Technische Universität München
Fakultät für Informatik

Bachelor's Thesis in Wirtschaftsinformatik

Evaluation of Document-Centric Collaboration at a Supplier of Integrated Circuit Products

Evaluierung dokumentenbasierter Kooperation bei einem Hersteller von integrierten Schaltbausteinen

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Abstract

Over a number of years the role of knowledge in an organization has emerged to that of an essential corporate asset. Globalization, downsizing, decreasing cycle times, and rising competitive pressure have contributed to an increase in the meaning of knowledge for organizations. Since products and services become more complex and consequently more knowledge intensive, companies are more and more likely to position themselves on basis of their expertise. As a result, knowledge becomes an organization's main source of a sustainable competitive advantage allowing companies to be more successful than the competitors.

Information technologies are widely used in companies to support the frequent processes of knowledge management and thus facilitate generation of new knowledge and enable capture, retention and re-use of best practices as well as know-how within the company. Success of technologies supporting knowledge management depends, however, on the complex interplay of numerous factors.

Within the scope of this thesis, knowledge management initiatives at a selected department of an integrated circuits supplier are evaluated with particular focus on document-centric collaboration. Thus, the status quo of collaboration support, including usage intensity of the available platforms and systems as well as their acceptance, is evaluated based on the empirical data gathered via an online-questionnaire. The concept of the survey questionnaire developed in the context of this thesis is substantiated by the analysis of various approaches to estimation of knowledge management success. In conclusion, core obstacles for the existing collaboration support concept are identified and potential resolution strategies are discussed.

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Index of Acronyms

FYI	For Your Interest/Information
GUI	General User Interface
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IDCM	Integrative Document and Content Management [AM03]
IS	Information System
IT	Information Technology
KM	Knowledge Management
KMS	Knowledge Management System
MS	Microsoft
XML	Extensible Markup Language

1 Introduction

The subsequent sections of this chapter provide an overview on the motivation, objectives, environment, structure, and course of this thesis.

1.1 Motivation

Over a number of years, the importance of knowledge management for organizations has dramatically increased. The main reason for that is the growing significance of knowledge as that of a *corporate asset* [DP00]. Such trends in the global economy as decreasing cycle times and rising competitive pressure increase concurrently [PS04]. As a result, knowledge becomes a company's major *sustainable competitive advantage*, because knowledge- and expertise-rich companies are able to generate ideas faster and more efficiently than competitors [DP00].

On the one hand, use of appropriate information technologies for the support of knowledge management processes can facilitate knowledge generation, capture and re-use of best practices and know-how in an organization [PS04]. On the other hand, a wrong concept on knowledge management support will fail to deliver the value needed and result in enormous expenditures for a company [DP00]. For this reason, each initiative concerning changes of existing technologies for knowledge management support should precede a thorough analysis phase.

Within the scope of this thesis, evaluation of knowledge management initiatives with focus on document-centric collaboration at a supplier of integrated circuit products is to be conducted. The company we co-operate with is a leading supplier of computer memory products headquartered in Germany. Due to the high level of knowledge intensity of this industry, knowledge management is of particular importance for this company. In course of the thesis, we are going to evaluate the status quo of document-centric collaboration at one of the departments of this company based on the empirical data gathered via an online-questionnaire. Therefore, in context of this thesis, we are going to develop and implement an appropriate questionnaire, as well as consequently analyse the collected survey data in order to be able to identify the weaknesses of the existing collaboration concept. In conclusion, we are going to discuss possible resolution and improvement strategies.

1.2 Objectives and Course of Action

Evaluation of document-centric collaboration at a supplier of integrated circuit products is the main objective of this thesis. Therefore, firstly we are going to document the status quo of the collaboration support throughout the department of Product Development. Consequently, our next objective is to evaluate the actual usage of these systems on basis of the empirical data gathered via a questionnaire survey. For this purpose, a group of parameters influencing success and acceptance of systems for knowledge management support in an organization is to be identified. Further, we are going to develop an appropriate questionnaire and consequently evaluate and analyse the data collected within the study. As a result, the main problem fields are to be identified and potential resolution strategies from literature are to be discussed.

The course of action can be described by the following milestones:

- Getting acquainted with the environment at the surveyed company
- Documentation of the status quo of collaboration tools usage
- Development of the questionnaire concept
- Implementation and pre-test of the questionnaire
- Conduction of the survey
- Analysis and interpretation of the results.

1.3 Thesis Structure

The subsequent chapters of this bachelor's thesis are further structured according to the following description.

In Chapter 2, the role of knowledge management in an organization, as found in literature, is discussed and the main theoretical foundations on this topic are presented. Section 2.1 provides the main term definitions and discusses the differences between the notions of data, information, and knowledge. Further, Section 2.2 is concerned with the role of knowledge in an organization: knowledge as corporate asset and consequently as source of a sustainable competitive advantage. Finally, Section 2.3 explains the main processes of knowledge management in an organization.

Chapter 3 is devoted to information technologies and their role in support of knowledge management processes in an organization. Section 3.1 describes the role of information systems in knowledge management. Section 3.2 provides the definition of a document further used in the context of the thesis. In Section 3.3 the essential properties of information systems for document-centric collaboration are discussed. Section 3.4 provides an overview of collaboration technologies used at the department of Product Development at the surveyed company. In Section 3.5 critical success factors of systems supporting knowledge management in an organization are deduced. Finally, Section 3.6 defines the main questions to be answered in course of the study.

Chapter 4 illustrates the design process of a survey questionnaire. Thus, Section 4.1 gives the definition of a questionnaire and Section 4.2 describes the core planning phases of questionnaire design. In Section 4.3 the major questionnaire types are discussed and finally, Section 4.4 provides an overview of the central issues related to online-questionnaires.

Chapter 5 presents the analysis of the survey results. The study population, the sample and the sample size are described in Section 5.1. Section 5.2 discusses at first the information needs of respondents. As next, "official" information allocation is compared to the actual information sharing habits of the surveyed employees. Subsequently, the level of user satisfaction with means of sharing knowledge as well as knowledge management in general is analysed. Section 5.3 is devoted to the evaluations of the critical success factors deduced in Chapter 3. Section 5.4 provides insights into the future use prospects of the existing knowledge management systems. Finally, Section 5.5 summarizes the results of the survey.

The thesis concludes in the Chapter 6 with a summary of contributions, and outlook on future research directions.

2 Knowledge Management

The subsequent sections of this chapter are considered with the role of knowledge management in an organization. At the beginning, the main term definitions are provided. Further, the significance of knowledge management in an enterprise is discussed. And finally, the main processes of knowledge management are explained.

2.1 Data, Information, and Knowledge

The terms knowledge, information and data seem to be quite familiar to all of us. Nevertheless, differences exist and it is important to bear in mind that confusion about what these terms mean and how they differ, often results in enormous expenditures on technology initiatives, failing to deliver the value that firms need. For this reason, understanding these three concepts is essential to being successful in knowledge work [DP00]. The subsequent sections try to give a clear terminology, which will be used throughout the remainder of the thesis.

Data

"*Data* is a set of discrete, objective facts about events" [DP00]. "Standing alone, such facts have no intrinsic meaning, but can be easily captured, transmitted, and stored electronically" [PS04]. In an organizational context, data can be defined as "structured records of transactions" and is usually stored in database management systems. In modern organizations data management is often evaluated *quantitatively* in terms of speed, cost, and capacity. Thus, the main concerns about data can comprise the costs of capturing and retrieving pieces of data, or speed of entering data into the systems and calling it up. To the *qualitative* measurements of data belong timeliness, relevance, and clarity: "Do we have access to it *when* we need it? Is it *what* we need? Can we make sense out of it?" [DP00]. One of the reasons why data is of great importance for organizations is that data provides an essential material for creating information [DP00].

Information

Peter F. Drucker defines *information* as "data endowed with relevance and purpose" [Dr88]. Therefore data can be turned into information while being organized into some dimensions of analysis, like customers, currency or dates. This process involves interpreting the context of the data and aggregating it into a compacted form [PS04]. Information can also be defined as a message, addressed from the sender to the receiver. Since information is considered to possess a certain degree of relevance and purpose, it is up to the receiver to decide, if the received message is really information. Consequently, successful communication of a message depends on the receiver's judgement or intelligence.

Information emerges from data by adding value it. There exist numerous ways of adding value:

- *Contextualized*: includes awareness about of the purpose the data gathered.
- *Categorized*: classified into units of analysis or data components.
- *Calculated*: gained through mathematical or statistical analysis.
- *Corrected*: free of errors.
- *Condensed*: summarized in a more concise form.

It is important to note that despite information technologies are well-suited to help in transforming data into information by adding value, but to a great degree only humans are capable of categorization, calculation, or condensing. Therefore, one of the important issues is the confusion of information and the delivering technology. Davenport and Prusak assert that the medium does not equal the message, although it can have a strong effect on the message. And furthermore, availability of more information technology does not necessarily result in a better state of information in an organization.

In organizations, information circulates through *hard* and *soft* networks. *Hard* networks imply a visible and definite infrastructure, such as wires, satellite dishes, addresses, and electronic mail-boxes that deliver messages in various forms, e.g. as delivery-service packages, e-mails, and internet transmissions. *Soft* channels are less formal and visible, they are ad hoc. Receiving a copy of an article from a colleague, marked as "FYI", is an example of transmitting information via soft networks.

Quantitatively, information management uses measures as *connectivity* and *transactions*: e.g. the number of e-mail accounts or the number of messages sent in a given period. *Qualitative* parameters evaluate *informativeness* and *usefulness*, e.g. if information is suitable for decision making or solving a problem [DP00].

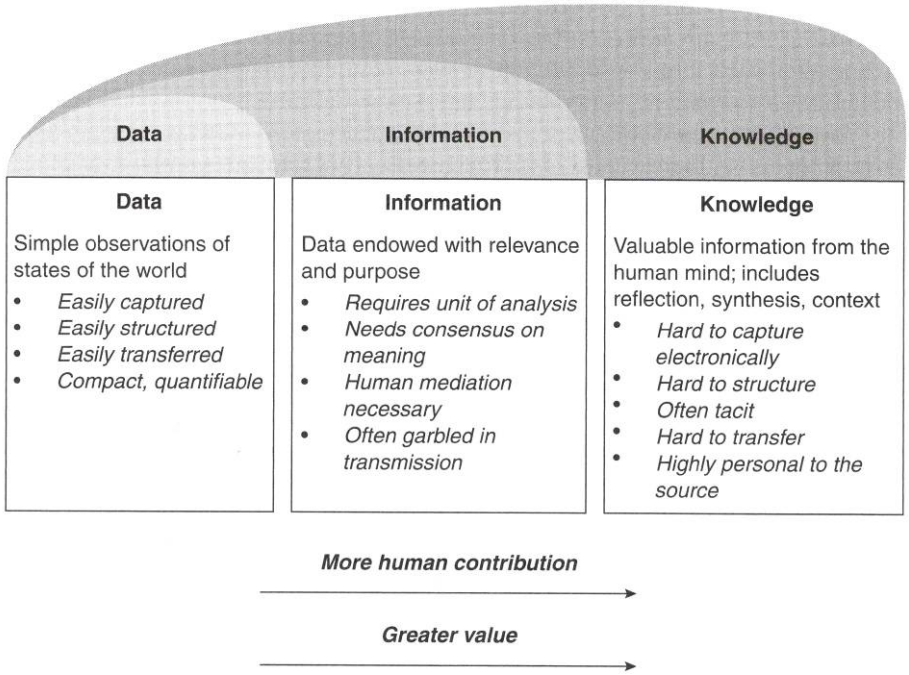

Figure 2.1: The relationship between data, information, and knowledge (source: [PS04], 276).

Knowledge

Davenport and Prusak [DP00] define knowledge as deriving from minds at work: "Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms" [DP00]. The major issues, differentiating data, information and knowledge, as well as the connection between those are demonstrated in Figure 2.1.

So, knowledge is highly personal to the source and involves much more complexity than data or information. Information is being transformed into knowledge, during the process of thinking thoroughly about it and while adding one's own unique experience, judgement, and wisdom. There are several types of knowing to be considered. *Knowing what* is concerned with recognizing, describing and classifying concepts. While applying knowledge, *knowing how* to do something emerges. This type of knowing requires the ability of ordering events or transactions into a sequence. After all, *knowing what* and *knowing how* are merged through the reasoning process into *knowing why*. *Knowing why* represents the causal knowledge of why something happens [PS04].

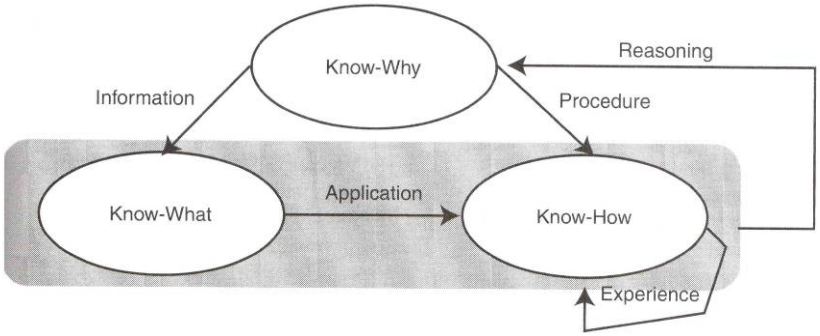

Figure 2.2: Taxonomy of knowledge (source: [PS04], 277).

While deriving knowledge from information, the following processes are of importance:

- *Comparison*: comparing the information to some familiar events or situations
- *Consequences*: impact of the information upon decisions and actions
- *Connections*: correlation of pieces of knowledge to each other
- *Conversation*: opinion of other individuals, concerning definite information

It is obvious that the process of generating knowledge first of all requires high involvement on the part of humans. On the contrary to data derived from records and transactions, or information contained in messages, knowledge is created by individuals and groups of knowers. Knowledge can be further transmitted through structured media, like books and documents on the one hand, and through informal channels, as person-to-person contacts, on the other hand [DP00].

The amount of human involvement increases along the continuum from data through information to knowledge. Computers are quite efficient in processing data, but are less suitable for managing information. More complex pieces of knowledge, like tacit knowledge, are extremely difficult to capture electronically [PS04].

Tacit Knowledge vs. Explicit Knowledge

Further, knowledge can be categorized in two classes: tacit and explicit. "*Tacit knowledge* is personal, context-specific, and hard to formalize and communicate. It comprises experiences, beliefs, and skills. Tacit knowledge is entirely subjective and is often acquired through physically practicing a skill or activity" [PS04]. Knowing how to swim or ride a bicycle is an example of tacit knowledge.

In contrast, *explicit knowledge* "can be easily collected, organized, and transferred through digital means, like a memorandum or a financial report" [PS04]. Explicit knowledge is "objective, theoretical, and codified for transmission in a formal, systematic method, using

grammar, syntax, and the printed word" [PS04]. Patents are an example of explicit codified knowledge, because they contain a detailed description of product properties or some processes, captured in text form. In the same way, reports and other structured documents stand for explicit knowledge [DP00]. The basic differences between these two knowledge classes are summarized in Figure 2.3

Tacit Knowledge	**Explicit Knowledge**
• Knowing how to identify the key issues necessary to solve a problem • Applying similar experiences from past situations • Estimating work required based on intuition and experience • Deciding on an appropriate course of action	• Procedures listed in a manual • Books and articles • News reports and financial statements • Information left over from past projects

Figure 2.3: Examples of explicit and tacit knowledge (source: [PS04], 278).

It is extremely important to differentiate between these two types of knowledge, because the concepts for capturing and transferring knowledge base upon this distinction. For example, explicit knowledge has traditionally been in focus of IT, whereas tacit knowledge is considered to be less suitable for digital processing, since it is to a great degree personal and is tightly related to one's own experiences and skills [PS04].

2.2 Knowledge as Corporate Asset

Speaking about knowledge management and corporate information systems supporting it, it is first of all necessary to clear why knowledge management is of importance for an organization. Hence, the subsequent section discusses the motivation for managing knowledge in a company and discusses the main objectives of corporate-wide knowledge management.

Motivation

Speaking about the role of knowledge in a contemporary organization, Rehäuser and Krcmar [RK96] note that knowledge and information are often referred to as the fourth factor of production. Thus, the traditional distinction of labour, land, and capital as main factors of production, is now often supplemented with the fourth factor - information. Information is required to co-ordinate the distribution of traditional factors of production in course of production of goods and services. The process of combining these factors requires knowledge, in order to network the available business process information according to the business objectives. From the logistic point of view, the value adding process requires therefore getting the right knowledge at the right time, in the right amount, at the right place, in the required quality. In times of globalization and thus geographically distributed work places, shortening production cycles and increasing competition, this task is, however, not quite easy to deal with [PS04].

The goal of knowledge management is for an organization to be aware of individual and collective knowledge so that it may make the most effective use of the knowledge it has [BB03]. Knowledge management has always been important to organizations [PS04]. The need to make the most of organizational knowledge, and to gain as much value as possible

from it, is, however, nowadays greater than in the past. The significance of knowledge, as that of a *corporate asset,* increases; and as a result, knowledge management activities are paid greater attention to then ever, consequently increasing the amount of investments in this field [DP00].

Knowledge as Competitive Advantage

The major trends, explaining the growing importance of knowledge management to organizations, as shown in Figure 2.4, are globalization, downsizing, rapid change, and finally the most essential one - the necessity of developing a company's *sustainable competitive advantage* [PS04].

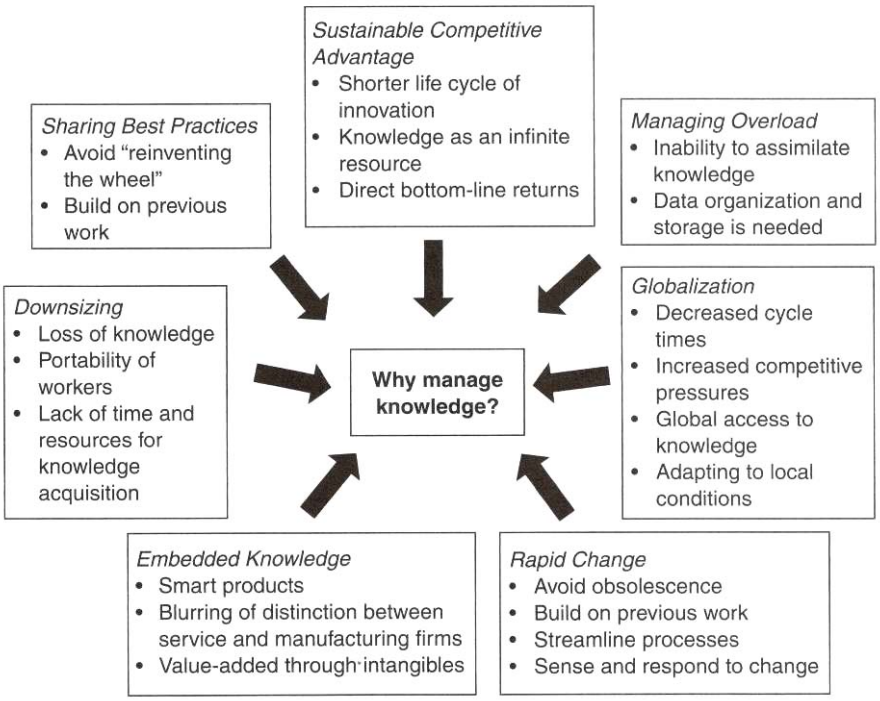

Figure 2.4: Reasons for managing knowledge (source: [PS04], 284)

In terms of globalization, the processes of designing, testing, and manufacturing products are distributed all over the world. In order to lower costs and to organize the supply chain efficiently working places often become geographically dispersed and thus knowledge sharing must take place in a global context [PS04]. Another issue, threatening company's knowledge base are employees leaving the company, since loss of employees means loss of their know-how and valuable experiences. New employees, however, need firstly much time to develop the expertise specific to the firm [PS04].

In terms of the changing global economy companies are likely to position themselves on basis of their expertise [DP00]. Decreasing cycle times and rising competitive pressure increase concurrently the speed of innovation. For this reason, products and services tend to become more complex and consequently contain a significant information element [PS04]. As competitors can hardly be prevented from matching products and processes, and even exceeding the developed standards of price and quality, the only way to still hold the market leadership is to be superior in terms of efficiency, quality and creativity [PS04]. As Robert Reich notes, "core corporations no longer focus on products as such; their business strategies increasingly centre upon specialized knowledge" [Kr05]. Thus, new knowledge must be assimilated at a more rapid rate. Companies are forced to act better and faster than the competitors do [PS04].

As a result, knowledge becomes a company's major sustainable competitive advantage, because only knowledge- and expertise-rich companies are able to generate ideas faster and more efficiently than competitors [DP00].

Knowledge Management in Organizations
According to Davenport and Prusak [DP00], experts in the field of knowledge management, most knowledge management projects carried out in organizations have one of the following aims: (1) making the corporate knowledge visible, and showing its role through tools as maps, and yellow pages, for example. (2) developing a knowledge-intensive corporate culture by encouraging knowledge sharing (as opposed to knowledge hoarding), (3) creating a corporate knowledge infrastructure going far beyond a mere technical system and thus, building a web of connections among the employees given space, time, tools, and motivation to interact and collaborate.

2.3 Organizational Knowledge Management Processes

Consistent with the interest in organizational knowledge and knowledge management, the importance of knowledge management systems has recently increased. The main objective of knowledge management systems is "to support creation, transfer, and application of knowledge in organizations" [AL01].

Since the systems to be evaluated in course of this thesis support single knowledge management processes of the overall corporate knowledge management system, it is important to describe in detail these core processes as well as their meaning for managing knowledge in an organization.

Classification of Knowledge Management Processes
The classification of knowledge management processes can be based on various perspectives. Thus, Pearlson and Saunders [PS04], as well as Davenport and Prusak [DP00] define the four core processes of knowledge management as: generation, capture, codification, and transfer of knowledge. *Knowledge generation* involves all activities that discover "new" knowledge. In this case, knowledge can be new to an individual, a company, or referring to the whole theoretical discipline. After knowledge generation comes *knowledge capture*, including the continuous process of scanning, organizing and packaging the generated knowledge. Further, the process of *knowledge codification* provides a representation of knowledge in a manner that can be easily accessed and transferred [PS04]. And finally, k*nowledge transfer* implies transmitting knowledge among individuals or groups of individuals in connection with its absorption later, and considers not being possible without absorption. According to this definition of knowledge management processes, *knowledge management* "seeks to enhance the efficiency and the effectiveness of these activities and leverage their value for the firm as well as the individual. Knowledge management is a dynamic and continuously evolving process" [PS04].

Since the thesis objectives first of all refer to collaboration technologies and their role in the corporate knowledge management, it is necessary to consider the systematic framework firstly originated from the research works of Berger and Luckman, as well as Gurvitch, Holzner and Marx [AL01]. This framework views organizations as social collectives and "knowledge systems". According to it, organizations as knowledge systems consist of four basic socially enacted knowledge processes: (1) creation, (2) storage/ retrieval, (3) transfer, and finally (4) application. This concept takes into account both, the cognitive and social nature of

organizational knowledge as well as the equal value of the individual's cognition and the collective practices and culture [AL01].

2.3.1 Knowledge Creation

Knowledge generation is primarily considered with "the internal activities of an organization to acquire or create new knowledge" [PS04]. It is one of the key sources of continuous innovation and knowledge base growth in the organization. There are two basic kinds of generating new knowledge: knowledge creation (exploration) and knowledge sharing (exploitation). *Knowledge creation* produces new knowledge by means of experimenting and examining alternatives. Creation and adaptation to new circumstances are the techniques used for knowledge exploration. *Knowledge sharing* is based on further development of already known concepts, and is much faster in comparison to knowledge creation. Exploitation uses such methods as purchase or rental, shared problem solving, and development via informal networks [PS04].

Further we focus on knowledge creation in an organizational context. Organizational knowledge creation "involves developing new content within the organization's tacit and explicit knowledge" [AL01]. Thus, organizational knowledge can be viewed as "a continual interplay between the tacit and explicit dimensions of knowledge and a growing spiral flow as knowledge moves through individual, group, and organizational levels" [AL01]. In their book "The knowledge-creating company" [NT95] Nonaka and Takeuchi differentiate fore core models of knowledge conversion (see Figure 2.5).

According to them, the tacit knowledge can be directly acquired through *socialization*. Socialization means that knowledge is transferred through shared experiences and collective solving problems, rather than bare using print media [Kr05]. It usually takes place in form of mentoring and apprenticeships, on-the-job trainings, or even such informal kinds of communication between colleagues, as "talking at the water cooler" [PS04]. A good example of knowledge socialization in organizations give Nonaka and Takeuchi [NT95], speaking about the experiences of "brainstorming camps" at Honda. The so-called "brainstorming camps" are informal meetings (accessible for any interested employee), held with the purpose of solving problems that occur in product development projects. This kind of creative dialogues has proven to be extremely useful for sharing tacit knowledge and creating a new perspective, because it aligns the mental models of the participants in the same direction, and thus benefiting from the experiences and knowledge of each other.

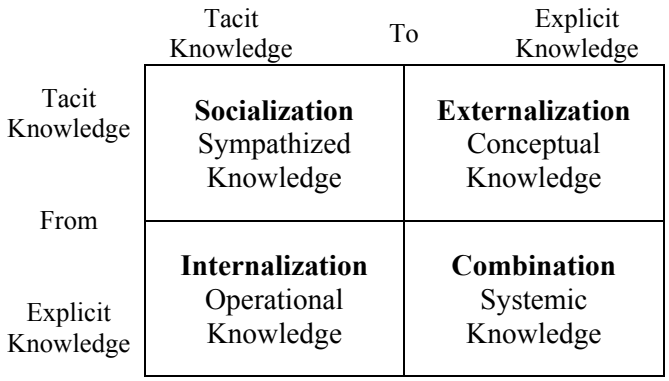

Figure 2.5: The four models of knowledge creation (source: [NT95], 72).

"*Externalization* is a process of articulating tacit knowledge into explicit concepts. It is a quintessential knowledge-creation process in that tacit knowledge becomes explicit, taking the shapes of metaphors, analogies, concepts, hypotheses, or models" [NT95]. While trying to convert a tacit concept into written facts, different individuals would choose various approaches to express their thoughts. The expressions are mostly subjective, inadequate, and inconsistent. This kind of discrepancy between the image and its expression, however, encourages reflection as well as interaction between individuals. For this reason, knowledge externalisation can be treated as the process of creating new explicit concepts from tacit knowledge; activated by dialogue or collective reflection. To perform this process successfully, the concepts of metaphor, analogy, and model are to be sequentially implemented. "Metaphor is a way of perceiving or intuitively understanding one thing by imagining another thing symbolically" [NT95]. Thus, metaphor is an important tool for generating a network of concepts, by means of relating concepts to each other. Contradictions, revealed by metaphor, are then harmonized by analogy. Analogy emphasizes the "commonness" of two concepts, soothing the inconsistencies, and bridging the gap between an image and its logical model. After all, the explicit concepts are to be modelled, in a consistent manner, and free of contradictions [NT95].

"*Combination* is the process of systemizing concepts into a knowledge system" [NT95]. This type of knowledge transfer combines pieces of explicit knowledge coming from multiple sources. Individuals exchange information through documents, meetings, telephone conversations, and computerized communication networks. The received information is then synthesized through sorting, adding, combining, and classification of explicit knowledge. This is the typical way of knowledge creation that takes place in trainings at schools [NT95].

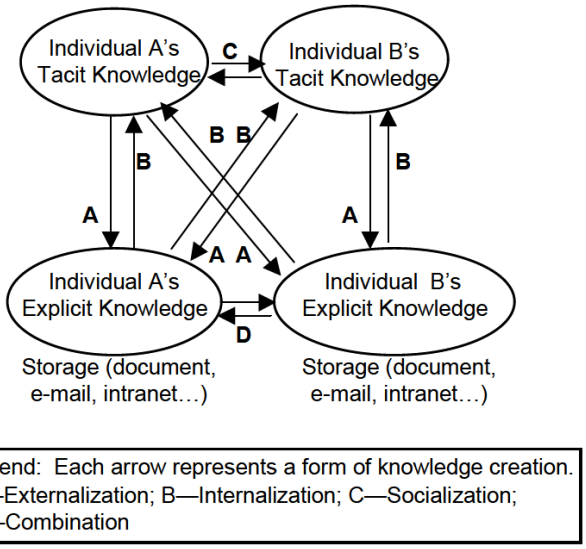

Figure 2.6: Relationships between the knowledge creation models (source: [AL01], 117).

"*Internalization* is a process of embodying explicit knowledge into tacit knowledge. It is closely related to "learning by doing". When experiences through socialization, externalization, and combination are internalized into individual's tacit knowledge bases in the form of shared mental models or technical know-how, they become valuable assets" [NT95]. "Internationalization is the process of experiencing knowledge through an explicit source" [PS04]. To transform explicit knowledge into tacit, it is to be verbalized or documented into documents, diagrams, or oral stories. While documenting, individuals internalize their experience thus enriching their tacit knowledge [NT95]. Thus, after viewing some video materials, and relating the new knowledge from the narrative with the

experiences, an employee may choose another way of acting he wouldn't otherwise have taken into account [PS04]. The interplay among the four knowledge creation models is shown in Figure 2.1 and can be useful to further demonstrate the process of knowledge creation in an organization in detail [AL01].

2.3.2 Knowledge Storage and Retrieval

Empirical studies demonstrate that parallel to the processes of knowledge creation and learning, organizations also forget, i.e. lose track of the knowledge acquired. For this reason, the storage, organization, and retrieval of organizational knowledge are also often referred to as *organizational memory*. Organizational memory, in its turn, constitutes an essential element of effective knowledge management in a company [AL01]. "Organizational memory includes knowledge residing in various component forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures, and processes and tacit knowledge acquired by individuals and networks of individuals" [AL01].

Knowledge Capturing and Codification
First step to storage and retrieval of knowledge is knowledge *capturing*. Tacit knowledge is generally difficult to capture in a codified form. Since, tacit knowledge is of great value for organizations, there exist numerous strategies aimed at preserving internal tacit knowledge of the employees in the enterprise. Simple mapping of knowledge to certain employees within an organization creates a kind of knowledge inventory. However, it does not necessarily provide availability of tacit knowledge at any time and at any place. The accessibility of knowledge depends largely on its owner. The necessity to capture tacit knowledge is therefore fostered by the threat of losing the entire company's knowledge asset, in case the experts leave the company [DP00].

A widely-spread strategy for protecting tacit knowledge in organizations is person-to-person transfer of knowledge through apprenticeship, workshops, and similar trainings. As a result, knowledge is distributed among multiple persons, avoiding its concentration in a single expert. Another strategy focuses upon transferring tacit knowledge (or at least some of its pieces) into explicit, often by means of IT [DP00]. The main activities of knowledge capture are scanning, organizing, and designing knowledge maps.

Scanning
Scanning usually combines electronic and human components. Electronic scanning captures relevant information from a particular source, if it is electronically available. Redundant or duplicate pieces of information are then automatically filtered out by the scanning system. "Human analysts, however, can add the most value to the scanning process by using their own knowledge of what is important to the company to provide context, interpretation, comparison, and condensation." In order this kind of individual scanning to be effective, the information should be shared within the organization. A successful example of scanning provides Toshiba, a Japanese electronics firm. Toshiba maintains a central team, constantly scanning a variety of external sources, like business, and industry publications, for relevant information. They produce then daily reports, deliver them to selected users, and finally index and archive them for later retrieval [PS04].

Organizing
Organizing aims at structuring the knowledge, accumulated through scanning, because only structured knowledge can be accessed rapidly. On the other hand, one should be careful while structuring the available knowledge, because "too much structure can effectively hide knowledge from employees whose mental models do not fit those of the organizer" [PS04], p. 290. Organization schemes are always subjective and never value-neutral, because they reflect the personal approach and position of the taxonomy creators.

While implementing a categorization scheme, the following issues are to be taken into account:

- The business function to be served
- The kind of individual knowledge behaviour to be optimized
- If the information originally contains a kind of natural categorization
- If the existing standardized scheme can be applied without violating the knowledge management objectives
- How can maintenance and updates be realized

Knowledge Maps
Mapping the knowledge that a human mind contains to paper or electronic media in its full complexity is almost impossible. Tacit knowledge incorporates much of the knower's over a long period of time collected experience, practical skills, and sometimes the individual's way of acting. These skills cannot be *effectively* codified in print. For this reason, in organizational context, the process of codifying tacit knowledge, the most valuable company's asset, is generally limited to pointing out experts and then making a reference to them, in case some questions arise [DP00].

Knowledge maps can have different forms, for example knowledge "Yellow Pages", or a database. However, their key principle is locating important knowledge within the firm and then creating a guide, where to find that. Knowledge maps contain references both- to people and databases. The greatest benefit of a good designed knowledge map is providing access to expertise sources that would otherwise be difficult to find. Another advantage is giving the big picture of the company's overall knowledge stock, which in its turn, points out the strengths and identifies gaps to be filled [DP00].

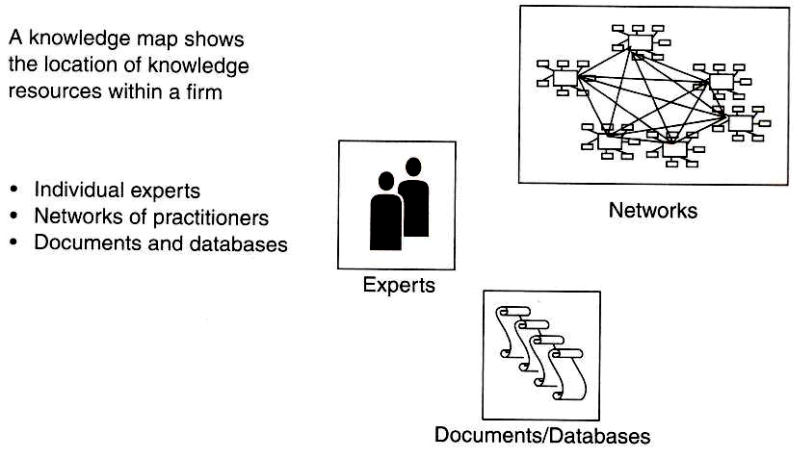

Figure 2.7: Contents of knowledge maps (source: [PS04], 292).

Knowledge mapping can be divided into physical, qualitative, process, functional, and conceptual mapping. *Physical mapping* is the way of mapping knowledge according to its physical location within the firm's information system, pointing directly to databases, file

servers, document management systems, and groupware resources. This classification is well-suited to help employees quickly find the desirable information; nonetheless, it requires some investigation of the company's IT infrastructure. *Qualitative mapping* matches information first of all by subject, not location; and deals primarily with processes, functions, and concepts. *Process mapping* maps the generalized business model to the knowledge contained in the organization. *Functional mapping* uses organizational charts and is not considered to be effective for sharing knowledge across functions [PS04]. "A good knowledge map goes beyond conventional department boundaries" [DP00], because employees' titles and job descriptions do not contain information about the availability of knowledge, i.e. if the person is willing and has time to share it with the others [DP00]. *Conceptual mapping* is the most useful way of organizing knowledge, its sufficient trade-off, however, is the complexity of designing, building, and maintaining. Conceptual maps concentrate on objects, like proposals, customers, and employees. These objects comprise information, stemming form various functional areas. This fact, in its turn, requires transfer of knowledge across the organization [PS04].

Knowledge Codification

After being captured in a certain data storage medium, like a sheet of paper or a database, that knowledge must be made available for the user. This means, it should be *codified* [PS04]. Codification "turns knowledge into a code (though not necessarily a computer code) to make it as organized, explicit, portable, and easy to understand as possible" [DP00].

In organizational context, codification transforms knowledge into accessible formats, so that it can be categorized, described, modelled and embedded into internal rules. This means, making knowledge available to those, who need it. New technologies provide an essential basis for knowledge codification and offer diverse approaches [DP00]. Davenport and Prusak distinguish four basic principles for successful knowledge codification:

- Decide the business goals the codified knowledge will serve.
- Identify knowledge existing in various forms appropriate to reaching these goals.
- Evaluate knowledge for usefulness and appropriateness for codification.
- Identify the appropriate medium for codification and distribution [DP00].

Knowledge codification and capture require first of all the business problem to be identified and clearly specified. Then, the knowledge to be captured is to be aligned with the main business goals, because the superior aim of knowledge codification is relevance, not completeness [PS04]. "Since the purpose of knowledge codification is to put knowledge in a usable form, the corporation needs some idea of what uses it has in mind" [DP00]. Application of knowledge capture and codification to a small part of a narrow specific problem domain can be very useful in terms of refinement and improvement of implementation methods; especially before applying the approaches across the whole organization [PS04].

Identifying and evaluating the existing knowledge is quite a complex and difficult process, because it is based on the subjective and individual mechanisms, i.e. how individuals perceive and make sense of their environment [PS04]. While determining the knowledge requirements, there are several important questions to be answered. Firstly, the sources of knowledge should be found out. To discover the sources of knowledge is obviously indispensable. Only knowing where knowledge resides makes it possible to get access to and evaluate it. Afterwards, in order to decide *whether* to do anything with the knowledge, one should evaluate how important it is.

And finally, in order to decide *what* to do with it, the type of knowledge is to be detected [DP00]. The choice of alternative means for codification and transmission of knowledge will depend on the richness and complexity of the knowledge captured [PS04].

2.3.3 Knowledge Transfer

An important process of knowledge management is that of knowledge transfer as shown in Figure 2.8. In an organization transfer of knowledge takes place at different levels: between individuals, from individuals to explicit sources, from individuals to groups, between groups, across groups, and from the group to the organization. Thus, the Figure 2.8 shows with the arrows labelled D the process of knowledge application, and with those labelled E the process of learning (new knowledge creation). The latter occurs while individuals apply knowledge and observe the outcomes. The arrows labelled F represent the transfer of an individual's explicit knowledge to group semantic memory. This takes place, for example, if individuals place their reports on a group server and make those available for the others. Another process, labelled G, shows the possible transfer from individual's tacit knowledge to group episodic memory. It is possible for individuals to learn from both- the group semantic and episodic memories [AL01].

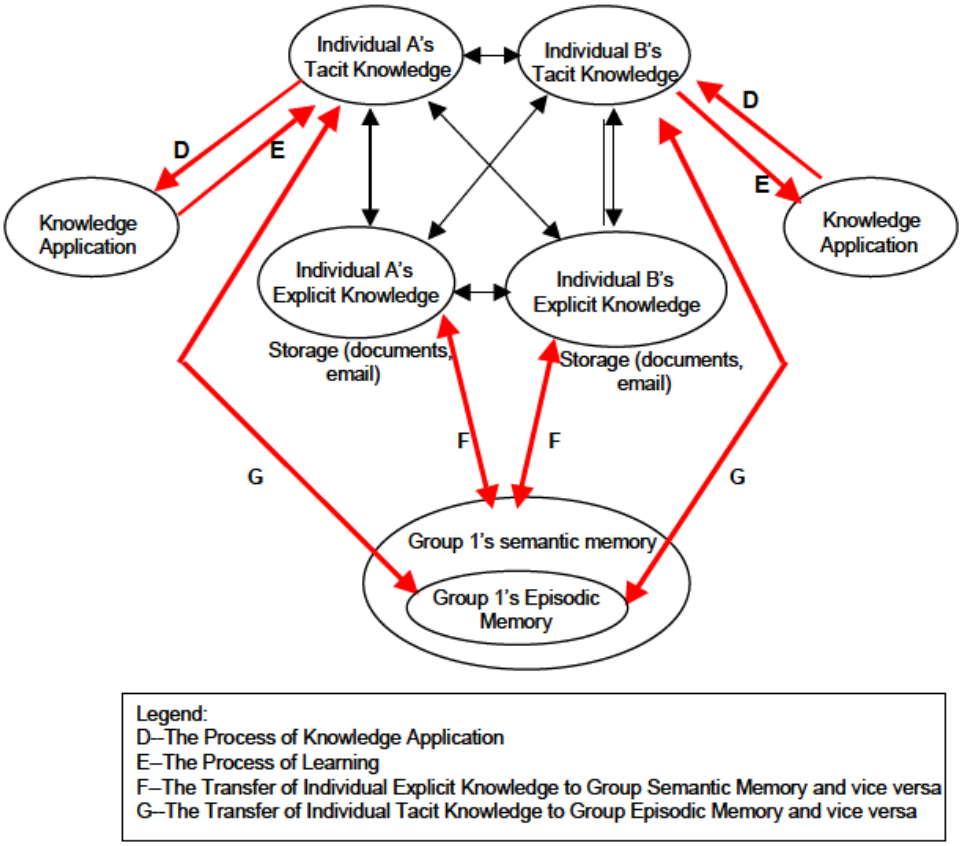

Figure 2.8: Knowledge transfer among individuals in a group (source: [AL01], 120).

An important process of knowledge management in an organization is "the transfer of knowledge to locations where it is needed and can be used" [AL01]. This is, however, not unproblematic since organizations often don't know what they know and have weak systems for locating knowledge residing in them [AL01]. The knowledge transfer in an organization is driven by communication processes and information flows.

Gupta and Dovindarajan [AL01] provide a concept of knowledge transfer in terms of five components:

1. "perceived value of the source unit's knowledge
2. motivational disposition of the source (i.e., their willingness to share knowledge)
3. existence and richness of transmission channels
4. motivational disposition of the receiving unit (i.e. their willingness to acquire knowledge from the source), and
5. the absorptive capacity of the receiving unit, defined as the ability not only to acquire and assimilate, but also to use knowledge" [AL01].

The fifth element, however, mostly depends on the recipient's cognitive capacity to receive stimuli [AL01]. The third element, knowledge transfer channels, considers being one of the most important ones. The knowledge transfer channels can be classified into informal or formal, and personal or impersonal [AL01]. *Informal* mechanisms as unscheduled meetings, informal seminars, or coffee break conversations are more effective in small organizations, because while facilitating socialization there is a threat of precluding wide dissemination. Furthermore, due to the absence of the formal coding, the knowledge transfer via informal channels can be less accurate. *Formal* mechanisms of knowledge transfer, as training sessions or plant tours are characterised by higher knowledge distribution, at the expense of creativity, however. *Personal* channels, e.g. apprenticeships, are relative effective for distributing highly context specific knowledge, while *impersonal* channels, as knowledge repositories, are most effective for knowledge that can be easily generalized [AL01].

2.3.4 Knowledge Application

The value of knowledge, as source of the competitive advantage considers first of all *knowledge application*, rather than the knowledge itself. The major means of integrating knowledge with the purpose of creating an organizational capability are directives, organizational routines, and self-contained task-terms [AL01]. *Directives* can be characterized as "specific set of rules, standards, procedures, and instructions developed through the conversion of specialists' tacit knowledge to explicit and integrated knowledge for efficient communication to non-specialists" [AL01]. Airplane safety checks and maintenance are a typical example of directives. *Organizational routines* concern "the development of task performance and coordination patterns, interaction protocols, and process specifications that allow individuals to apply and integrate their specialized knowledge without the need to articulate and communicate what they know to others" [AL01]. Routines vary from quite simple, like time patterned sequences, to relative complex, as for example a cockpit crew flying a passenger airplane. And finally, the third way of knowledge integration – creation of self-contained task terms- is applied in case the task complexity and uncertainty require forming groups of experts for solving the problem, instead of using directives specification and organizational routines [AL01].

3 Information Technology in Knowledge Management

The object of this thesis is document-centric collaboration at a supplier of integrated circuit products. For this reason, the research of this thesis is mainly concerned with systems available in the department of Product Development, as elements of the overall enterprise knowledge management system, supplying collaboration via leveraging document exchange and collaborative document maintenance. Therefore, the next sections of this chapter give an overview of relevant technologies supporting knowledge management in an organization and describe the information technologies used at the surveyed company. After that, the success factors of information systems are reviewed, and further hypotheses as basis for our questionnaire are deduced.

3.1 Information Systems

Information systems are often used as means of support for the most frequent processes of knowledge management and thus manage the data required in the context of knowledge management [Kr05]. Information systems are socio-technical systems, comprising human and technical components (subsystems) and are applied with the purpose of optimal provision of information and communication according to the appropriate business criteria [Kr05].

In order to develop information systems for support of knowledge management in an organization, it is important to understand the processes of knowledge acquisition, transfer, and application in the context of a company. On the one hand, knowledge management is related to the business processes because they generate and apply knowledge. On the other hand, there exist general processes of knowledge management, which are merged into uniform solutions for knowledge management. These encounter, for example, management of knowledge communities and management of knowledge repositories [Kr05].

Knowledge repositories are storage locations for explicit knowledge. They capture, manage and provide access to knowledge units. In this case, the knowledge units are documents, intranet-pages or business data contained in the corporate databases. The life-cycle of information resources allows to distinguish sub-processes of knowledge management, which can be further supported by information systems [Kr05].

The core functionalities of an information system supporting management of knowledge repositories include:

- Storage of knowledge units
- Provision of metadata for each of these knowledge units
- Version management
- Support of edit processes
- Indexing and categorization of the knowledge units with the purpose of enabling search within the contents of knowledge units
- Appropriate search function over the knowledge units [Kr05].

3.2 Document Nature

Speaking about knowledge units, documents are of our primary concern. From the viewpoint of a modern enterprise, there are two main forms of documents: paper-based and digital [AM03]. Thus, the symbols expressing an individual's thoughts are captured in a document in form of numerical data, text, drawings, sounds, etc. Further while speaking about documents, those in electronic form are meant.

The concept of a document in a fixed format is becoming nowadays more and more tenuous. Document description languages, as HTML and XML, for example, enable creation of documents with emphasis on their content and then allowing usage of different presentation forms and structures. The content of a document may also be continually changing. The process of content change can either be very dynamic, or less frequent, but still periodic (e.g. manuals and policy documents). For this reason, versioning helps to identify the successive representations of a document [AM03]. Management of documents, in its turn, requires additional documents, containing metadata. Metadata in forms of finding aids, catalogues, and data dictionaries ensures categorization and control over organizational documents. Some documents, also called compound, consist of several data format types (e.g. text, video and graphics). The compound relationship can also accept the form of linkages between various documents [AM03].

"The transience of the knowledge resource has lead to approaches to managing the intellectual capital of enterprises. These, in turn, have encouraged the knowledge management movement. Organizations that consider their knowledge workers to be a primary asset, want to retain at least some of the asset, seen to be tacit knowledge, as the employees move on to other organizations. They also wish to keep tapping this asset should the employee be moved to a different role within the organization. […] Once the knowledge is made explicit, often in documentary form, it becomes information until it can be assimilated as knowledge by those taking it in" [AM03]. Therefore, knowledge management "searches for ways of explicating how the tacit knowledge can be shared more widely within an enterprise" [AM03] by means of tutorials, apprenticeships, lessons-learned databases, etc. In so doing, tacit material can be written, to a certain extent, as information for learning. The writing, for example, can take form of a graphic representation of processes' workflows, a retrospective reporting, or oral tape recordings [AM03].

This examples show, that "if knowledge is to be managed, it is going to depend in great part upon recorded information" [AM03]. Consequently, "the various media, in which the information is recorded all fall within the purview of documents" [AM03] in the sense as described earlier in this section.

Asprey and Middleton, define *document* as "any medium that carries symbolic representation of human thought: recorded information on paper such as a form, report, directive, correspondence, book or map, or its equivalent created and used on another medium such as film or disk.

3.3 Information Systems for Document-Centric Collaboration

As noted before, the subject matter of the thesis is knowledge transfer among the knowledge workers of "Product Development" in terms of document-centric collaboration. We have chosen the term *document-centric collaboration* to shift the focus from document management in its pure form to collaboration, as the central point. Thus, we are concerned with collaboration, as means for sharing knowledge, in particular, however via leveraging document exchange and collaborative document maintenance.

Since, most of the state-of-the-art information systems in organizations are web-based, we are not only concerned with the traditional means of sharing work relevant documentation, as file share, for example, but rather the web-based platforms for collaborative document maintenance. There are, however some differences in the ways knowledge experts define these units of codified knowledge accessible both via file share, as well as over the web.

Some authors differentiate between the terms of a document and a document management system on the one hand, and set web-based technologies apart, as content and content management systems:
Krcmar, in his book "Information management" [Kr05], distinguishes between document and content management systems. The definition by Götzer, included in the book, describes document management as system for creation, collection, storage, management, retrieval, and further editing of documents [Kr05]. In contrast, a content management system focuses on editing contents on the Internet and intranet. The core function of a content management is thus to provide the separation between content and its representation on the web [Kr05].

Turban, McLean, and Wetherbe differentiate mainly between document management systems and web-based document management systems. According to their definition, *document management systems* "provide information in an electronic form to decision makers. "The full range of functions that a document management system may perform includes document identification, storage, and retrieval; tracking, version control; workflow management; and the presentation" [TMW04]. Further, these authors distinguish *web-based document management systems*. Their point of view is that, documents are viewed in many organizations as multimedia objects with hyperlinks, and therefore web-enabled document management systems make it easy to put information on intranets, since they convert documents to HTML. Additionally, they give an example of a web-based document management system, which can be used "not only for document storage and retrieval, but also for small-group collaboration and knowledge-sharing company-wide" [TMW04].

Thus it is quite obvious, that there is "a debate on whether the terms "document management" and "content management" mean the same thing with a variety of supporting and opposing views being expressed" [AM03]. Asprey and Middleton's point of view is that "a document is a container for information that may be represented in multiple formats, which includes "content" published as Web pages" [AM03]. Consequently, document and content management can be viewed as two sides of the same coin. Both terms deal with knowledge dissemination in an organization and in both cases the back-end functionality is much more the same. The primarily differences are in "how the authors interact with the development of documents and content, and the methods by which content is deployed (or published)" [AM03].

Therefore, after their research of the capabilities and opportunities of information systems, created for managing documents and Web content, Asprey and Middleton propose their integrative planning model, called Integrative Document and Content Management (IDCM), for the development and implementation of solutions concerning both document and Web content management [AM03]. According to it, document management implies control of documents through the stages of their life-cycle, also called continuum. While speaking about Web content management, the digital objects carrying the content can be regarded as documents [AM03]. These documents might be the word-processed ones; files marked up according to HTML, or XML; digital spreadsheets; sound or video files, or image files. "They too pass through stages from creation to destruction or archiving, and need to be organized and managed for access and retrieval" [AM03]. "If an enterprise is able to manage the various stages of design, creation, storage and retrieval, and disposal of documents, then it is contributing to the management of its own knowledge. The more effectively this can be done, the better that knowledge documented as information may be reutilized" [AM03].

In course of the further research, we join us the viewpoint of Asprey and Middleton, and consider the notions of content and document as synonyms. The term content management is further used as a synonym of a web-based document management system.

Collaboration

"*Collaboration* occurs when two or more people work together to achieve a common goal, result, or work product. When collaboration is effective, the results of the group are greater than could be produced by any of the individuals working alone. Collaboration involves coordination and communication, but it is greater than either of those" [Kr08], p. 31. The two essential factors enabling the group of knowledge workers to produce a greater output than single persons could accomplish working individually are *feedback* and *iteration*. "In a collaborative environment, team members review each others' work product and revise that product as a result "[Kr08], p. 31. The whole process proceeds in a series of these steps, or iterations in which the team members learn from each other and influence the work product (e.g. a document).

Kroenke [Kr08] distinguishes three crucial factors driving successful collaboration: communication, content management, and workflow control.

While speaking about *communication* in a collaborative group of knowledge workers, the ability to give and receive critical feedback is an essential factor. Feedback helps to improve one's contributions based on the criticism received. With respect to the time perspective, communication can be classified, into synchronous and asynchronous. *Synchronous* communication occurs when all team members meet at the same time, for example during a face-to-face team meeting or conference calls. *Asynchronous* communication occurs if the collaborative work does not take place at the same time. The most widely- spread means of asynchronous communication is e-mail [Kr08].

The second driver of collaboration performance, as described by Kroenke [Kr08], is content management. In his book, the content management system is defined as a system for sharing different types of documents (the term "document" is therefore used as synonymous to "content"). Further, Kroenke distinguishes three types of content management control: absence of control, version management and version control (see Figure 3.1).

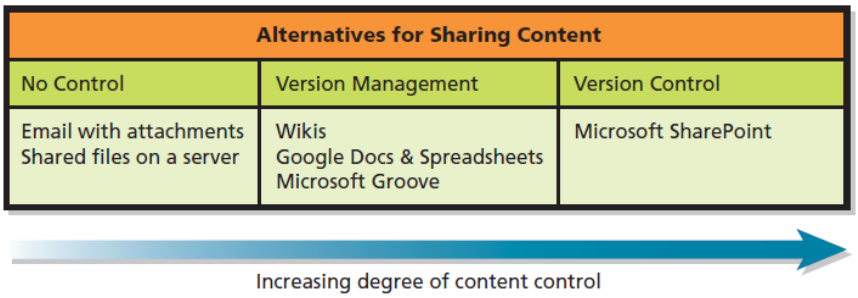

Figure 3.1: Information technology for sharing content (source: [Kr08], 36).

Control

A well-known way of sharing content is via e-mail attachments. It is, however, related to a number of disadvantages. Firstly, employees overloaded with e-mails may not notice an important e-mail or ignore the attachment. Secondly, if an e-mail attachment is edited by several employees, there is a high probability that the changes are not going to be merged together, so that there will finally exist numerous incompatible versions of the same document [Kr08].

Storing shared files on a server means, in the context of collaboration, that team members put documents on the server, these can be further downloaded and edited by other team members and uploaded back after the changes have been made. Storing documents on a corporate file share is considered to be better than exchanging e-mails only, because the documents have then a single storage location. The disadvantage of file shares is, however, there are no additional control mechanisms for administrating the content versioning and thus ensuring its consistency [Kr08].

Version Management

"Systems that provide *version management* track changes to documents and provide features and functions to accommodate concurrent work. The means by which this is done depends on the particular system used" [Kr08].
The simplest version management systems are wikis. A wiki is a shared knowledge base in which the content is contributed and further managed by the users. Collaborative teams in an organization can use the wiki technology to create knowledge repositories. Each of the new wiki entries contains information about its author, and the date of creation. After an entry has been modified, the editor's name and modification date are automatically saved [Kr08].

Version Control

"Version-management systems improve the tracking of shared content and potentially eliminate problems caused by concurrent document access. They do not, however, provide version control. They do not limit the actions that can be taken by any particular user, and they do not give control over the changes to documents to particular users" [Kr08].

Version-control systems offer the possibility to provide each team member with a set of permissions. Shared documents are thus placed into shared directories, also called libraries. Each team member can be given different kinds of permissions (read-only, read and edit, etc.) for each of the libraries. Another important feature is the check-in/ check-out mechanism controlling the consistency of document modifications. A checked-out document (a document which is currently being edited), for example, cannot be obtained for the purpose of modification by another user until it hasn't been checked-in again [Kr08].

There exists a variety of version-control applications. Microsoft SharePoint (also used in the surveyed company) is one of the most widely spread ones for general business use [Kr08]. Besides the document check-in/check-out, it includes many collaboration features and functions. "In addition to support for document libraries and lists, it has features for creating and managing the following team work products: surveys, discussion forums, wikis, member blogs, member Web sites, and workflow" [Kr08].

3.4 Collaboration Technologies: Status Quo

This section gives an overview of the technologies supporting document-centric collaboration at the surveyed company. Additionally, the main issues relevant for the further questionnaire survey are identified.

E-mail
The most widely-spread digital documents, used in every organization, are, as defined by Asprey and Middleton [AM03], e-mails and e-mail attachments. E-mails can include one or many documents as attachments, or shortcuts to documents. They may also contain hyperlinks to documents stored on corporate file shares, intranet, or Internet. An e-mail can be addressed to one or many recipients and additionally have various features activated, as importance, tracking options, delivery options, etc [AM03].

Knowledge and document exchange by means of e-mail is essential for the organization we conduct our survey in. One of the problem fields, as reported by the employees in the preparatory phase of our survey, is that they are often overloaded with e-mails. Therefore e-mail will be to a certain degree further examined in our survey.

File Share
File Share, usually accessed with Windows Explorer, is one of the oldest systems for storing data files in the surveyed company. Each Department has its own File Share, further segmented into Team domains. File Share contains project related, administrative and organizational information, and sometimes technical know-how. Therefore, it is mostly used for storing data files of the standard Word, Excel, PowerPoint, Adobe Acrobat and Image formats. The special engineering CAD drawings are administrated extra in the UNIX development environment and are not further taken into consideration.

After years of File Share usage, it is now planned to be completely migrated to the MS SharePoint portal. The main reasons for the migration, as perceived by the management of the surveyed company, are unsatisfactory response times from remote sites, access administration problems, and the poor search function. In terms of latency, accessing the File Share locally is quite efficient; however the remote access does not offer the desirable performance. What concerns the implementation of the search function, File Share provides only simple searching by file names, while full text search is not available.

Intranet
"The concept of the corporate portal intranet is a rich, full function, ubiquitous environment for information dissemination, communication, and application sharing, built on top of open technology standards" [Co01]. Intranets are corporate computer networks composed of various network devices, systems, and services supporting Internet as well as business applications" [Ho97].

Corporate Intranet of the surveyed company provides a web-site interface for accessing information concerning overall company issues and serves as a global information pool. On the one hand, it contains information about the company's structural organization and on the other hand comprises data specific to each department. Thus, it serves as the main entry page to the corporate information resources. The intranet search function differentiates between searching for information in English or German, and shows additionally the relevance degree of the results. However, neither advanced search features, nor helpful after-search results handling are implemented. Since, it is not possible to limit the query scope the search results usually contain information entries from all departments.

Wiki

The Product Development Wiki is based upon the MediaWiki technology. MediaWiki is a free Wiki software package originally created for Wikipedia [Medi08] . The aim of introducing the Product Development Wiki as an additional means for knowledge management support is incremental creation of a know-how database on product development topics as well as facilitating and improving knowledge exchange within the Product Development department. Thus, for example, instead of answering just the same question many times, an expert can create an appropriate Wiki article, that will be available for his/her colleagues all over the world. Since Wiki is intended to be a knowledge database, all articles are sorted by knowledge domains, rather than organizational units.

As an important condition for a well-functioning knowledge exchange portal, adding and editing text information in Wiki is quite easy and uncomplicated. Enriching the articles with images requires, however, some more effort, but isn't particularly difficult as well. Furthermore, Wiki pages support version history, which shows how the content evolves. If a mistake was made, the content can be rolled back to one of the previous versions.

The department's Wiki includes the following features of advantage:

- Version control and e-mail notifications of changes
- Accessibility with numerous Internet browsers (e.g. Firefox under UNIX)
- Possibility to use one's favourite text editor for creating and changing content
- HTML syntax with numerous shortcuts facilitates adding contents
- Full text search availability
- Can be accessed and edited by any employee world wide
- Integration of .gif and .jpg data into articles.

There are however, also some aspects in Wiki which generally need to be improved in the future:

- The process of adding graphical data to the articles quite complicated
- Advanced search not implemented
- No additional after search options, like e.g. sorting, filtering the search results
- Search results include no relevance degrees.

The articles in Wiki are written, edited and updated by the product development employees all over the company. In general they concern technical know-how as well as best practices. By the time of the thesis compilation Wiki has counted more than 1200 articles and 800 images.

As already mentioned above, Wiki implements full text search. Its greatest drawback, however, is the post search manipulation of the search results. The hit lists do not provide

information about the relevance. Therefore, in order to increase knowledge accessibility, the search function implementation needs to be refined.

One of the Wiki articles, also examined later in our survey, is the **Expert Teams List**. It contains names of experts in different areas, sometimes also linked to his/her homepage in Intranet. The purpose of the Expert Teams List is to help employees quickly define experts in different areas of Product Development, and thus facilitate explicit knowledge exchange between those.

Corporate SharePoint Portal

Corporate SharePoint portal is based upon the SharePoint Server of Microsoft. MS SharePoint provides organizations with an e-Collaboration platform for sharing information and working together in teams. A SharePoint site offers tools and workplaces that serve to communicate with team members, track projects, coordinate deadlines and collaboratively create and edit documents [Micr08] . The SharePoint Server is large-scale commercial-off-the-shelf software that can be subsequently customized with respect to the individual needs of each customer.

The SharePoint portal can be accessed via an Internet browser like Internet Explorer or Firefox (thus, the access is not restricted to Microsoft environment) and is designed for managing team and project related information. It consists of different site templates, which can be then at any time added and further refined. The variety of available site templates depends, however, on the current version of the MS SharePoint Server. The five general templates available at the corporate SharePoint portal of the surveyed company are: the SharePoint TeamSite, Meeting Workspace, Document Workspace, and the Blog site template. The range of functions for each template can be flexibly expanded and changed due to the concept of Web Parts.

Web Parts is an integrated set of server-side controls that run inside the context of Web Part pages within a SharePoint Services site. They are the “building blocks” of pages that enable end users to modify the content, appearance, and behaviour of Web pages directly from a browser. The modifications can either be applied to all users on the site or to individual users [Msdn08]. Web Parts include such content templates as lists, libraries, surveys, and discussions. The built-in SharePoint Lists, for example, can display announcements, links, contacts, calendar functionality, and tasks.

Since, the main concern of the thesis is document-centric collaboration, it is particularly important to comment on the Library content template. The SharePoint Libraries provide possibilities for uploading, storing, and retrieving data files of different formats as well as different confidentiality classes. In contrast to the traditional File Share, the SharePoint Libraries allow adding metadata, what makes it is much easier to find the relevant documents. Also full text search is an important improvement vs. traditional File Share. The document collections, based on the Library templates, also allow a document to be edited collaboratively- one simply needs to check out the data file he/she wants to change and check it in again after the necessary modifications have been made. In addition, the SharePoint Libraries also support version tracking, so that none of the older document versions gets lost [Micr08] .

There is a wide range of SharePoint library templates that can be created to arrange documents in groups depending on their contents and purpose:

- *Documents*: Storing and managing documents
- *Forms*: Storing XML-based data entry forms, generating workflows via MS Info Path
- *Pictures*: Storing images, view thumbnails, download images and send images to MS Office applications
- *Slide Library*: Sharing and reusing MS PowerPoint slides in a central location
- *Translation management*: workflow integrated management of document translations

SharePoint Knowledge Library

The largest collection of Product Development relevant documents is contained in the SharePoint Knowledge Library. It serves as a library for the corporate proprietary technical data. One can find there information concerning:

- Checklists and guidelines
- Circuit descriptions
- Design analysis information
- Technical reports and specifications
- Training material

Since, the SharePoint PD Knowledge Library is part of the overall SharePoint knowledge management platform it benefits from the uniformly implemented SharePoint search and data access functionalities. All the documents contained in the PD Knowledge Library can be accessed via an Internet interface. While uploading data files into the Knowledge Library via an upload menu, users have to specify the appropriate metadata. This allows the document to be easily found later. In general, while trying to find the desirable document, users can choose between three search options: full text search, metadata search, and advanced metadata search. Simple metadata search implies the searching for documents by categories like name, title, creator, description, site of relevance, topic and technology. Advanced metadata search performs Boolean search on documents, additionally using comparison methods as “contains”, “begins with”, “(not) equal to”, “greater than”, “less than or equal to”, “is null”, etc.

The SharePoint e-Collaboration platform seamlessly connects employees and information on virtual workspaces. Furthermore, it incorporates numerous features that go beyond a simple data base functionality. Thus, the portal provides different types of site templates that can be used to create sites and therefore improve knowledge sharing within teams and project work groups.

Project TeamSite

One of the most significant tools for knowledge sharing at Product Development is the Project TeamSite, based on the SharePoint TeamSite template. The Project TeamSite serves as the central information and knowledge sharing platform and is aimed at facilitating project team work. It is first of all aimed at managing projects and document-related tasks. It can be used by team members in their daily work to create and manage documents, track issues and tasks, and share links and contacts. By using the Project TeamSite as a collaborative workspace, teams can become more productive and more efficient, since the whole relevant information is then located and can be further managed on a single site. The Project TeamSite includes tools for aggregating various team relevant items: shared documents, announcements list, meeting calendar, team discussion list, tasks, and contact data [Micr08] . It also offers the possibility to create Document Workspace sub-sites within the Project TeamSite for editing documents on special topics in smaller groups. Besides, team members can choose from

various ways of sharing information. Thus, for example, users can exchange files directly out of Microsoft Office applications to coordinate appointments, or work collaboratively with other team members on documents, or participate in online discussions. The seamless integration in MS Office additionally enables direct access to SharePoint out of all common Office applications (e.g. Word, Excel, PowerPoint, Project). Moreover, it is possible to take document libraries offline in MS Outlook and thus view and edit documents while not being connected to the network (but this is limited to Office 2007 and therefore not usable within the surveyed company).

Beside file sharing and information aggregation, the TeamSite supports the full text search function, document versioning, and workflows. As a rule, the SharePoint TeamSite is used in Product Development for accessing the following types of information:

- Project specific information
- Project related administrative and organizational information
- Document references
- Checklists

What concerns document-centric collaboration issues, SharePoint has following differences, as compared to the standard File Share:

Advantages SharePoint

- Comfortable access via an Internet browser (UNIX compatible, not limited to Microsoft)
- Better performance for remote access via WAN
- Full text search for all standard document types
- Advanced search option
- Metadata search and advanced metadata search
- Search results sorting by relevance
- Versioning
- Check-in/ check-out mechanism for managing collaborative document editing
- Easy access right management: automatically maintained using Active Directory Secure Groups
- Additional web-collaboration features (e.g. blogs, wikis)
- Cross-referencing of information via Shared Favourites on personal MySites

Advantages File Share

- Familiar to all
- Better performance for local access compared to SharePoint
- Placing references is easier than in SharePoint document libraries
- Cheaper than SharePoint

Blog (Weblog)

Blogs (a contraction of "Web log") are "pages with reverse chronological sequences of dated entries, usually containing a persistent sidebar containing profile information (and often other blogs read by the author) and usually maintained and published by one of the common variants of public-domain blog software" [Ku03]. Blogging is a wide-spread practice of publishing and sharing personal knowledge and information on the web, mainly in form of textual entries [Le07]. The contents of the blog entries are usually supplied by a single individual, or sometimes a group of individuals. Besides text, also images, video and audio contents can be embedded into a blog entry [Le07].

In recent years, blogs have increased greatly in their popularity, and thus are considered to be "an electronic communications powerhouse that is likely to have greater impact on business communications and corporate reputations than e-mail, instant messaging, and traditional marketing-oriented web-sites combined" [Fl06]. In spite of their popularity, blogs are, however, not necessarily an appropriate communication tool equally well-suited for every organization. Therefore, despite the personal blogging is booming, the business community is much slower to adopt them as a standard communication tool [Fl06]. A business blog, hosted by an employer, gives employees a possibility to comment both positively and negatively on the organization's people and products. Another issue is who is going to read the blog. The majority of business blogs attract a significantly small audience, mainly consisting of colleagues, customers or friends, who either have a personal interest in the topic, appreciate the blogger's viewpoint, or simply enjoy his or her writing style [Fl06].

In the company we research, there's currently only one active blogger regularly posting his blog entries addressed at the employees of the Product Development department. Despite this low use rate, we still include the blog in our survey due to the emerging popularity of Enterprise 2.0 tools.

Survey Implications

To ensure that the whole spectrum of systems relevant for document-centric collaboration will be covered by the survey, all of the systems mentioned above are included to a greater or smaller degree in the questionnaire survey. Thus, they are:

- E-mail,
- Intranet,
- File Share,
- Wiki, and Expert Teams List in Wiki,
- Corporate SharePoint Portal: Project TeamSite and Knowledge Library,
- Blog.

Since File Share, Intranet, Wiki and SharePoint Portal, however, are considered to play a more sufficient role in the document-centric collaboration of the Product Development department the survey will try to study these systems in a more detail.

While collecting information for our survey, a meeting with management representatives responsible for effective document management in the department was held. In course of the meeting, a study conducted one year ago in the surveyed company by a well-known consulting agency was mentioned. According to its results much of employees' working time was spent on information queries, while information and knowledge were preferably exchanged via one-to-one requests or in team meetings, instead of formal documentation.

For this reason, we include team meetings and direct contact to colleagues into the survey to check to what degree these alternative means of knowledge exchange are preferred over the computer supported tools and platforms listed above.

3.5 Critical Success Factors

In order to be able to evaluate the current usage of systems in an organization as well as their user acceptance, it is essentially important to correctly describe the success factors of business information systems. These aspects will serve later to define the variables for the questionnaire survey. Thus, the definitions of the critical success factors of information systems for knowledge management support are based upon the DeLone and McLean Model of information systems success (D&M IS Success Model) [DM02], [DM03] and the knowledge management success model by Kulkarni, Ravindran, and Freeze [KRF06].

3.5.1 DeLone and McLean IS Success Model

The original D&M IS success model based on the process model of information systems by Shannon and Weaver was firstly introduced 1992. The model included a taxonomy and an interactive model as frameworks for conceptualizing and operationalizing IS success. The wide popularity and numerous references and modifications by other authors which followed later encouraged DeLone and McLean to further review and modify their original model of IS success. Thus, in 2002 came a reformulated and in 2003 an enhanced ten-year update versions of their model [DM02], [DM03].

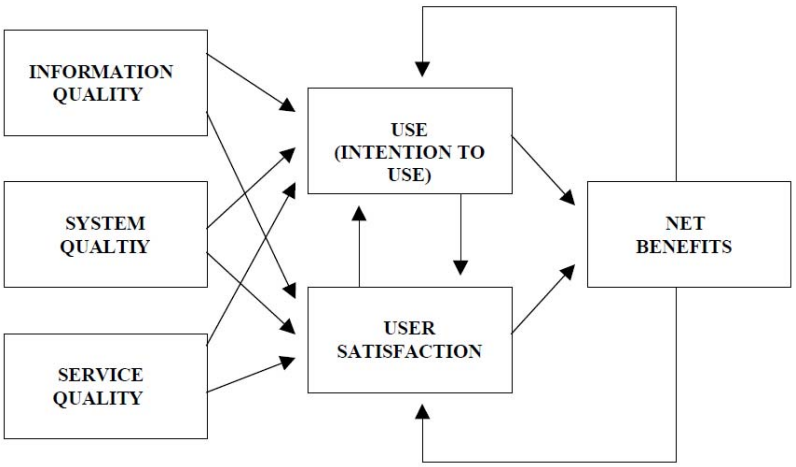

Figure 3.2: Updated D&M IS success model (source: [DM02], 9).

In the updated D&M IS success model (see Figure 3.2) there are three major dimensions of IS quality: information quality, systems quality, and service quality. Each of these components is to be measured or controlled for separately, because singularly or jointly they subsequently affect use and user satisfaction [DM02]. *Information quality* can be measured in terms of accuracy, timeliness, completeness, relevance, and consistency [DM03]. *System quality* characteristics to be taken into account, for example while concerning Internet based e-commerce applications, can be usability, availability, reliability, adaptability, and response time (e.g., download time) [DM03]. *Service quality* deals with the overall support delivered by the service provider. It considers such aspects as assurance, empathy, and responsiveness and is particularly important in branches, like e-commerce, where customer service is crucial [DM03].

Use and user satisfaction are usually closely interrelated [DM02]. In case of information systems with web-interface, for example, *usage* measures everything- from a visit to a Web site to site navigation, information retrieval, and other transactions. The term *user satisfaction* is an essential aspect and measures the user's experiences with the information system [DM03]. Thus, in a process sense, use must precede user satisfaction, while on the other hand, positive usage experiences cause greater user satisfaction. Increased user satisfaction, in its turn, will similarly lead to increased intention to use and the use itself. As a result of use and user satisfaction, certain net benefits are likely to occur. The assumption is that *net benefits* positively influence an information system or a service, since they reinforce and facilitate further use as well as user satisfaction. The lack of positive net benefit, however, is likely to have lower use rates as consequence and possibly even the discontinuance of the system itself [DM02]. Thus, for example, corporate wikis and content sites "gain momentum when new visitors discover and contribute high-quality content, which in turn makes the sites worthwhile for yet more newcomers" [Bu07]. Further net-benefits help user to save their time and effort and thus again increase user satisfaction and intention to use [DM03].

3.5.2 Knowledge Management Success Model

Since numerous information systems considered in our survey finally contribute to the overall knowledge management system of the organisation (in our case, - its organizational unit- the department of Product Development), we have considered the *knowledge management success model* by Kulkarni, Ravindran, and Freeze [KRF06] while designing our survey (see Figure 3.3).

This KM success model was derived from the updated D&M IS success model. The essential conceptual differences, however, are firstly the move from *information* to *knowledge*, and secondly from a single information system to the knowledge management system implementation. These differences consequently affect the elements of the model as well as the relationships between those [KRF06]. A *knowledge management system*, in the context of this model, is "any system that automates the input, storage, transfer, and retrieval of knowledge. These may include contextual taxonomy for knowledge (meta knowledge), systems for capturing various types of knowledge, systems for classifying knowledge documents, systems for locating the relevant experts, technology to facilitate sharing of expertise (groupware, video conferencing, and so on), repositories for structured as well as unstructured information, and so on" [KRF06].

Further, the term *knowledge sharing* is used in the model to denote both contributing to and using available knowledge. Accordingly, knowledge sharing serves as an appropriate and practical intermediate measure of knowledge management success. Thus, the perceived usefulness of knowledge sharing is an overall measure of the KM initiatives, not tied to a single system [KRF06].

The category of *knowledge content quality* represents the notion of knowledge quality and comprises the quality of information residing in company's electronic repositories, documents, reports, and so forth. It considers aspects as relevance, timeliness, applicability, accuracy, presentation formats, extent of insight, availability of expertise and advice, and so on [KRF06].

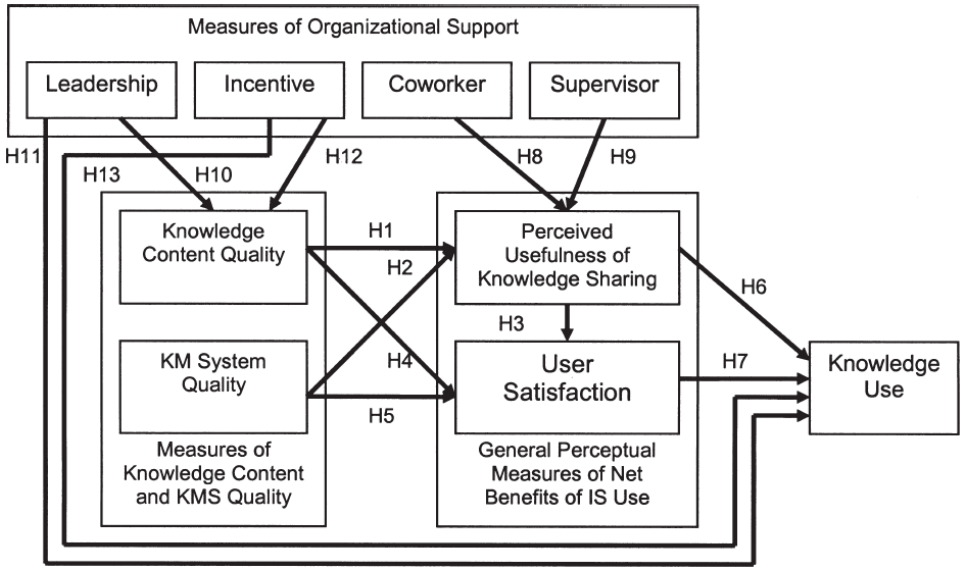

Figure 3.3: Knowledge management success model (source: [KRF06], 314).

Knowledge system quality is the measure of how well the KM systems support and enhance knowledge management related activities. It is aimed at capturing multiple dimensions of the knowledge management system's quality. Therefore, this parameter deals with such aspects, as accessibility (from anywhere/anytime), ease of use for retrieval as well as input, output flexibility to meet the needs, search capability, documentation, etc [KRF06].
User satisfaction is "the subjective evaluation of the various outcomes due to the knowledge sharing/retrieval capabilities existing within the organization, including ease of getting the information/ knowledge needed, satisfaction with the access to knowledge, adequacy of the information/knowledge to meet one's demands" [KRF06].

Information technology is an essential enabler of knowledge management initiatives, since it allows knowledge workers to share, store, and retrieve documents relevant for their work. Despite this, the total success of the overall knowledge management requires a complete solution, also encompassing the human factor besides IT. A mere IT-based knowledge management system providing access to knowledge repositories does not guarantee that knowledge workers are going to make their knowledge available for the others there or retrieve the knowledge it contains [KRF06]. For this reason the KM success model by Kulkarni, Ravindran, and Freeze also includes the *organizational support element*, which includes such constituents as supervisor, co-worker, leadership, and incentive. The support of supervisors and co-workers is the measure of the encouragement degree provided to the knowledge worker in knowledge sharing solutions. It also considers the openness of communication, opportunity for face-to-face and computer supported meetings with the purpose of knowledge sharing. Leadership is a subjective measure of commitment to knowledge management by the top levels of management. Incentive refers to the recognition of efforts by knowledge workers for facilitating knowledge sharing initiatives [KRF06].

3.5.3 Critical Success Factors: Conclusion

As described in the previous sections, there exist different reasons accounting for users' satisfaction with information and knowledge systems. According to DeLone and McLean's IS success model [DM03], success of an information system is strongly influenced by the factors as:

- System quality,
- Information quality,
- Use as well as intention to use, and
- User satisfaction.

The knowledge management success model by Kulkarni, Ravindran, and Freeze [KRF06] makes emphasis on knowledge management in an organization. This model makes emphasis on the overall knowledge management success, not a single isolated information system. The essential factors contributing to KM success as differentiated in it are:

- KM system quality
- Knowledge content quality
- User satisfaction
- Knowledge use, and
- Measures of organizational support.

Since we are considered with document-centric collaboration, it makes sense additionally to take into account Gupta and Dovindarajan's [AL01] point of view on the concept of knowledge transfer and its components:

- Perceived value of the knowledge sources
- Willingness to share knowledge (motivation of knowledge providers)
- Existence and richness of transmission channels
- Willingness to acquire knowledge (motivation of knowledge users)
- Ability to use knowledge [AL01], p. 119-120.

Due to the fact that our survey goes beyond mere evaluation of isolated information systems, and rather focuses on the collaboration side of knowledge exchange, we consider all these three concepts. Merged together, they yield following *critical factors* of successful computer supported document-centric collaboration:

- System quality
- Knowledge content quality
- User Satisfaction
- System use and intention to use
- Motivation to contribute one's own and use available knowledge

Survey Implication:
Taking into account the critical success factors discussed in this chapter, the following aspects are going to be examined in the survey:

- Quality of relevant systems
- Quality of the knowledge contents contained in relevant systems
- User Satisfaction
- Usage of relevant systems
- Motivation of knowledge workers to share their know-how via collaboration platforms.

3.6 Research Questions

Within the preparatory works for our study, we had a number of discussions with management representatives of the surveyed department, who are responsible for document management at the department. The purpose of these discussions was to define main issues for our research. Thus, we have collected a number of questions the stakeholders would like to have answered by our questionnaire survey.

First of all, they are interested to know how satisfied (or dissatisfied) with the status quo of document-centric collaboration the employees are.

- ⇨ **Research Question 1**: Evaluate general user satisfaction with knowledge management at the department.

Secondly, an important issue at the department is that, according to the viewpoints of our contact persons, best practices and know-how acquired in previous projects get lost and cannot be re-used on new projects. Our contact persons at the department wonder if this problem results:

- because employees are not fond of documenting their best-practices and thus there no documents with such contents, or
- because employees do not know where they can find this kind of information and thus use wrong systems for their search?

- ⇨ **Research Question 2:** Evaluate how likely the employees are to document their best practices and know-how.
- ⇨ **Research Question 3:** Evaluate use intensity of available means for searching for information and knowledge.
- ⇨ **Research Question 4:** Evaluate if there are sufficient differences between information allocation and the search habits of employees.

Further, our contact persons assume that the existing systems for sharing knowledge among employees need to be improved in terms of content structure, as well as knowledge search and knowledge upload functionalities. According to their experiences, it is often difficult to find out where to store which data. Further they presume that the systems need to be improved in terms of performance and usability.

- ⇨ **Research Question 5:** Evaluate performance aspects as perceived by users
- ⇨ **Research Question 6:** Evaluate user-friendliness as perceived by users.
- ⇨ **Research Question 7:** Evaluate functionality related to content search as perceived by users.
- ⇨ **Research Question 8:** Evaluate functionality related to content provision as perceived by users.
- ⇨ **Research Question 9:** Evaluate systems in terms of content structure as perceived by users.
- ⇨ **Research Question 10:** Evaluate role of the department's Wiki for organizational knowledge management.

3.6.1 Parameters to be examined

The research questions defined are going to be evaluated on basis of the success factors described in the previous sections. Each of the success factors includes a number of parameters which contribute to its overall value. As next, it is important to define which of the parameters will be taken into account for measuring the success factors in.

User Satisfaction

Speaking about the number of the information systems users in an organization it also makes sense to consider besides the user satisfaction another characteristic aspect. According to Reichheld [RK96], a useful predictor of growth is willingness to recommend a product or service to someone else. According to his studies of the relationship between customer satisfaction and sales growth, the only reliable indicator of the future customer behaviour is the willingness of customers to recommend a product to their friends, family, and colleagues, since it indicates the customer's loyalty on the one hand, and puts the recommender's reputation on the line, on the other hand. Reichheld's research shows that satisfaction rates lack a consistently demonstrable connection to actual customer behaviour and growth, and it is generally difficult to recognize a strong correlation between high customer satisfaction scores and outstanding sales growth. Thus, customer satisfaction demonstrates the status quo, while the willingness to recommend is stronger related to predict the situation in the future [RK96].

Survey Implication:

Since we are not only considered with the status quo of users' satisfaction, but also are interested in its future development, the survey should consider the issues of:

- User satisfaction
- User recommendation

System Quality

Speaking about *system quality* DeLone and McLean [DM03] consider such components as adaptability, availability, reliability, response time, and usability. Kulkarny, Ravindran, and Freeze [KRF06] refer in this case accessibility (from anywhere and anytime), ease of use for retrieval and input, output flexibility and search capability. During our meeting with management representatives at the surveyed company possible weaknesses of the available systems were discussed. Thus, according to their opinion, the possible problem fields could be remote access latency, search function implementation, and the functionality for uploading data. As a result, the following research hypothesis has emerged.

Survey Implication:

Taking into account the defined research questions, the potential problem fields to be examined are:

- Performance aspects
- General user interface
- Content search functionality
- Content provision functionality
- Content structure

Use and Intention to Use

Knowledge contained in a KMS "can be considered to be a public good, an asset available to all members of the community or organization regardless of whether the members contributed to its constitution" [Ma08]. Unfortunately, a fundamental issue concerning all public goods is the so-called "fee rider problem". The *free rider problem* means that a number of individuals utilize the public good without fair contribution of their own. Thorn and Connolly [Ma08] apply this theory to sharing knowledge via knowledge management systems. And their assertion is that information in a shared database will generally be undersupplied, similar to other public goods, because individuals are not likely to share their valuable, personally held information via knowledge management systems [Ma08]. Similar conclusion was done by McKinsey in their survey of online communities, which showed that just 3 to 6 percent of the membership added 75 percent of the videos available for the download [Bu07].

Since knowledge exchange process is threatened by the "free rider problem", as discussed above, another hypothesis we would like to test through the survey is whether there exists a great difference between the amounts of knowledge contributors to the common knowledge pool, and those who use the available knowledge resources.

Survey Implication:

To examine the issues described as well as the Research Question 2, the following items are to be analysed in course of the survey:

- Use intensity of available means for knowledge exchange:
  - Rates of knowledge content provision
  - Rates of knowledge content search / use

In order to be able to answer the Research Question 4, the following aspects should be evaluated:

- Differenced between "official" information allocation and search habits of employees.

Knowledge Content Quality

What concerns information or knowledge content quality, DeLone and McLean [DM03] suggest to take such aspects into consideration as completeness, ease of understanding, personalization, relevance, security. The knowledge management success model [KRF06] differentiates, for example, relevance, accuracy, timeliness, presentation formats, extent of insight, and availability of expertise and advice as content quality aspects. After getting acquainted with the existing systems, on the one hand, and the viewpoints of document management experts from the surveyed company, on the other hand, we have decided to include the performance and GUI aspects into the evaluation profiles of the Wiki and corporate SharePoint (these two systems are first of all considered because of their focus on collaboration).

Survey Implication:

- Timeliness, correctness, scope, and number of information/knowledge entries
- Content structure (e.g., classification into folders)
- Content layout and presentation
- Availability of multi-media content elements

Motivation
Knowledge management systems "promise the potential for contributing to an organization's strategic advantage by unlocking knowledge heretofore housed only in the minds of certain organizational members" [Ma08]. "If organizational members share valuable information freely with other members, the organization's responsiveness and effectiveness can be greatly augmented by preventing those members from having to repeatedly solve the same problems. In an environment of organizational sharing, a KMS can readily save time and money for both providers and users of knowledge" [Ma08]. Since any knowledge management system, however, requires individuals to share their knowledge and know-how with colleagues, success cannot be guaranteed in advance [Ma08].

"*Motivation* is a feeling of interest that makes you want to do something, a reason for doing something or behaving in a certain way. Motivation comes from within, so it is up to each individual to motivate him/herself" [Rwke08]. One of the most significant problems is lack of motivation for sharing valuable knowledge with the others, because "individuals often gain considerable power when they hold unique knowledge […], especially when it is perceived to be of high value" [Ma08]. For this reason employees are often hesitant to share their knowledge, since it would consequently lead to the loss of their personal competitive advantage. Therefore it is important to identify positive motivators, encouraging employees to contribute their knowledge, even if the costs of sharing are high [Ma08]. Thus, studies of corporate usage of Web 2.0 tools show that companies employing more tactics to motivate their employees have distinctly higher levels of satisfaction with the overall performance of the tools [BMM08].

- ⇨ **Research Question 9:** There is a certain probability that the number of activities used for motivating employees to contribute their knowledge to the overall knowledge pool is not quiet sufficient. Therefore, it is necessary to check how motivating and encouraging the environment of knowledge workers at the surveyed department is.

Survey Implication:
Speaking about the environment of knowledge workers, their colleagues can be considered first of all. For this reason the survey should first of all check whether employees see their colleagues as active user and provider of knowledge in common knowledge repositories.

Reputation
Further studies of technologies that foster online collaboration and cooperative document creation, like wikis and blogs, carried out by McKinsey [Bu07] also gave insights into the nature of motivation. Thus, McKinsey research conducted in Germany showed that major motives encouraging employees to collaboration and thus sharing knowledge are desire for fame and feeling of identification with a community. Thus, for example, according to the study at one cable company more than the half of the employees who contributed to an internal wiki said that the main factors motivating them are reputation building, team spirit, and community identification, and only 20 percent were driven by the possibility of a financial bonus [Bu07].

Survey Implication: Further questions aimed at validation of motivating factors should concern such aspects as: reputation of the content contributors as well as the general working culture or team spirit, and internal rules of the department.

Feedback
Rick Kilton, Presedent of RWK Enterprises and holder of a foundation certificate in IT Service Management (ITIL) emphasizes the role of positive and effective feedback as an important motivation driver [Rwke08]. According to Frederick Herzberg's study of motivation, the most powerful motivational factor is self-achievement [He87]. Kilton states that providing feedback that is relevant, specific, timely, valuable, and accurate is the best way to fulfil that internal sense of value. "In this case, feedback demonstrates interest, reinforces desirable behaviors and redirects undesirable or misdirected behaviors" [Rwke08].

Survey Implication: It makes sense to check whether authors of knowledge contents get enough feedback from their colleagues.

Management Encouragement
The study carried out by Marks and his co-authors [Ma08] have shown that successful adoption and use of knowledge management systems can be facilitated through substantial *encouragement by management* (prompting). Thus, their study demonstrates that prompting knowledge workers with meaningful reminders can have a desired positive effect on their attitude towards sharing knowledge and thus increase their contribution to a knowledge management system [Ma08]. Another survey, proving the role of managers in motivation of their staff, shows that a higher level of Web 2.0 tools usage is found in companies where senior managers act as role models for adoption [BMM08].

Survey Implication: The survey should check to what degree superiors encourage sharing of knowledge via knowledge management platforms.

Lack of Time, Awareness
Another factor potentially threatening the successful adoption of collaboration technologies in an organization is lack of time for contributing content, because busy knowledge workers won't take time for contributing their knowledge to the systems since they are overloaded with other important tasks to solve [Mc06]. An important feature hindering knowledge contribution is also unawareness about the usefulness of possessed information for the others. Thus, for example, knowledge workers may be "unaware of what they have learned; moreover, even if they realize what they have learned from a project, they may be unaware of what aspects of their learning would be relevant for others" [AL01].

Survey Implication: Taking into account these facts, it makes sense check if knowledge workers of the Product Development department consider to have enough time to contribute contents to the knowledge management systems, and if they are aware of possessing information which could be relevant and valuable for their colleagues.

4 Survey Concept

The subsequent sections of this chapter provide theoretical foundation on questionnaire surveys. At the beginning, the process of questionnaire design is discussed. Further, different classifications of questionnaires are presented as well as the peculiarities concerning online-questionnaires and employee surveys.

4.1 Questionnaire Definition

One of the most widely-spread means for conducting statistical analyses is a questionnaire survey that considers collecting the necessary data via interviews. "A structured interview is one in which each subject or respondent is asked a series of questions according to a prepared and fixed interviewing schedule- the questionnaire" [Br04]. Structured interviews can be carried out using different data collection media: paper questionnaire, telephone, E-mail, online- questionnaire, or a face-to-face interview. In all cases the major purpose of a questionnaire is to provide a standardized interview across all subjects, and thus collect information enabling the researcher to answer the objectives of the survey [Br04].

While designing the interview questions, it is important for the researcher or questionnaire writer to judge the demands of different stakeholders, as clients, interviewers, respondents, and data processors. Consequently the questionnaire should be straightforward to administer and easy to understand, allow uncomplicated data entry and be suitable for the production of data tables, and other required statistical analyses [Br04].

4.2 Planning a Questionnaire

In order to ensure a questionnaire is going to provide accurate, good-quality information it needs to be thought about and carefully planned, before starting with writing questions. The sequence of different topics to be covered, the sequence of questions and prompted responses can all dramatically influence the accuracy and reliability of the collected data [Br04].

4.2.1 Business and Research Objectives

The first step to begin with is to define the *business objectives* of the survey and consequently the *research objectives* required to achieve them. The questionnaire design itself should be then related to the research objectives [Br04]. "It is one of the skills of the researcher, to turn the objectives of the study into a set of *information requirements*, and from there to create questions to provide that information and then turn those into a questionnaire" [Br04].

The *business objectives* of our survey can be defined as follows:

- Market leadership (i.e. expertise leadership) within the industry of integrated circuit products.

The achievement of business objectives depends on various factors. To a great degree, however, they depend on retention of tacit knowledge within the company (especially the department for Product development) which can be reasonably facilitated via improvements of the existing document-centric collaboration at the department of Product Development.

Therefore, the following *research objectives* for our survey can be derived from these superior goals:

- Evaluate document-centric collaboration at the department of Product Development:
  - Determine the employees' level of satisfaction with the existing systems,
  - Determine possible weak sides of the systems,
  - Find out, if the systems are used according to the functions they were primarily designed for,
  - Compare the currently used systems with each other in terms of functionality, and
  - Determine if the employees are motivated enough to use the existing systems for sharing knowledge

4.2.2 Information Requirements

Once the researcher has analyzed the research environment and decided about the data collection medium and the survey design, the questions themselves can be drafted [Br04]. Thus, the next planning steps are:

- Define the principal information required and its detail level,
- Determine the additional data required for analyses purposes (e.g. demographic data, product usage), and
- Map the flow of the subject areas or sub-sections within the questionnaire [Br04].

In order to decide about the actual *information requirements*, the starting point of our questionnaire, we have used hypotheses and survey implications developed in the preceding chapter. Therefore the following information requirements were deduced:

- *Evaluation of change in performance* (as compared to that of one year ago)
- *User satisfaction (status quo and the future perspective)*
  - Level of satisfaction with knowledge management in general
  - Level of satisfaction with means for sharing knowledge
  - Level of recommendation of knowledge management in general
  - Level of recommendation of means for sharing knowledge
- *Use and intention to use (knowledge user and knowledge provider perspectives)*
  - General information needs
  - Knowledge search intensity
  - Knowledge provision intensity
  - Information allocation vs. search habits
- *System quality*
  - Local access latency
  - Remote access latency
  - General user interface
  - Intuitiveness of usage
  - Ease of content search
  - Ease of content provision
  - Relevance of search results
  - Advanced search functions
  - Post search handling of results

- *Knowledge content quality*
  - Content quality in general (relevance, correctness, timeliness)
  - Scope
  - Number
  - Structure
  - Presentation/Layout
  - Multi-media content elements
- *Motivation*
  - Colleagues (content provision and content use)
  - Internal rules incentives
  - Encouragement through superior
  - Working culture in general
  - Feedback
  - Reputation benefits
  - Awareness
  - Time

4.2.3 Questionnaire Structure

As soon as the decisions about the principal and analysis information requirements have been made, the *questionnaire* itself can be properly planned. It is common to divide the questionnaire into three parts:

- Exclusion or security questions,
- Screening questions, and
- Main questionnaire [Br04].

Security questions are usually placed at the very beginning of the questionnaire having its purpose to exclude the respondents working in market research, marketing, or the client's industry from the survey. This is generally done firstly to protect the confidentiality of the survey contents, and secondly to avoid the over-representation of unusual behaviour and attitudes [Br04].

Screening questions indicate the respondents' eligibility for the survey. As a rule, the respondents to be interviewed must possess certain characteristics, either behavioural or attitudinal. Only few studies do not have special requirements for the screening section. Since the sequence of questions usually depends on the respondent's target group, the screening questions are to be asked at the beginning. Such placement ensures eligibility, and if necessary excludes the respondents not meeting the sample definition from the survey [Br04].

There are also some rules, considering question ordering in *the main questionnaire.* The questionnaire is to be mapped so, that it logically moves from one subject area to the next, without returning to the previous topics. Flow diagrams can assist the questionnaire design process to ensure that all the respondents are asked the sections relevant to them and in the correct sequence. The questions are to be ordered so that:

- *Behavioural* questions are placed before *attitudes* and images,
- *Spontaneous* responses are to be given before *prompted*,
- *Sensitive* sections are not allowed to be asked right at the beginning of the interview, before a trustful relationship was built between the interviewer and the respondent,
- *Classification* questions, like gender, age, income, social grouping, etc., are often treated as intrusive by the respondents. For this reason, the demographic metrics are to be checked at the end, after the respondent has got acquainted with the survey and is more willing to disclose this sensitive information [Br04], [2ask08].

In our survey the respondents' target group included all employees of the department for Product development without any exceptions. In particular, the focus was however on employees in a technical position. For this reason, our survey didn't include security and screening questions, but rather classification ones.

4.2.4 Employee Surveys

With respect to the targeted respondents, various types of surveys can be differentiated: *customer* and *employee* surveys, *members* and *patients* surveys, etc. These types differentiate slightly in terms of main issues to be taken care of while designing the questionnaire [Aska08]. Since, the survey to be conducted was addressed at all employees of the surveyed department, a certain number of guidelines, concerning employee surveys had to be carefully observed.

The most important requirement in employee surveys is to respect the data protection laws and guarantee the confidentiality within the processes of collecting and evaluating the survey data. Figure 4.1shows the general confidentiality guidelines for employee surveys.

- The employee survey participation is *voluntary*.
- The respondents' names are not collected
- Only three demographical characteristics are for further feedback to be collected:
  - Tenure (5 grades possible)
  - Organizational unit
  - Hierarchy level (5 levels possible)
- Answering each question is to be optional (a no-answer possibility for each question)
- The employee survey results are to be presented in summary (e.g. mean or median values)

Figure 4.1: Employee surveys: confidentiality guidelines (adapted from [Bo02], 27).

Before starting the employee survey, the questionnaire contents are usually to be approved by the *work council*. Hence, while scheduling the course of the survey, extra time for presenting the questionnaire to the work council should be allowed for [Bo02].

As to our survey, we have carefully observed the guidelines for employee surveys. Thus, for example, the firstly intended question about the age of the employees was excluded from the questionnaire, and the classification questions were limited to the following items:

- *Job position*
  - Employee in a technical position
  - Manager
  - Other function: e.g. team assistant, accounting, marketing, etc.
- *Site location*
  - Germany
  - USA
  - China
  - Other location

- *Tenure*
  - Less than 1 year
  - 1-5 years
  - 6-10 years
  - Since more than 10 years.

Finally, the completed questionnaire was presented to the members of the corporate *work council*. During this meeting the objectives and contents, as well as the confidentiality policy of the survey were presented and further discussed. Important issues were work relevance of the contents and absence of questions relating to the private life of the employees. Since all requirements were fulfilled, the questionnaire was successfully approved by the work council, and it was possible to start the next phase of the survey- questionnaire implementation.

4.3 Questionnaire Typology

There can be distinguished two basic types of interviews: *interviewer- administrated* and *self-completion* surveys.

4.3.1 Interviewer-Administrated Surveys

Interviewer-administrated surveys mostly benefit from having an interviewer, who assists the respondents while answering the survey questions and thus helps to deal with the queries about the meaning of a question, corrects misunderstandings, and encourages deeper responses to open questions.
Interviewer-administrated surveys can be further classified into *face-to-face* (including CATI: computer- assisted personal interviews) and *telephone-administered* interviewing. Both methods have their advantages and disadvantages (see Figure 2.1). The choice of the interviewing method is however strongly influenced by the overall survey design, as well as the appropriateness of the medium to the questions to be asked [Br04].

Face-to-face interviewing		**Telephone interviewing**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
• Ability to show response cards.	• Self-presentation bias.	• Relative anonymity can reduce bias.	• Use of prompts can be difficult.
• Ability to show stimulus material.	• Selection bias		• Difficult to show stimulus material.
• More complex questions can be asked.	• Third party bias.		

Figure 4.2: Different types of interviewer-administrated surveys: pros and cons (source: [Br04], 25).

4.3.2 Self-Completion Surveys

"Self-completion surveys, whether *paper- based* or *electronic*, can benefit from the absence of an interviewer from the process. This removes the major source of potential bias in the responses, and makes it easier for the respondents to be honest about sensitive subjects" [Br04].

Paper-based self-completion questionnaires
Paper self-completion questionnaires are usually sent by mail to people qualified as eligible for the study [Br04]. The main disadvantage of mailed questionnaires is, however, time: firstly, the data collection takes relatively long, and secondly, entering the data into the computer for the further statistical analysis requires additional time [Th04]. Paper-based questionnaires also can prevent from answering a spontaneous awareness question objectively, since it gives the respondent a possibility to read through the questionnaire [Br04].

Web-based self-completion questionnaires
There exist several ways of conducting surveys via Internet. Bradley [Br04] differentiates the following types of electronic questionnaires:

- *Open Web*- a Web site open to every visitor
- *Closed Web*- respondents are invited to visit a web site to complete a questionnaire
- *Hidden Web*- the questionnaire appears to a visitor only when triggered by some event (e.g. date, visitor number, interest in a specific page, etc.)
- *E-mail URL embedded*- respondents receive an invitation e-mail with a link to the survey
- *Simple e-mail*- an e-mail containing questions (rarely used in commercial research)
- *E-mail attachment*- the questionnaire is attached to the e-mail (rarely used in commercial research) [Br04].

Most practitioners now use questionnaires hosted on a web site, to which the respondents are routed in some way. There exists a wide variety of companies supporting platforms for online surveys (e.g., 2ask.de [2ask08], askallo.de [Aska08])

On the one hand, the estimated number of employees to be interviewed in course of our survey was approximately one thousand. On the other hand, the employees of the department are geographically distributed across sites in Germany, USA, and other countries. Therefore, a web-based self-completion questionnaire was chosen, as the most suitable survey medium. For the reason our survey was limited in terms of budget, it was decided not to use external survey platforms providers, but rather to make use of the Survey Template available on the corporate SharePoint platform. The invitations for the participation were sent to the respondents in form of an e-mail with the survey link enclosed. For this reason our survey can be further classified as an e-mail URL embedded one.

4.4 Online-Questionnaire

Online-questionnaires provide several advantages over traditional survey research methods in terms of cost, speed, appearance, flexibility, functionality, and usability. In particular, delivery is faster, responses are received more quickly, and data collection can be automated, or accelerated. There are also some features that traditional paper-based questionnaires are unable to provide: e.g. the possibility to integrate pop-up instructions and descriptive error messages, incorporated links, encoding difficult branching patterns and making them virtually invisible to the respondents [LM05]. Further advantages of online self-completion surveys are capturing unedited answers of the respondents, being more effective with sensitive issues (e.g. questions concerning medical issues, household income) [Br04], and direct data exchange with the state-of-the-art statistics software (e.g., SPSS) [2ask08].

Like many new technologies online-questionnaires are often criticized despite their advantages. Main problems, mainly caused by poor questionnaire design, are: *non-response*, *sampling*, and *measurement* errors. However, *the non-response* errors (failure to participate or abandonment) can be avoided by incorporating a range of context sensitive assistance during the response process. The probability of *poor sampling* (representative respondent groups) can be minimized by regarding browser configurations, bandwidth limitations, and user requirements during the questionnaire design process. To prevent *measurement* errors (poor question wording or presentation), Lumsden and Morgan [LM05] propose a special set of guidelines to be observed while implementing online-questionnaires. The main issues to be respected are outlined in Figure 4.3.

General Organization	Formatting	Question Type & Phrasing	General Technical Issues
Welcome Page	*Text*	*General Guidance*	*Privacy & Protection*
Registration/Login Page	*Color*	Sensitive Questions	*Computer Literacy*
Introduction Page	*Graphics*	Attitude Statements	*Automation*
Screening Test Page	*Flash*	Phraseology	*Platforms & Browsers*
Questionnaire Questions	*Tables & Frames*	*Types of Question*	*Devices*
Additional Information Links	*Feedback*	Open-Ended	*Assistive Technology*
Thank You	*Miscellaneous*	Closed-Ended	
Layout	*Response Formats*	Rank-Order	
Frames	Matrix Questions	Categorical or Nominal	
Forms & Fields	Drop-Down Boxes	Magnitude Estimate	
Navigation	Radio Buttons	Ordinal Questions	
Buttons	Check Boxes	Likert Scale	
Links		Skip	
Site Maps			
Scrolling			

Figure 4.3: Online-questionnaire guidelines (source: [LM05]).

4.4.1 Special Issues

An online-questionnaire actually combines the questionnaire-based survey functionality with that of a webpage. For this reason the design of an online-questionnaire should incorporate principles from both contributing fields [LM05].

Figure 4.4 (a) highlights the design process of an online-questionnaire developed by Lumsden and Morgan [LM05], in the picture arrows show progression, a double-barred arrow indicates

choice in the structure. According to it, the activities contributing to the generation of an online-questionnaire are as follows:

- *Define the research question*: Identify clearly the purpose of the questionnaire. Set the out the mission and the objectives of the survey.
- *Divide the research question into sub-categories*: List and order logically the categories and sub-categories of the issues to be addressed by the online-questionnaire. Then fill the questionnaire sections with appropriate questions and arrange them in a logical order.
- *Determine and profile the target audience*: To design and deliver the questionnaire content in a proper way, it is essential to profile the target audience and identify their specific requirements, e.g. questioning people with disabilities or the elderly.
- *Pilot/test the questionnaire*: Like traditional ones, online-questionnaires should be piloted prior to general release to identify possible misunderstandings of questions or instructions. Moreover, speaking about online-questionnaires, rigorous testing can help to eliminate errors within the source code. Having the necessary changes implemented, and the bugs fixed, the online-questionnaire should be re-tested. This process is to be iteratively repeated until the questionnaire is in its best possible position for administration.
- *Administer the questionnaire*: Online-questionnaires can be administered in several ways depending on the target audience. The process of profiling the target audience can help to identify which media for placing the questionnaire notification and calls for response best suite the context and the goals of the given survey [Lu05].

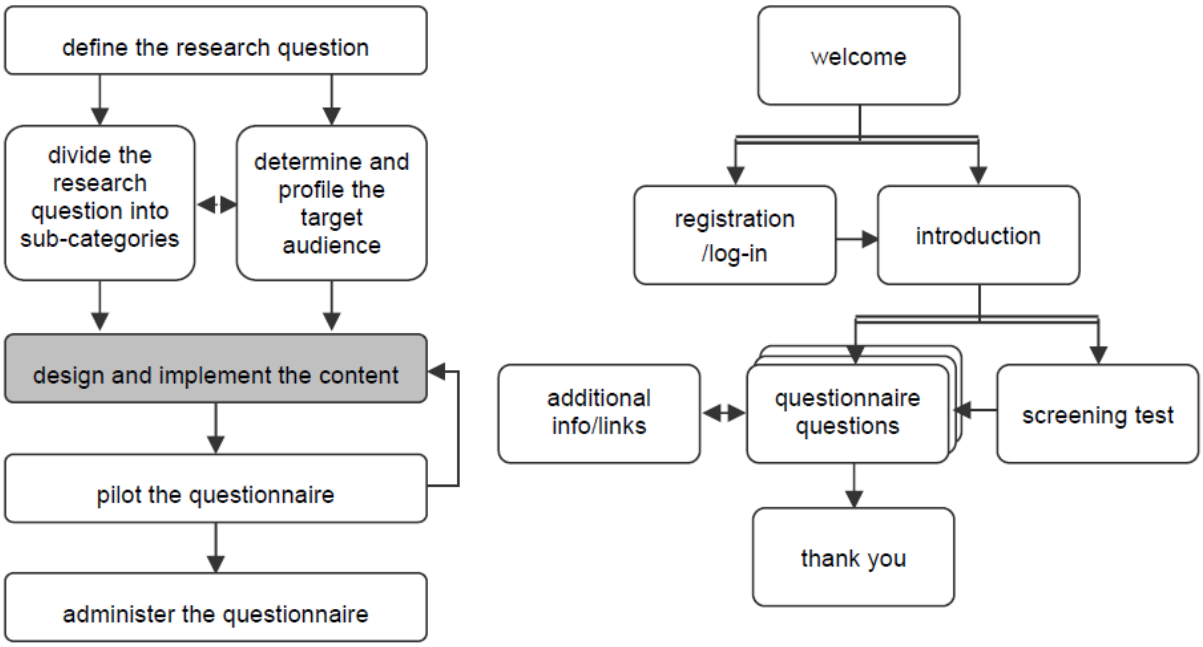

Figure 4.4: Online-questionnaire: (a) design process and (b) organizational structure (source: [LM05]).

Before launching the created questionnaire a short pre-test was conducted. Approximately ten employees were asked to participate in it and give their feedback. The main aspects to be tested in the pre-test were time needed to answer the questionnaire, understanding of the questions, and identification of further possible bugs. As a result, the pre-test respondents needed approximately 15 minutes to answer the questionnaire, which was equal to the assessed time; and did not have difficulties in understanding questions. No further technical deficiencies were identified in course of the pre-test.

4.4.2 Design Structure

While designing online-questionnaires, the issues of navigation and layout are to be taken care of, since they can contribute greatly to the rate of return as well as be the main reason of interview abandonment. Figure 4.4 (b) demonstrates the overall structure of online-questionnaires [Lu05, 5]:

- *Welcome*: The welcome page is one of the most important motivators for respondents to participate in the survey. Thus, it should be implemented to load quickly, emphasise the ease of responding and make it evident for the respondent how to proceed.
- *Registration/Login*: A registration or login screen is used if the questionnaire access is restricted with PIN numbers and passwords issued to a definite respondent audience only. In case of an error, only the fields that have been incorrectly completed are to be displayed. A meaningful error message explaining its cause is to be depicted. This alleviates user frustration and increases the likelihood of continued respondent participation.
- *Introduction*: This is a brief, but strong explanation of what the survey is about. It should also outline the security and privacy practices associated with the survey.
- *Screening Test*: Depending on the nature of the screening test, its position is open to debate. A simple screening test can be located within the introduction. Extensive screenings are to be assigned a page of its own. I order to prevent insult or offence, if a respondent fails a screening test, he/she shouldn't be denied the chance to complete the questionnaire, but instead his /her contribution should be simply discarded later.
- *Questionnaire Questions*: Questions are to be presented in a conventional format, similar to the basic paper-based standards. A few rules to be observed while creating the questions are:
    - The total number of questions shouldn't exceed 60, in order to prevent abandonment of an online-questionnaire.
    - The initial questions should be engaging and easy-to-answer, in order to motivate the respondents to continue the interview.
    - Most important questions are to be positioned about 1/3 of the way through the questionnaire, where the respondent has already got accustomed to the questionnaire, but is not yet bored.
    - Sometimes it is rewarded to repeat questions slightly rewarded in order to access the consistency of response.
- *Additional Information/Links*: Additional information concerning the topic of the interview can be included into the online-questionnaire. However, it should be possible for the respondent to navigate back to the main questionnaire at the point at which the respondent left it.
- *Thank You*: Every questionnaire should conclude by thanking the respondents for their time and effort. It is possible to ask the respondents for feedback or comments to the questionnaire administrators. [Lu05, 5]

In our questionnaire, most of the questions used are matrix questions base upon the Likert scale. Likert scale was firstly published by psychologist Rensis Likert in 1932 [Br04]. "The technique presents respondents with a series of attitude dimensions (a battery), for each of which they are asked whether, and how strongly, they agree or disagree, using one of a number of positions on a five-point scale" [Br04]. A five-point Likert scale includes two positive items (like, agree and strongly agree), two negative items (disagree and strongly disagree), and one neutral item (neither agree nor disagree) [Br04]. Sometimes the so-called

forced choice response scales are used, which does not contain the neutral middle option, and thus force respondents to give either a positive, or a negative rating [Soci08]. Responses using the Likert scale can be given scores for each statement, usually from 1 to 5. Since these represent interval data, means and standard deviations can be calculated for each statement [Br04].

Since the structure and design of our survey in general were limited by the functionalities included into the Survey Template of the corporate SharePoint portal, it was not possible to include an *introduction* and a *thank you* pages. Instead, a short *welcome screen* (see Figure 4.5) was created at the first page of the online questionnaire with a brief description of the survey objectives.

The provider of platforms for online surveys 2ask [2ask08] proposes a quality standard which can be applied to check if survey software is good enough for implementing a questionnaire. It describes must-have features which a well-implemented survey tool should include. Some of them are:

- Progress bar
- Possibility to make a break and be able continue the interview later
- Functionality to check if an obligatory question was answered
- Functionality to disable multiple participation in the survey
- User-friendly interface for easy survey implementation
- Possibility to implement a variety of question types
- Availability of numerous navigation possibilities
- Rotation of answer batteries in matrix questions
- Codification of answers
- Data export in Excel or SPSS
- Address import
- Personalized invitation e-mails
- Reminder e-mails
- etc [2ask08]

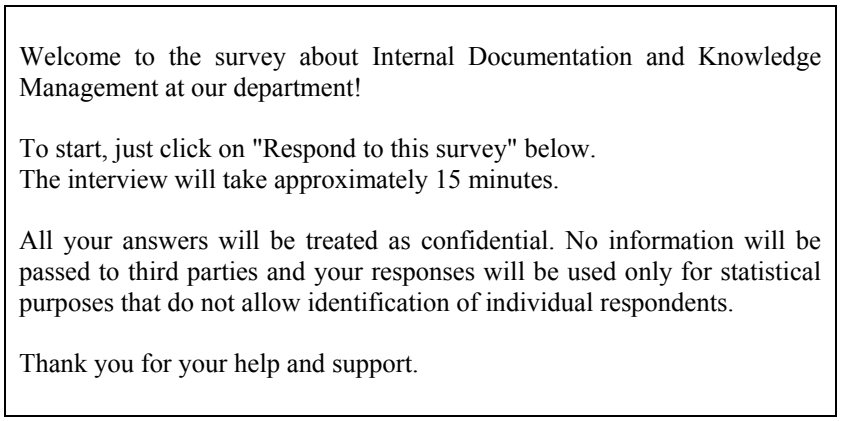

Figure 4.5: Welcome screen.

Speaking about the Survey Template of the corporate SharePoint portal, there was a number of difficulties to overcome during the phase of survey implementation. Firstly, it was not possible to change the font size, font style, and other formatting options. The default formatting settings, however, made the questions difficult to read and to answer. Secondly, implementation of questions was restricted to a few simple kinds, which forced us to change some of our questions in order to adapt them to the available implementation possibilities. Further, such important functionality as codification of answers was only partially available.

For this reason some of the data was consequently imported to Excel in text form, and some in form of default encoding. Thanks to the help of IT-department of the surveyed company, some changes in the source code of the Survey Template were made so that it was possible to import scale questions into Excel. And finally, the whole address management was not included into the scope of the survey software, so that it was not possible to send reminder mails to the participants which were invited but did not take part in the survey. Another issue dealt with during the survey conduction phase was that the existing "save" button could not save the collected answers, instead the user was forwarder to the start page and thus had to start the survey from the very beginning again. All these issues made us to conclude that the SharePoint survey template is well-suited for small size surveys rather than extensive ones.

The advantages provided by the SharePoint survey template are:

- Free of charge, since available on the corporate SharePoint portal
- Anonymity of responses
- Easy to use for short surveys
- Branching functionality
- Graphical presentation of results
- Possibility to disable multiple participation.

5 Analysis and Evaluation of the Survey Results

The subsequent sections of this chapter provide analysis and evaluation of the survey results. At the beginning, the sample size and the representativenss of the survey results are discussed. Further, information needs as well as general use habits of respondents are described and the general usage profile of the surveyed systems is analysed. Consequently, the evaluation of the critical success factors of knowledge sharing are considered, and finally the future tendencies are assessed.

5.1 Study Population, Sample and the Sample Size

The total number of invitations for survey participation sent to employees of the Product Development department in Germany, USA, and China and other locations is about one thousand: approx. 700 invitations in Germany, approx. 200 in the USA, and approx. 100 in China and other locations. The total *participation rate* is 192 respondents and thus 19,2%. Further, 149 of the survey participants completed the survey. Consequently, the *dropout rate* is 22,40% and the overall *response rate* is 14,90%.

Site Location	Target Universe	Sample	Response Rate
Base	1.000	149	14,9%
Germany	70,0%	75,2%	16,0%
USA	20,0%	16,8%	12,5%
China and other locations	10,0%	8,1%	12,0%

Table 5.1: Study population and sample size.

Considering paper-based surveys, the usual response rates are 1-5% or max. 10%, while those with response rates over 15% are considered to be extremely successful. Online questionnaires, however, are generally able to receive much higher response rates of 25%-35%. In our case, the achieved response rate of 14,9% is not particularly high. The main factors which could be improved in the future in order to achieve higher participation level are: (1) Increased support on the part of local senior management, and (2) Improvements of the survey tool.

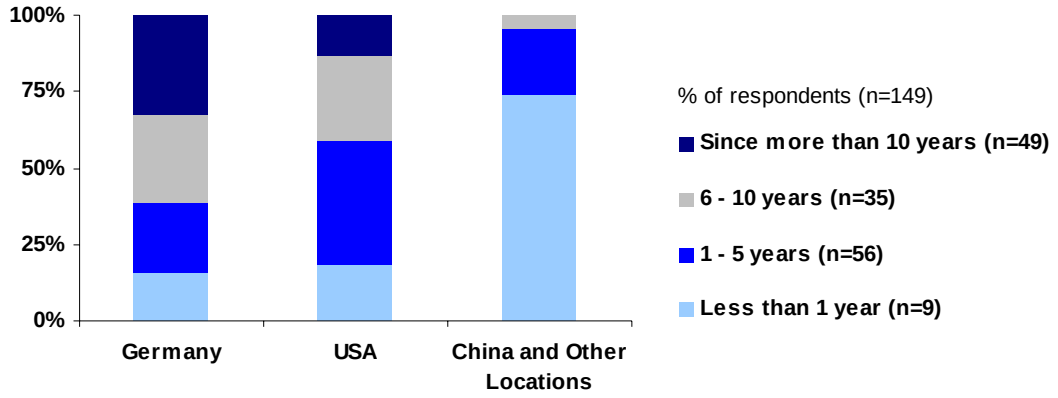

Figure 5.1: Distribution of respondents by tenure and location.

Still, despite the response rate of below 20%, comparison of the sample distribution by location shows that the relationship between those is quite proportional, despite Germany is slightly overrepresented (see Table 5.1). The absence of bias allows us to conclude that the assessed results are quite representative, since it shows that no particular respondent groups ignored the survey.

Most of the respondents come from Germany (75,2%), are employees in a technical position (87,9%), and work since 1 up to 5 years in the company (37,6%). Further analyses of the respondents' distribution show that most employees with tenure over 10 years work in Germany, whereas China has the highest rates on newcomers. It is also noteworthy that employees with tenure under 5 years are slightly underrepresented in Germany (see Table A.1).

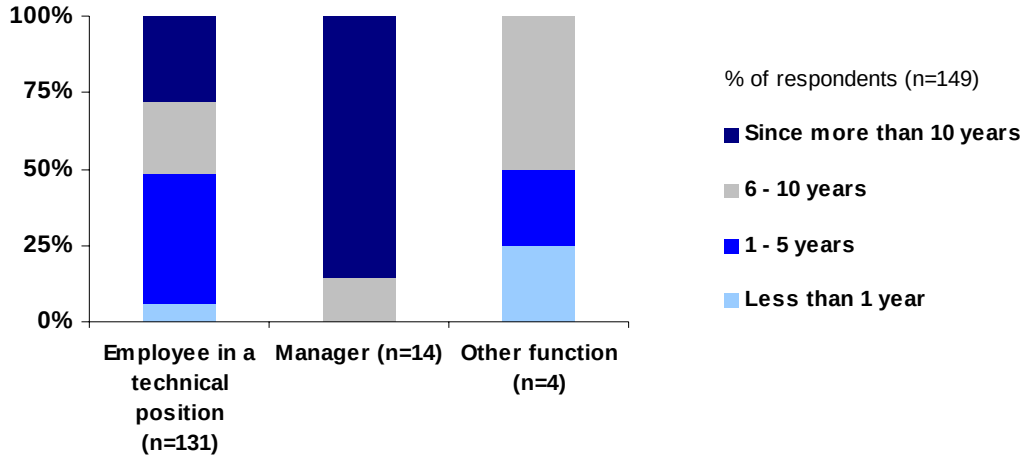

Figure 5.2: Distribution of respondents by job position and tenure.

The distribution of respondents by job position and tenure (as shown in Figure 5.2) points out that most managers have been working since more than 10 years in the company, while employees in a technical position are relatively consistent distributed by tenure (for the appropriate cross-tabulation see Table A.2). Since only four respondents belong to the *other function*, this sample is not representative enough to make separate conclusions about this group as opposite to the representatives of other functions.

5.2 General Usage Profile

The general usage profile firstly assesses the information needs of the users. Consequently the actual information allocation is compared to the use habits of the respondents. Finally, the level of user satisfaction with available means for sharing knowledge and information is analysed.

5.2.1 Information Needs

One of the most important elements contributing to the success of information systems is information quality [DM03]. Information quality, in its turn, comprises such aspects as relevance and completeness. This means that the contents contained in the systems supporting knowledge exchange must be relevant for their user. In order to be able to judge if the information systems at the examined department provide employees with relevant knowledge content, we need firstly to find out what information needs they have. Therefore, the first factor we analyse is what types of information the employees need in their daily work most of all.

The top two information categories, as perceived by both employees in a technical position and managers, are *project specific information* and *technical know-how, best practices and guidelines* (see Figure 5.3). They are followed by *tool and design flow documentation* and *expert networking*. According to the survey data, these four types of information are slightly more important for employees in a technical position, than managers.

Further, in contrast to the employees in a technical position, managers rate *organizational and administrative information* at 50,0% just as high as *tool and design flow documentation* (50,0%). Similar, much more managers perceive *Checklists* as extremely or very important for their work (38,5%), compared to the employees in a technical position (23,4%).

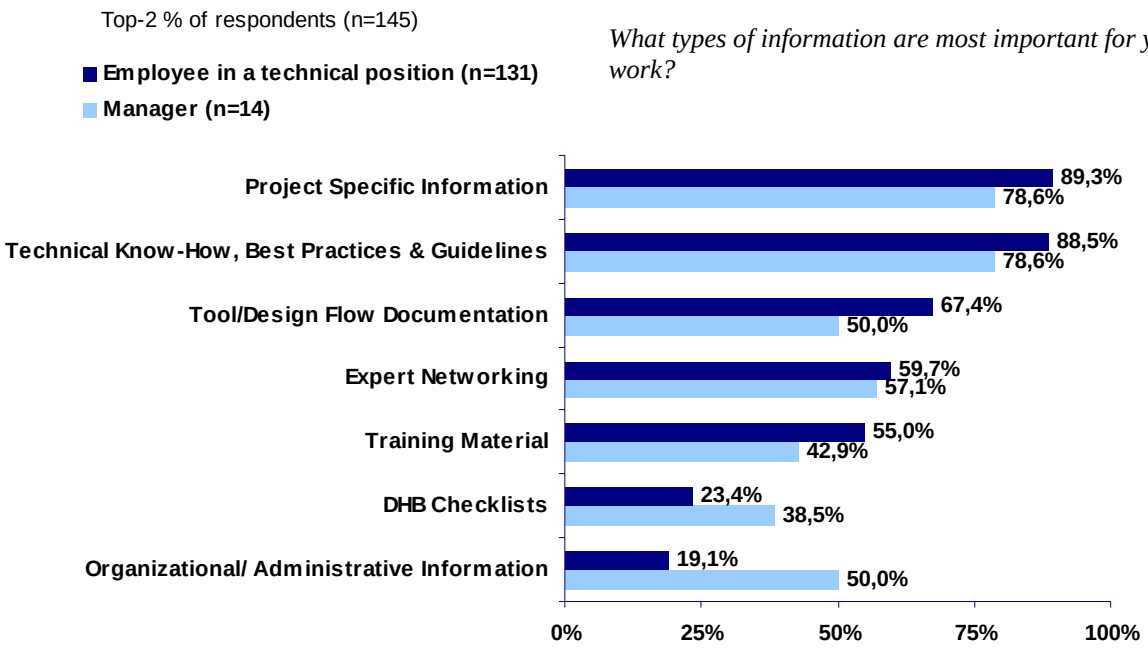

Figure 5.3: Information needs by job position.

Considering the allocation of information needs by tenure, the newcomers seem to be above-average interested in most of the information types (see Table 5.2). A bit surprising is, however, that their interest in *expert networking* is clearly below the average. Much experienced employees with tenure over ten years show least interest in *technical know-how, best practices, and guidelines*, as well as *training material*.

The only remarkable geographical difference in information needed is that the employees in China show much more interest in *training materials*, *expert networking*, as well as *project related information* and *best practices*, as compared to those from the USA and Germany (for details see Table A.3).

Conclusion:
Project specific information as well as *technical know-how, best practices, and guidelines* are considered to be the most important types of information for employees in a technical position and their managers. Therefore, the systems providing these kinds of contents (*Project TeamSite* and *File Share*; *Wiki* and *Knowledge Library* respectively) should be paid greater attention to in our further analyses.

	Tenure					
	Base	Top-2	Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Project Specific Information	148	65,5%	87,5%	57,1%	71,4%	67,3%
Technical Know-How	148	43,2%	75,0%	42,9%	54,3%	30,6%
Design Flow Documentation	146	31,5%	50,0%	32,1%	30,3%	28,6%
Administrative Information	148	7,4%	0,0%	5,4%	11,4%	8,2%
Expert Networking	146	21,9%	12,5%	25,5%	17,1%	22,9%
Checklists	109	11,0%	33,3%	11,9%	9,1%	7,7%
Training Material	146	17,1%	75,0%	14,3%	20,6%	8,3%

Table 5.2: Cross-tabulation of information needs by tenure.

5.2.2 Information Allocation vs. Search Habits

The next question to be answered (Research Question 4) is whether the work relevant types of information are searched for in the appropriate systems and if there is a sufficient difference between the users' search habits and the "official" information allocation.

The most popular way of acquiring desired information, independently of its type, is contacting colleagues either directly or via e-mail (see Table A.11 - Table A.14). Since we are first of all considered with evaluation of collaboration tools, we don't take person-to-person communication channels as contacting colleagues directly, via e-mails or during team meetings and reviews into account during the next four analyses. Instead, we make emphasis on the systems and platforms used. In case of searching for *project specific information*, the most widely used systems correspond exactly to its allocation spaces: the Project TeamSite (71,1%) and File Share (62,4%).

Only one third of newcomers (33,3%) uses the File Share for retrieval of project related information. Their Project TeamSite use rates are also below average (55,6%), while the Knowledge Library (22,2%) and Intranet (33,3%) seem to be much more popular, as compared to the colleagues with more work experience in the company (for details see Table A.15).

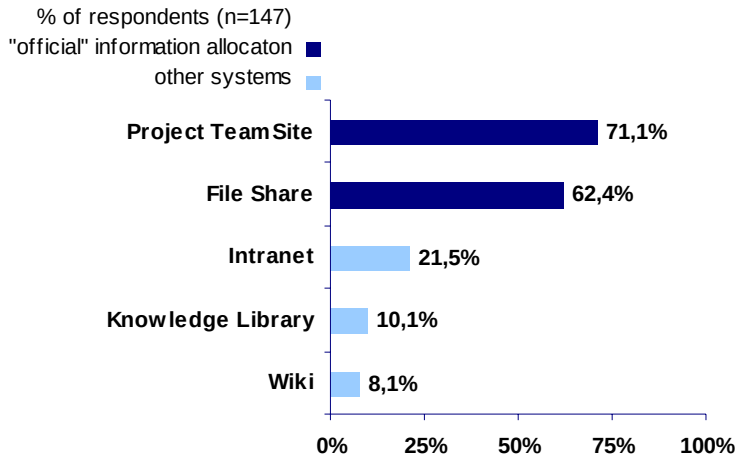

Figure 5.4: Information allocation vs. search habits: project specific information.

Tool and design flow documentation, mainly allocated in the Intranet and department's Wiki, is, however, preferably searched for in the Intranet (61,9%), whereas its second reliable source- Wiki -is only moderately used at 30,6%.

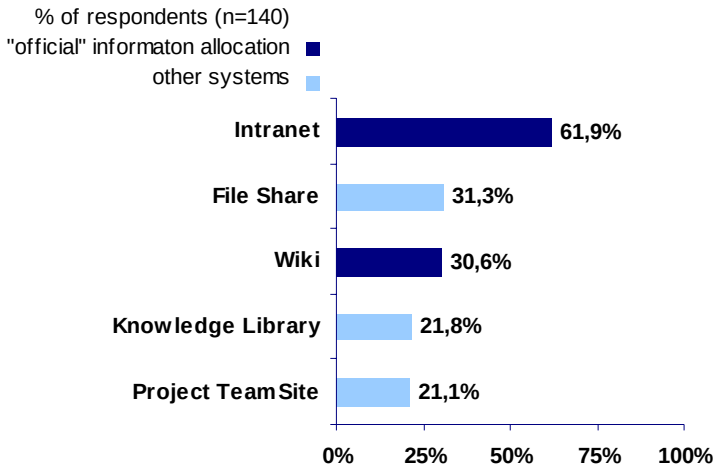

Figure 5.5: Information allocation vs. search habits: tool and design flow documentation.

Employees with tenure of less than one year seem to use all available systems similar intensively, which can also indicate that they are not particularly aware of the actual allocation places for the tool and design flow documentation (see Table A.16).

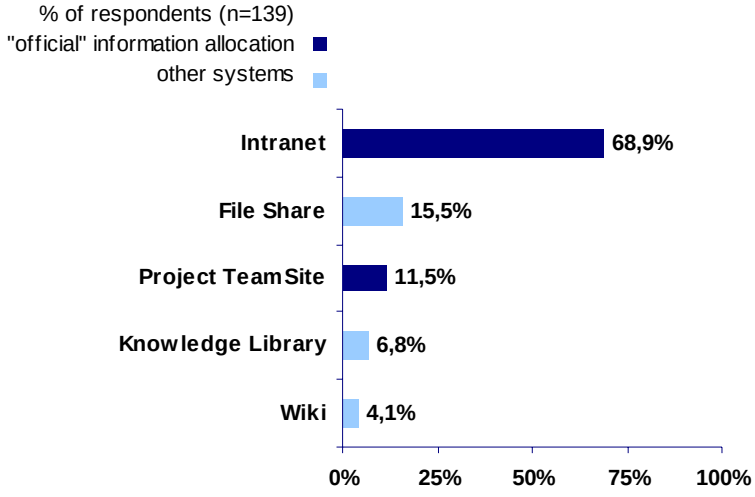

Figure 5.6: Information allocation vs. search habits: organizational information.

The Intranet is also used correctly as source of o*rganizational and administrative information* by the largest share of respondents (68,9%). The Project TeamSite is, however, only seldom taken into account (11,5%).

Speaking about queries for the second most important type of information - *technical know how and best practices*- File Share and Intranet still top the search rates, despite their major allocation places are the Wiki and the Knowledge Library- merely rated at 39,9%, and 35,8% respectively. And only the employees from China consult the Knowledge Library more often (54,5%) than the rest (see Table A.17). Apart from that there are no particular differences by tenure and position.

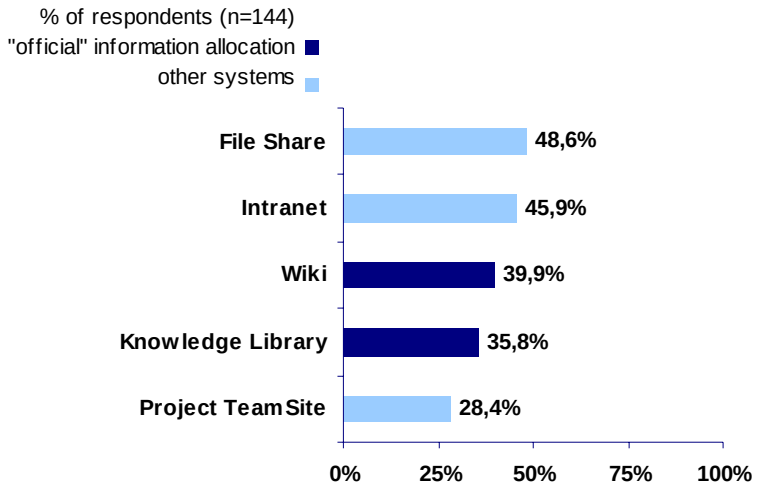

Figure 5.7: Information allocation vs. search habits: technical know-how and best practices.

Conclusions:

- Person-to-person communication is the dominating source of knowledge and information
- File Share and Intranet are the most frequently used tools, independently of the information type searched for
- The Wiki, Project TeamSite, and the Knowledge Library are relatively seldom used
- There exists a considerable inconsistency between the actual information needs of the users and their search habits
    - In particular, the newcomers (tenure of less than one year) seem not to know exactly where to search for which types of information and therefore tend to use all the available sources for their queries with equal intensity, independently of the information types they search for

Further Analysis Implications:

To explain the differences between the "official" information allocation and user search habits following hypotheses can be deduced:

Hypothesis 1: Firstly, a necessary condition for a system to be used is the user awareness of the system's existence as well as awareness about its contents.

Hypothesis 2: Secondly, users of an available system must perceive it as sufficiently satisfactory to be encouraged to use it again and again.

Therefore the next parameter we are going to evaluate is the level of user satisfaction.

5.2.3 Level of User Satisfaction

Six months before our survey was conducted some improvement initiatives were carried out by the management of the surveyed department. Their purpose was to make information and knowledge sharing more efficient and effective. Therefore, the new SharePoint Project TeamSite was introduced; the formerly used Lotus Notes database was migrated to the SharePoint Knowledge Library; and finally the documentation guidelines as well as information about expert teams were placed into the department's Wiki. In order to prove if these employees have benefited from the changes, one of the first questions asked was if respondents have experienced any improvements in performance. Analysis of the survey data shows that 60% of respondents have noticed improvements in document-centric collaboration platforms as compared to those of one year ago (see Table A.18).

The next question analysed (Research Question 1) directly deals with the level of users' satisfaction: on the one hand concerning knowledge management in general and on the other hand the available systems supporting it, also including the person-to-person communication channels.

Figure 5.8 shows the distribution of users' satisfaction rates. As one can see, merely 13% of respondents are extremely or very satisfied with the overall concept of knowledge management. It is also remarkable that newcomers seem to be much more satisfied as compared to the employees with tenure of more than six years (for details see Table A.19).

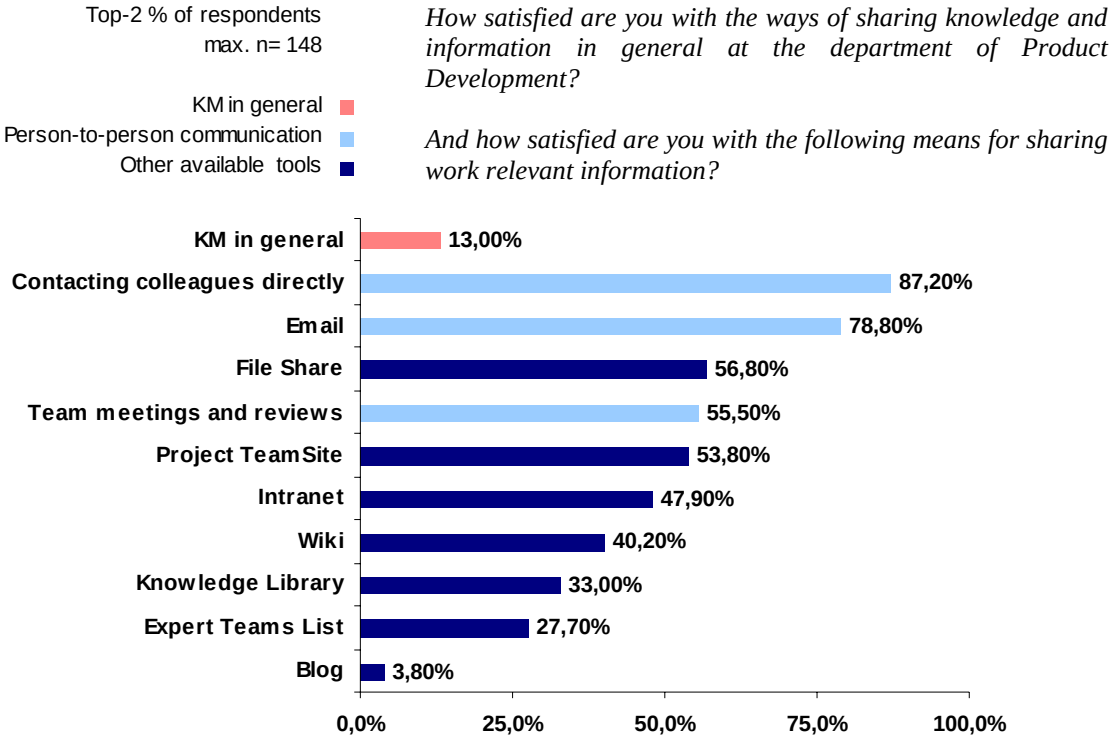

Figure 5.8: Level of satisfaction.

In contrast to the extremely low satisfaction rates concerning the knowledge management strategy in general, separate systems supporting it have achieved much better evaluations. Level of satisfaction varies markedly by the type of collaboration. Thus, person-to-person communication channels, as direct contact to colleagues and e-mail, top the list and thus have

the highest satisfaction quota as compared to the rest means of sharing knowledge. Team meetings and reviews are somehow far below direct contact to colleagues and e-mails in terms of satisfaction.

What concerns computer supported means of sharing information and knowledge, File Share tops the list and is thus the tool with the highest level of users' satisfaction (56,8%), for more details see Table A.20. The Project TeamSite has picked a similar share of satisfied users (53,8%) and is followed by the Intranet which scores slightly less than fifty percent (47,9%). Similar to the usage pattern analysed in the previous section, Wiki and the Knowledge Library do not seem to belong to the respondents' absolute favourites and are positioned relatively in the middle of the satisfaction scale with 40,2% and 33,0% respectively, while the Blog accounts for 3,8% only.

Conclusion:

- The highest level of satisfaction was achieved by person-to-person communication
- Traditional systems for document storage and retrieval (e.g., File Share and Intranet) attain a higher level of user satisfaction than the relatively new introduced collaboration technologies (Wiki, Blog, and Knowledge Library)
- Taking into account that the overall satisfaction with knowledge management in the surveyed department is extremely low, as compared to single systems, it can be recommended to check if there exist a necessity to improve the integration of the existing systems

Further Analysis Implications:
According to the surveyed data, evaluation of the available platforms and tools for sharing knowledge also varies in terms of user satisfaction. Thus some systems have achieved relatively good assessments, while others are considered by the respondents to be far less satisfactory. Thus, the next question to be answered is what reasons influenced the evaluation of the systems.

5.3 Critical Success Factors Evaluation

The subsequent sections provide analysis and evaluation of the IS critical success factors, as defined in Chapter 3. These results are essential for identification of the reasons of both satisfaction and dissatisfaction with the systems.

5.3.1 Evaluation of System Quality

In this section we compare the tools and platforms available for document-centric collaboration in the studied department in terms of their quality. Since Knowledge Library and Project TeamSite belong to the same collaboration platform based upon Microsoft SharePoint and therefore are generally similar to each other in terms of performance, they were surveyed together. Further, the Expert Teams List was also not treated separately, since it belongs to the Wiki articles. Finally, taking into account the small number of bloggers, we didn't assess the Blog in terms of system and content quality. As a result, the four following systems were surveyed in more detail: the File Share, Intranet, corporate SharePoint platform, and Wiki (for details see Table A.22-Table A.25).

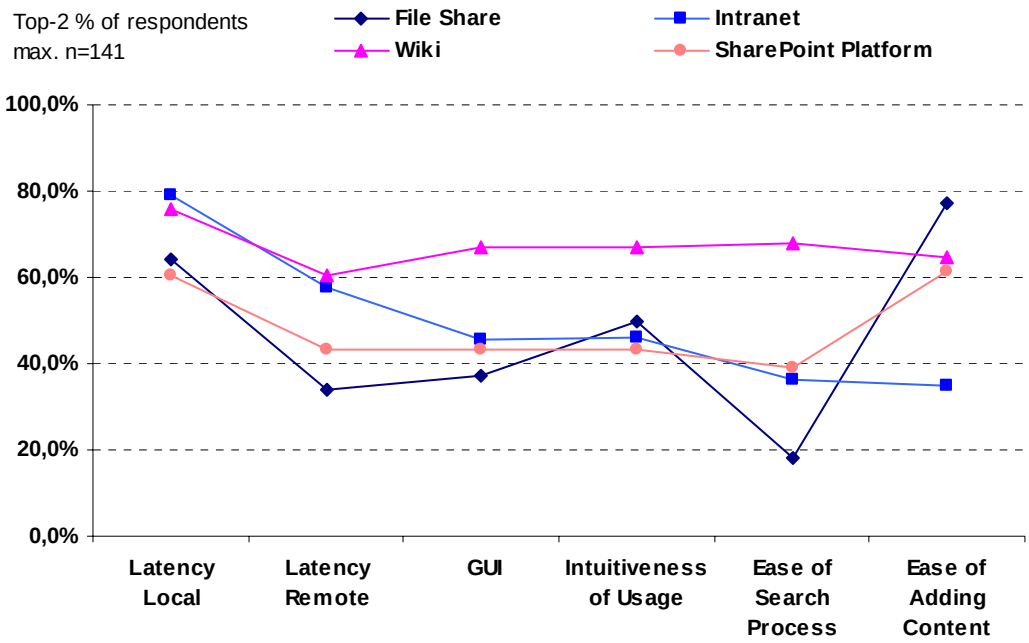

Figure 5.9: Evaluation of system quality.

Figure 5.9 displays the evaluation of systems considering the system quality (for details see Table A.26). The evaluated parameters are response times characterizing local and remote access (Research Question 5), user-friendliness of the general user interface and intuitiveness of usage (Research Question 6), and ease of processes for search and provision of knowledge content (Research Questions 7 and 8).

The graph shows that evaluations of Wiki as well as those of the SharePoint platform remain steady across all aspects. Wiki definitely holds the leading position, while the evaluations of the SharePoint portal are roughly 20% lower, with the exception of ease of adding content, which is almost the same for both systems. Evaluations of the Intranet are less homogeneous. Thus, its response times are relatively high evaluated, the GUI and Intuitiveness of usage evaluations drop down at almost 45% and further slightly degrease in terms of content provision and retrieval easiness. The evaluations of FileShare are fluctuating between about 20 and 80 percent. Thus, FileShare has achieved relatively high assessments in terms of local access latency, the user satisfaction with its functionality for adding content rises at 77,2% but then falls dramatically to 18% in terms of search process evaluation.

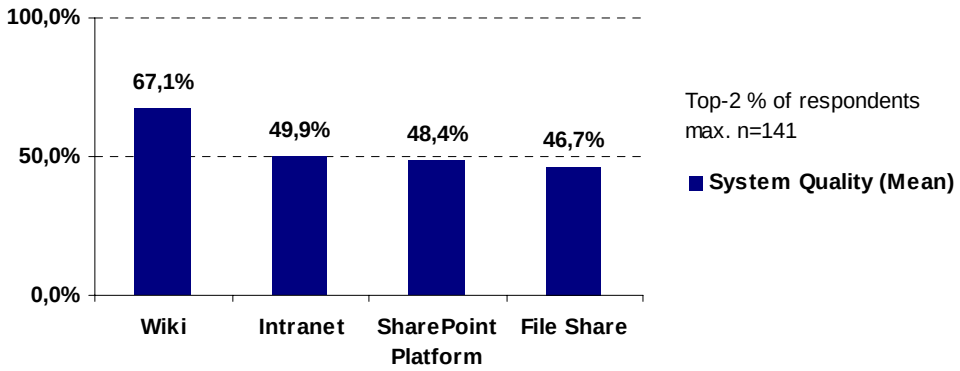

Figure 5.10: System quality: overview.

Speaking about the ratings of separate aspects, latency of local access is similarly well rated in all four systems, with Intranet and Wiki as the top systems. Evaluation of latency in terms of remote access is about 20% below local access values for all systems surveyed, still with Wiki and Intranet as top two. User-friendliness of the general user interface and intuitiveness of usage of File Share (37,1% / 49,6%) , Intranet (45,5% / 45,9%), and SharePoint platform (43,3% / 43,3%) are far below Wiki (67,0% / 67,0%). Totally, they separated with the gap of almost 20 percent

5.3.2 Evaluation of Search Related Issues

This section concerns the evaluation of the next group of parameters dealing with the system quality (Research Question 9, Research Question 7).

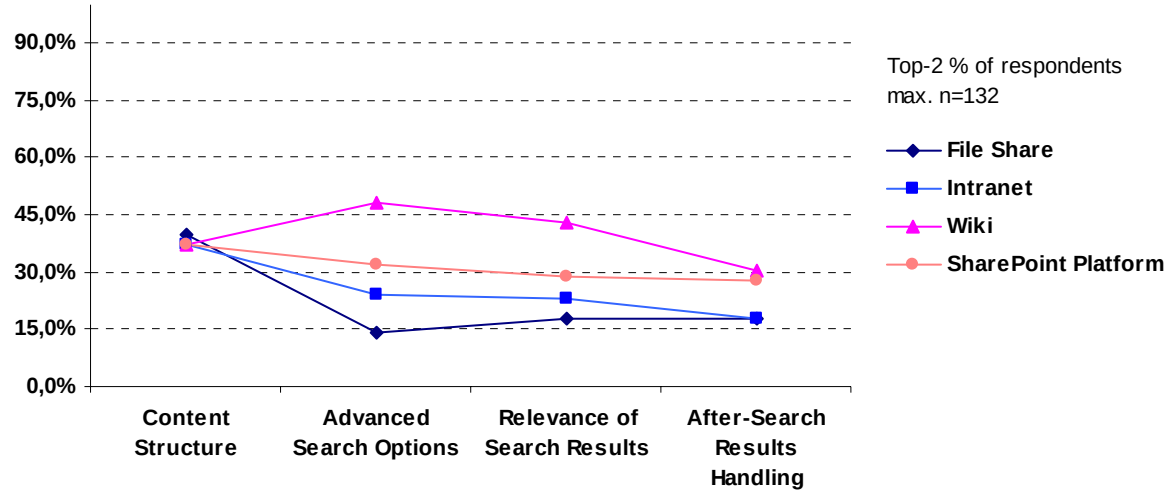

Figure 5.11: Evaluation of search related functions.

Figure 5.11 shows the distribution of respondents' viewpoints on such operations as finding one's way through the knowledge content (content structure) and evaluation of search related functions.

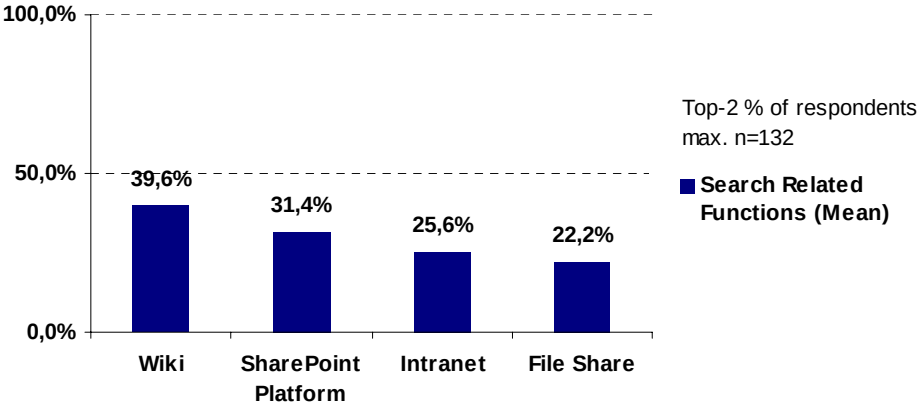

Figure 5.12: Evaluation of search related functions: overview.

All the systems surveyed exhibit similar evaluations of the content structure. About 38% of respondents rate the content classification as good or very good. Functions enabling effective differentiation of the search results as sorting, filtering and general navigating through the search hits are assessed as very good only by approximately 30 percent of users or less. Evaluations of other search aspects fluctuate between about 15% and just over 45% depending on the particular system.

Advanced search options and relevance of search results are according to the respondents' evaluation at their best implemented in Wiki. The total ratings of search related functionality, shows, however, that the leading system (Wiki) achieves merely about 40 percent of respondents' appreciation, the second best-evaluated system, the SharePoint platform yields about 30 percent, and is followed by Intranet and FileShare at roughly slightly about 20 percent.

Conclusion:

- The best rated system in terms of search related functionality is the Wiki. Taking into account the generally low evaluations of all surveyed systems, an improvement of the search functionality can be recommended.

Summary: System Quality and Level of Satisfaction

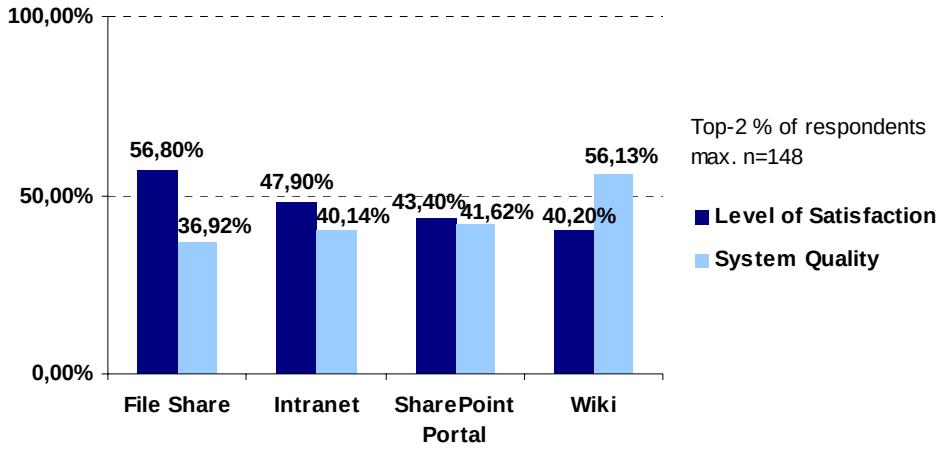

Figure 5.13: Summary: level of satisfaction and system quality.

Figure 5.13 summarizes the evaluations of system quality (across all aspects described), and compares those to the level of user satisfaction (level of satisfaction with the SharePoint portal is displayed as the mean derived from the Knowledge Library and Project TeamSite evaluations). The graph demonstrates that in our case the evaluations of the system quality do not let to make a clear conclusion why the level of satisfaction with Wiki and SharePoint is lower than with the others. For this reason, it is necessary to make analyses of further aspect to be able to answer this question.

5.3.3 Content Quality Evaluation

Since the focus of the thesis is document-centric collaboration, the survey was aimed at a more profound examination of the systems enabling collaborative creation and editing of documents. These systems are the corporate Wiki and the SharePoint knowledge portal. Additionally, due to further survey constraints as number of questions and maximal 15 minutes interview length prevented us from an equally comprehensive examination of all available systems. For this reason, the detailed survey of content quality reasons was conducted only with regard to the tools with prevailing collaboration orientation, as Wiki and SharePoint portal.

Figure 5.14 shows how many respondents perceive quality aspects of the knowledge content as extremely or very good. According to it, content aspects as relevance, timeliness, and correctness in both the Wiki and SharePoint portal are evaluated by about 50 percent of employees as of high quality. SharePoint is leading in number of content entries as well as options for adding multi-media contents. In other aspects, as scope and layout, both the systems have picked similar evaluations of roughly 40%.

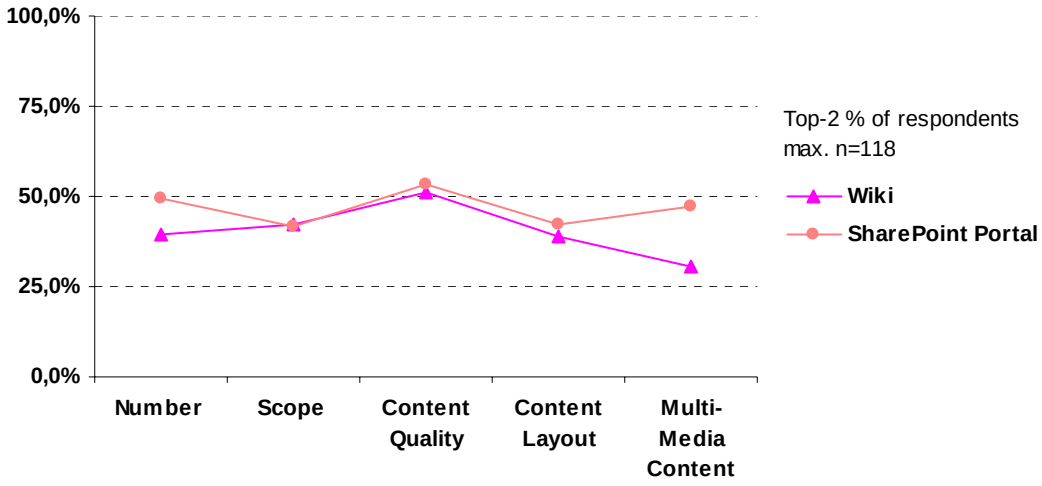

Figure 5.14: Evaluation of knowledge content quality.

Conclusion:

- In sum, SharePoint knowledge portal and Wiki have achieved quite similar rates of respondents' satisfaction with the content quality aspects (46,8% and 40,4% respectively). The general amount of users considering the knowledge content quality as extremely or very good is merely about 50 percent for both the systems. Therefore, some improvements in terms of content quality (relevance, timeliness, and correctness), scope and number could considerably increase the overall knowledge content quality.

5.3.4 Intensity of Information Provision

The next point of our evaluation is to find out if system use influences has impact on the respondents' satisfaction with available systems. Since our survey distinguishes between the roles of content provider and content user, we also differentiate between the cases of using the systems for the purpose of information search or retrieval on the one hand, and providing work relevant information on the other hand.
Figure 5.15 displays the use rates of different means for providing knowledge and information (Research Question 2). The chart shows the top two values for each of the relevant information sources (for detailed figures see Table A.7-Table A.9). The top three means for providing work relevant knowledge and information belong to person-to-person communication. They are *e-mail*, *contacting colleagues directly*, and *team meetings and reviews* respectively. Providing colleagues with information via e-mail comes top of the survey at 93,9%. It is noteworthy that a survey conducted in the same company in March 2007 also concluded that one-to-one requests are preferred over queries in electronic media. What concerns information systems, the most popular tool for providing information is the standard *File Share* at 60,5%, followed by the *Project TeamSite* at 42%.

The two tools considered to be the most important sources for providing technical know-how, best practices and thus tacit knowledge seem to be, however, quite undersupplied. Thus, merely 12,8% of employees share their know-how with colleagues via creating *Wiki* articles. And only 5,8% contribute to the contents of the *Knowledge Library*. In contrast to the importance of technical know-how and best practices as information types the tools containing them hold extremely low rates of information provision.

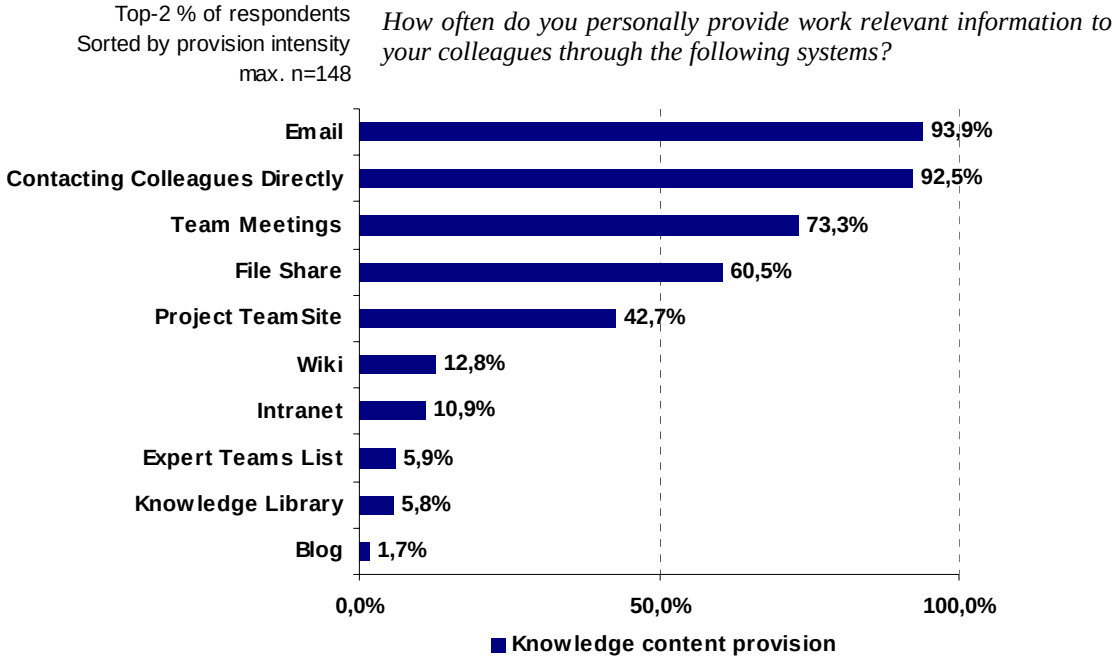

Figure 5.15: Intensity of knowledge content provision.

Compared to the File Share and Project TeamSite, the rates of information provision via *Intranet* are also relatively low (10,9%). But this can be perhaps explained by the types of documents accessible via Intranet (such as tool and design flow documentation as well as organizational or administrative information).

Expert Teams List (5,9%) also belongs to the least frequently used tools. The low usage rates, in this case, can be, however, explained by the fact that its contents are quite steady and don't need to be updated daily. And finally, the least frequently used tool for providing knowledge and information is the department's *Blog*. This can be explained by the fact that currently there is only one active blogger in the department of Product Development.

There are only slight regional differences in the usage of tools: a larger share of respondents in the USA (56,0%) often provides information to the *Project TeamSite*, compared to China (45,5%) and Germany (39,3%) (see Table A.8). The department's *Wiki* is more frequently supplied with contents from Germany (15,7%), whereas the *Intranet* and *Knowledge Library* are more often contributed to by the employees from China. It is, however, noteworthy that rates of information provision to the Wiki, Intranet, and Knowledge Library are extremely low across all site locations.

Speaking about the frequency of information provision by tenure, it is remarkable, that new employees (working since less than one year in the company), compared to the rest, quite seldom provide information to the *File Share*, *Project TeamSite*, and *Knowledge Library*;

however are more frequent contributors to the Intranet (see Table A.7). The most frequent content providers of the *Project TeamSite* and *Wiki*, compared to the average contribution rates, are the employees with working experience from since six to ten years. It is also worth mentioning that the *Knowledge Library* seems to be seldom supplied with contents, independently of tenure or location.
The distribution of provision intensity by the current job position shows that managers are much more likely to contribute to the department's Wiki, Knowledge Library as well as Intranet and Blog, as compared to the average.

5.3.5 Intensity of Information Search

The graph in Figure 5.16 shows how often the systems are used by the employees while searching for work relevant information (Research Question 3). The top two means, quite similar to provision of work relevant content, are *contacting colleagues* either *directly* or via *e-mail*.

In contrast to Figure 5.15, in case of searching for information team meetings are slightly less popular, whereas the standard File Share scores 74% and thus almost 15% increase in use and is doubtless not only the oldest, but also the most popular document sharing system.

Project TeamSite enjoys increased popularity as well (63%) and therefore is the second most popular means of sharing information after File Share. *Intranet* usage rates for search purposes are dramatically increased, as compared to information provision, and are at 43,8%. This difference between provision and search intensity can be explained by the types of information available in Intranet, since provision of *tool and design flow documentation*, as well as *organizational and administrative information* are restricted to a smaller number of employees, whereas the number of their addressees is much bigger.

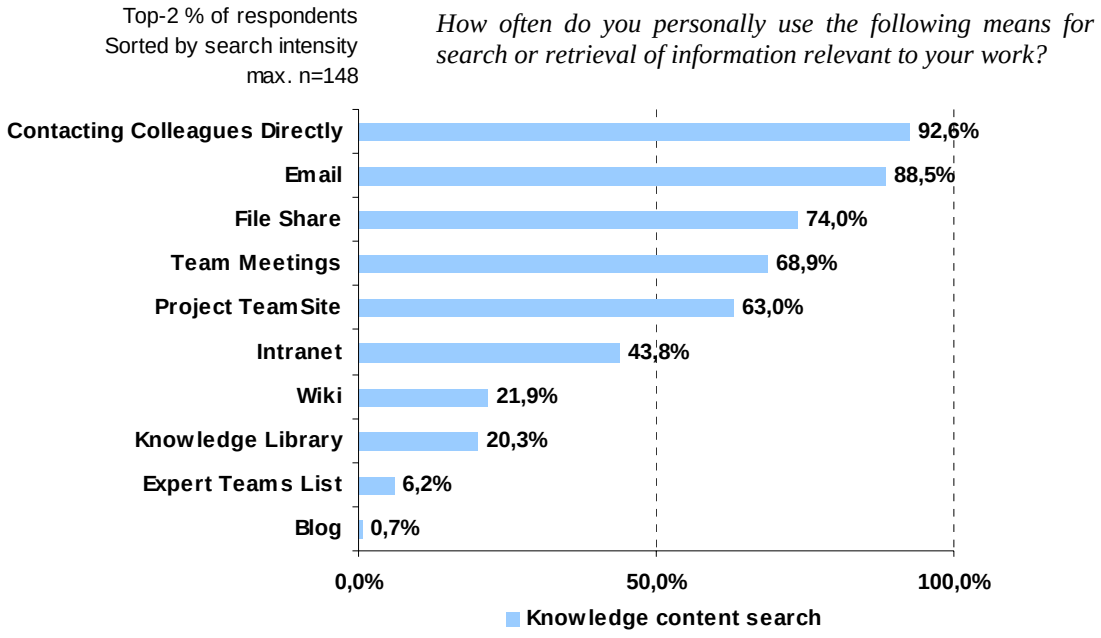

Figure 5.16: Intensity of knowledge content search.

In terms of search popularity, the department's *Wiki* and *Knowledge Library* picked similar shares of 21,9% and 20,3% respectively. This shows that the interest in these newly introduced systems is not particularly high despite the potential benefits they could provide. And, they are relatively underused in comparison to such traditional technologies as File Share and Intranet.

Expert Teams List is also rather seldom consulted (6,2%) while searching for information. Since, the Expert Teams List only contains the contact data of employees, it serves as a source of information necessary to get in touch with the experts rather than provides answers to the questions one has. Another factor possibly explaining its low popularity is that an advice to look through the expert lists is very likely to be communicated through other means rather than the Expert List itself. Finally, quite at the bottom of the rating scale is the *Blog*, at merely 0,7% and thus, unfortunately, the least popular source of information.

Search habits of our respondents by position or location and mostly follow the general usage trends (see Table A.4-Table A.6). As for tenure, newcomers tend to search much more often in the File Share (88,9%), Intranet (75,0%)and Knowledge Library (50,0%) than the rest of the employees. Surprising is, however, that none of them seems to use the Expert Teams List while searching for information. The Expert Teams List seems in its turn to be more intensively used by experienced employees with tenure of 6 to 10 years (11,4%) as compared to the average. Employees with experience of more than 10 years, tend, however to be the least frequent users of the Expert Teams List (2,1%) and Knowledge Library (12,2%).
According to the analysis of search intensity by site location shows that the employees in the USA are using the Project TeamSite at the most frequent (80,0%) and those in China prefer using Wiki (36,4%) much more as compared to the average. Further, managers seem to consult Wiki far less frequent than the rest of the staff (7,1%).

5.3.6 Information Provision vs. Search and Retrieval

The two previous sections gave an overview of the most popular means for providing knowledge and information as well as searching for those. As already noted in previous chapters, important components of knowledge transfer are the motivation of knowledge workers to share their knowledge as well as to acquire it from available sources. For this reason, the next issue we consider is the difference between "information supply" and "information consume" with respect to available means of knowledge exchange.

Figure 5.17 shows the comparison between the search and provision intensities, sorted by frequency of search (for details see Table A.4 - Table A.9). According to this graph, some systems have a well-balanced relationship between providing and using knowledge and information. Others, in contrast have a much higher proportion of information queries as compared to usage.

In order to be able to make further analyses, the *provision/search ratio* was calculated (see Table A.10). While calculating, we don't take into account the systems with usage rates of under 10 users because of the extremely small sample sizes. Therefore, the Expert Teams List and the Blog are excluded from our ratio calculation.

The analysis of the provision/search ratio shows that knowledge contribution and usage are well-balanced (with slightly prevailing contribution) in person-to-person communication means, as direct contact, e-mail, and team meetings and reviews. In case of File Share, usage

slightly prevails over contribution (provision/search ratio=0,8). The Project TeamSite and department's Wiki seem to be much more often searched in, rather then contributed content to (ratios 0,68 and 0,58 correspondently). And finally the Knowledge Library and the Intranet are according to the ratios of 0,29 and 0,25 are extremely unbalanced.

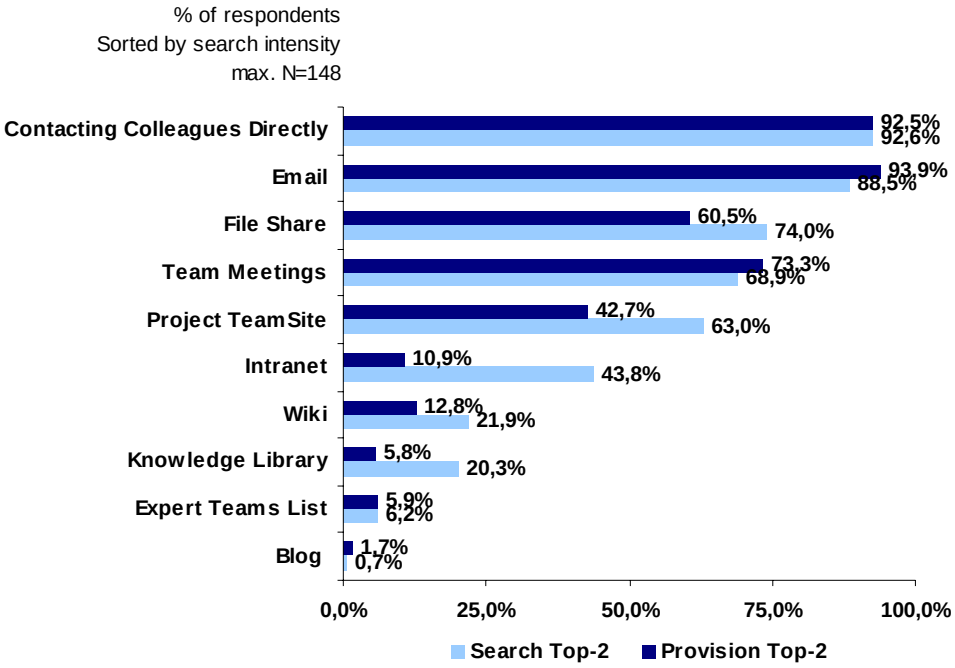

Figure 5.17: Search intensity as compared to provision intensity.

Conclusion: There is a high probability that information systems for sharing know-how, best practices, and project related information, as Wiki, Knowledge Library, and Project TeamSite are threatened by the "free rider" problem, since the information queries extremely prevail over content contribution.

Analysis: Level of Satisfaction and Use Intensity

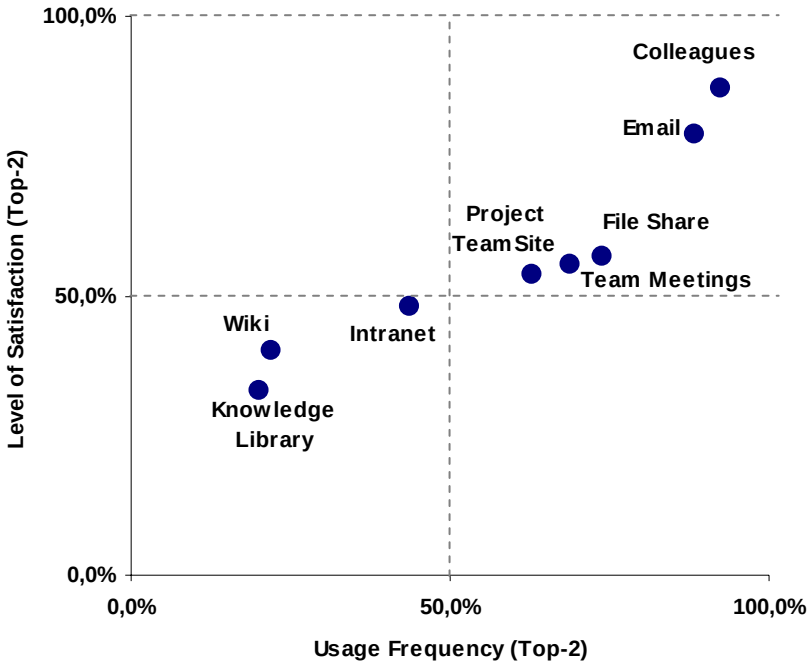

Figure 5.18: Correlation: level of satisfaction and usage frequency.

Another comparison we have performed (see Figure 5.18) shows the relationship between the usage intensity and user's level of satisfaction. The correlation coefficient of these parameters is 0,93 and thus points out a strong connection between these two aspects. The causal relationship is however difficult to distinguish. On the one hand, there exists a high probability that satisfied users frequently use their favourite means for acquiring knowledge and information. On the other hand, however, high usage rates can attract new users and consequently result in a better content supply which in its turn results in higher levels of satisfaction.

The interrelation between these two factors shows that possibly there can be chosen two strategies to increase the user's level of satisfaction as well as the usage rates.

Concluding research hypotheses:
To make the information systems more popular, on the one hand, it is possible to choose the "push" strategy and encourage users to increase their usage of the systems, which consequently will lead to higher satisfaction levels. On the other hand, there also exists a high probability that increase in users' satisfaction is firstly needed to encourage higher use intensity thus making the "pull" strategy a success. The right choice of means cannot be completely covered in terms of this bachelor thesis and thus remains an open question for the further researches.

Analysis: Level of Satisfaction and Provision/Search Ratio
Still, we have further tried to investigate if there is a connection between such variables as the level of user's satisfaction and the provision/search ratio.

The correlation of user's satisfaction level with the provision/search ratios produces a correlation coefficient of 0,77 which indicates a relatively high correlation (see Figure 5.19).

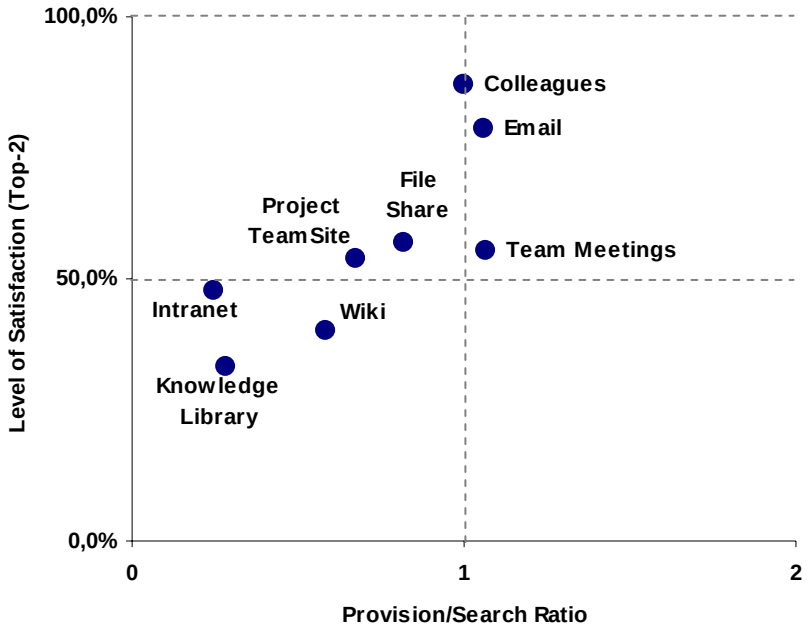

Figure 5.19: Correlation: level of satisfaction and content provision/search ratio.

The grid above shows that those systems with the provision/search rate at the closest to 1 also have the highest satisfaction rates. It is however noteworthy, that the closer to 1, the more increases the levels of satisfaction with the systems. And the values above 1 rapidly drop

down. While the low percentages of content contribution can be related to the low willingness of users to share their knowledge, the sinking satisfaction rates of the systems with the ratio of over 1 can be explained by the willingness of users to acquire knowledge from the source [AL01].

Conclusion:
According to the survey data analyses, the more well-balanced the proportion between the provide knowledge contents and those used, the higher is the level of user satisfaction. Therefore improvements of this ratio can facilitate further increase in the level of user satisfaction.

5.3.7 Motivation

Since motivation is an essential factor for facilitating knowledge contribution, the survey also included a number of questions concerned with it. The two sets of questions were related to the SharePoint platform and Wiki, because these systems not only enable document exchange, but first of all make emphasis on document-centric collaboration between knowledge workers.

Figure 5.20 shows the respondents' opinion of how often colleagues contribute to the corporate "knowledge pool". Similar to the information provision rates, almost half of the employees see their colleagues regularly contributing contents to the Project TeamSite. In contrast to that, the rates of knowledge contribution to the Knowledge Library and Wiki among colleagues are rather low – 15,7% and merely 7,8% respectively.

The evaluation of motivation drivers depicted in Figure 5.21 characterizes the overall knowledge sharing culture in the surveyed department. Search for fame or maintenance of the expert status are motivation drivers which have proved to be efficient in encouraging knowledge sharing among knowledge workers. In the surveyed department, however, only roughly 25% of the respondents consider that their reputation benefits from contributing their know-how to collaboration platforms. It is interesting, that 100% of the newcomers consider that creation of Wiki articles positively influences the author's reputation, while among experienced employees only 20% of respondents advance this view (see Table A.24).

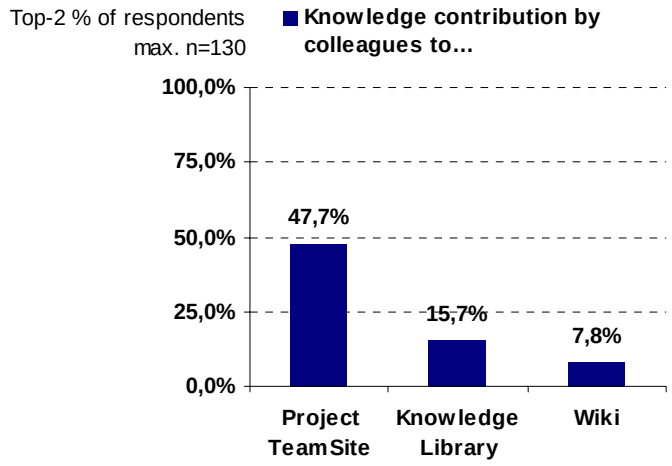

Figure 5.20: Rates of content contribution as seen by employees.

Further, the graph shows that less than 20% of interviewed employees say that authors of provided knowledge entries get feedback from their colleagues. Feedback is an essential

component of collaboration as well as a factor facilitating the quality and relevance of knowledge content. Therefore, it can be recommended to work out a strategy aimed to raise the feedback rates in order to improve collaboration among employees.

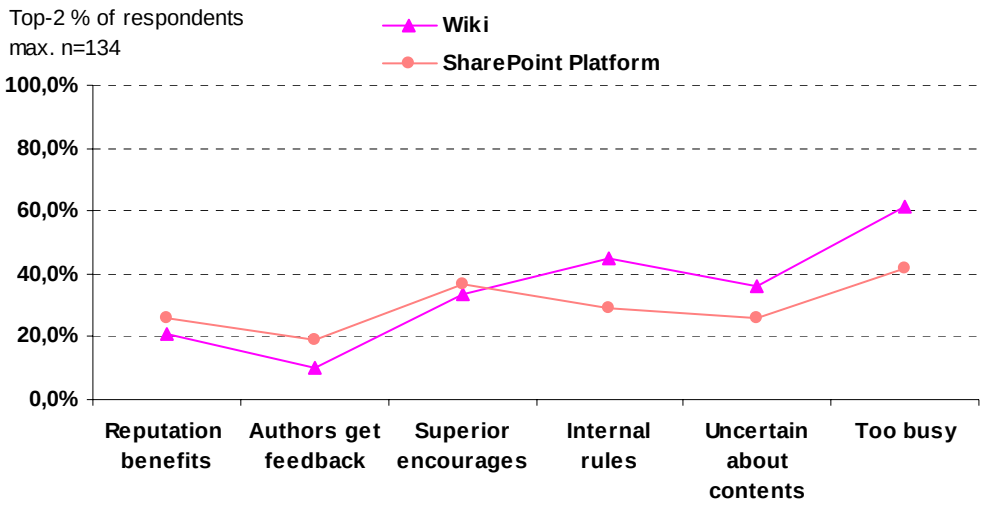

Figure 5.21: Motivation drivers.

About one third of interviewed employees say that sharing knowledge is encouraged by their superior as well as recommended by internal rules. It is remarkable, that though use of Wiki (45,1%) is to a much greater degree recommended by the internal rules of the department than the SharePoint platform (29,4%), both the Project TeamSite and Knowledge Library seem to account for higher quotes of knowledge contributors than Wiki.

Since only about 25% to 35% of respondents seem to be uncertain about which contents could be relevant for their colleagues and thus worth adding to one of the collaboration tools, it can be assumed that most employees are aware of the information needs of their colleagues. Thus, awareness about content matters cannot be considered a great obstacle to sharing information in this special case. Finally, forty to sixty percent say they do not have time to contribute their knowledge to the public knowledge repositories. On the one hand, it is difficult for employees to devote time to making one's knowledge available to the others via a collaboration platform if they are overloaded with their daily work. On the other hand, it is necessary to realize that once knowledge is codified and captured in Wiki articles or Knowledge Library entries, much of the valuable time can be saved.

Conclusion:

- According to the results of the survey, it can be recommended to increase the number of measures for motivating knowledge workers to share their know-how with each other via computer supported collaborations platforms.
- In particular, these measures should be aimed at facilitating user feedback, possibly introduction of a benefit system as a sign of appreciation of employees' contribution to the global "knowledge pools", which does not mean financial benefits [Bu07], but first of all paying tribute and recognition of one's expertise. Further, the time-saving benefits through the availability of codified knowledge should be made clear to the knowledge workers.

5.4 Use Prospects

To finish the evaluation, the analysis of the recommendation level was conducted. Recommendation is believed to be a stronger tool for predicting future behaviour than the level of satisfaction [RK96]. This phenomenon can also be described as "growth by word of mouth", because references are an accurate indicator of one's loyalty as well as the value added the one has received from the item he or she is going to recommend. Therefore, to assess future development perspectives of document-centric collaboration, the level of recommendation is going to be analysed in conclusion of the survey.

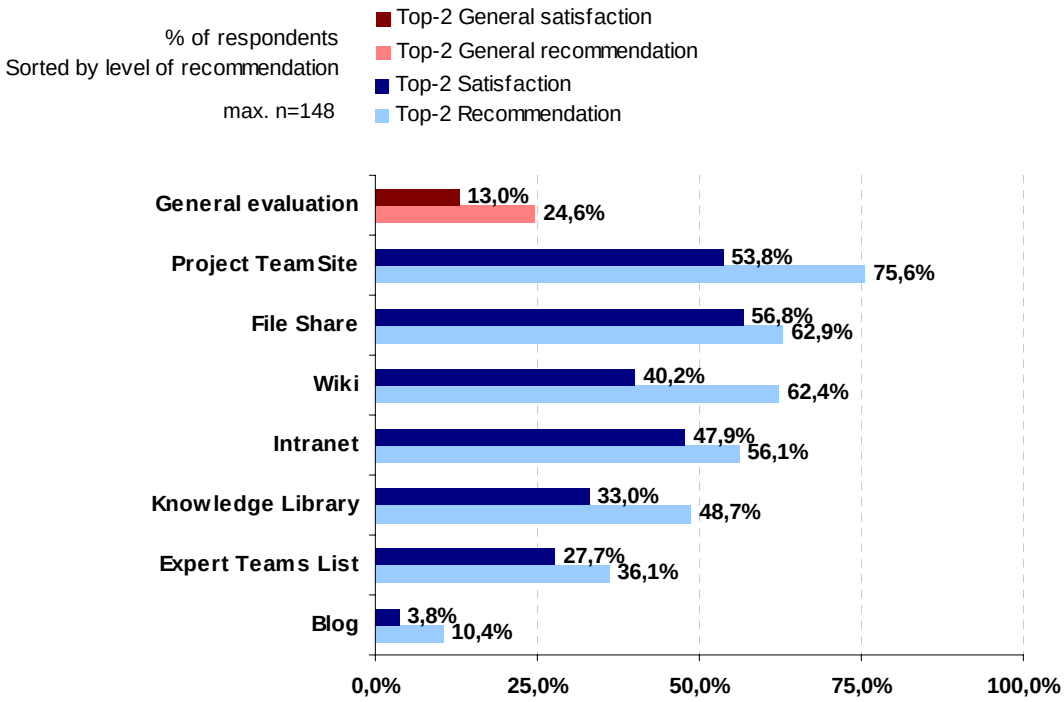

Figure 5.22: Level of recommendation as compared to that of satisfaction.

Figure 5.22 displays the level of recommendation as compared to the level of user satisfaction. On the one hand, the rate of user satisfaction is strongly correlated with the level of recommendation (correlation coefficient is 0,96). On the other hand, all the systems are much better evaluated in terms of recommendation as compared to the level of satisfaction. Such results point out a positive dynamic and thus indicate that the level of satisfaction as well as use rates show an increasing tendency and thus are likely to increase, provided all critical success factors remain the same or get better.

Further analysis shows, that the difference between recommendation and satisfaction rates is at its biggest in the evaluations of Wiki (+22,2%) and the Project TeamSite (21, 8%), followed by the Knowledge Library (15,7%). This allows us to anticipate an increase in the use rates of these systems.

5.5 Summary

This section provides a summary of the survey results and main findings made in course of our analyses.

Information Allocation vs. Search Habits

According to the study results, the most important types of information for the employees in a technical position are *project related information* and *technical know-how, best practices, and guidelines.* These are followed by *tool and design flow documentation* and *expert networking*.

As for project related information, its "official" allocation places coincide exactly with the systems actually used by employees for attaining it: the Project TeamSite and Intranet. Main storage spaces for technical know-how and best practices, the department's Wiki and Knowledge Library, seem, however, to be less familiar to employees. Less than 40% of employees use the Wiki and Knowledge Library for their queries on technical know-how and best practices, rather preferring to search in the File Share and Intranet instead. Further, despite tool and design flow documentation is contained in both- the Intranet and Wiki, most employees use only Intranet, while Wiki is taken in this case into account only by less than one third of users.

As next, according to the survey results most types of information, especially technical know-how and best practices, are preferably acquired via contacting colleagues- either directly or via e-mail. Further, this statistics also points out that the traditional File Share and Intranet are the most popular tools, used independently from the type of information searched for. Conversely, the two platforms (Wiki and Knowledge Library) containing one of the most important types of knowledge content (technical know-how, best practices, and guidelines) are relatively seldom used, which is quite contradictory to the information needs of the employees. All these facts show obvious differences between the "official" information allocation places and users' search habits; which can be explained either by low user awareness where to find which information, or by the low level of user satisfaction with the "officially recommended" systems. In our point of view, a possible solution of this problem could be integration of an overall search concept, or a collaborative tagging system, which would allow users to conduct queries over all available knowledge resources.

User Satisfaction

The next research question we tried to answer with the help of our survey was how satisfied the users are: in general and with respect to each single source of knowledge acquisition.

Contacting colleagues directly and via e-mail achieved the highest satisfaction rates (about 90% and 80% respectively). It is noticeable that team meetings in average scored about 30% less than person-to-person contact or e-mails.

The File Share and Project TeamSite lead among the systems for knowledge management support in terms of satisfaction rates at roughly about 60%, followed by the Intranet at slightly below 50%. Technologies with a greater collaborative focus, as Wiki, or Knowledge Library have achieved comparatively low evaluations (approx. 40% and 30% respectively). The department's Blog scored merely 3,8% concerning user satisfaction. We assess that the primary reason for this low rating is that only a small number of employee is aware of its existence (e.g., in our survey those are only 26 people out of 149 surveyed ones).

Further, it is noteworthy, that the level of satisfaction with knowledge management in general is dramatically low in comparison to the evaluations of separate systems- merely 13% of respondents said to be satisfied with it. Relatively high ratings of systems and tools for knowledge management support show that single systems cannot account for the low ratings of knowledge management as a whole. Therefore, our assumption is that the main reasons explaining this contrast are the corporate-wide integration of existing systems and the barriers existing between the systems and thus separating those from each other in terms of content access, search and retrieval functionalities. The IT landscape in the surveyed company consists of systems and platforms adapted in course of time independently from each other. As a result, the systems storing knowledge content are not integrated between each other and thus do not provide an overall solution for a uniform knowledge access.

System Quality

The File Share, Intranet, Wiki, and the corporate SharePoint have been further compared to each other in terms of system quality, in particular- performance, general user interface, and content search and provision functionalities.

The highest ranking across all parameters was achieved by the Wiki. The SharePoint portal and Intranet have picked a similar score of about 40%, and the traditional File Share was rated slightly below 40%.

File Share, Wiki and the SharePoint portal are all quite well evaluated with respect to the ease of process for adding content. Providing content to the Intranet, however, seems to cost respondents much more effort. In terms of the search and retrieval process, the File Share evaluations are at the lowest; Intranet and the SharePoint platform are slightly better evaluated, but still do not considerably exceed 30%. Thus, at 40%, Wiki is the best evaluated system with respect to the search functionality.

On the one hand, this relatively low scores point out the necessity of improvements of certain search aspects, as relevance of search results, post-search handling of the hits (e.g., sorting, filtering), and advanced search options. On the other hand, it could be recommended to think about the possibility of an integrated search across all available knowledge resources. An alternative approach allowing barrier free content access which could be considered is the concept of collaborative tagging. Currently, the surveyed department applies the concept of taxonomy for content categorization. Taxonomy is quite often used in organizations to index digital documents for search engines [BGT08]. There are, however, three issues which limit use of taxonomies:

- Not all documents can be automatically indexed,
- Ambiguity in the terms used results in irrelevant search results, and
- Search context is not considered [BGT08].

An alternative approach to taxonomies, which could improve the accessibility of corporate knowledge contents, is *collaborative tagging* [BGT08]. Collaborative tagging denotes a process in course of which, a user community of a system characterises objects contained in this system with metadata (as tags and categorizations). The notion of an object comprises images, audio and video data, text documents, weblogs, wiki-pages, references, etc. Therefore the first advantage of such a bookmarking system is that almost any resource can be tagged. Tags are key words freely chosen by users. The collection of all tags is called *folksonomy* (folk + taxonomy). Folksonomies are visualized via *tag clouds,* containing highlighted and alphabetically sorted tags [BGT08]. Studies of bookmark use show that people create them based on quality and personal relevance of the content, high frequency of current use, and a sense of potential for future use. Therefore, another essential benefit of an enterprise wide

social bookmarking is that it is an explicit assessment of the utility or value of various information resources [MFK05]. Currently, the MySite template in the SharePoint portal of the surveyed department allows users to create bookmarks which can be visible to the visitors of the MySite pages. In order to discover these bookmark collections, however, one firstly needs to navigate to the corresponding MySite. This fact decreases the re-use probability of bookmarks. In contrast, a collaborative tagging system would allow users to easily share their bookmarks with the others and thus efficiently discover valuable information [BGT08].

Content Quality
Since File Share is a common storage space for documents currently worked at, and Intranet contents are to a great degree corporate wide managed, the evaluation of content quality was focused on the systems with more focus on collaborative document maintenance: the department's Wiki and the SharePoint portal. The systems picked a similar share of satisfied users in terms of content quality, scope and layout (roughly about 50%). What concerns the evaluation of content in terms of number, and options for adding multi-media elements, Wiki has achieved slightly better results in comparison to the SharePoint (roughly about 50%). Since only half of users seems to be satisfied with the content quality, it can be recommended to think over an improvement strategy which would allow to increase the quality of knowledge contents in terms of relevance, timeliness, correctness, as well as number and scope of knowledge entries.

Intensity of Use
The analyses of use intensity for the purposes of information search and retrieval, as opposed to that of knowledge content provision has shown that there are certain differenced between these two aspects.

On the one hand, such person-to-person communication channels, as contacting colleagues directly, via e-mail or during team meetings are either well-balanced or have a slightly bigger quote of information provided. On the other hand, collaboration platforms and document management tools demonstrate an essential discrepancy between the amounts of knowledge content provided and the number of information queries. If we do not take Intranet into account (since much of its contents is centrally managed), most systems have a comparatively smaller quote of knowledge providers than that of information seekers. Therefore one can speak of the free rider problem, which is in particular essential for platforms concerning exchange of best practices and know-how. The correlation of the provision/search ratio to the level of user satisfaction shows that the more well-balanced the provision/search relationship is, the higher the level of user satisfaction. If, for example the amount of information provided is higher than the need for it, the level of satisfaction is likely to decrease (as in cases of e-mails and team meetings).
Therefore we can conclude that a well-balanced ratio between the amounts of knowledge content provided and searched for has a positive influence upon the level of user satisfaction.

Our further analyses show that level of satisfaction is also positively correlated with use frequency. Which factor however is the cause and which the consequence, is difficult to judge, since these two aspects are close interrelated. Thus, for example, increased use and increased knowledge content provision result in higher user satisfaction, which in its turn facilitates increased usage. Realization of net benefits is in particular importance for such technologies as Wiki, since an adequate number of articles is the first condition for its successful use in an enterprise [BGT08]. Therefore, we would definitely recommend to develop a concept which would motivate users to contribute more contents to the overall

department's knowledge pools, because sufficient amounts of relevant and correct knowledge content form the basis of these tools and serve as primary means for attracting new users.

Motivation

The evaluation of factors contributing to the motivation of individuals for sharing their knowledge with the others shows that a special motivation strategy needs to be developed in the surveyed department. This strategy should include a reward system as basis for facilitating motivation among employees. Examples of such rewards can be enhanced reputation and acknowledgement from peers, or access to information and knowledge shared by contributors in other networks [Ha01]. It could be also helpful to introduce a feedback system, which will provide the authors with comments on their contributions and thus improve the quality of the knowledge contents. Further, an important driver for the increase in motivation for knowledge sharing is development of an appropriate corporate culture [BGT08]. Moreover, speaking about collaboration technologies, the corporate culture is one of the main conditions for their success and acceptance in an organization [BGT08].

6 Conclusions and Prospects

This chapter summarizes the main contributions of this thesis and points out possible directions for the future research in the field of knowledge management supporting systems in an organization.

6.1 Summary

The main objective of this thesis was to evaluate document-centric collaboration at a supplier of integrated circuit products. In course of the research work, first of all the importance of knowledge management for an organization was discussed and the main theoretical foundations on this topic were presented. Thus the main processes of knowledge lifecycle in an organization were described as well as the role of information technologies supporting them.

As next, preparations for the questionnaire survey were carried out. Firstly, the collaborative environment at the surveyed department was studied and discussions with the representatives of the department were held in order to define the main concerns of the survey. In a next step, critical success factors influencing acceptance of collaboration technologies in an enterprise were identified. Consequently, information requirements for the questionnaire survey were deduced and the questionnaire itself was designed and implemented. Finally, the collected data was analysed in order to answer the research questions and create basis for further improvements.

In course of analysis, some deficiencies in the knowledge management support were discovered. These range from a mismatch between the tools for storing and those for retrieving certain types of information to motivation issues concerning the usage of modern knowledge management systems, such as wikis and blogs. Based on our findings, we consequently created ideas on how to address the identified problems, which are subsequently reconciled as directions for further research.

6.2 Outlook

The aforementioned mismatch between information storage and information retrieval points to an integrated approach to knowledge content access. Such an approach would essentially accompany unified search mechanisms over different information sources and storages. If such a mechanism cannot be created, e.g. due to integration reasons, a unified bookmarking mechanism could be applied as part of a respective solution. Such a mechanism could also be easily combined with tagging function – ending up in a tool similar to delicious [delicious.com], the flagship of the folksonomy movement. Bringing a collaborative bookmarking and tagging system inside the company's walls could be an interesting topic for future research.

Another important issue concerning the information systems used, especially the Wiki, the Knowledge Library, and the Project TeamSite, is facilitation of information and knowledge contribution as means for minimizing the free rider problem and increasing the content quality and use intensity. In order to encourage employees to contribute their know-how and best practices to the common knowledge pools an appropriate motivation strategy including a reward system should be developed. Reputation based mechanisms, as e.g. implemented in

web 2.0 applications like technorati [technorati.com], have proven successful means in this area. Again, the question of how to bring these tools inside the company's walls seems interesting for future research. Nevertheless, this might evolve to an unforeseeably complex issue, as legal questions on discrimination may play a role as well as potential demotivating side-effects.

The ideas mentioned above can be generalized to a more abstract direction of research concerned with web 2.0 technologies for enterprise knowledge management. While these technologies have proven widely successful over the Internet space, they often fail to deliver the same success stories when applied in an organization. Yet, no comprehensive model for explaining success and failure of these techniques exists. Consequently, the question, which factors make these collaboration techniques deliver the most value added for an enterprise, remains unanswered. Therefore, predictions of the usefulness of web 2.0 technologies prior to their introduction in an enterprise cannot be made. Future research, case studies, and experience reports could help to close the aforementioned gap of knowledge.

A. Appendix

The Appendix comprises two parts. The first part contains the questionnaire created within the context of this thesis. The second part of the appendix displays the statistical data collected and analysed in course of the thesis.

A.1 Questionnaire

Questionnaire Part 1: Knowledge Management: Performance and Usage Profile

Information Needs

1.1.	What types of information are **most important** for your work? (1 = extremely important; 5 = not very important)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
1.1.1	Project specific information	**O**	**O**	**O**	**O**	**O**		**O**
1.1.2	Technical know-how, best practices and guidelines	**O**	**O**	**O**	**O**	**O**		**O**
1.1.3	Tool/design flow documentation	**O**	**O**	**O**	**O**	**O**		**O**
1.1.4	Organizational or administrative information	**O**	**O**	**O**	**O**	**O**		**O**
1.1.5	Expert networking	**O**	**O**	**O**	**O**	**O**		**O**
1.1.6	Checklists	**O**	**O**	**O**	**O**	**O**		**O**
1.1.7	Training Material	**O**	**O**	**O**	**O**	**O**		**O**

Level of Satisfaction

1.2.		How **satisfied** are you with the *ways of sharing knowledge and information* in general at your department?
Code		**Response options**
1	**O**	Extremely satisfied
2	**O**	Very satisfied
3	**O**	Satisfied
4	**O**	Rather unsatisfied
5	**O**	Unsatisfied

Recommendation

1.3.		How likely are you to **recommend** other companies having similar requirements as your company to organize the *ways of sharing knowledge and information* in a similar way?
Code		**Response options**
1	**O**	Definitely recommend
2	**O**	Likely to recommend
3	**O**	Possibly recommend
4	**O**	Not likely to recommend
5	**O**	Definitely not recommend

Change in Performance

1.4.		When comparing the today's *ways of sharing knowledge and information* at your department with that of one year ago, have you experienced **any change** in performance?
Code		**Response options**
1	**O**	Very much improved
2	**O**	Improved
3	**O**	Stayed the same
4	**O**	Worsened
5	**O**	Very much worsened
99	**O**	Not observed

Frequency of Use: Information Search and Retrieval

1.5.	**How often** do you personally use the following means for **search or retrieval** of information relevant to your work? (1 = extremely often; 5 = never)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
1.5.1	File Share	**O**	**O**	**O**	**O**	**O**		**O**
1.5.2	Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.5.3	Expert Teams List in Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.5.4	Knowledge Library	**O**	**O**	**O**	**O**	**O**		**O**
1.5.5	Project TeamSite	**O**	**O**	**O**	**O**	**O**		**O**
1.5.6	Intranet	**O**	**O**	**O**	**O**	**O**		**O**
1.5.7	Contacting colleagues directly	**O**	**O**	**O**	**O**	**O**		**O**
1.5.8	E-mail	**O**	**O**	**O**	**O**	**O**		**O**
1.5.9	Team meetings and reviews	**O**	**O**	**O**	**O**	**O**		**O**
1.5.10	Blog	**O**	**O**	**O**	**O**	**O**		**O**

Satisfaction: Information Search and Retrieval

1.6.	And **how satisfied** are you with the following means for **sharing** of work relevant information? (1 = extremely satisfied; 5 = unsatisfied)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
1.6.1	File Share	**O**	**O**	**O**	**O**	**O**		**O**
1.6.2	Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.6.3	Expert Teams List in Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.6.4	Knowledge Library	**O**	**O**	**O**	**O**	**O**		**O**
1.6.5	Project TeamSite	**O**	**O**	**O**	**O**	**O**		**O**
1.6.6	Intranet	**O**	**O**	**O**	**O**	**O**		**O**
1.6.7	Contacting colleagues directly	**O**	**O**	**O**	**O**	**O**		**O**
1.6.8	E-mail	**O**	**O**	**O**	**O**	**O**		**O**
1.6.9	Team meetings and reviews	**O**	**O**	**O**	**O**	**O**		**O**
1.6.10	Blog	**O**	**O**	**O**	**O**	**O**		**O**

Frequency of Use: Information Provision

1.7.	**How often** do you personally **provide** work relevant information to your colleagues through the following systems? (1 = extremely often; 5 = never)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
1.7.1	File Share	**O**	**O**	**O**	**O**	**O**		**O**
1.7.2	Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.7.3	Expert Teams List in Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.7.4	Knowledge Library	**O**	**O**	**O**	**O**	**O**		**O**
1.7.5	Project TeamSite	**O**	**O**	**O**	**O**	**O**		**O**
1.7.6	Intranet	**O**	**O**	**O**	**O**	**O**		**O**
1.7.7	Contacting colleagues directly	**O**	**O**	**O**	**O**	**O**		**O**
1.7.8	E-mail	**O**	**O**	**O**	**O**	**O**		**O**
1.7.9	Team meetings and reviews	**O**	**O**	**O**	**O**	**O**		**O**
1.7.10	Blog	**O**	**O**	**O**	**O**	**O**		**O**

Recommendation

1.8.	How likely are you to **recommend** to your colleagues at Product Development to use the following means for **sharing** work relevant information? (1 = definitely recommend; 5 = definitely not recommend)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
1.8.1	File Share	**O**	**O**	**O**	**O**	**O**		**O**
1.8.2	Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.8.3	Expert Teams List in Wiki	**O**	**O**	**O**	**O**	**O**		**O**
1.8.4	Knowledge Library	**O**	**O**	**O**	**O**	**O**		**O**
1.8.5	Project TeamSite	**O**	**O**	**O**	**O**	**O**		**O**
1.8.6	Intranet	**O**	**O**	**O**	**O**	**O**		**O**
1.8.7	Contacting colleagues directly	**O**	**O**	**O**	**O**	**O**		**O**
1.8.8	E-mail	**O**	**O**	**O**	**O**	**O**		**O**
1.8.9	Team meetings and reviews	**O**	**O**	**O**	**O**	**O**		**O**
1.8.10	Blog							

Information Allocation vs. Search Habits

1.9.1.		Which of the following **information sources** do you usually use to access **project specific information?**
Code		**Response options**
1	☐	File Share
2	☐	Wiki
3	☐	Knowledge Library
4	☐	Project TeamSite
5	☐	Intranet
6	☐	Contacting colleagues directly
7	☐	E-mail
8	☐	Team meetings and reviews
99	**O**	No Answer

1.9.2.		Which of the following **information sources** do you usually use to access **technical know-how, best practices and guidelines?**
Code		**Response options**
1	☐	File Share
2	☐	Wiki
3	☐	Knowledge Library
4	☐	Project TeamSite
5	☐	Intranet
6	☐	Contacting colleagues directly
7	☐	E-mail
8	☐	Team meetings and reviews
99	**O**	No Answer

1.9.3.		Which of the following **information sources** do you usually use to access **tool/design flow documentation?**
Code		**Response options**
1	☐	File Share
2	☐	Wiki
3	☐	Knowledge Library
4	☐	Project TeamSite
5	☐	Intranet
6	☐	Contacting colleagues directly
7	☐	E-mail
8	☐	Team meetings and reviews
99	**O**	No Answer

1.9.4.		Which of the following **information sources** do you usually use to access **organizational or administrative information?**
Code		**Response options**
1	☐	File Share
2	☐	Wiki
3	☐	Knowledge Library
4	☐	Project TeamSite
5	☐	Intranet
6	☐	Contacting colleagues directly
7	☐	E-mail
8	☐[1]	Team meetings and reviews
99	**O**	No Answer

[1] Check-boxes "☐" allow multiple responses, in contrast to option boxes "**O**"

Questionnaire Part 2: Evaluation of File Share

Performance and GUI

2.1.	Following your experiences with **File Share**, how would you evaluate the following **general handling** aspects? (1= excellent; 5 = poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
2.1.1	Latency, while working in office	**O**	**O**	**O**	**O**	**O**		**O**
2.1.2	Latency, concerning remote access	**O**	**O**	**O**	**O**	**O**		**O**
2.1.3	User-friendliness of interface	**O**	**O**	**O**	**O**	**O**		**O**
2.1.4	Intuitiveness of usage	**O**	**O**	**O**	**O**	**O**		**O**

Search Function

2.2.	Following your experiences with **File Share (in particular searching information)**, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		**No Answer 99**
2.2.1	Ease of search process	**O**	**O**	**O**	**O**	**O**		**O**
2.2.2	Advanced search options available	**O**	**O**	**O**	**O**	**O**		**O**
2.2.3	Relevance of hits/search results	**O**	**O**	**O**	**O**	**O**		**O**
2.2.4	Search results handling (e.g. sorting, filtering)	**O**	**O**	**O**	**O**	**O**		**O**

Upload Function

2.3.	Following your experiences with **File Share (in particular uploading data files)**, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
2.3.1	Ease of process for uploading data files	**O**	**O**	**O**	**O**	**O**		**O**
2.3.2	Content structure/classification into folders (where to store which data files)	**O**	**O**	**O**	**O**	**O**		**O**

Questionnaire Part 3: Evaluation of Intranet

Performance and GUI

3.1.	Following your experiences with **Intranet**, how would you evaluate the following aspects? (1= excellent; 5 = poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
3.1.1	Latency, while working in office	**O**	**O**	**O**	**O**	**O**		**O**
3.1.2	Latency, concerning remote access	**O**	**O**	**O**	**O**	**O**		**O**
3.1.3	User-friendliness of interface	**O**	**O**	**O**	**O**	**O**		**O**
3.1.4	Intuitiveness of usage	**O**	**O**	**O**	**O**	**O**		**O**

Search Function

3.2.	Following your experiences with **Intranet**, in particular **searching information**, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		**No Answer 99**
3.2.1	Ease of search process	**O**	**O**	**O**	**O**	**O**		**O**
3.2.2	Advanced search options available	**O**	**O**	**O**	**O**	**O**		**O**
3.2.3	Relevance of hits/search results	**O**	**O**	**O**	**O**	**O**		**O**
3.2.4	Search results handling (e.g. sorting, filtering)	**O**	**O**	**O**	**O**	**O**		**O**

Upload Function

3.3.	Following your experiences with **Intranet**, in particular **uploading information**, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
3.3.1	Content structure/classification into categories (where to store which data files)	**O**	**O**	**O**	**O**	**O**		**O**
3.3.2	Ease of process for uploading data files	**O**	**O**	**O**	**O**	**O**		**O**

Questionnaire Part 4: Evaluation of the Department's Wiki

Performance and GUI

4.1.	Following your understanding of **Wiki**, how would you evaluate the following aspects? (1= excellent; 5 = poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
4.1.1	Latency, while working in office	**O**	**O**	**O**	**O**	**O**		**O**
4.1.2	Latency, concerning remote access	**O**	**O**	**O**	**O**	**O**		**O**
4.1.3	User-friendliness of interface	**O**	**O**	**O**	**O**	**O**		**O**
4.1.4	Intuitiveness of usage	**O**	**O**	**O**	**O**	**O**		**O**

Search Function

4.2.	Following your understanding of **Wiki**, concerning **search and retrieval** of work relevant information, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
4.2.1	Ease of search process	**O**	**O**	**O**	**O**	**O**		**O**
4.2.2	Advanced search options available	**O**	**O**	**O**	**O**	**O**		**O**
4.2.3	Relevance of hits/search results	**O**	**O**	**O**	**O**	**O**		**O**
4.2.4	Search results handling (e.g. sorting, filtering)	**O**	**O**	**O**	**O**	**O**		**O**

Content Provision Functionality

4.3.	Following your understanding of **Wiki** with respect to **creating and editing** articles, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
4.3.1	Ease of process for creating / editing articles	**O**	**O**	**O**	**O**	**O**		**O**
4.3.2	Options for adding/ editing multi-media elements to the articles, e.g. graphics, blue prints, videos	**O**	**O**	**O**	**O**	**O**		**O**
4.3.3	Content structure/classification (to what topic to assign which article)	**O**	**O**	**O**	**O**	**O**		**O**

Content Quality

4.4.	Following your understanding of **Wiki**, with respect to **quality of content**, how would you evaluate the following aspects? (1= excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
4.4.1	Number of articles and other information entries	**O**	**O**	**O**	**O**	**O**		**O**
4.4.2	Scope of information areas covered	**O**	**O**	**O**	**O**	**O**		**O**
4.4.3	Quality of information content (correctness, timeliness)	**O**	**O**	**O**	**O**	**O**		**O**
4.4.4	Presentation of content (e.g. layout, pictures, etc.)	**O**	**O**	**O**	**O**	**O**		**O**

Questionnaire Part 5: Wiki-Motivation Factors

External Factors

5.1.	To what extent do you **agree or disagree** with the following statements with respect to **Wiki**? (1 = totally agree; 5 = totally disagree)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
5.1.1	My **colleagues** frequently use Wiki for sharing work relevant information	**O**	**O**	**O**	**O**	**O**		**O**
5.1.2	Most of my colleagues **often create** articles for Wiki	**O**	**O**	**O**	**O**	**O**		**O**
5.1.3	Use of Wiki is recommended by PD **internal rules** and guidelines	**O**	**O**	**O**	**O**	**O**		**O**
5.1.4	My **superior** encourages sharing information through Wiki	**O**	**O**	**O**	**O**	**O**		**O**
5.1.5	Sharing information with each other through Wiki is part of our **working culture**	**O**	**O**	**O**	**O**	**O**		**O**

Motivation: Internal Factors

5.2.	The following statements concern **creating** articles for **Wiki.** To what extent do you agree or disagree with these statements? (1 = totally agree; 5 = totally disagree)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
5.2.1	Authors of Wiki articles **get enough feedback** on their articles from colleagues	**O**	**O**	**O**	**O**	**O**		**O**
5.2.2	Authors of Wiki articles **benefit** from better reputation	**O**	**O**	**O**	**O**	**O**		**O**
5.2.3	I often feel **uncertain**, while deciding what content could be worth adding to a Wiki article	**O**	**O**	**O**	**O**	**O**		**O**
5.2.4	I'm mostly **too busy** with my daily work to have time for creating an article	**O**	**O**	**O**	**O**	**O**		**O**

Questionnaire Part 6: Evaluation of the Corporate SharePoint Portal

Performance and GUI

6.1.	Following your understanding of **SharePoint**, how would you evaluate the following aspects? (1 = excellent; 5 = poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
6.1.1	Latency, while working in office	**O**	**O**	**O**	**O**	**O**		**O**
6.1.2	Latency, concerning remote access	**O**	**O**	**O**	**O**	**O**		**O**
6.1.3	User-friendliness of interface	**O**	**O**	**O**	**O**	**O**		**O**
6.1.4	Intuitiveness of usage	**O**	**O**	**O**	**O**	**O**		**O**

Search Function

6.2.	Following your understanding of **SharePoint, in particular Knowledge Library and Project TeamSite**, how would you evaluate the following aspects, concerning **search and retrieval** of work relevant information? (1 = excellent; 5= poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
6.2.1	Ease of search process	**O**	**O**	**O**	**O**	**O**		**O**
6.2.2	Advanced search options available	**O**	**O**	**O**	**O**	**O**		**O**
6.2.3	Relevance of hits/search results	**O**	**O**	**O**	**O**	**O**		**O**
6.2.4	Search results handling (e.g. sorting, filtering)	**O**	**O**	**O**	**O**	**O**		**O**

Content Provision Functionality

6.3.	Following your understanding of **SharePoint** with respect to **entering information** and **uploading data files**, how would you evaluate the following aspects? (1 = excellent; 5 = poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
6.3.1	Ease of process for storing / uploading information entries and data files	**O**	**O**	**O**	**O**	**O**		**O**
6.3.2	Options for entering multi-media elements, e.g. graphics, blue prints, videos	**O**	**O**	**O**	**O**	**O**		**O**
6.3.3	Content structure/classification (where to store which content)	**O**	**O**	**O**	**O**	**O**		**O**

Content Quality

6.4.	Following your understanding of **SharePoint**, with respect to **quality of content**, how would you evaluate the following aspects? (1 = excellent; 5 = poor)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
6.4.1	Number of information entries (e.g. articles in Knowledge Library)	**O**	**O**	**O**	**O**	**O**		**O**
6.4.2	Scope of information areas covered	**O**	**O**	**O**	**O**	**O**		**O**
6.4.3	Quality of information content (correctness, timeliness)	**O**	**O**	**O**	**O**	**O**		**O**
6.4.4	Presentation of content (e.g. layout, pictures, etc.)	**O**	**O**	**O**	**O**	**O**		**O**

Questionnaire Part 7: SharePoint Portal-Motivation Factors

Motivation: External Factors

7.1.	To what extent do you agree or disagree with the following statements with respect to **SharePoint**? (1 = totally agree; 5= totally disagree)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
7.1.1	Most of my **colleagues** frequently store / upload information into SharePoint	**O**	**O**	**O**	**O**	**O**		**O**
7.1.2	Most of my colleagues **often create** articles for Knowledge Library	**O**	**O**	**O**	**O**	**O**		**O**
7.1.3	Storage / upload of information into SharePoint is prescribed by PD **internal rules**	**O**	**O**	**O**	**O**	**O**		**O**
7.1.4	My **superior** insists on storage / upload of information into SharePoint	**O**	**O**	**O**	**O**	**O**		**O**
7.1.5	Sharing information with each other through SharePoint is part of our **working culture**	**O**	**O**	**O**	**O**	**O**		**O**

Motivation: Internal Factors

7.2.	The following statements concern **adding information entries** to **SharePoint** (in particular, creating articles for **Knowledge Library** and uploading data files to **Project TeamSite**). To what extent do you agree or disagree with these statements? (5 = totally agree; 1 = totally disagree)							
Code	**Response options**	**Code**						
		1	**2**	**3**	**4**	**5**		No Answer **99**
7.2.1	Authors of Knowledge Library articles get enough **feedback** from their colleagues.	**O**	**O**	**O**	**O**	**O**		**O**
7.2.2	Authors of Knowledge Library **benefit** from better reputation.	**O**	**O**	**O**	**O**	**O**		**O**
7.2.3	I often feel **uncertain**, while deciding what content could be worth adding to SharePoint portal.	**O**	**O**	**O**	**O**	**O**		**O**
7.2.4	I'm mostly **too busy** with my daily work to have time for adding contents to SharePoint (Project TeamSite, Knowledge Library, etc.)	**O**	**O**	**O**	**O**	**O**		**O**

Questionnaire Part 8: Classification Statistics

Job Position

8.1.		What is your current job position?
Code		**Response options**
1	**O**	Employee in a technical position
2	**O**	Manager
3	**O**	Other Function: e.g. team assistant, accounting, marketing, etc.

Site Location

8.2.		Please indicate your site location.
Code		**Response options**
1	**O**	Germany
2	**O**	USA
3	**O**	China
4	**O**	Other Location

Tenure

8.3.		For how long have you already been working at this company?
Code		**Response options**
1	**O**	Less than 1 year
2	**O**	1-5 years
3	**O**	6-10 years
4	**O**	Since more than 10 years

A.2 Survey Results

Table A.1: Cross tabulation of respondents by tenure and location.

		TOTAL	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
	Base	149	9	56	35	49
Germany		75,2%	44,4%	62,5%	80,0%	91,8%
USA		16,8%	11,1%	25,0%	17,1%	8,2%
China		7,4%	33,3%	12,5%	2,9%	0,0%
Other location		0,7%	11,1%	0,0%	0,0%	0,0%
TOTAL		100,0%	100,0%	100,0%	100,0%	100,0%

Table A.2: Cross-tabulation of respondents by position and tenure

		TOTAL	Position		
			Employee in a technical position	Manager	Other function
	Base	149	131	14	4
Less than 1 year		6,0%	6,1%	0,0%	25,0%
1 - 5 years		37,6%	42,0%	0,0%	25,0%
6 - 10 years		23,5%	23,7%	14,3%	50,0%
Since more than 10 years		32,9%	28,2%	85,7%	0,0%
TOTAL		100,0%	100,0%	100,0%	100,0%

Table A.3: Cross-tabulation of information needs by site location.

	Site Location				
	Base	Top-2	Germany	USA	China
Project Specific Information	148	65,5%	62,5%	72,0%	81,8%
Technical Know-How	148	43,2%	42,0%	40,0%	63,6%
Design Flow Documentation	146	31,5%	33,3%	33,3%	9,1%
Administrative Information	148	7,4%	8,9%	4,0%	0,0%
Expert Networking	146	21,9%	22,7%	12,0%	36,4%
Checklists	109	11,0%	9,5%	17,6%	12,5%
Training Material	146	17,1%	16,4%	12,0%	36,4%

Frequency of Use: Search for Information

Table A.4: Cross-tabulation of search intensity by tenure.

	Base	Total	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
File Share	146	74,0%	88,9%	80,0%	64,7%	70,8%
Wiki	146	21,9%	25,0%	25,5%	23,5%	16,3%
Expert Teams List	145	6,2%	0,0%	7,4%	11,4%	2,1%
Knowledge Library	148	20,3%	50,0%	21,4%	22,9%	12,2%
Project TeamSite	146	63,0%	62,5%	62,5%	70,6%	58,3%
Intranet	146	43,8%	75,0%	40,7%	45,7%	40,8%
Contacting Colleagues Directly	148	92,6%	100,0%	83,9%	94,3%	100,0%
E-mail	148	88,5%	87,5%	83,9%	91,4%	91,8%
Team Meetings	148	68,9%	75,0%	69,6%	68,6%	67,3%
Blog	134	0,7%	0,0%	2,1%	0,0%	0,0%

Table A.5: Cross-tabulation of search intensity by site location.

	Base	Total	Location		
			Germany	USA	China
File Share	146	74,0%	73,6%	70,8%	81,8%
Wiki	146	21,9%	21,6%	16,7%	36,4%
Expert Teams List	145	6,2%	6,4%	4,2%	9,1%
Knowledge Library	148	20,3%	19,6%	20,0%	27,3%
Project TeamSite	146	63,0%	59,1%	80,0%	63,6%
Intranet	146	43,8%	42,3%	50,0%	45,5%
Contacting Colleagues Directly	148	92,6%	94,6%	88,0%	81,8%
E-mail	148	88,5%	86,6%	96,0%	90,9%
Team Meetings	148	68,9%	67,0%	76,0%	72,7%
Blog	134	0,7%	1,0%	0,0%	0,0%

Table A.6: Cross-tabulation of search intensity by job position.

	Base	Total	Position		
			Employee in a technical position	Manager	Other function[2]
File Share	146	74,0%	73,6%	78,6%	66,7%
Wiki	146	21,9%	23,1%	7,1%	50,0%
Expert Teams List	145	6,2%	6,3%	7,1%	0,0%
Knowledge Library	148	20,3%	20,6%	21,4%	0,0%
Project TeamSite	146	63,0%	63,1%	69,2%	33,3%
Intranet	146	43,8%	42,6%	50,0%	66,7%
Contacting Colleagues Directly	148	92,6%	92,4%	100,0%	66,7%
E-mail	148	88,5%	88,5%	92,9%	66,7%
Team Meetings	148	68,9%	67,9%	78,6%	66,7%
Blog	134	0,7%	0,8%	0,0%	0,0%

[2] Small sample size: $n \leq 4$

Frequency of Use: Provision of Information

Table A.7: Cross-tabulation of provision intensity by tenure.

	Base	Total	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
File Share	147	60,5%	25,0%	58,2%	71,4%	61,2%
Wiki	141	12,8%	14,3%	9,4%	20,6%	10,6%
Expert Teams List	135	5,9%		7,8%	6,1%	4,5%
Knowledge Library	138	5,8%		5,6%	6,3%	6,7%
Project TeamSite	143	42,7%	12,5%	43,6%	51,5%	40,4%
Intranet	138	10,9%	25,0%	9,4%	9,4%	11,1%
Contacting Colleagues Directly	146	92,5%	100,0%	83,6%	94,1%	100,0%
E-mail	147	93,9%	100,0%	85,7%	100,0%	98,0%
Team Meetings	146	73,3%	100,0%	69,6%	73,5%	73,5%
Blog	115	1,7%	0,0%	2,4%	0,0%	2,7%

Table A.8: Cross-tabulation of provision intensity by site location.

	Base	Total	Location		
			Germany	USA	China
File Share	147	60,5%	60,4%	60,0%	63,6%
Wiki	141	12,8%	15,7%	4,2%	0,0%
Expert Teams List	135	5,9%	6,9%	4,2%	0,0%
Knowledge Library	138	5,8%	5,8%	4,0%	11,1%
Project TeamSite	143	42,7%	39,3%	56,0%	45,5%
Intranet	138	10,9%	11,5%	4,2%	20,0%
Contacting Colleagues Directly	146	92,5%	94,5%	84,0%	90,9%
E-mail	147	93,9%	95,5%	88,0%	90,9%
Team Meetings	146	73,3%	72,1%	80,0%	70,0%
Blog	115	1,7%	2,4%	0,0%	0,0%

Table A.9: Cross-tabulation of provision intensity by job position.

	Base	Total	Position		
			Employee in a technical position	Manager	Other function[3]
File Share	147	60,5%	60,3%	71,4%	0,0%
Wiki	141	12,8%	11,1%	23,1%	50,0%
Expert Teams List	135	5,9%	5,8%	8,3%	0,0%
Knowledge Library	138	5,8%	4,8%	18,2%	0,0%
Project TeamSite	143	42,7%	42,2%	50,0%	0,0%
Intranet	138	10,9%	8,1%	25,0%	100,0%
Contacting Colleagues Directly	146	92,5%	91,5%	100,0%	100,0%
E-mail	147	93,9%	93,8%	92,9%	100,0%
Team Meetings	146	73,3%	72,9%	85,7%	33,3%
Blog	115	1,7%	1,0%	8,3%	0,0%

[3] Small sample size: $n \leq 4$

Table A.10: Information Provision/ Information Search Ratio.

	Search Top-2	Provision Top-2	Provision/ Search Ratio
Knowledge Library	20,3%	5,8%	0,29
Wiki	21,9%	12,8%	0,58
Intranet	43,8%	10,9%	0,25
Project TeamSite	63,0%	42,7%	0,68
Team Meetings	68,9%	73,3%	1,06
File Share	74,0%	60,5%	0,82
E-mail	88,5%	93,9%	1,06
Contacting Colleagues Directly	92,6%	92,5%	1,00

Table A.11: Search habits: project related information.

	Top-2
Base	149
FileShare	62,4%
Wiki	8,1%
Knowledge Library	10,1%
Project TeamSite	71,1%
Intranet	21,5%
Direct Contact	77,9%
E-mail	82,6%
Team Meeting	66,4%
No Answer	1,3%

Table A.12: Search habits: technical know-how, best practices and guidelines.

	Top-2
Base	149
FileShare	48,6%
Wiki	39,9%
Knowledge Library	35,8%
Project TeamSite	28,4%
Intranet	45,9%
Direct Contact	78,4%
E-mail	60,1%
Team Meeting	37,8%
No Answer	2,7%

Table A.13: Search habits: tool/design flow documentation.

	Top-2
Base	149
FileShare	31,3%
Wiki	30,6%
Knowledge Library	21,8%
Project TeamSite	21,1%
Intranet	61,9%
Direct Contact	53,7%
E-mail	40,8%
Team Meeting	18,4%
No Answer	5,4%

Table A.14: Search habits: organizational/ administrative information.

	Top-2
Base	149
FileShare	15,5%
Wiki	4,1%
Knowledge Library	6,8%
Project TeamSite	11,5%
Intranet	68,9%
Direct Contact	42,6%
E-mail	45,3%
Team Meeting	33,8%
No Answer	6,1%

Table A.15: Cross-tabulation: search habits (project related information) by tenure.

		Tenure			
	Top-2	Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Base	149	9	56	35	49
FileShare	62,4%	33,3%	66,1%	71,4%	57,1%
Wiki	8,1%	11,1%	5,4%	8,6%	10,2%
Knowledge Library	10,1%	22,2%	5,4%	14,3%	10,2%
Project TeamSite	71,1%	55,6%	71,4%	68,6%	75,5%
Intranet	21,5%	33,3%	14,3%	20,0%	28,6%
Direct Contact	77,9%	77,8%	73,2%	80,0%	81,6%
E-mail	82,6%	77,8%	78,6%	82,9%	87,8%
Team Meeting	66,4%	66,7%	66,1%	71,4%	63,3%
No Answer	1,3%	11,1%	1,8%		

Table A.16: Cross-tabulation: search habits (tool/design flow documentation) by tenure

		Tenure			
	TOTAL	Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Base	149	9	56	35	49
FileShare	31,3%	44,4%	30,9%	40,0%	22,9%
Wiki	30,6%	44,4%	29,1%	37,1%	25,0%
Knowledge Library	21,8%	33,3%	18,2%	22,9%	22,9%
Project TeamSite	21,1%	33,3%	20,0%	17,1%	22,9%
Intranet	61,9%	66,7%	61,8%	51,4%	68,8%
Direct Contact	53,7%	66,7%	58,2%	48,6%	50,0%
E-mail	40,8%	33,3%	41,8%	42,9%	39,6%
Team Meeting	18,4%	33,3%	20,0%	11,4%	18,8%
No Answer	5,4%	11,1%	5,5%	5,7%	4,2%

Table A.17: Cross-tabulation: search habits (technical know-how, best practices, and guidelines) by site location.

	TOTAL	Location		
		Germany	USA	China
Base	149	112	25	11
FileShare	48,6%	50,0%	41,7%	54,5%
Wiki	39,9%	42,9%	33,3%	27,3%
Knowledge Library	35,8%	33,9%	37,5%	54,5%
Project TeamSite	28,4%	27,7%	37,5%	18,2%
Intranet	45,9%	46,4%	45,8%	45,5%
Direct Contact	78,4%	83,0%	75,0%	45,5%
E-mail	60,1%	60,7%	62,5%	54,5%
Team Meeting	37,8%	36,6%	37,5%	54,5%
No Answer	2,7%	1,8%	0,0%	9,1%

Table A.18: Change in performance.

	TOTAL
Base	130
Very much improved	6,2%
Improved	53,8%
Stayed the same	32,3%
Worsened	7,7%
Very much worsened	0,0%
TOTAL	100,0%
Mean	2,4
Top-2	60,0%
Middle	32,3%
Bottom-2	7,7%

Table A.19: Cross-tabulation of the level of satisfaction with knowledge management by tenure.

	TOTAL	Tenure			
		Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Base	146	8	55	35	48
Extremely satisfied	1,4%	12,5%		2,9%	0,0%
Very satisfied	11,6%	12,5%	14,5%	5,7%	12,5%
Satisfied	58,9%	62,5%	58,2%	57,1%	60,4%
Rather satisfied	21,9%	12,5%	18,2%	31,4%	20,8%
Unsatisfied	6,2%		9,1%	2,9%	6,3%
TOTAL	100,0%	100,0%	100,0%	100,0%	100,0%
Mean	3,2	2,8	3,2	3,3	3,2
Top-2	13,0%	25,0%	14,5%	8,6%	12,5%
Middle	58,9%	62,5%	58,2%	57,1%	60,4%
Bottom-2	28,1%	12,5%	27,3%	34,3%	27,1%

Table A.20: Cross-tabulation of the level of satisfaction with available means for sharing knowledge by tenure.

	Base	TOTAL	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
File Share	139	56,8%	57,1%	54,7%	54,5%	60,9%
Wiki	112	40,2%	28,6%	40,9%	37,0%	44,1%
Expert Teams List	83	27,7%	28,6%	28,6%	27,8%	26,1%
Knowledge Library	112	33,0%	42,9%	36,4%	34,6%	25,7%
Project TeamSite	132	53,8%	57,1%	59,6%	55,2%	45,5%
Intranet	142	47,9%	62,5%	44,2%	55,9%	43,8%
Contacting colleagues directly	148	87,2%	62,5%	85,7%	88,6%	91,8%
E-mail	146	78,8%	75,0%	83,6%	68,6%	81,3%
Team meetings and reviews	146	55,5%	62,5%	60,0%	54,3%	50,0%
Blog	26	3,8%	0,0%	10,0%	0,0%	0,0%

Table A.21: Cross-tabulation of the recommendation of available means for sharing knowledge by tenure.

	Base	TOTAL	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
File Share	140	62,9%	75,0%	57,4%	68,8%	63,0%
Wiki	117	62,4%	66,7%	61,4%	69,2%	58,5%
Expert Teams List	97	36,1%	50,0%	39,5%	47,4%	23,5%
Knowledge Library	115	48,7%	71,4%	48,9%	54,2%	40,5%
Project TeamSite	131	75,6%	87,5%	76,9%	85,7%	65,1%
Intranet	132	56,1%	75,0%	57,8%	58,1%	50,0%
Contacting colleagues	145	91,7%	100,0%	87,3%	94,1%	93,8%
E-mail	144	77,1%	87,5%	74,5%	81,8%	75,0%
Team meetings	143	71,3%	85,7%	74,5%	69,7%	66,7%
Blog	67	10,4%	16,7%	9,1%	13,3%	8,3%

Table A.22: Evaluation of File Share.

File Share	Base	TOTAL
Latency Office	129	64,3%
Latency Remote	109	33,9%
User-Friendliness of GUI	132	37,1%
Intuitiveness of Usage	129	49,6%
Ease of Search Process	128	18,0%
Ease of Uploading	123	77,2%
Content Structure	126	39,7%
Advanced Search	121	14,0%
Relevance of Search Results	114	17,5%
After Search Results Handling	113	17,7%

Table A.23: Evaluation of Intranet: cross-tabulation by tenure.

Intranet	Base	TOTAL	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Latency Office	133	78,9%	71,4%	78,7%	84,4%	76,6%
Latency Remote	104	57,7%	50,0%	52,5%	65,2%	59,5%
User-Friendliness of GUI	134	45,5%	57,1%	39,6%	46,9%	48,9%
Intuitiveness of Usage	133	45,9%	57,1%	40,4%	56,3%	42,6%
Ease of Search Process	135	36,3%	71,4%	43,8%	33,3%	25,5%
Ease of Uploading		34,8%		40,9%	53,8%	24,1%
Content Structure	81	37,0%	33,3%	31,0%	56,3%	33,3%
Advanced Search Options	125	24,0%	57,1%	31,1%	13,8%	18,2%
Relevance of Search Results	129	23,3%	57,1%	34,0%	12,9%	13,6%
After-Search Results Handling	128	18,0%	57,1%	21,3%	12,9%	11,6%

Table A.24: Evaluation of Wiki: cross-tabulation by tenure.

Wiki	Base	TOTAL	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Latency Office	95	75,8%	40,0%	70,3%	86,4%	80,6%
Latency Remote	76	60,5%	50,0%	50,0%	70,6%	71,4%
User Friendliness of GUI	94	67,0%	80,0%	55,6%	81,8%	67,7%
Intuitiveness of Usage	94	67,0%	80,0%	56,8%	68,2%	76,7%
Ease of Search Process	93	67,7%	100,0%	55,6%	78,3%	69,0%
Ease of Adding Content	65	64,6%	100,0%	59,1%	83,3%	54,2%
Number of Articles	84	39,3%	80,0%	34,4%	38,1%	38,5%
Scope of Articles	83	42,2%	80,0%	38,7%	38,1%	42,3%
Content Quality	86	51,2%	40,0%	54,8%	54,5%	46,4%
Content Presentation	85	38,8%	80,0%	29,0%	36,4%	44,4%
Adding Multi-Media Content	49	30,6%	100,0%	35,3%	41,7%	15,8%
Content Structure	65	36,9%	100,0%	39,1%	33,3%	31,8%
Advanced Search Options	79	48,1%	100,0%	46,7%	40,0%	45,8%
Relevance of Search Results	88	43,2%	80,0%	44,1%	40,9%	37,0%
After-Search Results Handling	79	30,4%	80,0%	27,3%	27,8%	26,1%
Colleagues often use	104	19,2%	20,0%	22,5%	16,7%	17,1%
Colleagues often create articles	103	7,8%	20,0%	7,7%	8,3%	5,7%
Internal Rules	91	45,1%	25,0%	44,7%	47,4%	46,7%
Encouraged by superior	101	33,7%	20,0%	32,5%	34,8%	36,4%
Authors get feedback	61	9,8%	100,0%		17,6%	11,1%
Authors have better reputation	63	20,6%	100,0%	23,1%	7,1%	19,0%
Uncertain	67	35,8%	50,0%	37,0%	36,8%	31,6%
Too busy	78	61,5%	100,0%	56,7%	61,9%	64,0%

Table A.25: Evaluation of the corporate SharePoint portal: cross-tabulation by tenure.

Corporate SharePoint Portal	Base	TOTAL	Tenure			
			Less than 1 year	1 - 5 years	6 - 10 years	Since more than 10 years
Latency Office	139	60,4%	57,1%	54,7%	69,7%	60,9%
Latency Remote	111	43,2%	25,0%	40,4%	48,0%	45,7%
User-Friendliness of GUI	141	43,3%	57,1%	50,0%	39,4%	36,2%
Intuitiveness of Usage	141	43,3%	57,1%	51,9%	39,4%	34,0%
Ease of Search Process	125	39,2%	66,7%	38,0%	50,0%	29,3%
Ease of Uploading	116	61,2%	50,0%	66,0%	62,1%	55,3%
Number of Information Entries	109	49,5%	60,0%	54,5%	48,1%	42,4%
Scope of Content	110	41,8%	40,0%	45,7%	39,3%	38,7%
Content Quality	111	53,2%	20,0%	53,2%	48,1%	62,5%
Content Presentation	114	42,1%	40,0%	43,5%	41,4%	41,2%
Adding Multi-Media Content	91	47,3%	100,0%	46,2%	37,5%	55,6%
Content Structure	118	37,3%	25,0%	45,8%	31,0%	32,4%
Advanced Search Options	109	32,1%	66,7%	35,6%	30,4%	22,9%
Relevance of Search Results	115	28,7%	50,0%	25,5%	32,0%	27,0%
After-Search Results Handling	109	27,5%	66,7%	26,1%	30,4%	20,6%
Colleagues often store	130	47,7%	40,0%	50,0%	45,2%	47,7%
Colleagues often create	121	15,7%	20,0%	18,4%	10,0%	16,2%
Internal Rules	102	29,4%	20,0%	34,1%	36,4%	19,4%
Superior insists	126	36,5%	20,0%	36,5%	40,0%	35,9%
Working Culture	134	41,0%	40,0%	41,5%	45,2%	37,8%
Authors get Feedback	73	19,2%	33,3%	28,6%	11,1%	12,5%
Authors' reputation benefits	77	26,0%	50,0%	32,1%	16,7%	22,2%
Uncertain about contents	89	25,8%	33,3%	26,5%	28,6%	22,6%
Too busy	100	42,0%	50,0%	35,9%	50,0%	42,9%

Table A.26: Evaluations of system quality.

	Top-2 File Share	Top-2 Intranet	Top-2 Wiki	Top-2 SharePoint Platform
Latency Office	64,3%	78,9%	75,8%	60,4%
Latency Remote	33,9%	57,7%	60,5%	43,2%
GUI	37,1%	45,5%	67,0%	43,3%
Intuitiveness of Usage	49,6%	45,9%	67,0%	43,3%
Ease of Search Process	18,0%	36,3%	67,7%	39,2%
Ease of Adding Content	77,2%	34,8%	64,6%	61,2%

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