Chapter 3
Knowledge Management

3.1 Preface

The previous chapter explained the different definitions of SMEs. It also outlined their difficulties and competition factors. One of these difficulties is the handling of knowledge. Knowledge has been identified as the fourth production factor and hence needs to be managed. It is therefore essential to know how Knowledge Management works.

This chapter starts with a definition of Knowledge Management. A comparison of the various types of knowledge will help distinguish the forms from each other. After explaining the types of knowledge, the concepts and theoretical approaches to Knowledge Management will be introduced. One of these concepts is 'The SECI Model' by Nonaka/Takeuchi that is divided into an epistemological and ontological dimension. The second concept is the 'Munich Knowledge Management Model' by Reinmann-Rothmeier. Within this model, knowledge is compared with the different states of water.

3.2 Definition and Types of 'Knowledge'

As mentioned in the chapters before, Knowledge Management has become increasingly important in recent years. But what exactly is KM? There is no single agreed definition of this term.

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Nahapiet and Ghoshal defined it as the task of developing and exploiting both tangible and intangible resources of a company. Tangible assets include information and experience-based knowledge about customers, products, competitors etc. Intangible assets include the competencies and knowledge resources of employees in a company.[1]

Knowledge itself is divided into various types and these are explained hereinafter. Recommendations are also made for each type.

3.2.1 Internal vs. External Knowledge

Internal knowledge derives from information sources within an organization, e.g. EDP specialists. By contrast, external knowledge is available from outside, e.g. from the internet or from other companies' experts, and therefore needs to be acquired. The acquisition of knowledge from external sources is often advantageous because there is no need inside the company for the long-term, time-consuming process of knowledge development.[2] In many cases, the use of external knowledge sources is even a must. Nowadays, it is impossible for anybody to have all of the required knowledge and skills. Knowledge is rapidly increasing and the number of information sources is rising as well. In view of these facts, there is no chance for individuals to keep themselves up to date about everything and at all times.[3] Finally, it should be mentioned that internal knowledge within a company can be used directly while external knowledge is not directly available, but can be of high interest.[4]

3.2.2 Theoretical vs. Practical Knowledge

Knowledge can be divided into theoretical and practical knowledge. Theoretical knowledge consists of internal and external

[1] Cf. Nahapiet, J., Ghoshal, S. (1998), p. 242.
[2] Cf. Heckert, U. (2002), p. 20.
[3] Cf. Voelker, R., Sauer S., Simon M. (2007), p. 52.
[4] Cf. Hopfenbeck, W., Mueller, M., Peisl, T. (2001), p. 37.

company-related facts and processes. This is also called factual knowledge resp. 'know-that'. This type of knowledge is easy to put into words whereas practical knowledge is difficult to verbalize and visualize. Practical knowledge includes abilities and skills and is also known as application knowledge or 'know-how'. Theoretical knowledge forms the basis for the communication of knowledge among human beings. Practical knowledge can be gained from carrying out activities and tasks (learning by doing). Afterwards, both the existing and the new experiences gained can be linked with action.[5] In brief, practical knowledge can be divided into two main aspects. One of these is the skills that are needed to achieve goals in a given situation. The second aspect is related to employees' familiarity with their work. By contrast, theoretical knowledge is of an intellectual and descriptive character and includes theories, methods and facts that are needed to know about the work.[6]

3.2.3 Individual vs. Collective Knowledge

Individual knowledge is the knowledge held by each employee in a company. It is mainly present in implicit form, i.e. it basically exists in the head of an individual. Collective knowledge, by contrast, occurs through communication and interaction among employees. As collective knowledge is based on norms, rules or structures prevailing within a company, it is also often referred to as 'organizational knowledge'. On the one hand, it is essential for organizations to transfer individual knowledge into collective knowledge through the cooperation of single knowledge carriers. On the other hand, it is also important to convert collective knowledge into individual knowledge – only then is it possible to set up an organizational knowledge basis.[7] The concept of an 'organizational knowledge basis' has been defined by Probst et al. as follows: An organizational knowledge basis consists of an individual and collective knowledge inventory which is accessible

[5] Cf. Heckert, U. (2002), p. 21.
[6] Cf. Staudt, E., Kailer, N., Kottmann, M. (2002), p. 162.
[7] Cf. Heckert, U. (2002), p. 19.

for an organization in order to solve its tasks. Furthermore, it also includes data and information inventories on which individual and collective knowledge is built.[8]

3.2.4 Tacit vs. Explicit Knowledge

The distinction between tacit and explicit knowledge is of prime importance in the KM process. The characteristic of explicit knowledge is that it can be easily articulated and therefore be saved outside the head of single persons (like a document in a folder or computer file). Consequently, it is processable, transferable and storable by using EDP.[9] Tacit knowledge exists inside the head of individuals. It comprises practical knowledge which is difficult to communicate and therefore difficult to transfer and store in an explicit way. Tacit knowledge is based on an individual's convictions, intuitions and ideals and is of a more unconscious nature. This kind of knowledge is dangerous for companies, because it cannot be separated easily from the knowledge carrier.[10] For example, if long-standing employees quit their jobs, the company must be aware of a massive loss of know-how. To avoid this scenario, it is important to transfer tacit into explicit knowledge.[11]

3.3 Concepts of and Approaches to 'Knowledge Management'

There exist a lot of Knowledge Management models, but only few have established themselves – established in the sense of becoming generally valid, finding high acceptance in practical contexts and gaining recognition in scientific circles. The model of the Knowledge Spiral developed by Nonaka 1994 as well as Nonaka/Takeuchi 1995 complies with these three criteria and will

[8] Cf. Probst, G., Raub, S., Romhardt, K. (2006), p. 22.
[9] Cf. Schreyoegg, G., Geiger, D. (2003), p. 14.
[10] Cf. Gehle, M. (2006), p. 26.
[11] Cf. von Krogh, G., Nonaka, I., Nishiguchi, T. (2000), p. 9.

be presented hereinafter.[12] In addition, the Munich Model by Reinmann-Rothmeier will be explained.

3.3.1 'The SECI Model' by Nonaka/Takeuchi

The approach taken by Nonaka/Takeuchi aims at generating and distributing knowledge within a company. Their model consists of two main elements, the epistemological and the ontological dimension (Fig. 3.1).[13]

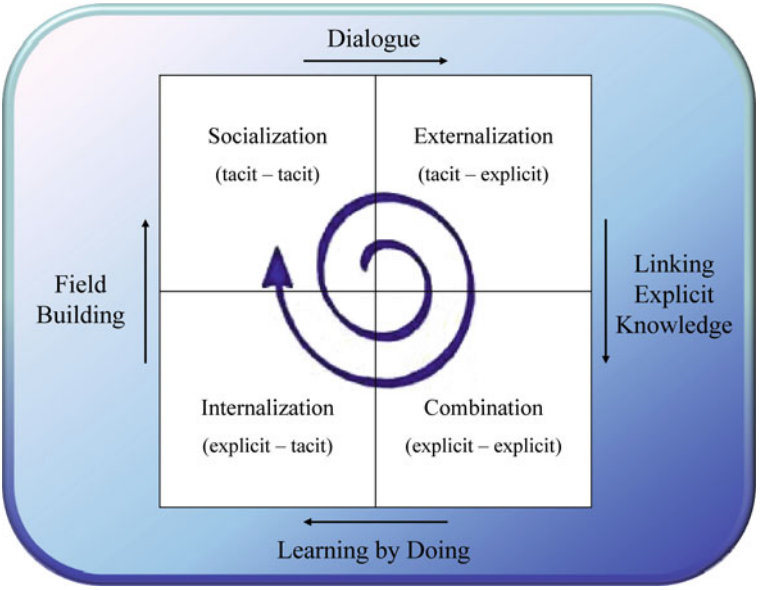

Fig. 3.1 Knowledge Spiral on Epistemological Level[14]

(i) *Epistemology* is the study of knowledge.[15] It describes the various types – tacit and explicit – of knowledge and is divided into four main processes of knowledge exchange. Through the dynamic interaction of the epistemological and the ontological dimension, existing and new knowledge can be extended and results in a knowledge spiral. The four

[12] Cf. Reinmann-Rothmeier, G. (n.d.), p. 3.
[13] Cf. Lehner, F. (2006), p. 39.
[14] Cf. Nonaka, I., Takeuchi, H. (1997), p. 84.
[15] Cf. Brown, T., Smith, L. (2002), p. 201.

modes of knowledge conversion interacting in the spiral are **S**ocialization (from tacit to tacit), **E**xternalization (from tacit to explicit), **C**ombination (from explicit to explicit) and **I**nternalization (from explicit to tacit).[16]

- *Socialization* happens when two persons exchange tacit knowledge face-to-face. Examples are a personal dialogue or a conference, but also 'exchange of experience' through observation or imitation.[17]
- Only through *Externalization* can knowledge be developed and made available for the whole company (e.g. through documentation). This is probably the most important form of knowledge development. Tacit knowledge adopts the form of concepts and hypotheses.[18]
- *Combination* is the amalgamation of existing explicit knowledge to develop new explicit knowledge. This form of knowledge exchange is supported through documents, PCs, networks and communication tools.[19]
- *Internalization* is a learning process that is linked to 'learning by doing'. The formation of an own opinion is an example. The explicit knowledge becomes part of the individual's knowledge base and thus an asset for the organization. It is an individual operationalization of knowledge.[20]

The above forms of knowledge development are restricted in their use to the generation of new knowledge. Tacit and explicit knowledge must interact dynamically. The core concepts of knowledge exchange by Nonaka/Takeuchi consist of two different knowledge spirals.[21] The 2nd spiral of knowledge development exists on the ontological level.

[16] Cf. Nonaka, I. (1992), p. 96; Nonaka, I., Takeuchi, H. (1997), p. 71.
[17] Cf. Vollmar, G. (2007), p. 57.
[18] Cf. Nonaka, I., Takeuchi, H. (1995), p. 71.
[19] Cf. Lehner, F. (2006), p. 40; Nonaka, I., Takeuchi, H. (1995), p. 71.
[20] Cf. Eschenbach, S., Geyer, B. (2004), p. 98; Nonaka, I., Takeuchi, H. (1995), p. 71.
[21] Cf. Nonaka, I., Takeuchi, H. (1997), p. 86.

(ii) *Ontology* is a branch of metaphysics that deals with the nature of being.[22] It tries to answer the questions which entities exist and how they can be grouped or related within a hierarchy. In the context of knowledge sharing, the term ontology is a description of the concepts and relationships that can exist for an agent or a community of agents. First, the tacit knowledge of employees needs to be mobilized. This takes place via 4 exchange forms.[23] Knowledge is hereby enhanced and pushed forward to higher ontological levels.[24] This process is triggered by an individual, continues through teams, across departments and divisions well beyond the company borders (Fig. 3.2).[25]

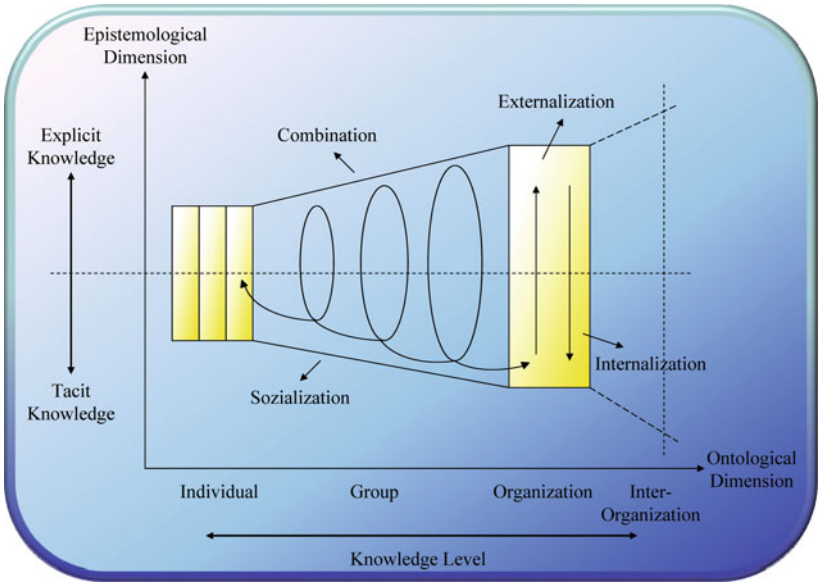

Fig. 3.2 Spiral of Knowledge Development Within an Organization[26]

[22] Cf. Wallace, D. P. (2007), p. 175.
[23] Cf. Lehner, F. (2006), p. 40; Nonaka, I., Takeuchi, H. (1997), p. 85.
[24] Cf. Rutten, R. (2003), p. 68.
[25] Cf. Lehner, F. (2006), p. 41.
[26] Cf. Nonaka, I., Takeuchi, H. (1997), p. 87.

The concept of the knowledge spiral causes a suitable frame within a company.[27] The five preconditions for knowledge development and generation in the SECI Model are Intention, Autonomy, Fluctuation and creative Chaos, Redundancy and the necessary Diversity.

- The first requirement is the *Intention* – in other words: the strong aim of a company to achieve certain goals. Based on this pursuit, strategies, benchmarks and visions evolve which, by necessity are value-oriented. The company's intention is the criterion for evaluating any knowledge that is created. It is also meant to strengthen the commitment of the employees by promoting their further development. The company's intention thus controls the knowledge spiral.[28]
- The employees of a company should perform in *Autonomy* to strengthen their level of commitment and motivation. The organization should establish a system where all autonomous individuals and groups have the same level of information to determine task boundaries by themselves. Self-organized groups build such an autonomy-friendly area as explained by Nonaka/Takeuchi.[29]
- Another precondition is *Fluctuation and creative Chaos.* Due to a fluctuating environment, e.g. changing demands or competition, a situation may develop within a company where the employees fear a crisis. Based on the disturbance of their habits, the staff now has the possibility to break their stereotyped mindset[30] and to develop new concepts. The collapse of routine processes may lead to creative Chaos. This mood of crisis can be generated intentionally by the management.[31]
- Western managers often have negative associations with the term *Redundancy*, e.g. double work or already existing information. In this case, however, Redundancy means additional

[27] Cf. Liebowitz, J. (2004), p. 86.
[28] Cf. Gehle, M. (2006), p. 65.
[29] Cf. Nonaka, I., Takeuchi, H. (1995), p. 81.
[30] Cf. Bontis, N., Choo, C. W. (2002), p. 441.
[31] Cf. Eschenbach, S., Geyer, B. (2004), p. 101; Nonaka, I., Takeuchi, H. (1995), p. 78.

information that is not directly related to purposes. It helps employees to exchange knowledge among different departments, work out new perspectives and integrate into the company as a whole.[32]

- The last requirement is the *necessary internal Diversity.* Employees need sufficient flexibility to react immediately to changes in the business environment, meet the complexity of this environment and demonstrate their internal diversity.[33] This can be achieved by having equal access rights to information and information systems. Further possibilities are the reduction of rigid hierarchies, staff rotation and a new organizational structure.[34]

Both spirals are dynamic: the epistemological through interaction of the four exchange forms and the ontological through repeated interaction among individuals, teams, on company level but also among companies. But only through simultaneous collaboration of both can knowledge be developed and innovations be triggered.[35]

3.3.2 'Munich Knowledge Management Model' by Reinmann-Rothmeier

Contrary to the concept described above, Reinmann-Rothmeier integrates pedagogical-psychological aspects into her KM model. Based on the results and approaches taken by the models displayed above, this model tries to react and adjust their deficits. The Munich Model differentiates between information knowledge – which is similar to explicit knowledge – and practical knowledge which is comparable to tacit knowledge.[36]

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[32] Cf. Lehner, F. (2006), p. 42; Nonaka, I., Takeuchi, H. (1997), p. 101.
[33] Cf. Morey, D., Maybury, M., Thuraisingham, B. (2002), p. 170.
[34] Cf. Lehner, F. (2006), p. 42; Waltz, E. (2003), p 74.
[35] Cf. Nonaka, I., Takeuchi, H. (1997), p. 84.
[36] Cf. North, K. (2005), p. 176; Reinmann-Rothmeier, G. (2001), p. 15.

As Reinmann-Rothmeier's KM model compares knowledge with water, this model is also called the 'Water Model of the Munich School' (Fig. 3.3).[37]

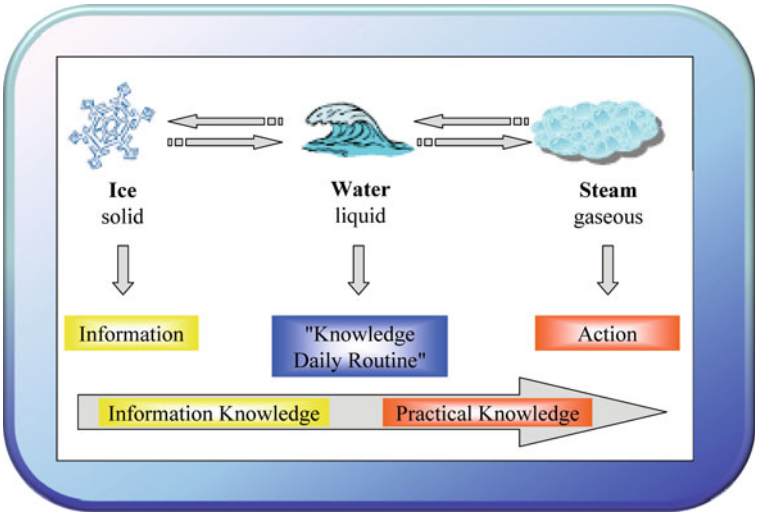

Fig. 3.3 Water Analogy of Knowledge[38]

Water exists in three different physical states: solid, liquid and gaseous. This insight can be transferred to the concept of knowledge. The knowledge that we are confronted with day by day can be compared to the liquid state of water. Water is constantly in motion, it can be dammed or directed, but it cannot be grasped. The same applies to knowledge: the tacit and explicit parts of knowledge can be influenced and formed.[39] When water freezes into ice, it can be transported, piled up and structured. In this state, water is easy to handle. Ice can therefore be compared with information knowledge (explicit knowledge). This type of knowledge can be documented, transported and forwarded.[40] The gaseous state of water is similar to practical knowledge (tacit knowledge).

[37] Cf. Gehle, M. (2006), p. 67.
[38] Cf. Reinmann-Rothmeier, G. (2001), p. 16.
[39] Cf. Maisch, J. (2006), p. 65.
[40] Cf. Gehle, M. (2006), p. 27.

There is no direct access to this type of knowledge, and the same applies to steam.[41]

Based on this model, KM is explained as an approach to influencing knowledge processes in an area of tension between information and action. In addition, the company needs to create a general framework that allows access to all parties involved. Nevertheless, KM has only limited influence on knowledge motion, i.e. the transformation of information into action.[42]

The essence of this model lies in 4 different knowledge processes: *knowledge presentation, knowledge use, knowledge communication* and *knowledge generation.*[43] They simultaneously affect individual and organizational procedures, actions and interests. Also psychological processes of knowledge motion are taken into consideration.[44]

(i) *Knowledge presentation* aims at making knowledge visible, accessible and transportable.[45] At this stage, knowledge is 'frozen' (water analogy) to make it manageable. Through information and communication technology it can be passed on to others.[46] This model also considers personal barriers. Apart from the willingness of an individual to share personal knowledge,[47] skills are requested to share the knowledge in a way that makes it easily accessible. The task of a company's management is to foster a good working atmosphere for knowledge transfer to happen and to promote the individual skills of articulation, visualization and presentation of knowledge.[48]

(ii) *Knowledge use* is the attempt to make knowledge applicable for actions and decisions, to make knowledge 'come alive'.

[41] Cf. Reinmann-Rothmeier, G. (2001), p. 18.
[42] Cf. Dittmar, C. (2004), p. 106; Reinmann-Rothmeier, G., Mandl, H. (1999), p. 27.
[43] Cf. Reinmann-Rothmeier, G. (2001), p. 22.
[44] Cf. Lehner, F. (2009), p. 31.
[45] Cf. North, K. (2005), p. 177.
[46] Cf. Reinmann-Rothmeier, G. (n.d.), p. 18.
[47] Cf. Nonaka, I. (1994), p. 14.
[48] Cf. Maisch, J. (2006), p. 65; Reinmann-Rothmeier, G. (2001), p. 22.

The use of knowledge can be compared to the gaseous state of water. Knowledge becomes visible and thus usable. The implicit parts of knowledge, however, remain 'foggy' and are not directly accessible. Nevertheless, the use of knowledge is linked with motion since knowledge is transferred into action.[49] The use of knowledge can only take place effectively if routine actions and habits are broken. This requires the willingness to break the mould by actively involving the company's employees.[50]

(iii) The focus of *knowledge communication* is the exchange of information and the cross-linking of knowledge. The single steps in the process of knowledge communication are possible with and without technical equipment.[51] In terms of the water analogy, we are talking about the liquid form of water here. Knowledge should be made to 'flow' and the aim is not to interrupt this flow. Through communication, knowledge is in motion and further spread, thus allowing it to grow and to be used by knowledge carriers.[52] For a better communication among the employees within an organization, feelings of trust and mutuality are needed. The exchange of knowledge should be characterized by a reciprocal give-and-take.[53] It is the management's task to create a trustworthy environment and to motivate employees' teamwork and cooperation. Contact barriers should be reduced. This can be done through expert directories with the data of relevant domain experts.[54]

(iv) *Knowledge generation* is the process of converting pure information into contextual and action-relevant knowledge. In this way, individual or collective knowledge can be issued and something new can be created for use in innovative ideas.[55] This means that generation processes ensure

[49] Cf. Reinmann-Rothmeier, G., Mandl, H. (2004), p. 53.
[50] Cf. Gehle, M. (2006), p. 57.
[51] Cf. Kolbe, L. M., Oesterle, H., Brenner, W. (2003), p. 47.
[52] Cf. Reinmann-Rothmeier, G. (2001), p. 24.
[53] Cf. Davenport, T. H., Prusak, L. (2000), p. 34.
[54] Cf. Reinmann-Rothmeier, G. (2001), p. 24.
[55] Cf. Grant, R. M. (2005), p. 176.

> that the source of the 'knowledge river' does not dry up. Only through generation of new knowledge is it possible for a company to be close to its customers and act in a future-oriented way. New knowledge can only be created if employees are able to derive from their own experience and knowledge and put it into other contexts. Furthermore, it is important that employees work in an environment where they can use their creativity and curiosity for generating new knowledge. The present model emphasizes that only such an environment is able to generate new knowledge, identify the potentials and bring the 'right' people together.[56]

The concept of an integrated and effective KM requires individual, social and organizational learning. KM and learning belong together and it is difficult to separate them. It is already a well-known fact that learning plays a pivotal role in companies, but the different concepts and approaches show that more than learning is needed. The approach to knowledge and learning must be systematic, methodical and take place consciously. Finally, it is important to recognize KM as an opportunity to build up, activate and apply the personal and organizational ability to learn.[57]

3.4 Summary

This chapter defined the concept of Knowledge Management. This was followed by a description of the various types of knowledge. Also the differences between internal and external knowledge as well as their advantages and disadvantages were presented. When comparing theoretical and practical knowledge, it is practical knowledge that can be easily verbalized while theoretical knowledge forms the basis of communication. Individual knowledge exists in the heads of persons and collective knowledge takes place through communication.[58] Explicit knowledge

[56] Cf. Ichijo, K., Nonaka, I. (2007), p. 217; Reinmann-Rothmeier, G. (2001), p. 25.
[57] Cf. Reinmann-Rothmeier, G. (2001), p. 21; Stacey, R. D. (2001), p. 14.
[58] Cf. Heckert, U. (2002), p. 21.

exists outside the heads of individuals and can be easily structured whereas tacit knowledge exists inside their heads. It is difficult to store it outside the knowledge carrier. Therefore, it is highly important to convert tacit into explicit knowledge.[59]

'The SECI Model' by Nonaka/Takeuchi consists of two main elements. On the one hand, epistemology describes the interaction of tacit and explicit knowledge. On the other hand, ontology deals with the agents and their relationships of knowledge sharing.[60] On the epistemological level, new knowledge can be created if or when it is provided by knowledge carriers. This is the process of using knowledge and converting it into more complex knowledge.[61] The ontological dimension divides agents into groups on different hierarchy levels within the SECI model. The preconditions mentioned in this chapter must be fulfilled before knowledge generation takes place.[62]

The 'Munich Knowledge Management Model' by Reinmann-Rothmeier compares knowledge with water. In its liquid state, water can be compared to the knowledge we are exposed to every day: it is in motion and cannot be grasped. In its frozen state, water (knowledge) can be documented, structured and transported. Water resp. knowledge in the gaseous state is difficultly accessible and controllable. In order to present knowledge, it has to be made visible and mobile. Before knowledge can be used, it needs to be made applicable. When knowledge is communicated, an exchange of information takes place. The generation of knowledge focuses on transforming pure information into contextual knowledge.[63]

The presented models have shown that knowledge is manageable. These theoretical approaches require an exchange of knowledge. Therefore, the next chapter focuses on the transfer and sharing of knowledge.

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[59] Cf. Gehle, M. (2006), p. 26; von Krogh, G., Nonaka, I., Nishiguchi, T. (2000), p. 9.
[60] Cf. Nonaka, I., Takeuchi, H. (1997), p. 71.
[61] Cf. Despres, C., Chauvel, D. (2000), p. 90.
[62] Cf. Nonaka, I., Takeuchi, H. (1997), p. 84.
[63] Cf. Reinmann-Rothmeier, G. (2001), p. 21.