analysis • return on investment managed • increased influence and recognized effectiveness in the larger organization 	<ul style="list-style-type: none"> • increase business understanding • strengthen commitment to productivity improvement and cost reduction and control • strategic alignment needed
<i>Level 5: Optimizing</i>	<ul style="list-style-type: none"> • information development promoted throughout the organization • strong strategic alignment • leadership in information architecture • business analytics 	<ul style="list-style-type: none"> • hard to sustain: requires constant innovation

In an IPMM assessment, the maturity level of an organization is evaluated according to eight key characteristics that help describe how a successful documentation department functions. The focus is on structure, processes and best practices. (Hackos 2007, p. 54.) As these eight characteristics separate well-working documentation departments from ineffective ones, these are necessary to pay attention to when planning on ways to improve effectiveness of documentation. Thus, the main characteristics of IPMM are:

1. organizational structure
2. quality assurance
3. planning
4. estimating and scheduling
5. hiring and training
6. publications design
7. cost control
8. quality management (Hackos 2007, p. 55).

From the basis of these eight characteristics, Hackos (2007, p. 80) has defined critical success factors to increase the effectiveness and future profitability of documentation. First of them is a centralized management structure. Second, processes and their measurement need to be defined in order for cost estimation. This requires that the processes are divided into distinct phases and the primary goals and activities of each phase are defined (Hackos 2007, p. 23). Third, it is critical that a business-oriented, strategic perspective on the value and role of documentation is followed. The fourth critical success factor is the ability to acquire and maintain professional staff and, finally, customer orientation should not be understated. In order to improve the efficiency, an organization should start with a process maturity assessment. (Hackos 2007, p. 80.) Afterwards, it should be relatively easily concluded what is needed for the transition to the next level. By paying attention to the eight characteristics and five success factors, the efficiency of documentation can most likely be in the long run improved.

Even though IPMM can surely be a useful tool for organizations, it has also drawn some criticism. For instance, Carliner (2012, p. 127) notes that it does not take a stand on the types of projects, skills or the level of influence of technical writers. In this sense, it can be concluded that it is a general model that describes best practices in the field. However, it can be a good starting point and an eye opener especially if these kinds of aspects have not been earlier discussed and reflected in the company. Further, it can also help point out the strengths and achievements of documentation to senior management.

3.4 Evaluation and management of documentation

The environment of technical documentation has in many ways become challenging. As a consequence, there is a greater need to manage and control the information. Thus, Hackos (2007, p. xx) notes, that documentation management has actually become information management. Technical documentation can also be seen as a vital part of the wide spectrum of knowledge management. From a knowledge management perspective, documentation should nowadays be rather competency-centric than product-oriented and more about communication than merely writing. (Wick 2000.) What makes documentation management even more challenging is that documentation managers are under constant pressure to reduce costs and the length of projects, do more with fewer resources and increase the overall value of documentation (Hackos 2007, p. 31). As a support task, the status of technical documentation is usually considered low, which is why it is certainly not first in line for receiving funding (Wishbow 1999, p. 29). Moreover, technical documentation is usually conceived as a cost centre that does not generate revenue. Consequently, the focus of documentation management has to be on efficiency and productivity. (Hackos 2007, pp. 107–108.) However, improving the efficiency requires development which, in turn, cannot be realized without budgeted resources. In this sense, the expectations and funding of documentation do not always confront.

Documentation, like any other business, needs to be properly evaluated and managed in order for it to be successful. However, according to Watts (2012, p. 2) in most businesses the adequate control of documentation is at least to some extent lacking. This is without a doubt one reason why the quality of documentation is often poor and the needs of the users are not fully met (see Hackos 2007, p. xx). Ultimately, quality is defined by the customers' view on how well their expectations are being met (see Wingkvist et al. 2010, p. 476). That is why the quality measures which matter the most are customer satisfaction and performance. If these are low, documentation cannot be regarded as successful. (Hackos 2007, p. 55.) Organizations must constantly weigh the value of quality against the pressures of productivity and time-to-market (McGee 2000, p. 35). To balance the goals of producing quality manuals fast but with minimum costs, Hsu & Dawidowsky (1999, p. 12) advice to concentrate on three major strategies: process orientation, documentation costs and customer orientation.

By supporting the whole documentation process, the quality and consistency of information as well as reproducibility of documentation are encouraged. Making processes more efficient requires simplifying and reducing document revision cycles, which, in turn, may demand some technical and organizational changes. In an efficient documentation system, information flows are recognized and supported by advanced documentation tools. (Hsu & Dawidowsky 1999, p. 12.) These tools can to a great extent help in managing documentation. For example, the release levels, access rights, approval processes and the like can be incorporated into one PDM system. When these are carefully

planned, it is ensured that the same processes are always used, only the related people can read or edit the information and incomplete documents are not made public. Furthermore, many processes can be automated and activities of the technical writers can be tracked easily, which diminishes the workload of documentation managers. (Philpotts 1996, p. 13.) Hence, it is evident that documentation cannot be properly managed without understanding the processes involved (Albing, 1996, p. 69).

Documentation induces both direct and indirect costs. Besides the resources that are required for documentation development, the costs associated with missing, inaccurate or outdated information can be substantial. (Hsu & Dawidowsky 1999, p. 12.) According to Hackos (2007, p. 73) the cost awareness of documentation managers is often not what one would hope for. Without proper cost information and control, the efficiency of documentation cannot be proved and documentation managers do not have any tools with which to argue that the work is currently being conducted according to expectations. Moreover, cost control in its simplest form is not that demanding. It requires only time tracking and knowledge of the related labour and overhead costs. Once you know how much time each individual has spent on a project or an output, the related people costs can without great effort be calculated. (Hackos 2007, pp. 73–74.) In this sense, time tracking is one of the most vital preconditions for financial management.

According to Hackos (2007, p. 73), documentation costs should be controlled especially around projects. However, in many organizations project management is not seen as documentation development responsibility at all. Documentation related projects, such as product development projects, are not managed by documentation managers but, for instance, engineering project managers. Quite often they are not able to estimate the work required for developing manuals correctly. Additionally, they tend to underfund documentation and include it in the project at too late a stage to produce high-quality manuals. (Hackos 2007, p. 20.) Few owners or managers understand the value of documentation and, as a result, it often receives a low priority by engineers (Mancini 2012, p. 9). It is the documentation manager's responsibility to ensure that documentation is given the attention it deserves. That is why the documentation manager needs to work in close cooperation with project managers and make sure that the projects are managed efficiently (see Hackos 2007, pp. 20–21). For instance, documentation needs to be planned at an early stage of the project as a part of the overall project planning. This way the work can be estimated and scheduled as well as staffed. By including technical writers in the project from the beginning and letting them actively participate, they are able to learn about user goals and plan their work beforehand. Once product specifications are better defined or an engineering change (EC) is made, the details of performing a task may easily be added or modified by the technical writer, since the underlying user goals usually stay the same. (Hackos 2007, pp. 61–62.)

Managing documentation involves more than simply controlling schedules and costs; it implies considering what information the user needs and in what form it should be made available (Albing 1996, p. 69). Hsu & Dawidowsky (1999, pp. 12–13) highlight three aspects of customer orientation, which should be paid attention to. First of them is structure, which measures how quickly readers can find the information they are looking for in the manual. If the required information cannot be found or it is outdated, too abstract or inappropriate, the reader's operation with the product is jeopardized. This can result in delays in installation, commissioning, operation and other schedules. Second, the content of documentation should be managed as well in order that the correspondence between the actual content and reader's intentions and expectations is assured. For example, a typical support document should inform the reader of how tasks can be completed and where additional information can be sought as well as track what the reader has already done. One challenge related to content is the different backgrounds of the users. Inexperienced users have naturally different needs regarding the manual than advanced ones. When these are both taken into account, the result may at worst be that the manual is too abstract for some users and too general for others. (Hsu & Dawidowsky 1999, pp. 12–13.)

As a third measure of customer orientation Hsu & Dawidowsky (1999, p. 13) mention accuracy, which describes how consistent the document the user has been provided with at the time of the purchase is through the product's whole life cycle. The problems related to accuracy can result in the same kind of end comes as those mentioned in the context of structure. The accuracy of a document is strongly affected by the updating and revision cycles. Moreover, a minor change, for instance, in the product structure can affect many documents, such as drawings, BOMs, system descriptions and training materials. It can already be challenging for the company itself to keep up with the changes and control that all the affected documents are updated. Consequently, customers can be overwhelmed by the changes and they may not be able to judge if the information in the document is up-to-date or not. (Hsu & Dawidowsky 1999, p. 13.)

If there are some defects in the structure, content or accuracy of the document and customers cannot locate the information they are looking for, they will probably end up contacting the company's technical support (see Hackos 2007, p. 21; Markel 2012, p. 13). On the other hand, if the information can easily be found in the manual, the workload of technical support is diminished. This is one additional reason why the quality of the manuals is worth managing. In order to measure and evaluate quality, there has to be a defined set of requirements (Wingkvist et al. 2010, p. 477). The quality of documentation can be evaluated with different tools, one of which is quality model. Wingkvist et al. (2010, p. 477) represent three requirements on a quality model for technical documentation. First, the model should be flexible in order to adapt to the users' changing perceptions of quality. Secondly, it should be based on objective measurements but supplemented with subjective metrics such as questionnaires. The final requirement is that

the model should provide visualization throughout the quality assessment process. One approach that fulfils these requirements is the Goal-Question-Metric (GQM) paradigm.

GQM is a goal-oriented approach to quality evaluation and it consists of three levels: the conceptual, operational and quantitative level. Goal represents the conceptual level and describes an overarching property that a document should possess. According to Markel (2012, p. 12) technical documentation has eight measures of excellence which are honesty, clarity, accuracy, comprehensiveness, accessibility, conciseness, professional appearance and correctness. These may well be applied as quality goals. At the operational level, different questions are formed in order to determine if the goal is achieved or not. Finally, data needed to answer these questions are collected at the quantitative level. (Wingkvist et al. 2010, p. 478.) As an example of the model's application Wingkvist et al. (2010, p. 478) mention that a quality goal, such as "high accessibility of information" can be supported by questions, such as, "appropriate access behaviour" or "completeness of testing" which, in turn, can be approached with metrics including "the time it takes to find information" and "the access path used". GQM is one general approach to quality evaluation that can be applied according to the specific situation. In this sense, different quality models can be created for a certain project or product. (Wingkvist et al. 2010, p. 477.)

Considering the evaluation of documentation, projects are the main focus of interest. In evaluating the success of a project, the best starting point is to look at the project-tracking data, weekly progress reports and other data that have been maintained throughout the project. Besides defining the success of the project, it is also important to analyse what part of the process could have been improved. This lays a foundation for future projects and helps prevent the same mistakes from realizing. (Hackos 1994, p. 511.) Nevertheless, it is not sufficient that discrete projects are managed; the whole system of documentation needs to be managed as well (Albing 1996, p. 68). Furthermore, according to Hackos (2007, p. 6) documentation management is too often solely concentrated on the operative performance, such as producing publications and meeting deadlines, and strategic management as well as development of documentation can easily be forgotten. One useful approach to remind management of all related responsibilities is the development of a Balanced Scorecard.

The Balanced Scorecard supplements traditional financial measures that are focused on past events with measures that guide the future performance. It consists of four perspectives, i. e. financial, customer, internal business process and learning and growth. The objectives and measures of these perspectives are based on the strategy and vision of the organization. (Kaplan & Norton 1996, pp. 7–8.) Hackos (2007, pp. 95–97) believes that in the field of documentation, the Balanced Scorecard can be applied to both drive and measure organizational change. This way the documentation strategy can be aligned with the overall strategy of the company and turned into objectives and explicit

measures. In a well-formulated Balanced Scorecard, planned actions are linked in a cause-and-effect relationship so that they together bring the organization closer to the desired objectives. In addition, it helps employees understand the financial consequences of their decisions and senior managers the drivers of the long-term success. (Hackos 2007, pp. 95–97; Kaplan & Norton 1996, pp. 8–9.) The Balanced Scorecard is a strategic management tool that clarifies the vision and strategy of the business unit, links strategic objectives with measures, helps in planning, targeting and aligning strategic initiatives and enhances feedback and learning (Kaplan & Norton 1996, p. 10). An example of a Balanced Scorecard is illustrated in Table 2.

Table 2. An example of a Balanced Scorecard for technical documentation.

Perspective	Objective	Measure
Financial	Enhance the efficiency of processes Lower the unit cost per manual	<ul style="list-style-type: none"> • lead-time of projects • # of revision cycles • % of revisions of total development time • cost per unit • # of duplicates • translation costs
Customer	Improve the quality of manuals Deliver manuals in schedule	<ul style="list-style-type: none"> • # of errors in distributed manuals • # of technical support calls • # of customers satisfied / unsatisfied • # of reviews / user tests • % of documents shipped with the product
Internal business process	Include writers early in projects Enhance communication and information transfer	<ul style="list-style-type: none"> • # of projects where documentation included in project planning / in every step • # of communication tools used
Learning and growth	Implement new tools and technologies Develop a training program	<ul style="list-style-type: none"> • # of new technologies learned • # of staff completing training

To conclude some of the aspects of technical documentation discussed in this theory section, it can be noted that technical communication is a complex field including a lot more than merely writing. Technical writers and documentation managers have to deal with many challenges, such as tight time constraints and pressure to do more with less. Additionally, technical documentation often has a low value in organizations which may complicate their daily work. In order to manage documentation effectively, one needs to understand the documentation processes. However, they cannot be inspected in a vacuum, since they are closely linked with other processes, such as engineering change management (ECM) and product development processes. Considering efficiency improvement, understanding the operative performance of documentation is essential. First, the processes and practices need to be inspected and only then the implementation of assisting tools can be considered. Documentation can be organized in various ways and there is no ideal structural arrangement. Thus, as with business problems usual, there are no off-the-shelf solutions, but the answer to the questions of the location, business model and resources of documentation depend on the needs of the organization.

4 EMPIRICAL CASE STUDY

The empirical part of this research was conducted as a single case study. The present state of documentation in the case company including the main challenges related to the current arrangement and the reasons for them was analysed by conducting one-to-one interviews. From this basis, the documentation arrangement alternatives were formed by applying theory of outsourcing and documentation arrangements to the case company.

This chapter is organized as follows. The case company of this research, Sandvik Mining and Construction, is presented in the next chapter. In addition, some basic knowledge of technical documentation in the case company is given and the issues that initiated this research are discussed. Then, the actual execution process of the empirical research is presented. First, in Chapter 4.2 it is described, how the interviews were held, how they succeeded and what was learnt from them. Finally, in Chapter 4.3 the main remarks of the analysis of the gathered data are made.

4.1 Case company and background of the study

Sandvik Mining and Construction (SMC) belongs to the global Sandvik Group, which is an engineering group in tooling, materials technology, mining and construction. Sandvik is divided into five different business areas, which are illustrated in Figure 11.



Figure 11. Sandvik Group (modified from Sandvik Construction 2012, pp. 4–5)

The Group was founded in 1862 in Sandviken, Sweden. Currently, it is a market leader in its field. In 2012, the Group had approximately 49 000 employees, subsidiaries in over 60 countries, representation in 130 countries with annual sales of about 99 000 MSEK. (Sandvik Group 2013a; Sandvik Group 2013b, p. 4.) In Finland, SMC has production facilities and offices in Tampere, Turku, Lahti, Hollola and Vantaa (Sandvik Suomi 2013). This research is conducted in cooperation with the Tampere plant (later referred to as SMC Tampere).

SMC Tampere was earlier known as Tamrock, which was founded in 1968 as a part of Tampella Group that had started manufacturing drifter parts already in early 1940's. The factory in Myllypuro, Tampere, was built in 1972. At the end of the eighties, the cooperation with Sandvik gradually begun but only over a decade later, in 2006, the company name was changed to Sandvik Mining and Construction Oy. Today the factory is a technology centre with R&D, engineering, production, marketing and after sales functions with approximately 900 employees (Sandvik Suomi 2012, p. 2.) It is divided into two different business areas: Construction (CNS) and Mining. This research focuses on the former business area.

At the global level, CNS provides solutions for surface rock quarrying, tunneling, excavation, demolition, road building, recycling and civil engineering (Sandvik Group 2013a). The product areas of CNS are illustrated in Figure 11. In the year 2012 CNS had invoiced sales of 9 700 MSEK and about 3 300 employees. Compared to Mining, the turnover of CNS is clearly smaller, since in the same year Mining had invoiced sales of almost 38 000 MSEK and also had over four times more employees. (Sandvik Group 2013b, p. 13.) In SMC Tampere the production is quite straightforwardly divided between these two business areas. In this factory, two types of drill rigs are produced: surface and underground mining drill rigs. Most of the surface drilling production belongs to CNS, while underground mining is mostly the responsibility of Mining.

SMC Tampere produces high-technology products, which is why technical documentation has an important role in, for instance, design engineering, manufacturing, training, field maintenance, technical and customer support and spare parts management. Technical documentation in SMC Tampere can be understood as an overarching term which covers documents such as manufacturing, design and support documentation. However, this research focuses on technical product support documentation, and the term technical documentation is used to describe this area of documentation.

In SMC Tampere, technical documentation creates and maintains different types of technical manuals, such as:

- operator's manuals
- maintenance manuals
- service and repair manuals
- spare parts manuals
- installation manuals
- component manuals
- technical instructions.

The manuals are used for many purposes by customers, employees and other stakeholders. Customers are provided with instruction manuals (operator's and maintenance manual) which are shipped with the machine. The situations when they might need the manuals are various. For example, at the beginning of the operation, some may need to refer to the manual in order to learn about the product's features, possibilities and usage. Additionally, the manual serves as first hand support when it is suspected that the machine is at fault. Internal users of the manuals include employees from maintenance, front line, technical support, spare parts and aftermarket. In many cases manuals are an important working tool and conducting a job assignment can be strongly dependent on documentation. For instance, in the maintenance of the machine, manuals are extremely important. Secondly, especially the spare parts manual is a selling tool on which after-sales are strongly based.

In SMC Tampere, technical documentation has in recent years branched into different directions in the two business areas. In CNS Tampere (later referred to as CNS), technical documentation is currently being entirely bought from an external service provider. Thus, CNS does not have any technical writers of its own but it does have a documentation manager who is responsible for the communication and cooperation between CNS and the service provider. In contrast, Mining Tampere (later referred to as Mining) has backsource its technical documentation a few years ago and it now has its own documentation department, which develops the most part of its instruction manuals. As a part of the transformation, Mining has developed its own content management system (CMS), which is currently fully implemented in the organization. Though, it still purchases some services from the same service provider as that of CNS. The current arrangements and processes of documentation are examined in more detail in Chapter 5.1, where the results of the analysis of the present state of documentation are presented. In this research the technical documentation of the surface drills of CNS is examined and that of Mining serves only as a point of comparison.

The fact that Mining has backsource its technical documentation has raised discussion in CNS, whether it should consider rearrangement of documentation as well. Addition-

ally, there has been some dissatisfaction with the way technical documentation is currently organized in CNS. The current arrangement has been perceived as difficult to manage especially financially partly because there is not a clear understanding of documentation as a whole inside the company. Consequently, the costs have escalated. Further, at the moment CNS does not have any defined tools or techniques for the measurement and evaluation of technical documentation, which hinders efficient management. When an activity or function is outsourced, control is naturally to some extent lost and dependency on external resources born. However, in CNS, the dependency on the service provider is already being diminished, since in summer 2013 CNS started the implementation of Sandvik's own CMS. Before this, the documentation tools and information systems of the service provider were only used. Besides high cost level, there have also been some quality issues with documentation. Whether or not these depend on the current arrangement, with structural rearrangements also quality problems could possibly be affected. All the mentioned factors call for evaluation of the outsourcing arrangement.

The underlying problem that initiated this research was to find out, in what different ways technical documentation in CNS could possibly be arranged and if some of these arrangements could support the formation of more effective documentation; documentation that is better manageable and controllable, more efficient and agile and results in better-quality outputs. In CNS, no major rearrangements of documentation have been made in the 21st century. An arrangement that worked perfectly fine sometime in the past may not adjust sufficiently to the current and upcoming business and customer needs. When it is suspected, that this might be the case, it is time to initiate an evaluation and development process. First, it needs to be analysed, what the cause for the current problems or issues is. When the underlying reasons are known and targets for development recognized, available solutions may be sought. Finally, the most optimal solutions can be chosen for closer examination. This is mainly what is being done in this research; for CNS the research acts as an assessment of the current arrangement and a preliminary study for the development of technical documentation.

4.2 Data gathering

In the empirical part of this research, data was collected by semi-structured one-to-one interviews held in two rounds: five interviews in the first round in October and seven in November 2013. The interviewees were chosen from different departments somehow related to documentation to form as broad a perspective as possible on the research topic. Additionally, the managers responsible for technical documentation were naturally included in the data sources. The sample included also a few employees that had in the past worked with documentation of CNS and did not have that close connections to it any more. Because the structural arrangement of technical documentation is divergent in the two business areas, employees from both CNS and Mining were interviewed in or-

der to be able to compare the different arrangements with each other. However, the focus of the research was to examine technical documentation in CNS, which is why most interviewees were selected from this business area.

The initial group of interviewees was selected at the very beginning of the research. However, in the course of the study, the group experienced some minor changes, as some new interviewees were added and some, in turn, eliminated from the list. The reason for this was that the interviewer got suggestions for possibly beneficial data sources from other interviewees. Additionally, she felt that one important job position and point of view was missing in the initial sample and this was later included in the study. The final group of interviewees is described in Table 3. All the interviews were successfully held according to the planned schedule and there were no major problems in regard to the schedule and organizing of them. All the contacted people were eager to take part in the study and replies to the interview invitations were mostly received quickly.

Table 3. *The interviewees of the research.*

Interviews in time sequence	Job title	Business area
I-1	Documentation Manager	Construction
I-2	Manager, Parts Support and Aftermarket Offering and Development	Construction
I-3	Global Product Line Manager	Construction
I-4	Design Manager, Current Product Engineering (CPE)	Construction
I-5	Manager/Vice President, R&D	Construction
I-6	Project Manager	Construction
I-7	Life Time Support Manager	Mining
I-8	Information Architect	Mining
I-9	Documentation Manager	Mining
I-10	Technical Training Development Manager	Construction
I-11	Technical Support Manager	Construction
I-12	Technical Product Support Manager	Construction

The interview invitations were sent by e-mail, in which the research topic was shortly introduced and a desired time span of the timing of the interview was suggested. The questions were not told to the interviewees beforehand and no material whatsoever was handed out before the interview. All the interviews were recorded and transcribed after the interview. The interviews were held in Finnish but the interview frame (see Appendix 1) was in English. That is why the formulation of the questions varied between the interviews. A couple of times it was noticed that the formulation of the question signified, since an interviewee could understand the question slightly differently than what the interviewer actually meant. In these cases the question was asked again with a different formulation (“what I actually meant was that...”). If the questions would have already been in the written form in Finnish, this would probably have happened less frequently. However, in general, there were no problems in communication.

The interview was roughly divided into different parts, which were background information, present state and future of documentation, process descriptions, management and control and documentation in Mining. Not all interviewees were asked all these parts, since some did not have special knowledge of them all. As an example, it would have been useless to ask questions of process flows if the interviewee was not familiar with the operative practices of technical documentation. The first two parts were in most cases asked in their entirety in every interview with the exception that present state and future of documentation was replaced with documentation in Mining when people from this business area were interviewed. These two alternative parts of the interview included the most essential questions regarding the research and usually induced discussion the most.

In the first round, the objective of the interviews was to get information of the present state of documentation and the related challenges. At this stage, the documentation related activities and processes were not known precisely and that is why another objective was to explore these. All the interviewees in the first round were from CNS. In comparison with the second round, the first five interviews were more structural. In the second round, the interviews were more open approaching thematic interviews, because the interviewer already had more both theoretic background knowledge and knowledge of the case company and case situation, which allowed her to ask further questions and even to some extent challenge the interviewees. Additionally, the interviewer was more relaxed in the interview situation which enabled a less structured approach. The objective in this round was the same as before but more emphasis was given to the development of documentation. In addition, the objective in the interviews with employees from Mining was to find out, why Mining decided to backsource documentation, how documentation had developed after the transition and how satisfied the interviewees were with the current arrangement.

Some questions that were already answered in the first round and were not the “core” of the research were eliminated from the interview frame before the second round. For example, in the first round, some interviewees were asked about the history of technical documentation; when and why it was outsourced, how the transition was planned and executed and how it developed after it was outsourced. When the interviewer got a sufficient picture of the matter, it was not seen as useful to ask these questions in the following interviews. On the other hand, some questions were also added to the interview frame in the course of the interview. Thus, the interview frame was developed as a result of continuous evaluation and emergence of new ideas. One of the key characteristics of exploratory research that was seen to depict the nature of this research (see Chapter 1.3.2) is flexibility and adaptability to change. Consequently, the focus of this type of study is usually at the beginning broad and becomes narrower as the project proceeds. (Saunders et al. 2009, p. 140.) In this research these characteristics were clearly visible, which supports the conclusion that this study was an exploratory research.

The length of the interviews varied from 30 to 62 minutes (the average length being approximately 43 minutes), partly because in some interviews more questions were asked than in others. Naturally, also the personality of the interviewee had an effect on the length: some simply spoke more and gave longer answers than others. Especially in the second round, there usually was some free conversation of the research topic after the actual interview. In these discussions the interviewer and interviewee could jointly discuss development ideas and the reasons for problems and the interviewer usually got support to the vision she had formed. In addition, some suggestions of how the topic could be further approached were received. It was noticed that some interviewees could express themselves in a more open and true manner in these discussions than in the actual interview probably because they were no longer recorded. In some cases, the interviewee could bring up a significant point of view that was not mentioned during the official interview.

All in all, the data collection succeeded well at a general level. After the one-to-one interviews, sufficient information was gathered for the data analysis which is discussed in more detail in the following chapter. Even though there were no major problems in the execution, conducting interviews was a learning point for the researcher. Her experience in holding interviews was quite limited before the case study and a more experienced researcher could have done some things differently. However, with proper planning and preparation it was ensured that this did not hinder the success of the data collection. Naturally, there were some details that could have been done differently but, in the researcher's opinion, these did not have a significant impact on the results. Thus, it is justified to conclude that the interviews succeeded according to the expectations and plans.

4.3 Data analysis

Analysis was in this research a continuous and incremental process that begun right from the beginning of the study. Always when new theoretical approaches to the research topic were found out, the theory was more or less deliberately applied to the case company. Consequently, remarks of the case study were written down already at an early stage of the study. This would probably not have been possible if the researcher did not have prior knowledge and experience of the case company. The researcher had been working for it in technical documentation related work assignments. However, the actual data analysis was a separate process that took place after all the one-to-one interviews were held.

Every one-to-one interview was transcribed by listening to the interview recordings. This was usually done right after the execution of the interview. The interviews were not transcribed entirely word by word but anyway quite precisely in order that the recordings would not need to be relistened. After all the interviews were held, the tran-

scriptions were printed out. An initial categorization of different themes was formed and a summary of things that had been said about each theme was filled as the transcriptions were read. When reading, the most important parts were highlighted and, simultaneously, the core data of each interview was translated into English and written in the summaries of the pre-determined themes. If the summaries were beginning to become too extensive and complicated, they were restructured.

This process resulted in a great amount of material, which was further narrowed down, summarized and reorganized in themes. It was a time consuming phase that proceeded in many cycles. When the themes and summaries started to find their final form, the analysis turned into theme-oriented concentrating on one theme at a time. Especially in this phase and in previous restructuring colour-codes were used in the analysis to help structure the information. For example, different categories, contradictive opinions and the most interesting points of view were highlighted with different colours. When conducting the data analysis, any own remarks and given insights were written down separately from the actual interview data.

The rearrangement alternatives of technical documentation were formed on the basis of the data gathered by the literature review and one-to-one interviews. The different arrangements were taken from literature and applied to the case study. A categorization of the arrangements was formed already before conducting the interviews and only minor changes to this were made. However, only after the data gathering it was possible to evaluate the appropriateness of the arrangements. The perception of the suitability of the arrangements changed and developed continuously as more data was gathered. In the data analysis phase, special attention was given to accuracy and completeness in order to get comprehensive and reliable results. However, this did not take more time than planned and it was succeeded to perform the data analysis on schedule.

After the results of the interviews were analysed and the rearrangement alternatives formed, it was found very useful to reflect them on one's own as well as with other people. For example, summarizing the results of the study helped in understanding what the main findings of the study actually were. Additionally, in discussions of the topic, some further insights and new points of view could be brought up and, this way, the analysis taken a step further. Thus, the analysis really was a continuous process that started right from the beginning of the study and continued also after the actual data analysis. All in all, the data analysis can be regarded as successful and the analysis process as fairly fluent. Maybe the greatest challenge in the data analysis turned out to be the vast amount of data, but with systematic analysis techniques the data could be managed well. On the other hand, with more limited amount of data, the liability of the results would have been questionable. Since the aim of the research was to gain deep understanding, it was evitable to collect a certain amount of data. Thus, also from this aspect, the data gathered and its analysis were suitable for this particular research.

5 RESULTS

In this section, the results of the empirical study are presented. First, the present state of documentation in the case company is discussed in Chapter 5.1. In the following chapter, the challenges related to technical documentation are introduced. These demonstrate why the development of documentation is needed. Additionally, some issues of technical documentation that make development difficult are discussed. The present state and the challenges of documentation were analysed from the data gathered by one-to-one interviews. Finally, in Chapter 5.3 the different documentation arrangements are considered. First, the starting point for analysis including the description of the current arrangement and process maturity is presented in Chapter 5.3.1. Then, in Chapter 5.3.2 the different arrangement possibilities are presented and their suitability reflected.

5.1 Present state of documentation in the case company

In CNS, the role of technical documentation is regarded from a few different perspectives. First, many interviewees were of the opinion that technical support documentation is an important part of customer satisfaction and the product. Readable, available and usable manuals with correct and suitable information that can be found easily affect the user experience positively and add customer satisfaction. On the other hand, if the customer does not for some reason receive sufficient support by the manuals and has to search information elsewhere, the customer's work is interrupted and the affect to customer satisfaction is the opposite. What was also noted was that the manuals serve as information transfer channels. The better the quality of the manuals is, the less workload and pressure the organization and especially the technical support have in transferring the same information to customers. A few interviewees mentioned that the perceived quality of the manuals can even be considered by the customer when planning next purchases. Thus, high-quality manuals can be a differentiator and strengthen the competitiveness of the company.

Another aspect of technical documentation mentioned is that user manuals and safety instructions are required by the law and industrial standards. These set the minimum level of documentation that has to be filled. However, many interviewees noted that the manuals would be produced and delivered even if there were no legal obligations. They play an important role in ensuring the safety of the customer by guiding the correct usage of the product. Finally, one role of documentation and especially spare parts manuals is to support aftermarket which is an ever growing business area that is being invested in. The spare parts manual is the foundation for aftermarket and a selling tool that is being used by the spare parts support daily. Thus, it should be the easiest and most effi-

cient channel for the client to purchase spare parts compared to any rivals in order to ensure and increase after-sales. To sum up, technical documentation supports customers and front line and, in its ideal state, enables them to work efficiently and safely.

In the current arrangement, CNS has only one internal resource for documentation: the documentation manager. His responsibility is to control documentation and create common policies in order that the same order and cost practices will be used throughout the company. Most importantly, he is the contact person between the service provider and CNS and in charge of communication, coordination and feedback between the two. This job position is relatively new, which is why the responsibilities have not yet fully settled. Prior to this, there has not been a full-time documentation manager in CNS and the job assignment has been treated as a secondary job. Except for this task, technical documentation is outsourced to a third-party service provider. There are currently two technical writers/information architects on the service provider's side working full-time on documentation of CNS. In addition, the service provider has likewise a contact person that passes on the information to both directions.

When simplified, documentation is all about bringing the thoughts and ideas of the product and its functionality from the designer's desk to the customer. Technical documentation serves as a bridge between these two by translating design documents and designer's ideas to a language the customer can understand. Also in CNS, design engineering is the source of information and raw material for technical documentation, and product manuals are produced in a design-oriented way. In order for documentation to succeed, the close cooperation with design and the correctness of the source material are indispensable. In CNS, the design department's task is not to control technical documentation but it has to support the process by participating actively in tasks, such as informing the technical writers, reviewing documentation and giving feedback. In design documentation, certain parameters need to be set in the PDM system in order for the information to transfer smoothly and correctly to support documentation. However, the PDMS was recently renewed, and this has caused some challenges with the correctness of the information. Its use has not yet entirely stabilized and the implementation is partly still in a learning phase. However, some interviewees noticed that the information system renewal can also be regarded to have positive effects on documentation, since working methods have to be altered and this way some "ingrained bad habits" of employees may be eliminated.

Technical documentation includes both developing documentation for new products as well as updating and maintaining existing documentation as engineering changes (ECs) are made or mistakes noticed. In SMC, new product development (NPD) projects follow a general R&D project model, which includes certain defined steps and milestones for technical documentation. However, the following process description is based mainly on the data gathered by the interviews. Technical documentation in the NPD-projects

starts with defining the documentation scope and requirements. The service provider makes an estimate of the documentation work on the basis of these requirements. In the current NPD-project, an offer was requested from the service provider but this has not necessarily always been done in previous projects. The content planning starts with an analysis of the product structure and the equivalence of the new structure with current products and their manuals. The closest manual structure is then chosen as the basis of the new manual.

Technical documentation is in the NPD-projects developed according to the state of readiness of the product structure. In the design phase, the product structure is under continuous development which is why documentation is not developed in advance. Thus, it is produced piece by piece when a certain part of the product structure is locked, which means that it will not experience any more alterations. When the product structure starts to find its form, the technical writers begin to collect information they need in order to modify the chosen manual structure to correspond to the new product. CNS arranges product training for technical writers so that they get to know the product and how it is used. The need for any new manual parts is recognized and they are placed in a suitable part of the manual structure. The content for these has to be developed from scratch; in other parts the existing material may be reused if it corresponds to the new product. At certain time intervals a review of the draft manuals is arranged and the manuals are corrected according to the feedback. The spare parts book is produced only when the final product design is ready. User manuals, technical documents and spare parts books need to be ready for 0-series products that are sent to the first customers. After the development phase, the manuals are published, translated when necessary and printed. It is the project manager's responsibility to ensure that the user manuals are developed on time. One challenge of documentation is that the documentation has to be ready when the first products are delivered but the design can be in progress until the first delivery, which can cause late changes to the product structure. That is why the time pressure of documentation is generally high at the end of the project.

Another part of technical documentation concerns Current Product Engineering (CPE), in which the products currently in production are being developed. There are several triggers that may cause an EC. For example, feedback from manufacturing, a request from the product manager, a new innovation or a noticed design mistake can cause a reason for change. Some changes are fairly small, such as replacing one component or correcting spare parts lists. The handling of the ECs follows a defined change management process. In some cases, the change may not affect functionality and documentation but otherwise the technical writers are informed of the change. Also in this case, the documentation is not developed in advance. It can be that the documentation work is conducted only when that type of a product is in production. For example, if only one module is redesigned, documentation is requested when that module is in production for

the first time. When a remarkable part of the technology changes and the change is not directly compatible with the old models, it can be handled as a year model change.

Designers usually inform the technical writers directly of the changes when the writers are on-site. When the update has been made by the technical writer, it is sent for approval and afterwards published. If a mistake in a manual is noticed by a customer, field maintenance or someone else, the documentation manager is usually contacted and he starts exploring where the mistake results from. Especially new product manuals tend to contain some mistakes at the beginning and the manual lags easily behind in the fast cycle of changes. On the other hand, manuals concerning more mature and stable products have already been corrected and are easier to maintain. The general opinion of the interviewees was that usually the mistakes in the manuals are caused by CNS and not by the service provider. As already said, if technical documentation gets incorrect information or it is not informed, the manuals are automatically affected. When the origin of the mistake is known, the mistake can be corrected. If it requires changing of design documentation, the design department is informed, after which the mistake in the manual can be corrected according to the updated source material.

So far the costs of documentation have mainly been followed on a project level. In a project, a certain budget is defined and it is followed at a general level throughout the project. For example in the present NPD-project, an estimate of the schedule was delivered with the documentation offer and it is monthly reviewed, how the budget and schedule correspond to the given estimates. Now that there is a person responsible for documentation on CNS's side, it is also possible to look at the documentation as a whole and estimate the total costs of documentation. Nevertheless, the problem is that the practices related to invoicing and cost control are quite scattered. Usually the invoice goes for approval to the manager who is responsible for ordering the work. For example, if the work is related to product development, it goes to the project manager or R&D manager. If it is related to operational development, in turn, the documentation manager is asked for its approval. In addition, the responsibilities and general management practices of documentation were unclear to the interviewees. Yet again, at a project level these were easier to define but the interviewees felt that the total ownership and responsibility of documentation were missing.

Communication with the service provider was perceived to be relatively easy. The main communication channel used is e-mail, but the technical writers also sit part-time in the premises of CNS, which makes direct face-to-face communication with them possible. This was seen as crucial by many interviewees. Project managers usually discuss directly with the service provider but the documentation manager is also kept posted. Others may contact the documentation manager who forwards the message to the service provider when needed. In the current NPD-project, also a monthly report informing how well the given schedule and budget are being met has been implemented. If there are

some serious deviations, a meeting is called and it is planned how the schedule is caught up. Previously, documentation steering group meetings were held approximately once a month but for some time these have not been arranged. The mission was to gather the related people, such as project managers from either side, designers, trainers, product managers, the documentation manager and spare parts people and inform everyone of the ongoing projects and their degree of readiness as well as introduce the people responsible. The attempt now is to rethink the steering group meetings and start holding them regularly again in the near future.

The service provider was in the interviews described with adjectives, such as agile, flexible, active, fast and service-oriented. The general opinion was that there are no major problems with the daily operation of it. Further, it got credit for expertise in the products of CNS. Many acknowledged that without talented writers who have understanding of the products and technology documentation cannot succeed. On the other hand, it came out that currently this kind of experience is tied to certain individuals who are strongly trusted in. Furthermore, some felt that the expertise and the service provider's tie to SMC had over the years diminished. When technical documentation was decided to be outsourced, former employees and technical writers of SMC started their own documentation business and continued to do documentation for the organization in the same manner as before but under a different company name. Over the years their company expanded and also the owner switched which had its effects on the customer relationship. Technical writers have partly changed and SMC is probably no longer considered as the top customer.

The general opinion of the interviewees was that the present state of documentation is not especially good, but not especially alarming either. The manuals are for the most part shipped with the product on schedule, which was considered as an important measure of success. Additionally, the quality of them was regarded as fairly satisfying by most interviewees, even though it was noted that there are some mistakes in them as well. Many brought up that in comparison with other product lines of SMC, competitors and other industrial companies, the manuals produced in CNS Tampere lead the field. On the other hand, technical documentation was not perceived to be very efficient. The documentation processes were described as, for example, slow and heavy which results in high cost-level and inefficiency of documentation. In addition, there was no clear consensus of the development of documentation. Some felt that the state of documentation has gotten worse while others were of the opinion that documentation is currently going in a better direction, since some flaws have been recognized and there is more dialogue between functions in the NPD-projects. Probably the most common opinion of the state of documentation was that it has remained mainly the same; there has always been a lot of discussion about it but actions and systematic development have been lacking. Thus, it can be concluded that there is at least some room for improvement.

The attitude towards documentation, as it came across in the interviews, was somewhat contradictory. Technical documentation was said to be important but apparently its importance is easily forgotten in daily work. Because documentation related activities, such as reviewing of manuals and guiding of the writers, are not the main job of anyone, these tasks often remain low in prioritization. A few interviewees noted that documentation and the service provider are often even entirely forgotten and remembered only at a late stage of the project, which causes additional time pressures for the writers. This kind of action may seem as low interest in documentation. As one interviewee noted, “we rather skip it if possible”. Another aspect that seems to be dominant in the atmosphere is a tendency to accuse the service provider also for mistakes that were not its fault. However, most interviewees were conscious of this and noted that the greatest flaws of documentation are caused by CNS’s own operation. Additionally, it seems that documentation has not necessarily received the role it should in CNS and it is very strongly seen as not a part of the core business. This kind of atmosphere can decrease the motivation of technical writers and does not encourage them to efficient working methods and striving for high quality. The challenges related to the current documentation arrangement in CNS are closer examined in the next chapter.

5.2 Challenges related to documentation

In the interviews, a quite wide spectrum of challenges of documentation was revealed. Some are related to the nature of documentation and the operational environment of CNS but the most are connected to the present working methods and the way technical documentation is currently arranged. In this chapter, the general challenges of documentation are first shortly presented after which the challenges that can more easily be affected by altering the arrangement and working methods are focused on.

First, it was noticed by many interviewees that technical documentation is strongly dependent on other processes, such as design, and their effects on documentation are not necessarily always thought through. As mentioned, the correctness of source material is critical for documentation. As another challenge related to the background processes of documentation, the timing of the product changes was brought up by some interviewees. This means knowing the moment that a product change has been implemented in production after the product structure has been updated in PDMS. From that moment on, the manuals need to be in accordance with the new structure. One interviewee said that there have been situations in which a change has been implemented in PDMS and production but the manuals have for some reason not been updated. Also the opposite situations have emerged; the delivered manuals have been developed according to the new structure even though the product change has not yet been in production. The fact that technical documentation is dependent on other processes cannot be affected but closer cooperation and communication between the processes and departments can be en-

hanced and that way ensured that the manual and the product delivered correspond to each other.

Another challenge relating to the operational environment of CNS is the fast cycle of product changes. As one interviewee noted, “our products are a huge amount of complex systems that change independently all the time”. In CNS, there are no volume sales where the product structure could be frozen. Instead, the development proceeds product by product and every machine is in one sense its own delivery. Further, the development of automation and software causes additional challenges since in comparison with physical components software development is more agile producing several new software versions a year. One interviewee noted that CNS is slow in reacting to the changes and another continued that sometimes faulty manuals are being delivered for quite some time before the flaw is detected. What makes this even more challenging for documentation is that it usually has to complete the work on short notice. For example, at a late stage of an NPD-project, the project is often already behind schedule and additionally, the suppliers tend to delay the project even more. As a result, there is a hurry to get the machines to the field and the time pressure eventually accumulates on technical documentation. From the viewpoint of documentation, technical documentation should be included in its background processes more closely in order to adapt better to the business environment.

Many of the interviewees were not satisfied with the current documentation processes. The documentation development phase was regarded to have too much iteration meaning that many versions of the content are made before the content corresponds with the requirements. This was seen to cause frustration in CNS, since it causes additional work load for internal employees who need to review the content and give feedback to technical documentation. Furthermore, every iteration results in additional costs whether or not the reason for the corrections is caused by the service provider or CNS. This slows down the process and makes it expensive. Some interviewees were of the opinion that there is nothing in the current pricing model that would encourage the service provider towards more efficient processes and a better outcome. A few interviewees also questioned if the service provider has the needed talent for it either. What was seen as problematic was that documentation currently consists of a set of separate processes, which makes it inefficient as a whole.

Lack of documentation know-how was regarded to cause some challenges as well. First, because design does not have expertise in technical documentation, there easily exists a language barrier between design and documentation. Lack of common understanding and terminology may be one reason why many correction iterations are needed, in case the designer does not succeed in sharing his vision of the design and the manual with the technical writer correctly the first time. In addition, design may not realize what information technical documentation needs in order to complete its work assignments.

Secondly, due to insufficient knowledge efficient management of documentation was not seen as possible. As a result, many saw that technical documentation in CNS is currently very much service provider controlled. Finally, also the technical know-how of the service provider was questioned by some interviewees. One interviewee was of the opinion that it is not at the level what is expected from a company that sells these kinds of services. In general, it was seen that the technical know-how is very dependent on individuals. Some mentioned that this causes inconvenience especially if some other technical writer than one of the regulars is involved in a project.

Personification was a strong theme that came up in many interviews. In this context, it is related to the way talent is divided among the employees as well as the effect of individuals on documentation. In CNS, there is a high trust on the performance of individuals. As a matter of fact, technical documentation was seen to be very much dependent on one experienced technical writer who has written manuals for CNS for a long time. When the dependency of one individual is very strong, the consequences may be serious if this individual is for some reason lost. According to some interviewees, this has not necessarily been taken into account in CNS.

Another aspect of personification, which was considered to affect the overall success and fluentness of documentation, was the contact person and its activity. From the technical writer's point of view, it was seen as an important support from CNS that the contact person keeps in contact with the writers and arranges, for example, reviews. On the other hand, if the contact person does not contact the writers regularly, it may seem like there is no interest on the subject matter which can affect negatively the motivation of the technical writers. It was mentioned that there has been some variation in the activity of different contact people. From the CNS's point of view, the same applies for the contact person of the service provider. One interviewee noted that all contact people have not necessarily been as active as could have been hoped for. Personification was also brought up in the context of design. Some mentioned that the designers have their own individual working methods and there exists some "ingrained bad habits" that may complicate documentation.

High trust on individual performance and variation in the working methods imply that the documentation processes and working methods have not been well defined. This argument was further supported by the interviewees. When asked about rules and guides related to documentation, the most interviewees answered that they were not familiar with any. The ones that were mentioned related mostly to the appearance of the manuals. As one interviewee noted, "over the years some working methods have developed and no one questions anymore if they are reasonable". This, in turn, implies also lack of systematic development, which was mentioned by many interviewees. Some felt that CNS is lagging behind competitors because no development work has taken place in the last decade. Especially the current distribution media – paper manual and CD-ROM –

was seen as old-fashioned, and a need for web-based electric manuals was recognized by almost all interviewees.

The fluent flow of information is one of the most critical success factors of documentation. The success of documentation in CNS requires a lot of information from different sources and it is also in this regard very much dependent on other processes. It came evident that there are some information transfer challenges in the background processes of documentation but as they are not examined in this research, these challenges are not presented in more detail. From the viewpoint of documentation, especially the information transfer from design is significant. As already shortly mentioned, the communication between design and documentation is not totally straightforward in CNS. Some felt that there is not sufficiently communication between different functions and documentation is not necessarily sufficiently supported by design. This was partly seen because of inflexible processes that do not support the information transfer and partly because of insufficient effort by design.

There are also some challenges related to the financial management of documentation in CNS. First, the cost awareness of CNS does not seem to be in a desired state, since many interviewees suspected that the total costs of documentation have not really been inspected. Also approving invoices was perceived challenging, mainly because the invoices were described as undetailed and broad. As a result, it is not always necessarily known what the invoice consists of and who should approve and pay for it. This, in turn, makes invoice verification difficult or, as one interviewee noted, nearly impossible. Some interviewees expressed that there exists a small doubt if this is taken advantage of by the service provider. Apparently, there has been some discussion in CNS of the correctness and suitability of invoicing. No one claimed that the work would not get done but the problem is that CNS cannot evaluate reliably if the invoiced working hours reflect the actual work amount.

As the next challenge, it was noted that the support of documentation from CNS's side may be quite shallow. For example, the proofreading practises do not necessarily always support the creation of high-quality manuals. Proofreading and reviewing is nobody's main job and that is why it often does not receive the attention it should. Resources for reviewing were seen as one of the main problems: there is lack of time for extensive reviews and the reviewer may not be even able to define what information the manual should contain and if the information is correct or not. Very often the approval and review of content is in the responsibility of design, but many interviewees questioned, if the designers really read the documentation or merely approve them. This is why mistakes are often not noticed before feedback from customer. Mistakes in manuals were at a general level not considered as a serious problem but in spare parts manuals it was seen otherwise. They contain incorrect information more easily due to their scale, product changes and the direct effect of wrong source information in PDMS. As noted by a

few interviewees, if the spare parts manual contains wrong information, the spare part that a customer orders can be something totally else than what is expected and needed.

Finally, the management of documentation were by all interviewees recognized as relatively weak. Nearly no one seemed to have a clear picture of how documentation is managed and some were even of the opinion that it has not been managed at all. Similarly, most of the interviewees said that the responsibilities of documentation were not clear to them. Also decision making was criticized by a few interviewees and it was seen that it is more advanced in Mining. There decisions have been actively made and systematic development of documentation has taken place and continued. Additionally, there is also a clear understanding of the present state of documentation and a vision and plans for the future. In CNS, this kind of systematic approach of documentation planning, management and development did not come up. The present challenges of documentation in CNS are summarized in Table 4.

Table 4. *The current challenges of technical documentation.*

strong dependency on other processes
fast cycle of product changes, time pressure in NPD-projects
inefficient and separate processes
high cost level
lack of internal expertise
insufficient communication between functions
unclear invoicing practices
strong personification in many regards
no systematic development in recent years
weak support of documentation
weak management of documentation
mistakes in spare parts manuals

The challenges are by no means separate; rather they are very much interconnected. It can be considered that they constitute networks and loops of challenges where one factor easily leads to others. For example, lack of expertise contributes to many of the above mentioned factors. Without sufficient understanding, it is not possible to manage documentation effectively and, additionally, it is difficult to interfere in any issues. This may lead to passiveness, which might seem as lack of interest on the subject matter. Similarly, weak management causes many problems. Because of the past management practises, the rules of the game have not been well-defined and, consequently, employees have come up with their own ways of performing things and these are not necessarily always the most efficient or reasonable courses of action. As another example, also inefficiency is a sum of many factors. In answering to these challenges, the rearrangement of documentation can be considered. In the next chapter, the alternatives for the rearrangement of documentation are presented and explored.

5.3 Rearrangement of documentation

In this chapter the current arrangement of technical documentation in CNS is first described with the concepts presented in the theoretical part of this research. Then, the different alternatives for the arrangement are presented and it is examined if the arrangements fit CNS or not.

5.3.1 Starting point for analysis

From the perspective of outsourcing engagements presented in Chapters 2.3.2 and 2.3.3, the current arrangement of technical documentation in CNS can be described as on-shore outsourcing, since the service is conducted within the same country in which the client organization is located (see Power et al. 2006, p. 12). When considering the scope of outsourcing, the arrangement clearly reflects total outsourcing since the development, production and maintenance of manuals is entirely conducted by external resources (see Lacity et al. 1996, p. 14). Also the co-managed service model of Sanders et al. (2007) describes the arrangement quite well. Its key features are that a larger scoped task or function is outsourced but the management of it is partly kept in-house. As mentioned in Chapter 2.3.3, typically the tasks outsourced as co-managed services are strategically less significant and the intention is to meet financial or resource-based objectives. (Sanders et al. 2007, pp. 7, 10.) This applies with documentation in CNS, since technical documentation is a support task and the more efficiently it is produced, the more net profit the organization gets. Because the management of technical documentation has in CNS been weak, the arrangement could also be considered as managed services, in which the management of the outsourced task or function is the responsibility of the service provider (see Sanders et al. 2007, p. 7).

The different outsourcing strategy alternatives were described in Chapter 2.3.1. In the light of the presented strategies, the outsourcing strategy of documentation in CNS moves clearly more towards efficiency-seeking than innovation-seeking, since the objective is to produce high-quality manuals cost-effectively. The strategy reflects resource-seeking, since CNS does not currently possess the capabilities and competencies required to develop documentation itself. As a result, it needs to obtain these resources outside its organizational boundaries. (see Kang et al. 2012; Hätönen 2008, p. 67.) However, documentation is a part of the customer's perceived quality of the product and an important working tool, which is why the costs cannot be the only criteria. Thus, ensuring of high quality needs to be taken into account as well when considering the most appropriate arrangement for documentation. Different business models of documentation were presented in Chapter 3.3.2. Clearly, the technical documentation of CNS operates under the Contractor Model, since it is focused on both maintaining existing and developing new documentation for products of long life cycles. A key feature of this business model is that the documentation development group may consist of external resources, which also applies to CNS. (see Carliner 2012, p. 138.)

According to Hackos (2007, p. 80) an organization should start efficiency improvement with a process maturity assessment in order to analyse the present state and find out the most important action proposals. The IPMM was presented in Chapter 3.3.3. Next, the maturity assessment of technical documentation in CNS is shortly described. The inspection is conducted from the perspective of CNS, and the maturity of the documentation processes from the viewpoint of the service provider is not taken a stand on. To begin with, technical documentation in CNS is clearly above maturity level one, Ad hoc, since documentation in the organization is not a new business area and over the years some uniform practices and structures have evolved (see Hackos 2007, p. 40). However, there are some features of level two, Rudimentary. CNS has implemented a modular approach to information design, which is possible only at level two (see Hackos 2007, p. 45). Additionally, a level two organization is in the process of putting processes and structures in place (Hackos 2007, p. 44). As the content management system (CMS), the person responsible as well as technical writers have recently experienced changes in CNS, the best courses of action are still searched for and the practices have not yet entirely stabilized. Further, at level two, management knows usually only little about the work done by technical writers (Hackos 2007, p. 68), which is in many respects true in CNS. The managers in CNS are experts in other fields than documentation, which is why their knowledge of the operational work of documentation may be inadequate.

At level three, Organized and Repeatable, the organization has according to Hackos (2007, p. 46) stable and repeatable processes that ensure the production and delivery of a quality product on schedule and budget. This applies to some extent with documentation of CNS, since documentation follows certain patterns that were described in Chapter 5.1 and there are always some control and quality assurance practices in projects. However, the completion of the process is to some extent dependent on individuals, such as technical writers, designers and project managers participating in the process, since the processes have not been defined in detail. Thus, at level three, the processes should be documented and defined (Hackos 2007, p. 46). Also sound processes to plan, estimate and track projects in a level three organization (see Hackos 2007, p. 36) are lacking in CNS. According to Hackos (2007, p. 46), a successful implementation and application of a CMS is not possible prior level three. CNS has recently introduced its own CMS, but this would not have been possible without the help of Mining, where the information system was initially developed and implemented.

To sum up, technical documentation of CNS is somewhere in between levels two and three. It can well be that it has already been at level three or even four but lack of innovation and systematic development has brought it backwards. To move up to level three CNS needs to develop a comprehensive vision and define where costs can be saved through process redesign and sell this vision to senior management (see Hackos 2007, p. 45). As already mentioned in Chapter 3.3.3, also a firm commitment to following the

processes and standards needs to be established and a standard set of templates, a style guide, a project workflow and sound processes need to be defined and obeyed. In CNS, the former two are under control but the latter two require some effort.

When considering the possibilities for rearrangement, many different criteria need to be taken into account. In order to deliver high-quality manuals that are readable, usable, available and correct, technical documentation needs sufficient resources and support as well as fluent processes. The most important resources include talented technical writers, correct source material, working information systems and active contact people from other departments and functions. From the perspective of support, the understanding of the role of documentation and the support from senior management are particularly important. Further, continuous small development and common guidelines for content creation were also seen as necessary by the interviewees. As documentation can be considered as team play, the information flows and feedback loops between the different players are an essential part of documentation that needs to be ensured by the processes. As was mentioned by many interviewees, especially the proximity of design and technical documentation is an important factor that streamlines the processes. Finally, documentation needs to be a part of the planning of projects and also plans concerning the future of documentation should be continuously made. These critical success factors of documentation are summed up in Figure 12. In the rearrangement effort, the alternative that best supports the critical success factors should be chosen.

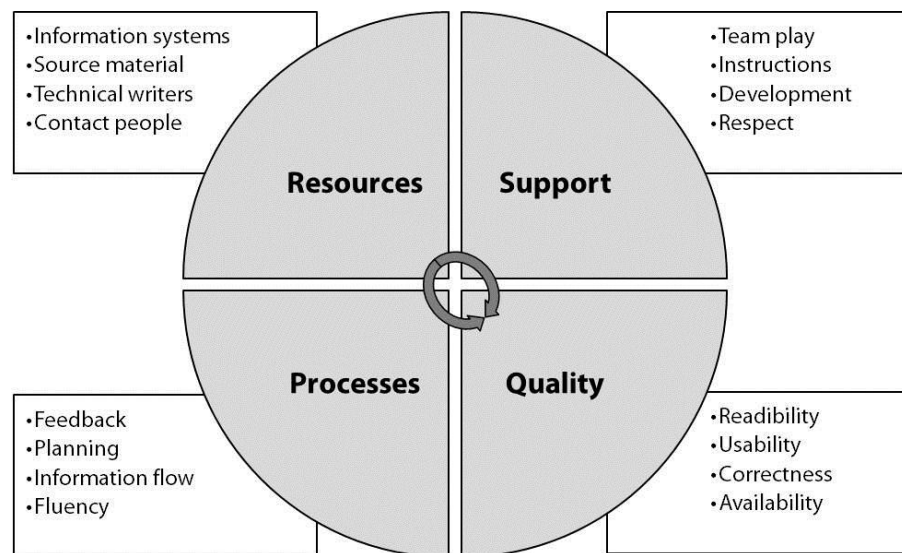


Figure 12. *The critical success factors of documentation.*

As the present state of documentation in CNS is at this point known, the possible solutions to present problems and different rearrangement alternatives can next be considered. So in the next chapter, the different arrangement alternatives are presented and their suitability reflected.

5.3.2 Documentation arrangement alternatives

The different documentation arrangement alternatives are presented in Table 5. In the arrangements one and two, the scope of outsourcing does not change in comparison with the present state but there are different options in regard to who conducts the work and where the service provider is located. In the arrangements three and four, documentation is to some extent back-sourced. These arrangements differ from each other in terms of under which organization and department the documentation team is placed and how the transition is implemented.

Table 5. The documentation rearrangement alternatives.

Arrangement	Alternatives	Main actions
1) Total onshore outsourcing	a) Current arrangement b) Service provider switch	<ul style="list-style-type: none"> • process/responsibilities descriptions • management, control and support of documentation • evaluation of external service market
2) Offshoring	a) International third-party service provider b) An offshore organization of the global Sandvik Group	<ul style="list-style-type: none"> • evaluation of global service market • risk analysis and management
3) Internal documentation team	a) Selective outsourcing b) Out-tasking	<ul style="list-style-type: none"> • formation of a management team • definition of the processes/sub-processes that are back-sourced • recruiting of technical writers
4) Centralized documentation department	a) Selective outsourcing b) Out-tasking	<ul style="list-style-type: none"> • formation of a management team • definition of the processes/sub-processes that are back-sourced • recruiting of technical writers

Whatever decision is made, it is important that it receives total support and the plans are carried out in a systematic way. This requires sufficient resources and support from senior management. If management does not show high interest in documentation, any development process is unlikely to succeed because of an unfavourable atmosphere. When considering the different arrangements, the main question is whether or not to outsource. The suitability of outsourcing is considered next, after which the possibilities for back-sourcing are examined.

Arrangements 1 and 2: outsourcing

As mentioned, technical documentation in CNS is currently outsourced to an external service provider and only the management of documentation is partly kept in-house. The interviewees were of the opinion that outsourcing has some advantages as well as disadvantages. First, it was noted by a few interviewees that outsourcing brings flexibility to the operation. An outsourcing arrangement was said to adapt better to the business situation, since there are considerably less fixed costs than in internal operations. Fur-

ther, it does not increase headcount, which is a noteworthy economical indicator for a stock company. It was also mentioned that an external service provider whose core competence is documentation has probably more prerequisites for the development of documentation than an organization for which technical documentation is purely a support task. From this point of view, with external capabilities it can be more likely that the development does not halt. Yet, this was not a unanimous opinion, since some interviewees noted that control and development are more difficult when most of the resources are outside the organization. Since CNS does not currently have any other resources for documentation than the documentation manager, it is quite limited what can be done before crossing the organizational boundaries. This means that a development project would also need to be for the most part bought from the service provider.

As it was concluded in the previous chapter, one critical success factor of documentation is smooth information flow. This was seen as one of the major challenges related to outsourcing. Many interviewees stated that communication with external resources will never be at the same level than it is in internal operations. As one interviewee noted, the information transfer from the initial data source to technical documentation is already by nature challenging and when that information should at the same time be transferred outside the organization, the process easily becomes inefficient. Because technical documentation is conducted mostly at the premises of the service provider, it is not possible to have daily face-to-face conversations between the technical writers and people responsible for documentation in CNS, such as documentation and project managers. That is why information transfer is partially prevented. However, the interviewees from Mining organization seemed satisfied with their current level of communication and information sharing, which had according to them substantially improved after back-sourcing documentation. They experienced that one remarkable advantage of having an internal documentation department is that daily conversations among technical writers and the documentation manager facilitate sharing of information in a whole new way. Additionally, the barrier to ask help or comments from other departments is low and all helping resources are close by in the same premises.

As another disadvantage of outsourcing, it was mentioned that it is not possible to affect the costs of documentation. This can be a serious risk in a single service provider arrangement that may realize if the exit barrier is high and the service provider takes advantage of it by acting opportunistically and focusing more on maximizing own profits than answering the business needs of the client (see Power et al. 2004, p. 39; Power et al. 2006, p. 175). In CNS the long cooperation with the same service provider has without a doubt created a moderate exit barrier, but not that high that it would not be possible to switch the service provider. Now that CNS has its own CMS, the transfer would be relatively easier than before the implementation of the information system (see Lehtikoinen & Töyrylä 2013, p. 174). Further, there are at least a few other organizations in Finland that sell the same services. Hence, a limited offering is not an obstacle either

and service provider switch could be one potential alternative. However, the interviewees were in general quite satisfied with the current service provider. From this viewpoint, there might not be cogent reasons to terminate the cooperation. Besides the cost level, also the human resources of technical documentation cannot be controlled in an outsourcing arrangement. One interviewee noted that there exists a risk that technical writers are sold to another project of some other client if there is a temporary work break in CNS. If the situation suddenly changes and more human resources are required, all the needed resources may not be available. Thus, the inability to affect costs and human resources both imply loss of control that is inherent in outsourcing.

According to Power et al. (2006, pp. 164–174) service provider switch should be considered only if the present service provider is clearly underperforming or there is something else seriously wrong with the relationship, because the operation requires a lot of effort and training of new people. In CNS there seems to be dissatisfaction with the service provider mostly only as regard to the efficiency and cost-level of documentation. In order to cut down the costs of documentation, offshoring it to a country of low cost-level could be considered. Technical documentation could either be offshored to an international third-party service provider or internally in the global Sandvik Group. CNS Tampere has, for example, connections to the documentation of CNS in China, which could at least theoretically be taken more advantage of. According to Größler et al. (2013, p. 309) an efficiency-seeking strategy of outsourcing encourages offshoring but capacity- or resource-seeking strategy is more often focused on onshore outsourcing (see Chapter 2.3.1). Even though the outsourcing strategy of documentation in CNS can be considered as efficiency-seeking, flexibility of documentation and the related resources was regarded as an important factor by the interviewees and it is best enhanced by onshore engagements.

There are also a few other considerations signalling that offshoring is probably not suitable for documentation in CNS. According to Hackos (2007, p. 54) an organization that is itself not at IPMM level three should not consider outsourcing or offshoring. He continues that this kind of organization does not have the required processes for effective communication with a new and untrained group of employees. It was concluded in the previous chapter that CNS is not yet entirely at level three, which means that it may not have what it takes to offshore documentation. Additionally, an offshore engagement would require capability to manage global and possibly decentralized documentation groups, which may turn out to be too challenging. Most importantly, the proximity of documentation and design was highlighted by many interviewees in the success of documentation. It was not perceived to be optimal even in the current arrangement and it certainly would not go in a better direction if the technical writers worked in another country of a different time zone. Since technical documentation in CNS is very much knowledge-oriented and demanding due to the fast changing operational environment and complex products, offshoring would most likely end up being a catastrophe.

Because the challenges related to technical documentation in CNS are mostly related to internal practises, an onshore or offshore service provider switch would not resolve the main issues. That is why it is not recommended by the researcher for CNS at least not without extensive planning and evaluation of the maturity of the potential new service provider, the net gains, the risks involved and its own documentation related practises. In the same manner, the scope of outsourcing should probably not be extended either, since many of the current challenges result from inadequate control and management which has led to a situation that was already considered as too much service provider controlled by some interviewees. However, even if a service provider switch is not recommended, it does not imply that the evaluation of the external service market would be useless. By exploring the external service market, CNS can assess how competitive the current outsourcing arrangement is and what opportunities other service providers could possibly bring. For example, another service provider may have implemented new technology that could be of interest for CNS.

It should be noted that the current arrangement entails some minor possibilities for rearrangement that can be considered instead of the greater reconstructions that service provider switch, offshoring and back-sourcing represent. There exist many alternatives especially concerning the management mode in the current arrangement. Thus, CNS needs to consider what part of the management it wants to keep to itself and what part of it is trusted to the service provider. As previously concluded, the current management mode is a mixture of co-managed and managed services. As CNS has recently employed a full-time documentation manager, the path seems to direct towards managed services. Considering the present challenges related to documentation, this development seems reasonable. Further, even if the case company decides to hold on to the current structural arrangement, it does not mean that documentation could or should not be developed. Next, some development ideas that came up in the interviews are shortly discussed. Since these relate to the current arrangement and challenges, it is in any case recommended to start the development work by paying attention to these. After they have been analysed and possibly some actions taken, there are more opportunities and chances of success in regard to the rearrangement of documentation.

First, it became evident in the interviews that the processes and responsibilities of technical documentation need to be defined. As Corbett (2004, p. 178) notes, a prerequisite for successful management of outsourcing is that people and system interfaces, data flows and reporting capabilities are all precisely defined. The responsibilities and process inspections were considered by the interviewees an important first step before any further development is possible. In order to define documentation responsibilities, a multilevel governance model may be applied (see Chapter 2.4.1). A few interviewees suggested that the information flows and different steps of the documentation processes should be inspected from a broad perspective. By defining the rules, it can be ensured

that common practices are applied and this way duplicate work can be prevented and efficiency enhanced.

When a clear understanding of the current processes is achieved, bottlenecks may be recognized and affected. Some interviewees brought up that the development of documentation needs to have a clear direction and it should proceed systematically. This indicates that clear targets for the development are defined and it is regularly inspected whether they are being met. As one interviewee noted: “product project is not a documentation development project”, which indicates that the possibilities to develop documentation as a part of NPD-projects can be very limited, if it is not especially specified in the project objectives. That is why the development of documentation needs to be budgeted in order for some progress to take place. This, in turn, requires understanding from senior management of the fact that some effort should be put on documentation. Another interviewee continued that the management needs to show an example to the subordinates; otherwise no improvement in any form can happen.

Also the need for better service provider control came up in the interviews. Luckily, the new CMS helps in controlling the work of both internal and external employees. With the new information system, it is, for instance, possible for CNS to follow the activities of technical writers. This is a handy tool for monitoring working hours and adding the transparency between the service provider and CNS. As a result, the efficiency of documentation can potentially be enhanced. For example, it could be closer examined how much time is needed for corrections after the first draft, which was considered as one possible measure for the efficiency of documentation by one interviewee. If the iterations are very time consuming, the reason for this should be recognized in order that the efficiency for the next round could be enhanced. An ideal state would naturally be that the content would be correct in one go but due to the character of documentation as knowledge work, it can probably never be accomplished. A more realistic goal would be to get the manual structure right in the first draft so that the details can be discussed straightaway, as noticed by one interviewee.

Finally, the activity from CNS's side towards documentation and the service provider should be enhanced. One way to enhance activity is to start arranging the documentation steering group meetings again. In order to ensure activity from design, documentation should somehow be built into the design processes more closely than it is today. This way the communication and information transfer would be improved and it would also be prevented that the role of technical documentation is forgotten in any stage. Not all of the above mentioned development ideas are demanding and time consuming especially not in comparison with the possible net gains. When CNS itself analyses the documentation activities, it gains knowledge which helps it to better understand the needs and the working methods of documentation. This in, turn, enables better support and control of technical documentation.

Arrangements 3 and 4: back sourcing

The fact that Mining has brought technical documentation back in-house has caused some discussion in CNS of the question if CNS should follow this path, too. To what extent these two organizations can be compared, divided the opinions of the interviewees. Some viewed the question from a pure business perspective concluding that since the business of CNS is of a different character than that of Mining, technical documentation needs to be seen differently as well. In Mining, more customization of the products is made and a single machine can be tailored according to customer specifications. In CNS the production is not totally standardized or customized but something in between, what one interviewee described as mass customization. However, when considering the question from a documentation point of view, the basic needs, processes and working methods are mostly the same in both. Thus, many interviewees were of the opinion that the Mining way could also work for CNS.

The reason why Mining decided to backsource documentation was to improve efficiency and lower costs. According to the Mining interviewees, the know-how of the service provider had diminished over the years as a result of some staff turnover. When documentation was first outsourced, most of the technical writers producing manuals for SMC Tampere were former employees of the organization, which is why they possessed high knowledge of the products, design and working methods. Over the years when new technical writers started to emerge, this kind of extensive understanding was to some extent lost. This resulted in inefficiency and cost increase, which showed as many iterations and corrections in the documentation process as well as mistakes in the final output. This was seen as a general trend of the field by one interviewee who had extensive experience of technical documentation. Thus, outsourcing works fine at first but then some talented people may be lost and the client organization has no ability to control the recruits of the service provider, which may result in a situation where manuals of worse quality are being produced at higher costs. This resembles in many ways the present state of documentation in CNS. Mining has succeeded in developing the quality and efficiency of documentation with its own documentation department, which could imply that one way to answer the efficiency and cost issues of CNS could be to engage in back sourcing.

The trend to backsource documentation was visible also when asked the interviewees about documentation arrangements outside SMC Tampere. Every example mentioned had at least some internal documentation operations and the direction was more in favour of bringing it steadily back in-house than outsourcing it more extensively. Also another reason for internal documentation that was brought up was the ever stricter laws and safety issues. Eventually, SMC has the final responsibility for the correctness of the instructions and the level of safety they provide, which is why it has to be able to rely on its documentation resources and their ability to produce high-quality outputs.

Most of the interviewees were of the opinion that documentation should be backsource. Backsourcing was justified by arguments, such as better flexibility, better commitment of technical writers, better communication, better-quality output and lower cost level in comparison with the current arrangement. Since a great amount of initial information and background processes directly affecting documentation are inside the organizational boundaries, it was seen as beneficial by a few interviewees to keep also the rest in their own hands. One interviewee mentioned that most of the documentation work consists of small changes that the organization's own resources could do easily and in a way that every correction would not constitute an invoice. With internal resources the confusions in invoicing practices could be solved as well. As another interviewee noted, it is easier to determine how many hours an internal employee has worked than an external one. Additionally, the service provider has certain minimum invoice amounts, which enables a situation in which an 8-hour day produces an invoice of more than eight hours.

Many interviewees were of the opinion that an internal documentation team would be less expensive than an external one. One important consideration in this regard is the cost savings Mining has reached. Currently, documentation at Mining is produced faster than before with less resources. This is mainly possible thanks to efficient and flexible working methods and improved information transfer. As an example given by one interviewee, due to the close connections of documentation and design, instructions are updated and problems found more quickly and quality controlled better, since the barrier to ask for help or comments is low. Efficient working methods positively affect quality as well as decrease costs. One Mining interviewee experienced that "only now we have true structured documentation", which saves money in translations and facilitates quality management, since less pages need to be reviewed in proofreading. Additionally, with internal resources some steps of the documentation process, such as requests for offers, and intermediaries may be eliminated, which streamlines the process.

As a result of this comprehensive development, Mining has already saved a considerable amount of money even though the transition is partly still in progress. At present, Mining develops all the instruction manuals for NPD-projects and most of the CPE-updates itself while spare parts books are still bought from outside. However, it is important to note that in Mining the documentation costs per unit are much higher than in CNS, because the manuals are customized and larger in volume. That is why it would not necessarily be possible to achieve that great cost savings in CNS. Thus, by looking at the present costs of documentation, it can easily be noted that CNS could surely employ a sufficient amount of technical writers with lower costs. Despite the general opinion of the possible cost savings, not all interviewees were of the opinion that backsourcing would be a good direction for the development of documentation.

Whereas some experienced that an internal documentation team would bring flexibility and that way efficiency to the working methods, one interviewee was of the opinion that the development time of manuals would become longer, because it would not be possible to put that many resources on documentation internally for a shorter period of time at the end of the projects when the documentation work load is at its greatest. However, another interviewee pointed out that it is no use bringing a new technical writer to the project at a late stage, since the work requires a lot of background knowledge of the machine, which is not possible to gain that fast. Further, at that stage there is not much mechanical work that could be transferred to someone less experienced. The effect of bringing documentation back in-house on commitment and motivation of technical writers was also regarded in contradictory ways. Some thought that the commitment of technical writers would be greater if they worked for SMC while especially one interviewee feared that it would decrease motivation, because technical documentation is not a core activity of CNS and the attitude atmosphere is not in its favour. Hence, if it was not succeeded to sustain motivation of the technical writers, it could be that internal resources would not be as agile and service-oriented as currently.

One interviewee expressed concern in how all the special knowledge that is needed in documentation could be tied to only a few technical writers. This issue has been treated in Mining by building flexible job positions so that everyone has their own area of responsibility but they are also able to do other tasks as well. In comparison with CNS, it seems that all technical writers have their own strictly defined job assignments and somewhat narrower expertise, which is why more people need to be involved in documentation. Naturally, this constitutes a risk. As one Mining interviewee noted, the transition to internal resources has two major risks: software and recruitment. Luckily, Mining succeeded in both even though the IT environment had to be created and the recruitment of talented technical writers was said to be challenging. For CNS, the first risk is eliminated since the software is already in use and developed into a mature state by Mining. The second risk is, however, substantial. Talented technical writers is one of the critical success factors of documentation and without them documentation cannot succeed. If documentation is back-sourced, also the turnover of staff is a serious risk, which can realize if it is not succeeded to attain motivated technical writers. High staff turnover could possibly result in quality and efficiency reductions since a lot of time would be wasted in the repeated learning periods of new employees. Finally, one interviewee expressed concern for ensuring that the skills of the external resources are sufficient in case only a part of documentation development is conducted outside.

When considering the scope of outsourcing, it should be noted that some parts of the documentation processes will anyway be bought from outside. These include routine-like tasks, such as, translating and printing services. If only these kinds of tasks are outsourced, the arrangement can be called as out-tasking. If some parts of the actual documentation development process are outsourced as well, the arrangement is referred to as

selective outsourcing, which is the current documentation arrangement of Mining. In selective outsourcing, the main question is what should be outsourced and what remained in-house. One interviewee suggested that an internal documentation team, which would have precise knowledge of the content of the manuals and the degree of readiness of documentation projects could in many respects be advantageous to CNS. This would imply that the core knowledge of documentation should be separated from mechanical work which could then be outsourced. However, one interviewee noted that there is not a lot of mechanical work in documentation, since it is mainly knowledge management. One possibility worth considering is that the internal resources could act as knowledge creators who would concentrate on the content of the manuals but would not need to spend time on issues, such as spelling and formatting. Thus, the final editing could then be purchased as an external service.

Another suggestion for selective back-sourcing was to start the transition first with NPD-production, which is what Mining did. When the needed software was operable, technical writers were prudently recruited and NPD-production started. When the operative environment became more stable, it was possible to extend the activities also to CPE-work. This kind of approach is less risky than taking over all documentation tasks at once as an out-tasking arrangement. If CNS would backsource all documentation operations simultaneously, it would burn a bridge behind it and lose all backup plans. Additionally, the transition would most likely cause serious disturbances in business operations. Moreover, it would be difficult to estimate, how many technical writers it should recruit. Hiring too few writers would cause additional disturbances and more internal or external resources should be acquired quickly. In case the amount of technical writers would be overestimated, the efficiency of documentation would decline, since there would not be enough work for everyone. Thus, it can be concluded that out-tasking is too risky a transition strategy for CNS.

Even though out-tasking is not possible straightaway, CNS could incrementally move towards out-tasking by selective back-sourcing. The transition would take place as a pilot project and if not successful, the back door to the previous arrangement would remain open. Also from a learning aspect, the gradual change seems more appropriate, since it enables incremental learning instead of having to learn every aspect of the matter at once. Nevertheless, as any other rearrangement, also this has its risks and possible disadvantages. One disadvantage mentioned by the Mining interviewees is that the pricing model of the service provider does not fit selective outsourcing, since it includes a considerable amount of fixed costs, such as overhead and management fees. The relative proportion of these costs grows, when the work load of the service provider diminishes. Thus, the outsourced services are regarded to be so expensive that the goal of Mining is to take over of all documentation activities as soon as the prerequisites for it exist.

Considering back sourcing, there are two major alternatives, where the technical writers could be placed in the organization. The first one is that a new documentation development and management team would be formed in CNS. Second, the back sourced operations could also be incorporated into the documentation department of Mining. Every interviewee, with whom the matter was discussed with, was of the opinion that the two currently separate documentation groups should be somehow combined and unified. Hence, CNS Tunnelling is already in the documentation pool of Mining. With a central documentation department CNS was said to get greater flexibility, since a single documentation team consisting of only a few writers is more vulnerable if it is not a part of a larger entity. Further, the products are in many ways similar and with a central department the joint technical know-how could best be taken advantage of. As already mentioned, the documentation process is also roughly the same in both sides and it includes a lot of common activities. Consequently, certain activities, such as management, translations and printing, could be controlled by one person irrespective of the business area. A further advantage would be that the manuals would be created according to the same instructions and rules, which would result in similar outcomes. It was noticed by one Mining interviewee that Mining would not necessarily benefit that much of the arrangement since it has survived on its own so far, but for CNS it could certainly be an attractive alternative.

An interesting consideration is whether the central documentation department could be established not only with internal resources but also with external ones as an on-site outsourcing arrangement. From the operational perspective, who pays the salary of the technical writer should not be that determining a factor. Though, from a financial perspective, it may have significance. Usually the hourly charges of external employees are higher than those of internal ones since the service provider needs to make some profit of the relationship. That is why the client organization needs to ask itself, what value it gets by paying this extra amount. If the premises and IT environment of the client organization were used and the client were also in charge of management, training and the like, the value the service provider would bring could be quite limited. Also another interesting arrangement would be that CNS would buy documentation services from Mining. As can be noted, a central documentation department could be pursued with many different kinds of approaches. Even though the central documentation department in many ways seems as the optimal arrangement, it remains a question whether it is in practise possible in SMC Tampere. It may not fit the current way of thinking in the organization since currently a clear distinction between the two business areas are made and they seem to continue to diverge more from each other. Thus, because of pure business limitations, CNS may need to settle for an internal documentation department arrangement.

If the current documentation arrangement of CNS is compared with that of Mining, it can be noted that it seems quite scattered. As one interviewee noted, at present there are

two employees working full-time for CNS at the service provider's side, one documentation manager in CNS and the technical infrastructure that is administered by Mining. Further, the documentation responsibilities and distribution of work are in Mining precisely defined as well as the processes that have been developed in order to adapt them to the business needs. Thus, also the satisfaction at documentation seemed higher in Mining than in CNS.

Backsourcing documentation would simplify the current decentralized arrangement and it would indicate that documentation is taken seriously. However, the decision naturally requires a lot of commitment and the transition is not possible in one night. As mentioned, CNS lacks documentation knowledge which is why outside expertise for the transition should probably be obtained. However, this cannot be regarded as an obstacle, since Mining did not have high internal expertise either when it made the decision but a documentation expert was recruited to take charge of the project. Further, now that Mining has its own documentation department, it has recovered this knowledge which should not be left unexploited by CNS either.

5.3.3 Synthesis

The results of the analysis of the arrangements formulated in the previous chapter are summed up in Table 6. The suitability of the arrangement alternatives is indicated by colour codes. The alternatives that according to the analysis cannot be applied in the case company are highlighted with colour grey and the ones that are not recommended with red. Thus, the colour green shows the most suitable arrangements.

Table 6. The suitability of the documentation rearrangement alternatives.

Arrangement	Alternatives
1) Total onshore outsourcing	a) Current arrangement b) Service provider switch
2) Offshoring	a) International third-party service provider b) An offshore organization of the global Sandvik Group
3) Internal documentation team	a) Selective outsourcing b) Out-tasking
4) Centralized documentation department	a) Selective outsourcing b) Out-tasking

First, it can be concluded that the current arrangement (alternative 1a) seems to be the best alternative from the different outsourcing alternatives within arrangements one and two. However, in order to solve the current issues, development and minor rearrangements are required even though the structural arrangement would for the most part stay the same. It was noted that offshoring (arrangement 2) is the least suitable arrangement for the case company, since the business environment is very complex. Because the challenges related to technical documentation are mainly internal, a service provider

switch (alternative 1b) would not solve them. Furthermore, no major danger signals implying a serious need to terminate the current arrangement were identified. Hence, developing the current arrangement seems more reasonable than trying to solve the dilemmas with a new service provider. However, it became clear in the case study that even if technical documentation is outsourced, there needs to be at least some internal management of documentation. That is why it is not recommended that the scope of outsourcing is expanded.

The arrangement four, centralized documentation department, can in many ways be regarded as the ideal state of documentation for the case company. This arrangement would enable the combination of the two currently separate documentation functions, which would diminish excess or duplicate work as well as result in joint working methods, policies and guidelines and enhanced flexibility. However, due to possible business limitations, the two documentation groups may need to be kept structurally separate. Thus, internal documentation team (arrangement 3) is also a potential backsourcing alternative that could bring substantial business benefits. Even though the two groups would be separated, the superior features of the centralized documentation department arrangement could be pursued by working in close cooperation. Additionally, it was found out that selective backsourcing (alternatives 3a or 4a) would be the best transition strategy for CNS, since out-tasking (alternatives 3b or 4b) was considered to be too risky and unrealistic. Two possible strategies for selective outsourcing were identified: the so called knowledge creator model and backsourcing of NPD-production. However, on a long-term basis, selective outsourcing may result in out-tasking, where only specific tasks, such as translating and printing services, are assigned to outside service providers. This can be accomplished by bringing more processes and operations incrementally back in-house.

According to the results of the empirical case study, backsourcing could solve many of the challenges mentioned in Chapter 5.2 and support the success factors of documentation discussed in Chapter 5.3.1. The challenges that could be affected by the rearrangement include unclear responsibilities, lack of total responsibility, high cost level, lack of expertise, insufficient communication and the confusions in financial management. Quality, process fluency, information flow and feedback as well as team play could possibly all be enhanced. Considering also that CNS already has a documentation manager and its own information systems for documentation and the fact that it would not need to recruit many technical writers, backsourcing does not seem like a bad idea at all. However, before any major rearrangements are initiated the internal practises need to be considered and possibly developed. This kind of development and definition work can most easily be conducted in the current arrangement. Thus, on a long-term basis, there exists a variety of different suitable rearrangement alternatives but these should not be adopted with haste.

6 DISCUSSION

In this research, technical documentation was investigated as a structural arrangement. The aim of the study was to find out, how technical documentation should be organized in an industrial enterprise. This research question was approached by dividing it into several sub-questions and conducting a literature review and a case study of the topic. In the literature review, outsourcing and technical documentation were inspected at a general level. The empirical part of the study was conducted as a single-case study. Next, the answers to the research questions are considered. Then, the results of the study are reflected at a general level and some action proposals for the case company are made. Finally, the success of the research is assessed and the possibilities for future studies are considered.

6.1 Summary of the results

The research question this research aimed to answer was: *How technical documentation should be organized in an industrial enterprise.* This question was further divided into following sub-questions:

- How can technical documentation be managed and controlled?
- How can outsourcing be exploited in technical documentation?
- What kind of alternatives are there to arrange technical product documentation in the case company?
- How should the case company arrange technical product documentation on a long-term basis?

Next, the answers to these questions are summed up. First, the answers to the four sub-questions are considered and finally, the main research question is answered.

How can technical documentation be managed and controlled?

In order to manage technical documentation effectively, a lot of expertise in documentation is needed and the management needs to be made someone's responsibility. Several different aspects need to be taken into account in documentation management. Thus, the processes, projects, project portfolio, people, costs, communication and knowledge all need to be properly managed. Furthermore, all the management tasks need to reflect customer-orientation since efficient processes and all other success factors of documentation go in vain if the content of the manuals does not meet customer needs. Hence, quality and content need to be controlled as well. Moreover, management of documen-

tation should not only be operative but include also the strategic level. This ensures that there is a clear vision for the future and a plan on how to achieve the determined goals. This way, technical documentation can also be strategically linked with the overall and product strategy of the organization. If strategic management is neglected, technical documentation becomes a clerical function which focuses only on completing the daily routines. It does not encourage innovation; rather the development is halted.

There are several tools that can assist in documentation management. First, PDM systems may automate some workflows, which decreases the need for the operative control of processes. In addition, they help time tracking and change management. However, information systems are only assisting tools and they can never fully replace human managers. There are also tools and models that can be used in the evaluation and measurement of documentation. These include, for example, quality models and the Balanced Scorecard. Despite these tools, the performance and effectiveness of technical documentation may still be perceived as hard to define. Documentation is mostly knowledge work which makes its measurement challenging. Additionally, especially the quality of the manuals is not easy to define since it is relative, which implies that users may perceive it differently. Nevertheless, with careful planning and consideration of the appropriate metrics and quality requirements these challenges are possible to overcome.

In documentation management, the theories of organizational control may be applied. Thus, social, process or output control can be practised. In order to define process controls, the documentation manager needs to be familiar with the processes. This type of control is usually applied if there is not a high trust on the controlees. In output control, control focuses on the evaluation of the final output, namely manuals. If there is a high trust on the staff and not necessarily high expertise in documentation, social control can be the best alternative. However, in the researcher's opinion, formal control types should not in any case be forgotten. Otherwise, it is difficult to define the performance of documentation and prove it to senior management. The best control approach is most likely a combination of the hard and soft management approach. In case documentation is outsourced, building close relationships with the service provider is probably not the factor in which the client should focus on. As documentation is a support task, it may be unwise to invest a lot of time and resources on relationship management. Thus, hard management approach that focuses on formal control measures may be sufficient but it can be supplemented with social control.

As can be noted, documentation management involves a lot of different tasks and areas of responsibility. It includes both running the daily operations as well as development, which requires strong leadership. In documentation management, expectations of different stakeholders as well as the value of quality against cost and time need to be constantly balanced. Documentation management should be especially focused on managing distinct projects as well as the project portfolio. If the documentation department is

large, it may well be that documentation management is too complicated a task to be conducted by one person. That is why the responsibility can be divided between different individuals. However, it needs to be ensured that each person responsible knows what is expected of them and there remains no management task that nobody is responsible for. In other words, the management responsibilities need to be clear for the managers themselves as well as for stakeholders.

How can outsourcing be exploited in technical documentation?

At a general level, it was found out that many factors affect the outsourcing decision. These include for example the criticality of the business operation and the reasons why outsourcing is considered. Several motives for outsourcing were identified. These strongly determine the outsourcing strategy, which can be either more efficiency-seeking or more innovation-seeking. The strategy, in turn, affects the decision between different outsourcing arrangements that vary in terms of scope and location. In general, the more extensive the arrangement is, the more management is needed. The main findings of these interrelations are illustrated in Figure 13.

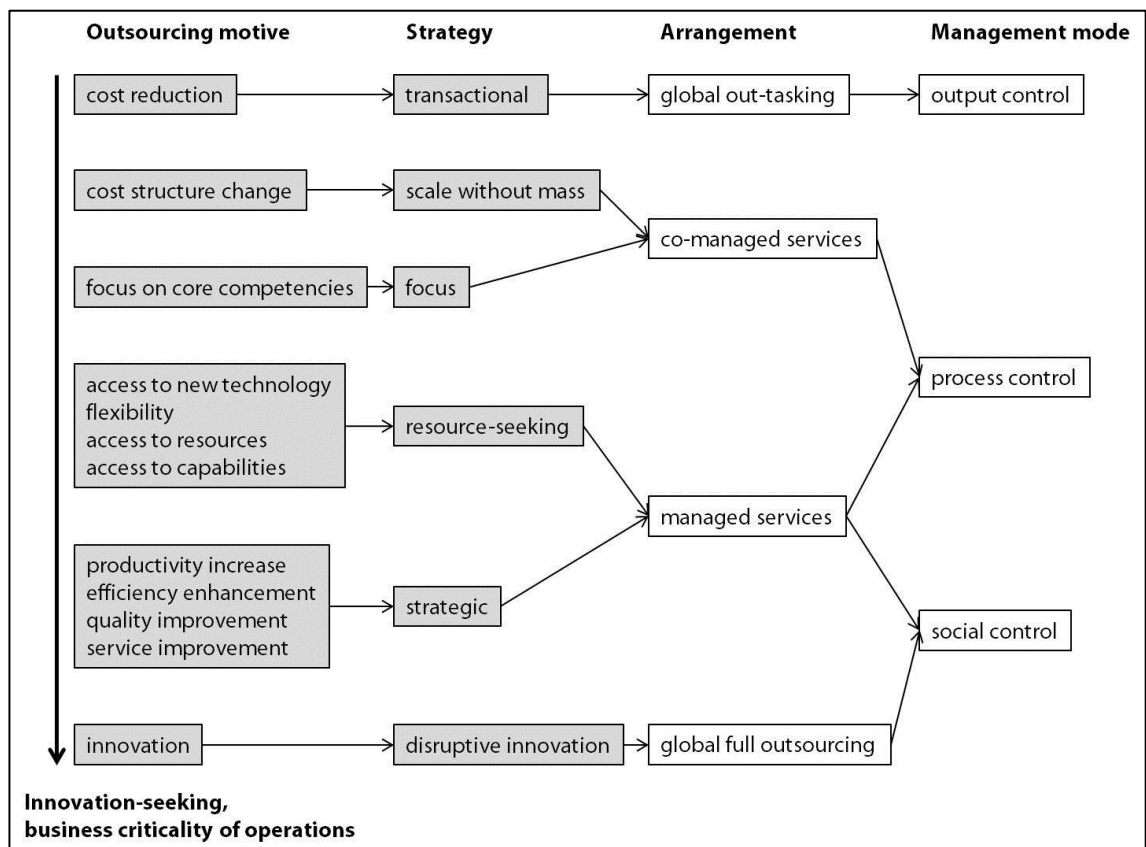


Figure 13. The relations of motives, strategies, arrangements and management in outsourcing.

When considering technical documentation, the strategy focuses usually more on efficiency-seeking than in innovation-seeking. Possible motives can be any of the ones mentioned in Figure 13. However, the most likely motives include cost reduction, focus on core competencies and access to resources or new technology. These result in different strategies and arrangements. It can be concluded, that there are several ways in which outsourcing may be applied in the context of technical documentation. There is not one best alternative that would fit every situation. Instead, each decision needs to be considered separately and made on the basis of the organizational and business needs.

There is not a lot of evidence of the suitability of technical documentation for outsourcing. However, it can be concluded that the complexity of the business environment affects the suitability. If the manuals are volume products and relatively stable, outsourcing can well be considered. In this kind of situation, documentation does not require continuous effort but consists mainly of routine work. For example, if the organization's products are from a technological aspect fairly simple and stable, product support documentation can be considered for outsourcing or even offshoring. On the other hand, if the products are complex and dynamic, a lot of knowledge management is needed in documentation. In this case, close cooperation with subject matter experts is required. Since technical documentation in this kind of environment requires a lot of internal effort even if outsourced, it may as well be worth keeping the rest in-house. If outsourcing is pursued, it may be wise to consider on-site outsourcing, in which the technical writers work in the premises of the client. This way information transfer between different functions can be enhanced and documentation better controlled.

What kind of alternatives are there to arrange technical product documentation in the case company?

The case company can either continue purchasing documentation services or start back-sourcing documentation. In total, eight different arrangement alternatives were recognized and these were divided into four different categories. Further, it was also recognized that some of the arrangements included several possible sub-arrangements. The documentation arrangement alternatives for the case company are:

1. total onshore outsourcing
2. offshoring
3. internal documentation team
4. centralized documentation department.

In the first two arrangements, documentation development is outsourced meaning that the case company does not possess any technical writers of its own. In the latter two arrangements, in turn, documentation is at least partially brought back in-house and technical writers are recruited. In the first alternative, total onshore outsourcing, the

documentation development is purchased outside in the same manner as before but a vendor switch can be considered as a result of an evaluation of the external service market. In this arrangement, one important decision concerns the appropriate management mode; what part of the management is kept in-house and what outsourced. Management can be partially or entirely kept in-house or fully given to the service provider. The second alternative, offshoring, entails a service provider switch either to an international external company or to an internal offshore organization. This implies that the manuals are developed in a different country than in which the case company is located.

The arrangement alternatives three and four imply that documentation is to some extent backsourced. In both cases, both selective and total backsourcing arrangements are possible. From the perspective of the outsourcing arrangements, the former results in selective outsourcing and the latter in out-tasking. Selective backsourcing indicates that only some parts of documentation are brought back in-house while, in total backsourcing, documentation development is entirely backsourced and only certain production services, such as printing and translating, are purchased. Two approaches for selective outsourcing were recognized. First, the NPD-production can be separated from other processes and brought back in-house. If successful, the scope of outsourcing can incrementally be decreased by bringing more processes in-house. Second, in the knowledge creator model the actual content creation is backsourced and routine tasks, such as formatting and editing bought from outside. If the alternative three is followed and an internal documentation team formed, technical documentation is structurally separated from the internal documentation department of the other business area of the organization (Mining). As the final alternative, a central documentation department where these two groups are combined can be formed.

How should the case company arrange technical product documentation on a long-term basis?

In the analysis of the different arrangement alternatives, it was concluded that the most optimal arrangements are the current outsourcing arrangement or the centralized documentation department. On a long-term basis, backsourcing would on the basis of the study most strongly support the needs of documentation. It would most likely be more cost effective and yield better-quality outputs than the current arrangement, since communication and cooperation would be enhanced and processes streamlined. In comparison with Mining, backsourcing would be a lot easier to conduct since technical documentation of CNS is smaller-scaled, the content management system has already been implemented and Mining has a lot of expertise that could be taken advantage of. If the case company decides to backsourcing documentation, it should carefully draft a precise transition plan and consider which parts of the process are worth bringing back in-house. A selective and incremental transition strategy is the least risky.

The centralized documentation department can from many aspects be regarded as the most attractive arrangement for the case company. In a centralized department, synergies between the two business areas can best be taken advantage of and the amount of duplicate work brought to a minimum. Nevertheless, the implementation of a centralized department may in practise be difficult, if there is a desire to keep the two business areas separate. Thus, even if the groups were structurally separate, they can at the operative level work in close cooperation, which is very much recommended. Nevertheless, back-sourcing cannot be considered as the only way to solve the present challenges.

In comparison with Mining, CNS manufactures volume products, which is why the business environment can be considered as more suitable for outsourcing than that of Mining, where there is a higher degree of customization. Thus, internal practises can be developed and the support of documentation improved also without any major rearrangements. However, the possibilities for development can be limited with only one internal resource. Whether internal or external resources are used, the technical writers should work in the same premises with the internal staff. This way they could work near the internal documentation department and designers, which would result in ease of communication and information transfer.

On a long-term basis, it depends on the attitude atmosphere and internal engagement, how documentation should be arranged. Bringing documentation back in-house requires strong support from senior management and a willingness to invest in the development of documentation. If a strong commitment of the stakeholders cannot be ensured, it is most likely better to choose the current arrangement. Moreover, the answer to the make-or-buy question depends strongly on the way the case company sees the value of documentation. If documentation is regarded as pure information transfer and a support task, outsourcing is probably seen as the most desirable alternative. From this point of view, by outsourcing documentation the case company can focus on its core competencies and continue purchasing documentation services from external experts of the field. However, if documentation is inspected from a knowledge management perspective, it can be regarded as a strategic function that is closely connected to the core competence of the company and, thus, needs to be kept in-house. The decision is also dependent on the case company's impression of the suitability of documentation for outsourcing. On the basis of this study, it seems that the case company has at least to some extent lost trust in the suitability of outsourcing in this particular context.

How should technical documentation be organized in an industrial enterprise?

The way in which technical documentation should be arranged in an organization depends on many factors. For example, the size of the organization and the nature of the products and technical documentation itself affect the decision. Thus, it is not possible to form one arrangement that would be the best for every organization. However, there

are some general principles that should be followed when considering the documentation arrangement. In a successful arrangement, the management structure is centralized, processes are defined, documentation is regarded from a business-oriented and strategic perspective and documents are developed by professionals. When considering questions, such as under which department documentation should be placed and whether it could be outsourced, the alternative that best supports the role and status of documentation should be selected. An underlying thought in these decisions should always be the impact of the arrangement on the organization's customer.

One critical factor of technical documentation which stood out in the theoretical as well as empirical part of this research was the proximity of technical documentation and design. Hence, it is vital that fluent communication between these functions is ensured and supported by the documentation arrangement. Another conclusion of the research was that outsourcing may not be a profitable option, if the products of the organization are complex and dynamic since documentation in this kind of environment requires knowledge management. Finally, it should be noted that business needs and environment constantly change. Thus, documentation needs to be made so flexible that it can adapt to the changes. However, as time goes by even the most flexible arrangement may become out-dated. That is why the arrangement needs to be evaluated and possibly altered from time to time.

6.2 Discussion and implications

When reflecting the results of the research at a general level, it can be noted that there were many findings in the empirical part of the study that were consistent with the related theory. For example, many of the challenges the case company struggled with reflected the general challenges of documentation. These include the low status of documentation, which has been a traditional problem of the field, and the fact that documentation is often included in projects at a late stage. Since other organizations struggle with the same kinds of problems, the results of this study may be interesting also outside the context of this research. On the other hand, it can also be comforting for the case company to know that they are not alone with these challenges. As another example, the case study supports the argument that management can be considered as the key reason for outsourcing failure. Even though the outsourcing arrangement of the case company cannot be regarded as total failure, many of the problems recognized were caused by improper management.

Since the empirical part of the study was conducted as a single case study, the generalization of the results is inevitably limited. However, some generalizations can be considered. Since theory was to a great extent applied when forming the different arrangement alternatives, with slight modifications the framework could possibly be applied outside the context of this study. Also the suitability of the arrangements could to some extent

be reflected at a general level. However, it must be noted that most part of the analysis was closely connected to the context. Finally, considering that there is not a lot of evidence of the suitability of technical documentation for outsourcing, this research can be considered as one attempt to fill this gap in literature.

This research acted for the case company as an assessment of the present state of documentation and a preliminary study for the development and possible rearrangement of documentation. Before engaging in any restructuring, it is recommended for the case company to define the processes, responsibilities, internal practises, and other rules and instructions of documentation. This creates a basis for efficient documentation as well as the rearrangement of documentation. In order to develop plans and a vision for the future that guide documentation, more strategic management of documentation is needed. This way it can be ensured that every decision has strategic justifications.

Also the status of documentation should be considered in the case company. It can be argued that the low status of documentation is one root cause to many of the challenges recognized in documentation. Low status of documentation can create vicious circles that result in the accumulation of problems. For example, if documentation is not respected, there is neither a commitment to following the common procedures nor supporting documentation and the service provider. This results in inefficiency, which, in turn, causes frustration in employees. Consequently, the motivation of technical writers will most likely decrease in this kind of working environment, which easily shows as indifference to goals, such as quality or productivity. Finally, the customer is affected, if the customer's work is interrupted due to an error in the manual. The fact that the role of documentation is recognized in the larger organization is a fundamental basis for any development initiative.

At the time when this thesis was finished, some development ideas mentioned in the research were already being implemented. For example, the process flows had been roughly defined and some issues related to the financial management were under closer investigation. The only way to get better knowledge and understanding of the current practices is to engage in this kind of activities. Thus, at the moment expertise is constantly being gathered in the case company, which allows for taking more management in its own hands in the future. The current development path of documentation is clearly moving more towards managed services. For example, managing printing and translating is becoming an internal management responsibility.

When the analysis of the results was ready, a meeting where the results and the development of documentation were discussed was arranged in the case company. In the meeting, it was concluded that the current expenses of documentation are high and they need to be cut down. It was seen as important that a clear direction for the development of documentation is defined. Additionally, it was noted that the development would

require additional resources. One approach for the development that was discussed is to form an ideal state of documentation without taking in consideration any constraints. The ideal state can be reflected from many aspects. For example, an ideal state of the manual or an ideal state of documentation processes can be constituted. When the desired state has been described, the actions that are needed in order to move towards it are defined. Finally, it is considered what kind of arrangement is needed to support the actions and the ideal state. The arrangement alternative that aroused the most discussion in the meeting was the knowledge creator model.

Technical documentation was an interesting research subject that turned out to be a more diverse field than expected at the beginning of the study. The connections of technical documentation to knowledge management are apparent. In fact, knowledge management can be regarded as one of the most important research topics in the field that has recently gained a lot of attention. It can be argued that documentation management has become information management and it is constantly moving one step further – towards knowledge management. Through the lenses of knowledge management, a broader conception of technical documentation can be formed. Also the role of technical writers can be understood in a new way. In the academic world, the knowledge management perspective on technical documentation has already gotten wide acceptance but it has not necessarily showed in the industrial sector. It appears that in many organizations documentation is still regarded from a narrow point of view as a support and somewhat even boring task. Thus, the academics and documentation managers have an important role in promoting the role and status of the field to business managers. Only this way, the field of technical documentation can develop into a profession.

6.3 Evaluation of the study and suggestions for future research

All in all, this research can be considered as successful, since the research questions and the research problem could be answered. The results can also be considered as fairly trustworthy, since a wide literature review was conducted and people from different backgrounds were included in the interviews. In addition, no major contradictions between the theoretical and the empirical part were identified. While carrying out the study, some alternative methods that could have been used in the research were identified. For example, the data analysis could have been conducted in two rounds. If there had been more data analysis between the two rounds of the interviews, the different arrangement alternatives could possibly have been more deeply discussed in the second round of the interviews. Although it is presumable that the results would have been similar also on the basis of this kind of research execution, there could have been some slight differences and supplements in comparison with the data collection and analysis methods that were applied. On the other hand, the schedule was predetermined and it was not possible to delay the interviews in the limits of it.

Another issue that was considered was the effect of the tape recorder on the responses of the interviewees. The researcher got the impression that in some cases the fact that the interview was recorded could have possibly affected the interview situation so that the interviewees might not have always stated their opinions directly and plainly. When the formal part of the interview was over and the recorder stopped, some of the interviewees could clearly speak more freely. However, if the interviews had not been recorded, the liability, extensiveness and depth of the results would surely have been negatively affected, because it would not have been possible to catch up everything that the interviewee said. Most likely, some important aspects would have been left unnoticed. However, the researcher could have paid more attention to the matter by trying harder to create a relaxed atmosphere and emphasizing to the interviewees that the interview was confidential and the recordings were listened only by the researcher.

From the basis of this study, some recommendations for future research can be given. First, a closer analysis of the most optimal documentation arrangement alternatives is needed in the case company. In the limits of this study, it was not possible to explore the arrangements at a detailed level. The arrangement alternatives presented in the study can be regarded only as frameworks and they need to be further analysed in order to arrive at one conclusion and develop a plan for the future. Especially, it should be explored, what the arrangements demand in practice: what resources are needed, what the total cost of an arrangement is, what decisions need to be made and what location, management and other options there are in each arrangement. Additionally, analysis of the background processes of documentation would be significant, since documentation is in many ways the end result of them. From this perspective, important considerations that were outside of the scope of this research are how design documents are made, how information is transferred between different departments, how engineering changes are scheduled and how these factors affect documentation.

Many recommendations for future studies were mentioned by the interviewees. One of the most critical research needs for the case company in the context of technical documentation is the development of electric spare parts manuals and new distribution media. This has been recognized in the case company and a possible technology has already been tentatively explored. Second, also single sourcing would be worthwhile studying for the case company in order that the content of the manuals could be directly used also when creating other documents, such as training or marketing material. Third, the measurement of documentation could be further explored, since in this research it could only be briefly discussed. This topic could be further explored also at a general level, since efficiency is strongly emphasized in documentation but its verification can be difficult due to the nature of the work. Also the suitability of technical documentation for outsourcing could be further studied in a wider context.

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APPENDIX 1: INTERVIEW FRAME

Background information

- What is your exact job title? Give a short job description, please.
- How long have you been working for SMC Tampere? How about in this job position?
- What does documentation in the context of SMC mean to you? How would you define documentation?
- How is your work connected to documentation? Do you use manuals in your daily work?
- Are there any formal, defined rules, procedures or guidelines related to these processes or documentation otherwise that you are aware of?

Present state and future of documentation

- What is your impression of the present state of documentation?
- Has your impression of documentation changed during your employment in SMC Tampere?
 - If yes, why?
- From your point of view, what is the objective of documentation in CNS?
- How strategically important documentation is for CNS?
- What are the current and future needs concerning documentation? Are the needs likely to change?
- What are the most important success factors of documentation?
- What are the major challenges with documentation?
- How could the issues you mentioned be solved?

- In your opinion, what is working well in the current arrangement? What are you especially satisfied with?
- What is your conception of the way documentation is organized and managed?
- How should it be organized and managed?
- What is your impression of the present service provider?
- What are the benefits that CNS gets from buying the service from an outside vendor? How about disadvantages?
- How should documentation be developed? Or should it be developed?
- Do you know how documentation is arranged in other sites of SMC? Are you aware of any practices applied elsewhere that could be advantageous to CNS?

Process descriptions

First: how well do you know the processes related to documentation (NPD, ECM)?

- How does the creation of a new manual proceed (NPD projects)?
- How are the manuals updated (ECM)? What triggers updating?
- Who are involved? How are the processes controlled?
- What is your overall impression of the processes?
- What are the major challenges with the processes?
- What is working well in the processes?
- How should the processes be organized and managed?

Management and control

- Can you estimate the expenses of documentation? Are they being followed on a regular basis?
- From your point of view, are the management responsibilities clearly defined?
- Do you know how the outputs and the work of the service provider are evaluated?
- How should they be evaluated?
- Do you know how the financial management is organized (e.g. checking of invoices)?
- How should it be organized?
- How is the communication with the service provider arranged (e.g. communication channels used)?

Documentation in Mining

- How is documentation organized in Mining?
- How was it organized before?
- Why was it decided to bring documentation back in-house?
- How was the transition planned? Were other arrangement options considered as well?
- How have the working methods of documentation developed after the transition?
- How has documentation developed after it was brought back in-house?
- How satisfied are you with the outcome? How well is documentation working compared to the former arrangement?
- Are there any challenges concerning the current arrangement?
- What is the vision for future?

- What is the workload of documentation altogether? How is it divided between employees?
- Is the workload continuous or more cyclic?

- Have the processes been defined?
- Can you compare the documentation in Mining with Construction?
 - e.g. working methods, quality of manuals, documentation needs, effectiveness..
- What is your impression of the present state of documentation in CNS?
- In your opinion, would the same kind of arrangement as that of Mining work in CNS?
- Do you consider it possible that the documentation activities of Mining and Construction could in the future be to some extent combined?
 - Would it pay off (from the viewpoint of Mining/Construction)?