Towards understanding internal knowledge exchange

A single case study

Lukas Spreitzer
Abstract
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Knowledge is a crucial resource in modern business environments. The proper management of an organization’s internal knowledge assets can lead to a sustainable competitive advantage. Literature on knowledge management has identified a large number of factors that influence the transfer of knowledge within organizations. The purpose of this study is to investigate how internal knowledge assets are managed in the R&D department of a large company in the high-tech healthcare industry, what informal and formal organizational factors influence the transfer of knowledge, and to explore possible requirements and success factors for ICTs in knowledge transfer. A qualitative case study approach is adopted and semi-structured interviews with a total of ten members of the research and development departments are performed. A theoretical framework is used with elements from the knowledge-based view of the firm, dimensions of knowledge strategies, operational knowledge management practise, knowledge transformation models, and social exchange theory. The results of the empirical research show a knowledge-heavy company that engages in personalization, as well as codification strategies with the support of ICTs. Socialisation, combination, externalisation, and internalization are identified and related to the organization’s processes and practises. In addition, drivers, such as a friendly, cooperative atmosphere and the complexity of task, as well as deterrents of knowledge transfer, such as lack of time and weaknesses of ICTs, are identified. Interviewees identified several requirements for ICTs, above all low thresholds and the attainment of critical mass, as well as the demand for standardization and formalization. It was also found that employees are willing to document their knowledge in a technological knowledge management system if they can retrieve knowledge for themselves from the same system. This study provides a relevant example of knowledge management and transfer processes and practises, as well as influences on internal knowledge exchange.
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1. Introduction

Knowledge is a crucial resource in modern business environments (Grant, 1996; Gold, et al., 2001; North & Kumta, 2018). Approaching from a resource-based perspective, the knowledge-based view of the firm identified knowledge as the primary resource to gain a sustainable competitive advantage (Grant, 1996). The transfer of rare, valuable, inimitable, and non-substitutable knowledge within and outside a company can increase the productivity and quality of a company’s performance (Grant, 1996; Inkinen, 2016). In order to make full use of a company’s knowledge assets in an environment characterized by innovation, adequate knowledge management practices are necessary (North & Kumta, 2018, p. 15).

Heisig (2009) identified five different knowledge management activities: share, identify, apply, store and create. The focus of this study will be on internal knowledge transfer, i.e. the active communication of what one knows or the active consultation of others to find out what they know (Krylova, et al., 2016).

Various scholars have investigated the relationship between firm performance and knowledge management activities (Inkinen, 2016; Andreeva & Kianto, 2012). Peter Heisig (2009) classified critical success factors for knowledge management into four categories: These are human-oriented, i.e. people, culture, and leadership; organization-oriented, i.e. structures and process, technology-oriented, i.e. infrastructure and applications; and management-process-oriented factors, i.e. strategy, goals, and measurements (ibid). Multiple scholars investigated barriers and drivers for knowledge management activities, with a special focus on the transfer of knowledge: Amongst others, change of behavior, lack of time, lack of trust, limitations of IT, a high cost of sharing have been identified as barriers, while a shared mental model, minimal structures, an intrinsic motivation to help others, or monetary rewards have been identified as drivers (Razmerita, et al., 2016; Krylova, et al., 2016; Qureshi & Evans, 2015). Further, organizational structures that encourage cooperation may lead to a competitive advantage (North & Kumta, 2018; Sieloff, 1999). Another framework used for the analysis of knowledge sharing is the social exchange theory (Serenko & Bontis, 2016). It describes the motivation for social interaction of organizational members (ibid). In a knowledge management context, it investigates the willingness of employees to engage in knowledge exchanges due to perceived benefits, such as promotion, monetary rewards, or job security (ibid).
Today, technology-free knowledge management initiatives of organizations are difficult to imagine (Bharati, et al., 2015). Various technological tools are used for the coordination and sharing of knowledge, including databases (Wijnhoven, 2003; Soto-Acosta & Cegarra-Navarro, 2016), and enterprise social networks (Turban, et al., 2011; Andriole, 2010; Archer-Brown & Kietzmann, 2018). Studies have linked information and communication technologies (ICTs) for knowledge management with organizational performance (Andreeva & Kianto, 2012; Inkinen, 2016). ICTs enables knowledge integration, and can eliminate barriers to communication (Gold, et al., 2001), and may facilitate operational activities (North & Kumta, 2018, p. 245). Enterprise social networks have been found to positively influence knowledge sharing within organizations (Palacios-Marqués, et al., 2016; Mirzaee & Ghaffari, 2018).

While most scholars have chosen quantitative studies (Inkinen, 2016), few studies have chosen a qualitative approach (e.g. (Al Saifi, et al., 2016; Qureshi & Evans, 2015). There is a need for case studies, as they can provide information of extremes (poor or extremely good performance), the best HRM practices, knowledge management leadership qualities and strategic KM practices (Inkinen, 2016).

The purpose of this study is to investigate, how internal knowledge assets are managed in the R&D department of a large high-tech company and what informal and formal organizational factors influence the transfer of knowledge and find out possible requirements and success factors for ICTs. By using a qualitative single case study approach in a knowledge-intensive industry and a theoretical framework built on the knowledge-based view of the firm, the findings of this study shall further contribute to the better understanding of knowledge management processes and practices, as well as drivers, deterrents and motivations for intra-organizational knowledge transfer.

The following research questions are investigated:

*How is knowledge management implemented in the R&D department of a large company in the high-tech healthcare industry?*

*What requirements and motivations do organizational members see for knowledge transfer through ICTs?*

*Which formal and informal organizational factors influence and motivate the transfer of knowledge?*
2. Methods
To address these research questions, first a literature review was performed to build a theoretical framework including the knowledge-based view of the firm, theory on knowledge management strategies, knowledge transformation, ICTs, and social exchange theory. Empirical data was gathered by using a qualitative case study approach with semi structured interviews aiming to investigate how internal knowledge assets are managed in the research and development of a large high-tech company in the healthcare industry.

The company and interviewees
The investigated organization is a German company with a long history and extensive experience in the high-tech healthcare sector. It is the market leader in its field, and its self-reported core competencies are technological know-how, products & solutions, as well as market knowledge, and customer proximity. It employs more than 6000 employees at more than 50 sites. The research and development departments are located at two main sites in Austria and Germany.

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<thead>
<tr>
<th>Number</th>
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<th>Position</th>
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<td>1</td>
<td>Research, Austria</td>
<td>Head of research hub (Vienna)</td>
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<tr>
<td>2</td>
<td>Research, Austria</td>
<td>PhD candidate</td>
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<td>3</td>
<td>Research, Austria</td>
<td>Opportunity manager</td>
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<td>Research, Austria</td>
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<td>5</td>
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<td>Research, Germany</td>
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Table 1: Study participants
The interviews were performed in the research department and the sample was kept as heterogenous as possible to gain different point of views. Table 1 shows the list of study participants. As can be seen six interview partners were part of the research department, two
of the intellectual property (IP) management unit, and two of the development department. Nine of the interviewees were located in the Austrian site, and one at the German site. It can further be seen, that a diverse sample of interviewees was selected. The experience in the firm ranged from 1 to 16 years, and a variety of positions including managers, project leaders, employees, and one PhD candidate.

The interviews

The interviews lasted between 24 and 62 mins, with an average duration of 43 minutes. Eight of the interviews were conducted at the Austrian site, and two during a video call. The questionnaire of the interview can be seen in the appendix. The first question addressed the professional background of the interviewees, their current position and corresponding tasks, and years of experience in the firm. The second questions aimed to investigate the current structure and organisation of the research and development departments. The question was based on findings of various scholars connecting organisational structure and organisation with knowledge management (e.g. (Ravasi & Verona, 2001; North & Kumta, 2018; Krylova, et al., 2016)). The third question, arguably the broadest question, investigates which policies, procedures, and resources are used for and influence knowledge management in the organisation, in particular in the investigated departments. The fourth question addressed cooperation and competition in connection to knowledge sharing, as scholars have found this to be an influencing factor for effective knowledge management (e.g. (Sieloff, 1999; North & Kumta, 2018). While question five addressed the availability of knowledge, question six addressed perceived improvements to the current state, motivation, and possible contribution of organizational members. Question seven addressed how individual knowledge is converted into collective, i.e. organizational, knowledge. The onboarding process, as well as possibilities for continuing education, which are of great importance for effective knowledge management (Davenport, et al., 1998), were further addressed with question eight. As the company operates in multiple sites, the communication and transfer of knowledge between the sites, was investigated with the ninth question. In addition, this question addressed communication and knowledge transfer between departments and units.

The interviews were performed in German, as this was the mother tongue of all participants and thus was perceived as the most expedient approach. The interviews were transcribed, and key passages were translated to English. The information gathered in the interviews was then put in a narrative form, with the insertion of key quotes to underline certain points.
Discussion study design

The research and development departments were chosen, as the management of knowledge is crucial, and creation of knowledge is one of the main tasks in these departments. A qualitative case study was chosen, as a lack of qualitative studies was reported in this field of research (Inkinen, 2016). Furthermore, case studies can contribute to a field of research by providing examples (Flyvberg, 2006). As can be seen above, the first research question is a “how”-question and is thus aiming to explore a matter of interest in detail. The semi-structured interview approach has the flexibility to explore certain phenomena in depth, while maintaining a structured agenda to see patterns in interviews (DiCicco-Bloom & Crabtree, 2006).

One might argue that one limitation is that only one firm is investigated, and thus the results cannot be generalized. However, it can be argued that by focusing on one firm and including as many individual viewpoints as possible in this single case study a relevant example is provided (Flyvberg, 2006). It makes sense that in a study on knowledge management, the actual sharing of individual knowledge is used to construct an image of how knowledge management takes place in one particular firm.

In addition, interviewees might have held back with criticism towards their own company. As it can be assumed that personal opinions were involved, the results may be biased. However, this study can contribute to the better understanding of motivations, drivers and deterrents of intraorganizational knowledge transfer, as qualitative interviews allow the in-depth analysis of specific aspects of knowledge management derived from previous findings (Crescentini & Giuditta, 2009; Qureshi & Evans, 2015).

Ethical considerations

A few ethical aspects must be considered here: First, the privacy of the interviewees must be ensured. The name of the participants will not be shown, thus anonymity is given. In addition, the name of the company, as well as information, that would inevitably lead to its identification, will not be stated. Second, the interviewees must give their informed consent before the interview. Third, the participants will be treated fairly and provided with all relevant information.
3. Literature Review

Knowledge Management is a common theme in organizational literature. Scholars have approached the topic from various angles, and several streams of literature may be identified: One major stream, especially by early scholars, aims to define knowledge (e.g., Nonaka & Takeuchi, 1995). The use of dichotomies is dominant for the definition of knowledge, e.g., tacit vs. explicit, individual vs. collective, or internal vs. external (Heisig, 2009). Other scholars have emphasized the relevance of knowledge to the firm (Grant, 1996; Andreeva & Kianto, 2012). The knowledge-based view of the firm is based on the assumption that knowledge is the primary resource of an organization to gain a sustainable competitive advantage (Grant, 1996). It is thus the role of knowledge management to utilize knowledge to improve firm performance (North & Kumta, 2018, p. 15). Engagement in knowledge management practices was found to have an impact on organizational and financial performance by enhancing creative problem solving and problem-solving speed (Giampoli, et al., 2017). Heisig (2009) further classified KM processes in organizations, which are the systematic handling of knowledge aiming towards organization goals: sharing, creation, identify, apply, and store. Similar classification can be found throughout literature (Wijnhoven, 2003; North & Kumta, 2018).

Two dimensions of knowledge management strategies have been identified through knowledge management literature: knowledge-type and knowledge origin (Kim, et al., 2014; Choi & Lee, 2003). Knowledge-type refers to the extent in which the knowledge management strategy is human-oriented (personalization) or system-oriented (codified), and knowledge origin to the extent of knowledge being externally or internally sourced. Kim et al. (2014) approached KM Strategies from a contingency perspective and argued that the employment of mixed strategies results in successful knowledge management. They identified four different strategies: external codification, internal codification, external personalization, and internal personalization. The codification strategy aims to identify, codify and store information in explicit form for future purpose, while the personalization strategy relies on the tacit knowledge “owned” by people and aims to set up infrastructure to facilitate and enable the knowledge flow between people (North & Kumta, 2018, p. 161). Kim et al. (2014) argued that the knowledge management strategy is influenced by contingency factors, such as that the environmental knowledge intensity and organizational information systems maturity.
Another major stream of knowledge management literature are success factors (Heisig, 2009). It is challenging to find the “right” approach to knowledge management. The culture of the company plays a role, as well as a combination of information systems and people systems (North & Kumta, 2018, p. X). Heisig (2009) classifies these factors in four categories: human-oriented, i.e. people, culture, leadership; organization-oriented, i.e. processes and structures; technology-oriented, i.e. infrastructure and applications; and management-process-oriented factors, i.e. strategy, goals, and measurements (ibid). In a survey performed in 341 project teams Khedhaouria and Jamal (2015) have found that the learning orientation of team members has a critical role for knowledge sourcing, reuse and creation, while the internet is effective for knowledge creation.

Multiple studies have investigated supporting and hindering factors of knowledge sharing and transfer. Knowledge transfer refers to the active communication of what one knows or the active consultation of others to find out what they know (Krylova, et al., 2016). Enjoying helping others, monetary rewards, managements support, encourages and motivation have been identified as drivers, while change of behavior, and lack of trust and time are hindering knowledge sharing (Razmerita, et al., 2016). Another study found experimental culture, storytelling practice, a shared mental model and minimal structures to be drivers (Krylova, et al., 2016). Qureshi & Evans (2015) identified the following obstacles for knowledge-sharing in the pharmaceutical industry: limitations of IT, knowledge-hiding, lack of trust, lack of time, non-educational mindset, poor leadership, high cost of knowledge sharing, lack of socialization and organizational politics.

A major stream in knowledge management literature is focusing on technologies that aim to enable the sharing of knowledge. Information and communication technologies (ICTs) may be classified in the technology-oriented success factors. Bharati et al. (2015) stated that it is difficult to imagine a knowledge management initiative of organization to be completely technology-free. Enterprise social networks have been found to positively influence knowledge sharing within organizations (Palacios-Marqués, et al., 2016; Mirzaee & Ghaffari, 2018). Oparachoa (2016) concluded that innovation in geographically dispersed organizations is driven by the utilization of intra-organizational social networks. In addition, Enterprise social media was found to uniquely complete traditional strategic knowledge management (Archer-Brown & Kietzmann, 2018). However, also face-to-face social networks were identified as a facilitator for knowledge sharing (Al Saifi, et al., 2016).
The motivational aspects of knowledge transfer have been approached from a Social exchange theory (SET) perspective (Serenko & Bontis, 2016; Oparachoa, 2016). According to this theoretical framework, organizational members are willing to share their knowledge, if they see a benefit in doing so (Serenko & Bontis, 2016). Social exchange is a process that consists of “transactions” and “exchanges” (Emerson, 1976). It further is bidirectional, reciprocal, mutually contingent and jointly beneficial (Serenko & Bontis, 2016).

Mainly, four different approaches were chosen to empirically investigate problems regarding knowledge transfer: literature review, quantitative, qualitative and mixed. Each of these approaches has its advantages and disadvantages. While a sole literature review might give a good overview of what has been done already, it might lack the practical application. The quantitative approach does not analyze problems into depth. However, a high number of participants can be reached. Few studies have chosen a qualitative approach (e.g. Al-Saifi, et al., 2016, Qureshi & Evans, 2015). While these investigated knowledge sharing phenomenon in a detailed manner, they might be limited in significance as only a few cases were analyzed. Razmerita et al. (2016) used a mixed approach (qualitative and quantitative) as they conducted a survey first and then engaged in expert interviews to analyze the findings in detail. As Inkinen (2016) pointed out, Knowledge Management practices, especially the association with firm performances, has mainly been investigated with surveys. There is a need for case studies, as they can provide information of extremes (poor or extremely good performance), the best HRM practices, knowledge management leadership qualities and strategic KM practices.
4. Theory

The following theoretical framework is based on the knowledge-based view of the firm, which identifies knowledge as the primary source to gain a sustainable competitive advantage. First, the resource-based view, upon which the knowledge-based view is built, will be described concisely. Then the knowledge-based view of the firm will be introduced, which includes the definitions of knowledge. Next, the concept of knowledge management will be introduced. It is based on the work of Heisig (2009), who in attempt to harmonize the understanding of knowledge management reviewed 160 relevant papers to work out differences and similarities between different frameworks.

A theoretical model of the knowledge creation process - the knowledge ladder – is used to explain the term of knowledge. Consequently, a theoretical framework of operational knowledge management, including information and communication technologies (ICTs) is introduced. Two forms of knowledge management strategies are introduced, which are based on either knowledge-type or knowledge-origin. Then a model of the knowledge conversion, the SECI-model, is described. The chapter ends with an introduction of one framework for social interaction, the social exchange theory, and a summary, in which the connection between all theoretical models will be shown.

The resource-based view of the firm

The resource-based view of the firm reasons that a company can build a sustainable competitive advantage by controlling and exploiting of its internal unique resources (Baraldi, et al., 2007) (Barney, 1991). Resources are internal strengths of organizations that be used to create, form and implement their strategies (Baraldi, et al., 2007, p. 884). They can further be classified into human capital (e.g. employee training, education), physical capital (equipments, plants, technology) and organizational capital (e.g. systems for coordination and control) (ibid).

According to Barney (1991) a sustained competitive advantage is present when a firm implements a value generating strategy, that is not simultaneously implemented by competitors and the benefits cannot be copied by them (ibid). A potential source of sustained competitive advantage must have the following attributes: it must be valuable, i.e. it creates value for the company; rare, i.e. unavailable to competitors; inimitable, i.e. potential and existing competitors are not able to mimic the resource; and non-substitutable, i.e. in control of the organization and without available substitutes (ibid) (Baraldi, et al., 2007).
Knowledge based view of the firm

The knowledge-based view of the firm proposed by Grant (1996) is an outgrowth of the resource-based view of the firm. Knowledge is seen as the primary resource to gain and sustain a competitive advantage, as well as the main source of value and the critical input in production (Grant, 1996). The firm is characterized as an institution for integrating knowledge (ibid). The knowledge-based view concerns itself with competitive advantage, strategic management, coordination, organizational structure, firm boundaries, innovation, and the role of management (ibid).

When investigating knowledge management, one must first understand what knowledge is. For organizations knowledge is part of the intellectual capital and an intangible asset (North & Kumta, 2018, p. 34). Knowledge can be divided into different types, including tacit and explicit knowledge. In contrast to explicit knowledge, tacit knowledge is knowledge that cannot be easily codified, i.e. not documented in written form (Schilling, 2013, p. 39) (Nonaka, 2008, p. 14). In an organizational context, it is the knowledge that exists in the minds of organizational members, such as “know-how” and skills acquired by personal experience (Razmerita, et al., 2016). Most explicit and tacit knowledge is stored within organizational members (Grant, 1996). However, the majority of it is created in organizations and is specific to companies (ibid). Nonaka (2008, p. 14) defined it as highly personal and difficult to formalize and thus communicate and articulate. It is entrenched in action and an individual’s specific context, such as their occupation, a technology or work group activities (ibid). He further stresses the cognitive dimension of tacit knowledge: It consists of taken for granted mental models, beliefs and perspectives, which makes it hard to articulate. (Nonaka, 2008, p. 15). Explicit knowledge, however, is shared more easily between organizational members than tacit knowledge (Hau, et al., 2013). It is formal and systematic and can thus be communicated more easily, e.g. through formulas, computer programs, or product specifications (Nonaka, 2008, p. 13).

The resource-based view recognizes the transferability, aggregation and appropriability of resources and capabilities as an indicator for the ability to gain a competitive advantage as a company (Grant, 1996). This can also be applied in the knowledge-based view of the firm. Tacit and explicit knowledge differ in transferability, as explicit knowledge is easier communicated (ibid). According to Grant (1996) the efficiency of knowledge transfer is influenced by the aggregating potential of knowledge, i.e. the ability of the recipient to add new knowledge to existing knowledge. Appropriability, the ability of the resource owner to
gain the same value the resource creates, is different for tacit and explicit knowledge. Explicit knowledge, provided it is public, can be resold without losing it (ibid). In addition, marketing knowledge places it at disposal for potential buyers. Tacit knowledge cannot be transferred directly, and is thus not directly appropriable (ibid).

Knowledge Management

Knowledge Management refers to the way organizations manage their knowledge assets and can be defined as the following:

“Knowledge management enables individuals, teams and entire organisations[sic] to collectively and systematically create, share and apply knowledge to achieve their strategic and operational objectives. Knowledge management contributes to increasing the efficiency and effectiveness of operations on the one hand and to innovate and change the quality of competition on the other.” (North & Kumta, 2018, p. X)

The concept of knowledge management may be classified into the following tasks: sharing and using of knowledge, protection of knowledge, learning, creation of knowledge, and acquisition of knowledge (North & Kumta, 2018, p. X). Similarly, Wijnhoven (2003) identified learning, which includes knowledge transformation processes such as maintenance and generation, and knowledge logistics, which include distribution and sharing, usage and storage, as the main knowledge management operations. Heisig (2009), in an attempt to harmonize knowledge management frameworks, identified five different knowledge management activities: share, identify, apply, store and create. The acquisition of knowledge was neglected, as it was mentioned in less than half of the 160 analyzed studies (ibid).

The knowledge ladder (figure 1) offers a good explanation of the terminology of knowledge-based creation and relationships. Symbols such as letters, signs and numbers are the base of human communication (North & Kumta, 2018, p. 35). When syntax is added, it becomes data (ibid). An example for that would be adding the unit value “m” for meter. However, for the data to be regarded as information it is necessary to add meaning, such as “girth of the arm”, or “length of the leg”. There are different levels in the development of knowledge, the first being “know what”. It results from information residing within individuals (ibid, p.36). For example, if an employee reads a paper on artificial intelligence and the person is not able to apply it to the organization yet, it remains within in the individual. However, the application of knowledge, for example by using the newly learned knowledge to implement a recruiting
software based on A.I., turns “know what” into “know how” (ibid). “Know why” is the understanding of what lies behind something (ibid).

Motivation is necessary for knowledge to become actions (ibid, p. 37). Thus, one of the main aims of knowledge management is to ensure the right motivational set-up (ibid). Competence (also expertise) is the right choice of knowledge at the right time and leads to knowledge-based value creation (ibid). The last step of the ladder, competitiveness, can be reached when uniquely bundling all competencies of organizational members and organizations, so that they are not imitable/matched by other competing companies (ibid). Core competencies are the base for an organization’s competitiveness and (1) provide access to wide variety of markets, (2) contribute to perceived customer benefit, (3) are difficult to imitate (ibid) (Pralahad & Hamel, 2006).

North and Kumta (2018, p. 38) utilize the knowledge ladder to describe the objective of knowledge management. It is the creation of measurable and sustainable value, by the transformation of information into knowledge, and ultimately the transformation of knowledge into competence (ibid). Accordingly, each step of the ladder is relevant (ibid). A top-down approach, i.e. defining competencies first, can be described as strategic knowledge management, while a bottom-up approach as operational information and knowledge management.
Dimensions of Knowledge Management Strategy

Two major dimensions of strategic knowledge management at firm level have been identified (Kim, et al., 2014): The first, knowledge type, is the extent to which knowledge is gathered or acquired by a system or a person. The strategy for system-oriented knowledge management is called codification and relies on simple and explicit knowledge in order to improve the overall performance of the firm by using a knowledge management system (Choi & Lee, 2003). Knowledge management and sharing may be formal and facilitated by codes, a priori procedures or manuals (Graham & Pizzo, 1996). A person- or human-oriented strategy is called personalization and emphasizes the acquisition and sharing of tacit and complex knowledge, as well as interpersonal experience (Kim, et al., 2014; Choi & Lee, 2003). Knowledge arises from informal social networks and the effectiveness of knowledge management is increased by the application of socialisation processes and personal contacts (Kim, et al., 2014) (Choi & Lee, 2003). Both, personalization and codification, are used to create, access and obtain explicit, as well as tacit knowledge (Kim, et al., 2014).

The second dimension of strategic knowledge management is knowledge origin. It differentiated between two approaches: internally-oriented and externally-oriented (Kim, et al., 2014; Menon & Pfeffer, 2003). When managing knowledge internally, knowledge is formed within organizational boundaries. Kim et al. (2014) describe knowledge generated within firm boundaries as unique and specific. Thus, it is valuable for the firm, as it is difficult to imitate for competing firms. When applying an externally oriented approach, knowledge is sourced from outside the firm using imitation or acquisition and then transferred throughout the company (ibid). The external orientation of organizational knowledge management will only be marginally touched in this study.

Operational knowledge management

The main aim of operational knowledge management is to make the right knowledge available to employees and other stakeholders at the right time and place (North & Kumta, 2018, p. 14). Wijnhoven (2003) further identified organizational integration, adaptation, goal attainment, and pattern maintenance as organizational goals, which may be reached with operational knowledge management. Organizational integration aims towards the unrestrained, instantaneous and ubiquitous access to a company’s knowledge base, as well as the spatial and temporal sharing of knowledge (ibid). Adaptation refers to the process of recognizing, capturing, and organization of external knowledge and the distribution within the
firms (ibid). Goal attainment refers to the supporting activities in planning and control, while pattern maintenance may be explained as the maintenance of values, norms, and attitudes that support corporate cohesion and morale (ibid). The latter may include the emphasis on the creation of a culture of cooperation, which has been identified as a driver for knowledge sharing (Sieloff, 1999).

The sharing of knowledge was identified as one of the main activities of knowledge management (Heisig, 2009; Wijnhoven, 2003; North & Kumta, 2018). It may be alternatively referred to as “transfer”, “distribution”, “knowledge communication”, “dissemination”, or “diffusion” (Heisig, 2009). Argote and Ingram (2000, p. 2) defined organizational knowledge transfer as “the process through which one unit (e.g., group, department, or division) is affected by the experience of another.” This may happen at an individual or group level (ibid). Knowledge transfer refers to the active communication of what one knows or the active consultation of others to find out what they know (Krylova, et al., 2016). Besides human means, knowledge logistics processes, which include acquisition, storage, maintenance, search and retrieval, and dissemination, may be facilitated by technologies (Wijnhoven, 2003). These will be discussed in the following paragraphs.

**Information and Communication Technologies for Knowledge Management**

Information and Communication Technologies (ICTs) can facilitate operational activities (North & Kumta, 2018, p. 245). The linkage of organizational information and communication systems enables knowledge integration and may eliminate barriers to communication (Gold, et al., 2001). There is a need for systems that increase workplace productivity by supporting collaboration of knowledge workers (Andriole, 2010). ICT systems may connect knowledge workers and support work processes (ibid). In addition, knowledge acquisition and creation, dissemination, conversion and utilization are facilitated by ICTs (Gold, et al., 2001).

With the advancements of machine intelligence and new technological opportunities, the unrestricted and ubiquitous access to a company’s knowledge base is of ever-increasing importance (North & Kumta, 2018, p. 14). According to Soto-Acosta and Cegarra-Navarro (2016) the main role of new technologies is to support the sharing of knowledge and information between people through electronic storage and common platforms. In addition, the acquisition, storing and transfer of knowledge may be facilitated – given users are trained and educated properly (ibid). Wijnhoven (2003) provides several examples for knowledge
logistic processes supported by IT means: Acquisition of knowledge may take place in the form of internet resources or business intelligence systems (Wijnhoven, 2003). Storing and maintenance may be enabled by databases or document management systems (ibid). Search engines and retrieval systems provide search and retrieval processes, while, for example, dissemination can be performed with content management and publishing software (ibid).

Recently, the use of ICTs, i.e. social networks and knowledge communities, for the acquisition, creation and sharing of knowledge is termed “Knowledge 2.0” (Soto-Acosta & Cegarra-Navarro, 2016; Sigala & Chalkiti, 2014). These may be utilized by firms to improve intraorganizational knowledge sharing and collaboration, e.g. in the form of internal blogs and wikis (Paroutis & Al Saleh, 2009). According to North and Kumta (2018, p. 255) ICTs can positively influence the individual efficiency of employees, support teamwork, supply employees with information, enable active information search, support cooperative knowledge use and aid management in planning and control activities.

According to the 5C-model social networks fulfil the purpose of communication, collaboration, connecting, completing, and combining (Jalonen, 2014). In the context of knowledge management, Enterprise Social Networks (ESNs) are employee-driven, technological tools for knowledge sharing, transfer, maintenance, creation, dissemination and idea sensation (Turban, et al., 2011). They can be utilized for the mapping of communities of practise, or the discovery of experts, as well as efficient and effective collaboration (e.g. problem solving) within and outside the firm (ibid). Successful examples of ESNs include Pfizer’s pfizerpedia, a big knowledge-base created by employees and partners, Caterpillars’ knowledge network system, and the internal social network of Northwestern Mutual Life, which enables the knowledge sharing for financial representatives (Turban, et al., 2011).

When implementing ICTs, organisations face several challenges in the form of balancing the requirements of users on the one side, and those of the organization on the other side (North & Kumta, 2018, p. 246). Harden (2012) argues that employers must understand what motivates employees. In addition, potential users must constantly balance risks versus benefits, thus organizations must decrease the perceived risks while increasing the benefits (ibid). Further drivers for the use of ESNs include critical mass and social influence (ibid).

North and Kumta (2018, p. 248f.) mention several critical factors for the contents of technologies: First, the system design must suit the work and function requirements of knowledge workers (ibid). That means, knowledge management system should follow user
requirements and be designed in harmony with the way the employees work (ibid). Individualisation, such as providing information to knowledge workers, or the systematic identification and evaluation of knowledge is often associated with financial efforts, and thus often neglected by organizations (ibid). However, a high availability of information, as well as filtering of unfitting information can increase productivity (ibid). Second, ICTs must be integrative in terms of practical use, for example, a common requirement is maximum use with few interfaces (ibid). The bridging and integration of interfaces is of great importance for a systems productivity, due to their influence on motivation, acceptance, or user know-how (ibid).

Third, firms should integrate knowledge workers in the development and implementation of knowledge management systems, and incentive systems and acceptance factors should be considered prior to the implementation (ibid). For example, lack of usage, lack of managerial support, information overload, and lack of trust in various are barriers to the use of knowledge in ICTs (Paroutis & Al Saleh, 2009). Last, the performance and productivity of the ICT system must be given and measured (North & Kumta, 2018, p. 249).

Organizations may face conflicts when implementing ICTs such as the trade-off between the use of resources and requirements of knowledge workers (ibid). In addition, security and privacy issues must be considered (Harden, 2012; Andriole, 2010; Bulgurcu, et al., 2010). As knowledge is very valuable, its protection and public disclosure is important (ibid).

**SECI-Model**

Nonaka and Takeuchi (1995) developed a model that explains how tacit and explicit knowledge are converted into organizational knowledge. Four different patterns can be distinguished to in connection to tacit and explicit knowledge (see figure 2). The four patterns are present in a knowledge creating company and interact dynamically (Nonaka, 2008, p.21). The interaction between tacit and explicit knowledge have been described as integral parts of learning (Wijnhoven, 2003).

**Socialization** happens when tacit knowledge is directly shared from one individual to another (Nonaka, 2008, p. 16). This may happen by imitating, observing, or practice. This is a rather limited form of knowledge exchange, as the knowledge never becomes explicit and thus cannot be utilized by the company. Often, norms and value objects, are subject to these transactions (Wijnhoven, 2003). Socialization requires a considerable personal commitment, and thus tacit knowledge sharing may require operational measures to dismantle barriers
(ibid). These may include a reward system for the sharing of tacit knowledge, the creation of synergetic environments, in which organizational members can profit from each other’s knowledge, or the development of an adequate knowledge infrastructure, such as skill databases (see ICT) (ibid).

![SECI-Model](image)

*Figure 2: exemplary SECI-Model (Nonaka & Takeuchi, 1995, p. 72).*

Pieces of explicit knowledge can be combined into a whole and create new explicit knowledge (Nonaka, 2008, p. 17). Two modes may be identified: configuration, which aims to connect owners of knowledge, e.g. in teams or departments, introducing them, or make reference to their knowledge objects; and synthesis, which is the integration of explicit knowledge objects into one or more new knowledge objects (Wijnhoven, 2003). Nonaka (2008, p. 17) provides the example of a controller creating a financial report by combining explicit information. *Combination* does not increase the existing knowledge base of an organization and can be described as pooling of knowledge (ibid). IT can facilitate combination by providing a communication infrastructure and emulators, which enable sharing of one’s knowledge and offers response possibilities (Wijnhoven, 2003).

The process of transforming tacit to explicit knowledge is called *externalization* or articulation (Nonaka, 2008, p. 18). Codification of experiences, group and personal skills, values and norms by experts, as well as documentation allow the transformation of tacit
knowledge, so it can be shared within the organization (North & Kumta, 2018, p. 161). Knowledge representation methods include: proposition and predicate logic, production rules, scripts, and semantic nets (Wijnhoven, 2003). ICT-systems for knowledge management may offer solutions for the externalization of expert knowledge (ibid) (see ICT).

**Internalization**, on the other hand, is the process of transforming explicit knowledge into tacit knowledge. It is the process of the intraorganizational sharing of knowledge, which results in internalization of the same by other employees (Nonaka, 2008, p. 18). Internalization might be described as “explicit knowledge is used to extend, broaden and reframe one’s own tacit knowledge” (ibid).

**Social Exchange Theory**

Another framework used for the analysis of knowledge sharing is the social exchange theory (Serenko & Bontis, 2016).

“Social exchange theory is best defined as a frame of reference, a collection of propositions or a set of hypotheses that explain people’s behavior within a social system as exchange processes between entities.” (Serenko & Bontis, 2016, p. 690)

The theory was first introduced by Homans (1958), who argued that exchanges are not limited to materialistic goods, but have a symbolic value (Croppanzano & Mitchell, 2005). Thibaut and Kelly (1959) further contributed by performing empirical tests of complex relations in larger groups exchange theory. While departing from different points of view SET Scholars agree that social systems are constituted of interdependent exchange process, that are dependent on its participants’ actions and controlled by exchange relations (Croppanzano & Mitchell, 2005; Serenko & Bontis, 2016).

Social exchange is a process that consists of transactions and exchanges (Emerson, 1976). It further is bidirectional, reciprocal, mutually contingent and jointly beneficial (Serenko & Bontis, 2016). Social exchange actions lead to benefits for the receiver and eventually result in reciprocation of benefits in some way or another for the initial giver (Serenko & Bontis, 2016). As people are motivated by self-interest this mutually rewarding behavior may result in lasting relationships (ibid). In order to do so, the involved parties must follow certain rules and norms (=guidelines) of exchange (Meeker, 1971; Croppanzano & Mitchell, 2005). Reciprocity rules are among the most recognized ones among scholars: Reciprocity refers to repayment in kind and three different types may be distinguished (Croppanzano & Mitchell, 2005): (1) Reciprocity as transactional pattern of interdependent exchanges, (2) reciprocity as
folk belief, and (3) reciprocity as a moral norm. The first is based on reciprocal interdependence, i.e. one individuals or parties’ action will lead to a counteraction by another (ibid). As actions of the respective parties are contingent, the interdependent character of the exchange reduces risk and encourages cooperation (ibid). After the initial action by one party, exchange and the associated consequences may lead to a self-reinforcing circle, as new rounds of exchange are initiated by reciprocation (ibid).

The second type, reciprocity as a folk belief, refers to “the cultural expectation that people get what they deserve” (Cropanzano & Mitchell, 2005, p. 876). In these social exchanges participants assume that the unhelpful ones will be punished, while the helpful will be rewarded, and with time a fair equilibrium of all exchanges will be reached (ibid). The difference to the third type, reciprocity as a moral norm, is that norms describe how on ought to behave, therefore the ones following the norms should behave reciprocally (ibid).

Apart from reciprocity rules, Cropanzano and Mitchell (2005) mention negotiated rules of social exchanges, in which duties and obligations are understood prior to the exchange. These exchanges are more explicit than reciprocal exchanges and are often part of economic transactions (ibid). Negotiated exchanges are associated with unhelpful power use and less quality, while reciprocity was found to result in improved work relationships and increased trust and commitment to one another (ibid).

Meeker (1971) argued that exchange decisions will follow certain exchange rules. These are (1) rationality, (2) reciprocity, (3) group gain, (4) altruism, (5) status consistency, and (6) competition. As reciprocity, on which most of the models in the organizational sciences are based on, was explained before, it will be left out in the following explanations. Rationality is an exchange rules, in which the participant is aiming for maximization of her total pay-off by using logic for the estimation of consequences (ibid). As people do not always act rationally other rules are necessary (Cropanzano & Mitchell, 2005). Altruism aims towards the maximum benefit of the exchange partner, while group gain aims towards the maximum value sum of all participants (Meeker, 1971). Competition aims to the maximum possible difference between the two participant’s outcome value (ibid). It is the opposite of altruism as the aim is to harm the other one even if this risks one’s own benefit (ibid). Status consistency refers to the distribution of benefits according to the social status of the participants (Cropanzano & Mitchell, 2005).
**Affect theory of social exchange**

The affect theory of social exchange was proposed by Lawler (2001) and explains how interactions between actors can lead to relations, group identity and group commitment. Social exchange leads to global emotions, which can either represent punishing or reinforcing stimulation (Cropanzano & Mitchell, 2005).

The affect theory of social exchange identifies four modes of social exchange: negotiated, reciprocal, generalized and productive (Serenko & Bontis, 2016). When engaging in the negotiated mode, reciprocation conditions are agreed upon prior to the knowledge exchange. The reciprocal mode is based on the assumption that the knowledge recipient will eventually share her knowledge in return. In the generalized mode an organizational member expects someone else in the organization to share their knowledge at some point, if she shares her knowledge with another individual. The productive mode is based on altruistic assumptions, i.e. the belief that all organizational members work towards the same common goal and knowledge should thus be shared unconditionally. (Serenko & Bontis, 2016)

In the context of knowledge sharing, the social exchange theory can be used to argue that organizational members are willing to share their own knowledge as this holds benefits (Serenko & Bontis, 2016; Cropanzano & Mitchell, 2005). Such benefits may include promotion, monetary rewards, or job security (ibid).

**Theoretical framework - Summary**

This chapter has shown that knowledge is considered an important resource in modern business environments (Grant, 1996; Gold, et al., 2001; North & Kumta, 2018). It has further been emphasized that proper management of knowledge can positively influence firm performance (Andreeva & Kianto, 2012; Choi & Lee, 2003; Inkinen, 2016). This study is departing from the knowledge-based view, which is derived from the resource-based view of the firm (Grant, 1996). Accordingly, knowledge can yield a sustainable competitive advantage, if it is rare, valuable, inimitable, and non-substitutable (ibid). Knowledge can be tacit or explicit, whereas tacit knowledge cannot be documented in written form, is highly personal and difficult to transfer, and explicit knowledge can easily be communicated, documented and transferred (Nonaka, 2008, p. 14f; Hau, et al., 2013). The approach to knowledge management is highly dependent on the type of knowledge. Tacit knowledge is often associated with a personalisation approach, which aims to store tacit knowledge in individuals (Kim, et al., 2014). Explicit knowledge is accumulated by codification, e.g. by
Nonaka and Takeuchi (1995) presented four different forms of transferring knowledge: socialisation (tacit to tacit), combination (explicit to explicit), internalisation (explicit to tacit), and externalisation (tacit to explicit).

The above mentioned theoretical models along with theories on social exchange and ICTs are used to construct the theoretical framework of this study: Literature has found several drivers and barriers of knowledge sharing (Heisig, 2009; Qureshi & Evans, 2015), i.e. the active communication of what one knows or the active consultation of others to find out what they know (Krylova, et al., 2016). In addition, literature has drawn a connection between ICTs and its supporting function for the transfer of knowledge (e.g. Andriole, 2010). The sharing of knowledge is highly dependent on motivational and infrastructural factors (North & Kumta, 2018, p. 35; Gold, et al., 2001). A considerable part of infrastructural factors are ICTs, to which the previously mentioned theoretical models can all be connected: The personalisation strategy exists in the form of locating persons with tacit knowledge, as well as intrapersonal exchange and collaboration between employees. The codification strategy exists in the form of storage and transfer of explicit knowledge with the support of ICTs.

All transformation forms of the SECI model may be connected to ICTs (Wijnhoven, 2003): Externalisation is the process of feeding the system with one’s own tacit knowledge, e.g. by documenting experience and making it explicit. Internalisation is the process of extracting knowledge from the system to learn a skill, thus transferring explicit into tacit knowledge. Combination is the process of taking explicit knowledge out of the ICT infrastructure and connecting it to new explicit knowledge, e.g. a report. Socialisation is enabled by making it able to locate people and communicate with them to transfer tacit knowledge between two individuals.

What motivation resides behind transferring knowledge? As North and Kumta (2018, p. 258) mentioned, ICTs alone are not sufficient to push the transfer and sharing of knowledge. Relationships and social exchanges play a major role (ibid). This is where the social exchange theory comes into play. According to it, individuals are willing to engage in exchange processes, if they expect a benefit from it (Serenko & Bontis, 2016). The social exchange theory can be used to determine what motivates people to share their knowledge, be it in person or via ICTs (ibid). It can further be used to analyse knowledge transformation such as socialization, externalisation, internalization and combination.
5. Empirical Research

The following part presents the findings of the empirical research. The data was gathered via semi-structured interviews with members of the company’s research and development departments. In the following, first, the structure and organisation of the departments of interest is presented. Next, technologies that are currently used for knowledge management are described. Consequently, formal processes, including the product development process, the “developer’s forum”, a physical platform to share knowledge, and the reporting of inventions are introduced. The chapter continues with a description of cooperation and competition behaviour in regards of knowledge sharing of employees, and summits in the presentation of the availability of knowledge and the properties of knowledge transfer within the company. Before ending with the onboarding process and continuing education of employees, the requirements for a technological system are presented.

Structure and Organisation of the Research Department

The company recently underwent a restructuring process, in which the former R&D department was formally divided into one global research and one global development department. The structure of the research department can be seen in figure 3. It consists of a global head who is responsible for all local research hubs. There are three research hubs, of which one is based in Austria, one in Germany and a significantly smaller one is based in the USA. The research hubs are led by one respective local head and underneath are members of the research department at the same level. Employees are divided into researchers, who conduct the research work, and innovation managers, who identify opportunities and coordinate projects. In addition, several students and PhD candidates (four in Vienna) were working on their theses at the time of the interviews. The hierarchy was described as flat, or “almost non-existent”(1) with “little transactional leadership”(5).

The working method is highly dependent on the respective project. Small tasks are performed individually, while larger tasks are performed in teams (of two to three persons (1)). Usually the person who initiated the project is named project owner (2). Members of the research department have, in general, a multidisciplinary background and a diversified knowledge base (10). However, as topics can be quite complex, interaction with other parts of the firms needs to take place in most cases. For example, if the idea that started off a project was delivered by a developer, she might provide a support function (2).
With the restructuring of the research and development departments, the intellectual property (IP) management unit was integrated into the research department. A global head of IP Management is responsible for the management of content, as well as coordination. The IP unit is responsible for the protection of knowledge assets and consists of eight employees globally.

**Structure and Organisation of the Development Department**

The development department is significantly bigger than the research department (“by a factor of ten or more”(5)), and, as can be seen in figure 4, is more structured. There are three development sites, one in Austria, one in Germany and one smaller site in the USA. The development department is led by a global head of development. Underneath are three divisions, namely Engineering, Verification and Product Refinement (6,9), which are each led by local heads. Within each division, e.g. Engineering, are sections, and underneath those are units with respective heads and five to fifteen employees (5,9). These units are designed along the value chain.

The operative structure is a matrix, i.e. project-based. The structural hierarchy’s purpose is to provide organisational structure and fulfil personnel management tasks (leadership, personnel development, resource allocation,..), while within project employees report to a project manager. Project teams consist of a core team, in which the most important disciplines are represented (6). The core teams are led by one lead engineer, who has the technical leadership, and one project manager who has the ultimate responsibility for the project result. In addition, representatives of the purchasing, production, and other relevant departments are represented. A system engineer/architect ensures synergies with the portfolio. The core team develops a project plan, and the project manager then requests resources (i.e. team members) from the departments. The majority of the project work is then performed by the members of
the project team, which are provided by the respective department. The department acts as a “sparring partner” (6) and ensures the quality of the project work. If the project is scheduled for a longer period, the project team is usually seated together. However, members of one project team may simultaneously work in others.

![Diagram of the development department structure]

**Technologies for Knowledge Management**

**Shared Knowledge Database – From Wiki to MIAP**

The majority of technology-assisted knowledge transfer happens through a global OneNote application (Microsoft, Washington, USA), which is a free note-taking software. The company’s internal tool is called MIAP (“Meta-Informations-Austausch-Programm”, which translates to “Meta information-exchange-program”) and resulted out of necessity to preserve knowledge (1), or as the employee who initiated the tool described the point of departure:

“How can we provide knowledge, that is generated, not only to one person, but to everyone” (10).

The necessity was given, as prior to that, a Wiki was used as a technological tool for knowledge storage and transfer. One employee stated that it was used for approximately five years (9). It was used for the description of components and interfaces. However, it was given up, as several barriers were associated with its usage and was therefore not used: One had to open the browser and type in the address to access the Wiki. In addition, media needed to be uploaded, i.e. there was no drag and drop function. Maintenance was difficult and the effort to fill it was very high compared to the benefit. Last, the population of the Wiki was difficult as a special syntax was required to properly format the entry. One employee described it as:
“What you see is not completely what you get (10)” another one said that “one almost needed HTLM skills (9)”. However, one interviewee remembered that the database helped him to answer a question once (4).

In succession, a pilot project with a OneNote notebook was performed in the mechanical development department. The intention was the implementation of a platform, in which experiences can be shared and searched for. Consequently, middle managers in the development department were asked for requirements, such as: which information exists or is missing, how can it be implemented, or what is expected of it. The two main conditions were, that it had to be free of charge, and no extra effort had to be expected by the employees. This was given with OneNote, a freeware installed on every computer in the company, and it was subsequently adopted by the majority of the development staff.

As of today, the research and each development department, each project and most employees have their own OneNote notebook. However, the utilization is not mandatory. The notebooks are thematically structured in several chapters, tabs, and sheets(1), often determined by modularity or discipline. The majority of internal documentation, apart from regulatory documentation (see below), is performed with MIAP. In addition, it serves as a library, where in-house theses and dissertations, eBooks as well as the where-abouts of physical books can be found. There is no general formal specification on the structure and how new contributions shall be entered. Although “some-what of a standard” emerged, the content can often be chaotic. (10)

> “Each project manager, team leader, can decide upon it on his own and there is no consensus on the form, in which it has to be pursued, and in which consistency it has to be implemented during project works” (10)

In projects MIAP is used for memos or the documentation of problem solving (4), decision making, and results (10).

The reasons why this tool has prevailed is due to several factors. First, it can be used to document one’s own work and to find the work of others. Second, the barriers are very low: it is intuitive to use, it is practical, everyone can access it and it can be edited simultaneously (located on SharePoint).

However, while it is, in principle, perceived as a useful tool, all interviewees saw room for improvement and identified weaknesses of the OneNote solution. As the amount of
knowledge grows in the system, the complexity of the system increases. It is hard to search for content and is described as chaotic. In addition, it is unclear whether information found in the system is still relevant.

“[...] it is a high pile of data, more of a datalake of knowledge, and hardly structured” (5)

Or as another employee put it:

“Some-what not unpractical, the whole thing, but from my point of view, some time is needed until one can really work well with it and put it to use” (8)

In addition, the tool is reaching its technological boundaries and infrastructural capacities, as the program has already accumulated 5GBs of cache (10).

**UII – Mailing List**

Another tool used for the sharing in knowledge is called UII – *useful interesting information*. As the name states, it is used when organizational members want to share interesting, useful information with co-workers. It works with a mailing list, whereas the information giver must fill in a mask, including what he found, the context, the experience with it, and key words (10). The information is not explained in detail, however, interested co-workers can approach the sender with questions. It is perceived as a useful tool and is broadly used, with one employee estimating one mail every two days. Messages may include a variety of topics, including technological information, new product releases, useful information, videos. The motivation behind it was described with the visibility of one’s innovativeness, received appreciation, or the pure joy of sharing information.

**Problem Solving – Edison**

Edison is a community tool for the creation of solutions for given problems. The community, the organizational members, can contribute by posting ideas, rating them or commenting on posts. However, this tool is not used any more. Although being perceived as useful for idea generation, it was problematic regarding knowledge protection. While content was only posted internally, the leaking of knowledge was a possibility due to the size of the company. Ideas posted on the platform were often not yet intellectually protected and were taken out when the IP unit interfered. Another reported weakness was the bitorientation and simplicity of the application, e.g. there was no possibility to sort the content.
infoPatent

Another source of (external) knowledge is infoPatent (infoapps GmbH, Munich, Germany), a database of patents. The database is populated with industry-relevant patents by the IP unit, and updated on a weekly basis. A folder system in the background enables organizing the content systematically. infoPatent is available for all developers to search for existing patents. Noteworthy, at this point, is that only the members of the IP unit mentioned this tool.

Datanet

The Datanet is the company’s intranet. It is used on a formal, organizational level to distribute formal knowledge elements (1). Several departments are represented in it, such as Human Resources, Finances and Accounting. It is perceived as a good tool for searching persons and respective numbers and fulfills mainly an administrative purpose (3). Links to other departments, tools such as SharePoints (Microsoft, Washington, USA, see below) and infoPatent, can be found via the Datanet. The intranet is not intended and used for the sharing of expertise knowledge.

SharePoints and shared platforms

The firm further uses SharePoints and other shared platforms for the internal transfer of knowledge. These are websites to file and share documents (5) and are particularly used in bigger projects or multi-site projects. All service-providing departments have SharePoints, such as Human Resources and Regulatory Affairs. Amongst other, the matrix and template of documents, and process guidelines are available on these (4). As mentioned before, they can be found in the Datanet. There is, for example, a SharePoint for working procedures. Employees mentioned limited access permissions, and the scattered and thus complex nature of the systems as weak points of the SharePoint-approach.

Formal Influences on Knowledge Management

Product Development Process

As the company operates in the healthcare sector and its products are classified as medical devices, the product development process (PDP) is subject to regulatory requirements. This includes documentation of every step in the process (1), which is stored in the project folders (4). Regarding knowledge management, it sometimes is perceived as more restricting than helping, however, one project leader claims that it can be seen as a red threat, as it provides an overview of rectifications, requirements and results (10). It is a different kind of documentation, claims one employee (6). Or as one interviewee described it:
“Much of the documentation is necessary to be in the right position regulatory-wise, but it is not always what you need as a developer afterwards.”

However, within the PDP framework, the firm’s global pursuit of implementing agile management methods contributes to the documentation of knowledge. It is based on the ScrumBut-principle, but is adapted to fit the company’s context. It consists of several six-week-cycles of sprints and reviews (6). At the start the project owner issues a list of features, of which certain predetermined features are processed in each cycle (5). At the end of each sprint the results are presented and documented using the MIAP tool (6). It supports the documentation of knowledge, as it helps the members of the Scrum team and the project owner to understand what they did and why (5).

**Developers Forum**

A developer’s forum is a scheduled meeting of the whole research and the whole development department. It takes place every four to six weeks and participation is voluntary. A research member described it the following:

“[..] the meeting place, where progress, so new developments and things, were presented” (2)

It is organized by an employee responsible for student projects and was a platform to raise awareness of what they are working on. However, as of today, also other presentation to up-to-date topics are held on these occasions. Interviewees reported to find the forum useful due to various reasons. First, the held presentations are documented and can be found in folders and the OneNote tool. Second, one can see what colleagues are working on, which avoids the repetition of tasks.

“[..] to tell people, what we are working on, and that we are not reinventing the wheel.” (3)

Third, due to the physical nature of the meeting, feedback can be given and questions can be asked. The developer’s forum is perceived as an efficient knowledge sharing platform by employees and described as an option to transform individual into collective knowledge.

**Reporting of inventions**

If an employee comes up with an idea, which could be useful to the company, there is a formal way of reporting it. She can approach the IP unit, fill out a form and present her idea to a board. The committee consists of IP experts of all departments, who qualified themselves
with extensive experience in their field of expertise and intellectual property laws. The board then proposes a recommendation, which is then either accepted or declined by the management. If an idea is accepted, the inventor receives a monetary reward. The next decision is whether a patent application should be issued. If the idea results in a patent, the inventor receives a commission according to the Austrian Patent Law. The bonuses and commissions are distributed proportionately if more than one person came up with the idea. Besides the monetary reward, appreciation was reported as an incentive for reporting ideas. An employee of the IP unit estimated a number of three ideas at their site per month, of which 80% are accepted. In a global perspective forty to fifty patents are issued annually.

**Competition and Cooperation**

Intellectual property was the sole thing mentioned that drives competition between employees regarding knowledge sharing. However, many reported no competition or knowledge hiding at all, one interviewee thought of it as a common issue, and three that it happens only as exception. Few cases were mentioned, in which employees were having disputes over who participated in the generation of an idea, and how the rewards shall be distributed. In general, there is a lot of cooperation and hardly any competition (1). Organizational members are ready to help out (2,6). As one interviewee put it:

"If you approach a colleague and say: 'Could you explain that real quick?' it usually happens." (1)

The atmosphere was described friendly, open and communicative. There is a low threshold to get to knowledge and readiness to help throughout the organisation. A picture of a community with open knowledge sharing was painted. One employee argued that members of the research department are kind of expected to help and inform others (3). The mentioned drivers and deterrents for cooperation regarding knowledge sharing are depicted in table 2. As can be seen the amicable workplace atmosphere was commonly mentioned. Another common answer is that complex tasks required cooperation and the results are better when sharing ideas and working on them together. Lack of time as well as the protection of ideas due to money and status incentives were the most commonly mentioned deterrents.

Cooperation and the exchange of knowledge between the two main sites (Germany, Austria) is also reinforced by today’s global structure of the departments. Prior to a restructuring process, the different sites used to work self-sufficiently, and an atmosphere of competition
between the sites and a silo mentality were described. Recent multi-site project and personal contacts supported the emergence of multi-site cooperation.

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<thead>
<tr>
<th>Drivers of Cooperation</th>
<th>Deterrents of Cooperation</th>
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<tbody>
<tr>
<td>Friendly workplace atmosphere</td>
<td>Spatial distance (earlier)</td>
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<tr>
<td>(1,3,4,7,10)</td>
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<tr>
<td>Complexity of task needs cooperation</td>
<td>“Location thinking” (1)</td>
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<tr>
<td>(1,2,5,8,9)</td>
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<tr>
<td>Open-plan offices (1,3)</td>
<td>Lack of time (1,3,10)</td>
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<td>Kitchen, free hot drinks (1,2)</td>
<td>Office grapevine (7)</td>
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<tr>
<td>No internal ranking (3)</td>
<td>Incentives for idea protection (2,5,8)</td>
</tr>
<tr>
<td>No monetary reward system (3)</td>
<td>No real platform, only personal contact (4)</td>
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<td>Fun to work with others (5)</td>
<td>Personal reasons (1)</td>
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<td>Team composition (6)</td>
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<td>Workshops (9)</td>
<td></td>
</tr>
<tr>
<td>Freedom to operate (10)</td>
<td></td>
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<tr>
<td>Mistakes are allowed (10)</td>
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</table>

Table 2: Drivers and deterrents of cooperation regarding knowledge sharing between organizational members

Availability and Transfer of Knowledge

According to its members a large quantity of knowledge exists within the organization. However, knowing where to find it might be difficult:

“The organisation, respectively their members, possess a lot of knowledge. The problem is that one does not know where to find it.” (1)

Although tools are used for its management, the organizational knowledge is to a high extent personal. In other words, knowledge carriers or experts, who have often been organizational members for a long time period, share their knowledge through personal contact when needed. However, the identification of these is troublesome in many cases, as knowledge is spread among several individuals. That means, if one knows, who has previously worked on a specific topic, and who one must ask, one will get the knowledge searched for. (4)

There is no adequate technological tool for locating and identifying knowledge carriers. In the intranet one can search for personnel, but it does not show their know-how or former projects they have worked on. However, others argue that by asking colleagues one will eventually find an expert. Once found, organizational members are willing to share their expertise.
“If someone is new to the firm, he will probably have a hard time and must ask someone again, his department head or so, until he will get to the right informant. But I think it is locatable for everybody, where to turn to – given he is still in the organisation.” (9)

Although knowledge carriers tend to stay in the company for a long period of time, the loss of knowledge along with employees is an issue stated by interviewees. Even though some knowledge carriers write down their knowledge there is no universal guideline.

“[..] the problem is, that each employee more or less deposits his accumulated knowledge on his own, maybe even uses network folders or something, which is ok. But that still does not mean, that others will know their way around and find something.” (2)

One employee argued that the visible personalization is reinforced by the weaknesses of tools and thought that personal talks will always be the best form of knowledge transfer. In addition, “improvement” (2) was observed, as there is a trend towards the formalization of knowledge, e.g. in the form of assembly and module datasheets in the mechanical development department. A part of knowledge can be found in MIAP or the company’s folder system. However, finding it in these may prove to be difficult:

“[..] if you attempt to find it in OneNote, it mostly fails. Although there is a good search function in it, it became such a juggernaut [Moloch], that you still won’t find anything properly.” (6)

An approach to locate knowledge, which involved personnel and technology, was mentioned during the interviews. If employees face a problem, they tend to approach colleagues in person, who then reference to where they put the answer in the system.

“[..] more like, one colleague asks: ‘hey, how does component XY function?’, and he says: ‘hey, I have documented all of that, I am going to send you the link and you can have a look’” (5)

Between the different sites, in particular the two main sites in Germany and in Austria, it was perceived as difficult to find out the knowledge carriers. Personal contacts to members at the other site were seen as crucial for communication and knowledge transfer. It was reported, that if you know someone to approach, it works fairly well. However the location of knowledge carriers is difficult for people who do not have contacts of anyone at the other site and simultaneously are not known there. If that is the case, one might need to go several
hierarchical levels up and down to find the person one is looking for (1). Data is exchanged via a shared infrastructure and network structure, such as SharePoints.

For the knowledge transfer between departments at the same site (Austria), a few barriers were identified. This included lack of time and weaknesses of the technological systems. Apart from that, personal interaction was reported as the main form of exchange. Short distances between departments was identified as one of the driving forces. Historically departments were located at two different sites with a travel time of 30min to 60min in between. After merging the sites, information exchange reportedly improved. Between the research and development departments knowledge exchange happens in a project framework, as it is common to include at least one developer in research projects. The matrix structure and the resulting interdisciplinary project teams further contribute to inter-departmental exchange. Personal exchange between members of different departments might also happen in the form of “office grapevine” (7).

**Requirements for technological tools**

In the interviews the participants proceeded to share their thought on, how an ideal technological platform for knowledge transfer would look like. Although the tool in OneNote, MIAP, was perceived as the best solution up to this point, room for improvement was seen.

> “Of course there are possibilities for improvement. OneNote is not the right choice, neither is a SharePoint” (3)

One thing, that was mentioned by several interviewees (see table 3), is the need for a system to have a low threshold. This means it should be time efficient, easy and intuitive to use, practical, and accessible for everyone in the organization. It was mentioned that OneNote has prevailed as the dominant tool for that reason.

> “OneNote is still performing best at that level, because it really is on a low-threshold level.” (1)

Another reported requirement, which OneNote also fulfils, is that a knowledge database must reach “critical mass” in time. That means, that enough information must be available, so people find it useful. Once this is the case, organizational members are willing to share their knowledge as an exchange.

> “[..] must reach critical mass, so people will populate it, so that others will look into it, so that it is really applicable.” (10)
An important aspect of this is, that the usefulness of the system must be visible for the users and justify the effort:

“People will then start to share, if they must, on the one side, only invest manageable and little energy and at the same time recognize benefits for themselves.” (1)

Further, interviewees mentioned that such a platform must be possible to search for knowledge of interest in an easy way. It was mentioned that this was not the case with existing solutions. Although there is a search tool in MIAP it is not working as well as employees wished. According to one employee an ideal solution would be to just have a search bar as a user (“somewhat like Google” (3)).

An additional requirement was the formalization of instructions and the standardization of content. Organizational members often perceived the existing solution to be unstructured and chaotic as contents were not standardized throughout all departments. In addition, while one participant wanted to make documentation mandatory for every employee, another interviewee said that the motivation to document should be intrinsic.

<table>
<thead>
<tr>
<th>Requirements</th>
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<tbody>
<tr>
<td>Low threshold (1,2,7,9)</td>
</tr>
<tr>
<td>▪ Time efficient (1,3,7)</td>
</tr>
<tr>
<td>▪ Easy, practical (2,6,7)</td>
</tr>
<tr>
<td>▪ Intuitive (2)</td>
</tr>
<tr>
<td>▪ Accessible (7)</td>
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<tr>
<td>▪ Clear (7)</td>
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<tr>
<td>Critical mass (1,2,3,6,7,9)</td>
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<tr>
<td>Clear instructions (2,4)</td>
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<tr>
<td>Mandatory (4)</td>
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<tr>
<td>Intrinsic motivation (9)</td>
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<tr>
<td>Standardized (2,4,6)</td>
</tr>
<tr>
<td>Searchable (2,3,4,6,7)</td>
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<td>Media (7)</td>
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</table>

table 3: Reported requirements for ICTs

35
Onboarding and continuing education

The onboarding process was described coincidently by the participants. When a new employee starts, the human resources department along with the responsible supervisor or manager issues a customised training plan. The training plan is a predefined list of all existing training measures for new employees. It consists of three parts: general points, such as security information or product presentation, organisational parts, such as meeting key personnel and other departments, and role-specific trainings. For new employees of the development department, the introduction to MIAP and OneNote is one part of the list. It is the responsibility of the employee to perform every ticked activity on the list within a timeframe of six to twelve months. Afterwards the list is filed in the “learning and development” folder of the respective employee. Although the onboarding process has reportedly improved, one employee mentioned that new employees might “feel a bit lost”, when starting. He reported that members of the research and developments departments, and thus supervisors, tend to be busy, and thus not available at all times. It is the responsibility of new employees to approach colleagues and ask for support. An interviewee, who has joined the company recently, reported that colleagues were open and friendly from the start. Another interviewee said, that he wished for a mentoring program, so that new employees would have a dedicated person to turn to for advice.

“[..] that a new employee, who enters, will be provided an experienced developer. Not someone, who tells him what to do, but someone, who in regular intervals checks: what does the new employee do, how could he help him, where could he give advise. ‘Hey someone did this before, ask XY’, or that he explains [..] how some of our specific approaches are.” (5)

A common way to join the organisation is through student projects. The research department offers several topics for theses or dissertations. In many cases, students are offered a job afterwards. Of the ten interviewees, five performed a theses or dissertation in collaboration with the company.

All organizational members have the possibility to educate themselves further. They can propose trainings from an internal list or own ideas to their supervisor in the framework of the annual employee appraisal. If the supervisor agrees with it, it undergoes a budgeting process and is eventually approved if the argumentation is reasonable and the financial resources are available. It is the responsibility of the employee to propose trainings. However, proposals may also come from management side if they see a necessity.
6. Analysis

Personalization vs. Codification

Knowledge is, to a high degree, personalized in the investigated company. It was stated that a major part of knowledge is stored within the heads of organizational members. When leveraging a personalization strategy, knowledge arises from informal social networks and the effectiveness of knowledge management is increased by the application of socialisation processes and personal contacts (Kim, et al., 2014; Choi & Lee, 2003). In the investigated company intrapersonal exchange of tacit knowledge often happens on a personal level. The high degree of personalization is associated with drawbacks, such as the loss of knowledge, if someone leaves. It was found out that in the company personalization was reinforced by the weaknesses of tools and the perception that personal talks are the best form of knowledge transfer. Scholars named the maturity of information systems as a decisive contingency factor for the choice of knowledge management strategy (Kim, et al., 2014; DeLone & McLean, 1992). This reported strategy is very similar to what Kim et al. (2014) described as internal personalization strategy., i.e. the knowledge is sourced from its internal personnel.

Knowledge, is to some extent, codified in the investigated company. The major part of codified knowledge can be found in the MIAP tool, the OneNote-based knowledge management system, used by the company. It includes project documentation, design rules, working procedures, and guidelines. One can see, that the company applies both strategies, personalization and codification. North and Kumta (2018, p. 161) argue that the codification strategy aims to identify, codify and store information for future purpose, while the personalization strategy relies on the knowledge “owned” by people and aims to set up infrastructure to facilitate and enable the knowledge flow between people. An example for the latter is the reorganization of the company towards global structures to enable the collaboration between sites, or the organization of the developer’s forum as a platform for knowledge exchange. The application of agile management methods for the product development process, and the creation of design rules, working procedures and guidelines contributes to codification of knowledge.

One could argue, that the knowledge management strategy of the investigated company, may be described as a dynamic style. Choi and Lee (2003) described such organizations as pursuing human-, as well as system-oriented methods, in order to exploit existing knowledge within the firm, while exploring further knowledge (Ravasi & Verona, 2001). Hewlett-
Packard has been described as one such companies, in which tacit knowledge is of high importance and information systems facilitate group works over spatial and temporal barriers (Sieloff, 1999; Choi & Lee, 2003).

**Transformation of knowledge**

The transformation of knowledge within the company is omnipresent, as well as facilitated and supported by ICTs. In the following, each form of transformation according to Nonaka and Takeuchi (1995) will be connected to reported processes in the firm. In figure 3 an overview of the transformation processes with the corresponding supporting factors in the company is depicted.

Socialization is present when knowledge is shared directly between individuals (Nonaka, 2008, p. 16). In the investigated firm socialization is a crucial process that results from the high personalization of knowledge. The most obvious form of socialisation is the above-mentioned knowledge transfer from experts to other employees. It is a common form of sourcing internal knowledge in the investigated firm. In addition, the onboarding process, in particular the training plan, puts a high emphasis on social contacts by introducing the new employees to the most important contacts (e.g. in other departments), in order to gain knowledge who to turn to when facing issues that cannot be solved with one’s own knowledge base. ICTs may facilitate socialization by providing an adequate knowledge infrastructure, e.g. a skill database (Wijnhoven, 2003). However, in the investigated company, although personnel can be found via the DataNet, the company’s intranet, there is no practical technological tool to find out, who knows what, and who has worked on projects in the past. Socialization may be also be facilitated by removing barriers, e.g. by a reward system for knowledge sharing, or the creation of synergetic environments (ibid). While there is no reward system for knowledge sharing in the company, an emphasis is put on enabling knowledge transfer through addressing environmental factors. Examples for that are open-space offices, an emphasis on a friendly atmosphere and the creation of platforms for personal exchange, such as the tea kitchen with free hot beverages for employees. A platform for socialization between individuals is the Developer’s Forum, in which individuals come together to share their knowledge with the whole department in presentations, as well as workshops, in which group efforts lead to the development of new ideas. Socialization also happens in the form of “office grapevine” or during lunch with colleagues.
Combination is the transformation of explicit knowledge pieces for the creation of new explicit knowledge (Nonaka, 2008, p. 17). Wijnhoven (2003) describes two modes of combination: configuration and synthesis. The mode of configuration, i.e. the connection of owners of knowledge, is present in the form of the cross-functional teams in the product development process, in which carriers of different explicit knowledge are working together. The output often includes explicit knowledge, as knowledge created in the project is documented in the respective sheet in MIAP. Configuration also includes referring of knowledge carriers to explicit knowledge objects (ibid). This can be exemplified with a previously mentioned way of knowledge sourcing in the company. Experts may be approached by employees who face an issue, and the expert then refers to where she stored it in MIAP or the folder system. Another form of configuration is the introduction of knowledge owners (ibid). This happens to some extent in the onboarding process, when key personnel of other departments is introduced. Synthesis, the integration of knowledge objects into a whole, may happen when an individual combines information found in the MIAP database. ICTs offer a supporting function by providing the communication infrastructure and emulators for knowledge sharing (ibid). Edison, the tool used by the company for idea generation, is a form of combining explicit knowledge for the creation of new explicit knowledge. A challenge is given, which is then solved by the combination of explicit knowledge of different organisational members.

Tacit knowledge is transformed to explicit knowledge by externalization (Nonaka, 2008, p. 18). Codification plays a central role in the transfer of knowledge across an organization (ibid). The documentation of organizational members or groups in the MIAP database is a form of this process. Individuals may document their own experience, i.e. their tacit knowledge, by externalization in the OneNote database, and thus making it accessible and useable for the whole organization. Besides “lessons learned”, design rules or working procedures are used for the transformation of originally tacit knowledge into explicit knowledge. The agile methods used in the product development process are reinforcing externalization, as documentation in the review phases are a form of codifying experiences. The motives for externalization are discussed in subsequent sections.
Internalization, the process of transforming explicit knowledge into tacit knowledge (Nonaka, 2008, p. 18). It is the other end of the externalization process. Tacit knowledge may be generated by internalizing explicit knowledge from the MIAP tool, infoPatent, or SharePoints and adding it to one’s knowledge base. Internalization may also happen in the form of continuing education offered by the company.

Information and Communication Technologies

Multiple technologies for information and communication are utilized in the described company for various knowledge management tasks. First, the empirical findings will be connected to theoretical findings on ICTs, which stress the importance of new technological platforms as enhancers for the transfer and storing of knowledge (Soto-Acosta & Cegarra-Navarro, 2016; North & Kumta, 2018; Wijnhoven, 2003). In a next step, the reported requirements for ICTs will be compared to success factors and barriers in literature findings.

Technological infrastructure

MIAP is a tool that can be used for knowledge transfer and storing. It is informally included in many research and development processes, in the form of documentation in projects, individual documentation, and documentation of best practise. The user generated content can
be retrieved by any member of the organization. Wijnhoven (2003) argued that storing and maintenance of knowledge may be performed with database systems, while the dissemination may be enabled with content management systems. MIAP enables both. Further, North and Kumta (2018, p. 255) stress the positive influence of ICTs on the teamwork, information supply of employees, and cooperative knowledge use – which were also reported for the MIAP system. Similarly, SharePoints and shared folders enable the storing and sharing of knowledge and facilitate the communication and coordination between organizational members. This coincides with the findings of Andriole (2010), that Web 2.0. technologies can support collaboration and cooperation of organizational members.

UII can be used for the dissemination of externally sourced knowledge within the company. Organizational members can share knowledge, which they find interesting, with others by filling in a simple email form. While this does not necessarily lead to internalization by other organizational members, it raises awareness of the topic and can be followed up by approaching the sender. infoPatent works in a similar manner, by providing organizational members with externally sourced knowledge. It is a searchable electronic database supporting knowledge creation, and the dissemination of external knowledge in the form of patents. This fulfills the role of supplying employees with information, active information search, and may positively influence the individual efficiency of organizational members (North & Kumta, 2018, p. 255).

DataNet is providing an organisational infrastructure and facilitates communication. Links to SharePoints, infoPatent and MIAP can be found on the platform. In addition, contact information of organizational members can be retrieved from the intranet. However, it cannot be used for the direct sharing of knowledge. It fulfills a coordinating, administrative role in the management of knowledge.

The formerly used tool Edison could be used for the combination of individual knowledge for the creation of new knowledge. It was a community-based idea generation tool, which motivated knowledge sharing behaviour. However, it missed out on aspects of knowledge protection and thus conflicted with means of IP management. It can be described as a form of enterprise social network (ESN), as users can create content and interact with other users. According to Turban et al. (2011) ESNs are employee-driven, technological tools for knowledge sharing, transfer, maintenance, creation, dissemination and idea sensation. Edison fulfilled this only partly. As numerous scholars mentioned security, privacy, trust, and protection of intellectual property are the main concern for ICTs to reach their full potential.
Especially the protection of intellectual property was reportedly not given with this tool, as the risk of sensitive information leaking was too high.

**Success factors and barriers of ICTs**

Knowledge Management literature has identified numerous critical success factors and barriers to the usage of ICTs. Soto-Acosta and Cegarra-Navarro (2016) identified ICTs as a supporting factor for knowledge sharing – given adequate training and education is provided. There are attempts in the firm to include trainings for information technologies in the onboarding process. An example was given of an introduction to the MIAP tool being included in the training plan for new members of the development department. When it comes to implementing and developing ICTs a balance between user requirements and resource availability must be found (Andriole, 2010; North & Kumta, 2018). In the case of the investigated company the willingness (or ability) to invest financial resources into an ICT for knowledge management is limited. The specifications for the development of the MIAP tool were that it had to be free of cost and no extra effort had to be expected by employees. The challenge for organizations is to balance the trade-off between fulfilling requirements and keeping the costs to a minimum (ibid). Members of the investigated firm named several requirements to a technological knowledge management system (table 3). A low threshold for usage, such as being time-efficient, practical, intuitive, accessible, and clear, was named critical for success by interviewees. Similarly, North and Kumta (2018) named the practicality of knowledge management technologies as a crucial factor for their success. The aim is towards maximum usability with few interfaces (ibid), in order to increase the employee’s motivation to use the system. According to study participants, a critical mass of the system, i.e. a high extent of relevant information, is a deciding factor for the perception of the usefulness of ICTs. North and Kumta (2018, p. 248) identify a high availability of information and the filtering of irrelevant data as critical. Similarly, Harden (2012) identified a positive relation between perception of critical mass and knowledge sharing intentions when using ESNs.

Participants mentioned multiple barriers to the usage of the existing ICT solutions, including lack of time, structural diversity of the content, overload of information, technological barriers, weaknesses in searchability, and lack of formalization. In comparison, Paroutis and Al Saleh (2009) identified lack of usage, lack of managerial support, information overload, and lack of trust as barriers. While, e.g. in the case of MIAP in the development department,
managerial support and lack of usage are not applicable, information overload and lack of trust was reported. MIAP fulfils most requirements mentioned by interviewees: It has a low threshold, and it reportedly reached the point of critical mass. However, it was criticized for the weaknesses of its search function, as well as the lack of formalization.

North and Kumta (North & Kumta, 2018) stress the importance of user participation in the definition of requirements prior to integration of an ICT. User requirements, incentive systems and acceptance factors have to be included from the beginning to ensure the usage of the system (ibid). In the case of the company, department heads were included prior to implementation. However, individualisation only took place to a low extent. The user motivations are overlapping with motivations of knowledge sharing and will be discussed in the following section. In addition, the productivity and performance of the system are not measurable. This is important for the success of an ICT (North & Kumta, 2018).

**Transfer and exchange of internal knowledge assets**

The following paragraphs address the factors that drive and hinder knowledge transfer and the motivation of organizational members to share their knowledge. As discussed before, knowledge is shared in intrapersonal, as well as technologically assisted forms.

**Knowledge sharing barriers and drivers**

Multiple studies have investigated supporting and hindering factors of knowledge sharing and transfer (e.g. (Krylova, et al., 2016; Razmerita, et al., 2016; Qureshi & Evans, 2015)). The reported drivers for cooperation can be seen in table 2. Organizational members all mentioned a culture of cooperation regarding knowledge transfer throughout the research and development department. A friendly atmosphere was the most reported facilitator of cooperative knowledge exchange between individuals. This may be described as a shared mental model, which has been identified as a driver for knowledge transfer (Krylova, et al., 2016). In addition, participants reported, that the high complexity of work task needed the combined knowledge base of individuals, e.g. workshops, projects. The design of offices, team composition, and meeting places were perceived as reinforcing factors for knowledge sharing. Driving factors influenced by management processes were the missing of a reward system, and absence of internal ranking. This stands in contrast to some literature findings, who identified monetary rewards as drivers for knowledge sharing (Razmerita, et al., 2016). An intrinsic driver mentioned was the joy of working with or helping others, which was also mentioned by Krylova et al. (2016).
Further, it was reported that the recent reorganisation of the company improved the knowledge transfer between different sites. While earlier, silo mentality and competition between sites was reported, the global orientation, as well as multi-site projects enable cooperation and knowledge sharing between sites. The organization and workflow of the development department were reported to contribute to knowledge transfer. The matrix organisation, as well as agile management methods, were named as drivers for the sharing of knowledge. In the research department minimal structures were reported to have a positive impact on knowledge sharing behaviour. This coincides with literature findings (Krylova, et al., 2016).

In general, no knowledge hoarding behaviour was reported. The only exception addressed the idea generation process, in which – in exceptions – competitive behaviour was observed. Although some scholars argue for the need to balance between cooperation and competition (e.g. (North & Kumta, 2018)), cooperation, i.e. the sharing of knowledge, was the dominant form compared to competition, i.e. knowledge hiding or hoarding. Barriers to cooperation in the form of knowledge sharing were lack of time, spatial distance, being excluded from “office grapevine”, the lack of ICTs that enable knowledge transfer via a technological platform, and personal reasons. This relates to findings of Qureshi & Evans (2015), who, amongst others, identified lack of time, limitations of IT as barrier to knowledge sharing. Especially lack of time is a commonly found deterrent in literature (Krylova, et al., 2016). Another reported barrier was the perceived difficulty in locating knowledge due to the above-mentioned high personalization and the lack of a skill database. A connection to the weaknesses of ICTs may be drawn, as there is no appropriate technological tool to locate knowledge carriers. This results in higher time efforts required to locate knowledge carriers and may deter knowledge transfer through lack of time – especially for new employees.

**Motivations for sharing Knowledge in ICTs**

One reported motivation for the use of ICTs for knowledge transfer by organizational members is the perceived benefit of sharing their own knowledge. A readiness to share was reported, if they were able to retrieve knowledge themselves. In addition, status and appreciations were name as possible return for knowledge exchange. Approaching from a social exchange theory perspective (Homans, 1958; Serenko & Bontis, 2016), it can be argued that organizational members are willing to share their own knowledge if they see benefits in this. This may take several forms. Reciprocity is among the most mentioned rules for
exchange decisions mentioned by scholars (Cropanzano & Mitchell, 2005; Meeker, 1971; Serenko & Bontis, 2016) and refers to the mutual benefit of parties during an exchange.

The four modes of social exchange according to the affect theory of social exchange (Lawler, 2001; Serenko & Bontis, 2016) can be observed within the reported motivational rationales of organizational members. The first, negotiated, refers to exchanges, in which the reciprocation conditions are agreed upon before engaging in the exchange (ibid). In the company’s knowledge transfer, this can be observed with the reporting of new inventions. An employee shares her idea in return for predefined returns. If the idea is accepted, the employee will get a monetary reward, and if the idea results in a patent, the employee will have a share in the profits. The second mode, reciprocation, is when it is assumed, that the knowledge recipient will eventually return the favour and share knowledge in return (ibid). This can be observed in intrapersonal exchange, e.g. in an informal exchange between employees in the tea kitchen. The third mode, the generalized mode, is based on the assumption that if individuals share their knowledge, someone else in the organisation will share their knowledge as well (ibid). Organizational members in the investigated company mentioned this in connection to the use of the MIAP tool. They are willing to share their knowledge, if they know that others are sharing theirs as well and they can retrieve knowledge when they need it. The last mode, productive exchange, is based on altruistic motives (ibid). Altruism aims to the maximum benefit of the exchange partner (Meeker, 1971). One participant mentioned that he shared knowledge, because he enjoyed helping others. In addition, group gain was named as a motive. Group gain aims to the maximum benefit for all members of the group (ibid).
7. Conclusion

The findings of this study enabled the answering of the following research questions:

R1: How is knowledge management implemented in the R&D department of a large company in the high-tech healthcare industry?

With the theoretical framework and the empirical research, a picture of an organization with a high amount of knowledge is painted. Knowledge is perceived as an important asset and is to a high degree located in the heads of organizational members. The personalization strategy is dominant, however, partly supported and partly supplemented by a codification strategy in the form of ICTs. One could argue, that the organization applies a dynamic knowledge management strategy. The most widely used ICT is a knowledge management system on a OneNote base called MIAP. Furthermore, transformation processes according to Nonaka and Takeuchi (1995) were identified and related to processes within the firm.

R2: What requirements and motivations do organizational members see for knowledge transfer through ICTs?

Although the dominant existing tool (MIAP) is perceived to be useful, organizational members identified weaknesses, such as the overload of information and the lack of formalization. Interviewees identified several requirements, above all, low thresholds and the attainment of critical mass, as well as the demand for standardization and formalization. Organizational members are willing to share their knowledge through ICTs if they perceive that they can retrieve knowledge from themselves from the same system.

R3: Which formal and informal organizational factors influence and motivate the transfer of knowledge?

The third research question addressed drivers and barriers of knowledge sharing from literature, as well as, empirical findings. Similar results were obtained with the organizational atmosphere and cooperative culture named as the main drivers, and lack of time and ICT weaknesses as the main barriers. Further drivers included the high complexity of work tasks, the design of offices, team composition, organisational structures, the missing of a reward system, the organisational structure and lack of internal competition. Further reported barriers were the high personalization of knowledge, the difficulty in locating knowledge carriers, and spatial distance.
This study provides a relevant example of knowledge management and transfer processes and practises in a large organization in a knowledge intensive industry. Knowledge management is a complicated and multifaceted topic, which is of ever-increasing importance to knowledge-intensive organisations. With the emergence of appropriate technologies for communication and information, the internal transfer of knowledge may be facilitated. However, it is challenging to balance knowledge management systems between user requirements and resource availability. The implementation of an ICT for knowledge transfer that fulfils all requirements, such as low thresholds, critical mass, and searchability, will require the provision of financial and human resources in the development phase. Without these, and top management efforts to implement a formalized structure, as well as a global responsibility for knowledge management, the success of ICTs will be limited. This study highlights the need for ICTs to support knowledge transfer within a company.

However, ICTs alone are not enough to exploit internal knowledge assets. Knowledge transfer in an organization is highly dependent on the motivation of its members to share their own knowledge, be it in person, or in a codified form via ICTs. Employees will do so, if they see a benefit for themselves. In the context of ICTs, the measurement of their performance is necessary to see their impact, and a critical mass is necessary to enable retrieval of information.

Although this study presented interesting results in that regard, further research is needed. Scholars should focus on how it is possible to present benefits of knowledge sharing to organisational members, ICT requirements, as well as further in-depth analyses on key enablers and deterrents of knowledge transfer.

**Limitations & criticism**

As only one company is investigated, one cannot generalize the findings. However, a relevant example is provided by including many different viewpoints in a single case study. The results of the empirical research were obtained with semi structured interviews of organizational members. It makes sense that in a study on knowledge management, the actual sharing of individual knowledge about the firm’s processes and practises is used to construct an image of how knowledge management works in one particular firm. The results may be biased as employees might not want to criticize their employer, and answers may have reflected personal opinions. In addition, the study group consisted of nine male and one female participants. This is predominantly caused by the fact, that especially in the research
department the majority of the members are male. Another limitation is that nine out of ten participants were located at the Austrian site, and thus results might differ from findings that would have been obtained at the German site. However, the obtained results were sent to the organization for validation.

**Contribution to the field of research**

This study contributes to the field of knowledge management research by providing a relevant example. It shows how internal knowledge assets are managed in the research and development departments of a market-leading organisation in the high-tech healthcare industry. In addition, it shows what motivates, deters and drives knowledge transfer within the company. Further, the importance of adequate ICT-solutions as a supporting system for knowledge transfer is highlighted and ICT requirements are identified.
References


Appendix

Interview Questions

1. What did your professional career look like until now and what is your current role at the organization?
   a. What are your tasks? What are your competences?
   b. What does your day-to-day work look like?
2. How is the R&D department structured and organized?
   a. Hierarchy?
   b. Way of working?
   c. How does it differ from other departments?
3. Which policies, procedures and resources in the organization/department augment or hinder the creation, sharing and use of knowledge?
   a. What formal guidelines exist for knowledge management? What do they look like?
   b. Which technologies support the transfer of knowledge? What do they look like and how are they implemented in processes?
   c. Is there an incentive system for the creation and sharing of knowledge? What does it look like?
4. What can you tell me about cooperation and competition between employees regarding knowledge sharing?
   a. What are the barriers/drivers for cooperation?
   b. What are the barriers/drivers for competition?
5. How would you assess the availability of knowledge?
   a. How easy is it to locate knowledge?
   b. How easy is it to contact persons with the appropriate knowledge?
6. From your perspective, how can managers/team leaders/employees and yourself facilitate the sharing of knowledge?
   a. Which measures?
   b. What is the motivation?
7. How and by whom is individual knowledge converted into collective knowledge/best practise?
   a. What are the barriers?
8. What does the onboarding process of new employees look like and which possibilities for further training exist?
   a. Are these made use of?
9. How does communication/transfer of knowledge happen between the locations and between the departments?