Knowledge sharing in expert-apprentice relations
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Chapter 2

**Theoretical background**

This chapter examines current theories on knowledge, knowledge sharing, experts and learning and establishes a solid base for the design of the expert-apprentice protocol. After each section relevant findings that can be drawn from that theory are noted. These are the starting point for the design requirements of the protocol, which are determined in chapter five.

This theoretical chapter is divided into three parts. The goal of expert-apprentice relations is to enhance the knowledge sharing between an expert and an apprentice within organisations, therefore first the concepts of knowledge and knowledge sharing in general are elaborated. Motives for knowledge sharing, knowledge sharing as a social process, and organisational theories are also included in this section. Knowledge sharing consists of and results in learning; therefore the second part of this chapter covers learning and learning theories. To be able to design expert-apprentice relations, a thorough understanding of experts and expertise is necessary. The development of expertise and the development from novice to expert are described in the third section of this chapter. Some topics that are relevant to this study are part of more than one section. However, they are discussed following the above mentioned structure.

2.1. **Knowledge and knowledge sharing**

This paragraph looks at the concepts of knowledge and knowledge sharing. The definitions and interpretations of these concepts are subject to ongoing debate in knowledge management literature. It is not the purpose of this research to contribute to or to solve this discussion. This section contains an overview of the relevant theories and discussions followed by working definitions of these concepts as they are used in this research.

2.1.1. The concept of knowledge

Many philosophers have reflected on a definition of the concept of knowledge. In designing expert-apprentice relations, it is important to define a working definition of knowledge and identify its characteristics. Because several definitions of knowledge are used in different management and organisation studies, one should be clear about how the term is used and what it encompasses. For example, the following definitions can be found in literature: 

"Knowledge is information combined with experience, context, interpretation, and
reflection. It is a high-value form of information that is ready to apply to decisions and actions” (Davenport et al., 1998). “Knowledge is understanding plus ability to transform into actions (skills) which yields performance” (Nootboorn, 1996); “The – partly unconscious – capacity that enables someone to perform a particular task” (Weggeman, 2000). Some definitions emphasize human action, others knowing. Most definitions state that knowledge can only reside within an individual, and that it is a result of (among other things) experiences within a certain context. Although some scholars argue that knowledge can also be embedded in non-human systems, like knowledge embedded in machinery or in documents (for example Boersma, 2002), this research follows the claim that knowledge cannot exist outside the individual and is highly personal. In this research the knowledge of experts is a central theme. As is described later in this chapter, the expert’s expertise consists for a large part of experience and intuition: therefore a definition of knowledge is required which acknowledges these aspects. The working definition of knowledge used in this study is the definition of Weggeman (2000). To understand this definition, the differences between the concepts ‘data’, ‘information’ and ‘knowledge’ first need to be discussed.

According to Weggeman, data are symbolic representations of quantities, facts and opinions. It is an observer’s perspective of the state of a variable. For example, ‘50 children’, ‘32 degrees Celsius’ or ‘Monday’, are forms of data. It is a representation of the observation of a person about the condition of a variable under consideration. Data becomes information when a meaning is attributed to it. In most cases through – subjective – directed comparison of arranged data. As humans decide which meaning they attribute to data (in contrast to e.g. machines) the conclusion can be drawn that information cannot exist outside the individual. To make information out of data – to be able to attribute a meaning to data – one requires knowledge. A consequence is that, as with information, knowledge cannot exist outside the individual and cannot be stored elsewhere.

Now that the concepts of data and information have been identified, knowledge can be defined as:

The – partly unconscious – capacity that enables someone to perform a particular task. The capacity is a metaphorical function of the Information, the Experience, the Skills and the Attitude which is at someone’s disposal at a certain moment in time: $K = f(I, ESA)$

$K$ represents the personal capacity: it is the product of information and experiences, skills and attitudes. $I$ represents the task-set information that is individual but can be transferred as person-independent data via communication. $ESA$ is formed by the collection of personal experiences, the source of feelings, associations and intuitions (E), the traditional and manual skills or communication skills (S), and the demeanour (Attitude and behaviour) which is (are) characteristic of a person in a particular situation and arises from basic assumptions such as standards and values (A).
In this definition of knowledge, according to Wegge man, the I-component equals explicit knowledge and the ESA-component equals tacit knowledge. This essential distinction between explicit knowledge and tacit knowledge is said to be first introduced by Polanyi (1966). Put simply, the distinction is often characterized by what has become a catchphrase in the field of knowledge management: ‘we can know more than we can tell’. Explicit knowledge, then, is the knowledge that we can tell, and tacit knowledge the knowledge that we cannot tell (Polanyi, 1966).

As is the case with the concept of knowledge, the distinction between explicit knowledge and tacit knowledge is subject to debate. Hildreth & Kimble (2002) describe this debate as follows: for Polanyi, tacit knowledge is knowledge that is known but cannot be told. It is the kind of knowledge that cannot be articulated because it has become internalised in the unconscious mind. It represents a level of understanding that cannot be externalised because it is “inaccessible to consciousness”. A more recent distinction between tacit and explicit knowledge is by Nonaka (1991) and Nonaka & Takeuchi (1995). According to Nonaka, explicit knowledge is knowledge that is easily expressed, captured, stored and reused. It can be transmitted as data and is found in databases, books, manuals and messages. In contrast, according to Nonaka tacit knowledge is highly personal, hard to formalize and therefore difficult to communicate to others. It is deeply rooted in action an in an individual’s commitment to a specific context. So, for Nonaka, tacit and explicit knowledge are not separate but mutually complementary entities. They interact with each other. This interaction between these two forms of knowledge is called the knowledge conversion process. According to Nonaka and Takeuchi, this process of knowledge conversion leads to knowledge creation. Knowledge creation, subsequently, results in continuous innovation which produces competitive advantage for the company.

The knowledge conversion processes between tacit and explicit knowledge are the base of the knowledge creation model of Nonaka and Takeuchi. According to Nonaka & Takeuchi, it is actually during the conversion from tacit into explicit (and from explicit into tacit) that knowledge creation takes place. Strict personal insights or ‘brain waves’ of individual workers are of little use to the company when the worker is not able to convert these insights into explicit knowledge that is accessible to other workers as well. Thus, by using social interaction, from tacit and explicit knowledge, human knowledge is created and enlarged. According to Nonaka & Takeuchi (1995), there are four forms of knowledge conversion: socialisation, externalisation, combination, and internalisation.

**Socialisation**
Socialisation is the conversion from tacit knowledge into tacit knowledge, from one person to another. A process in which the sharing of experiences takes place, and tacit knowledge is created in the form of mental models or skills. This process can take place without the
presence of language. Used methods are, for example, observation, imitation and practise to see and learn someone else’s tacit knowledge. The key word in socialisation is *experience*. For socialisation to take place, it is important that some mutual knowledge is already present in the individuals involved in socialisation. Socialisation results in shared knowledge. According to Nonaka & Takeuchi, the master-apprentice relation is a good method for this form of knowledge conversion.

**Externalisation**
Externalisation is the conversion from tacit knowledge into explicit knowledge. A process in which tacit knowledge is being expressed in explicit notions, for example in the form of metaphors, analogies, concepts, hypotheses and models. In this process, language is an important, but, on its own, not a sufficient instrument. Externalisation holds a key position in the process of knowledge creation. Externalisation results in conceptual knowledge.

**Combination**
Combination is the conversion from explicit knowledge into explicit knowledge. A process in which notions are synthesized into a knowledge system. Different compositions and forms of explicit knowledge are brought together and combined. Newly created knowledge meets existing knowledge. It is a restructuring of present knowledge – a form of data processing, from which new systematic knowledge can originate.

**Internalisation**
Internalisation is the conversion from explicit knowledge into tacit knowledge. A process through which explicit knowledge becomes part of the existing tacit knowledge. This process involves ‘learning by doing’. Internalisation takes place when experiences, through socialisation, externalisation and combination, become part of an individual’s tacit knowledge base, in the form of mental models or schemes or specialized knowledge: the experiences are internalised. Internalisation has to do with organisational learning and results in operational knowledge.

According to Nonaka and Takeuchi, knowledge creation is permanent and continuous interaction between tacit and explicit knowledge. The interaction is created by movements of different forms of knowledge conversion, which are initiated by various causes. The socialisation starts with the building of an ‘interaction field’. This field makes the sharing of experiences and mental models of the participants easier. Secondly, the externalisation is initiated by a relevant ‘discussion of collective consideration’, in which the use of the right metaphor or analogy helps the team members to verbalise their tacit knowledge which usually is hard to transfer and hidden. Thirdly, the combination mode is started by the networking (interchange) of recently created knowledge and presently existing knowledge from different organisational units. Through this, the knowledge crystallises into a new product, a new form of service or a new management system. Finally, ‘learning by doing’
leads to internalisation (Nonaka & Takeuchi, 1995). In figure 1, the knowledge creation spiral is illustrated.

![Knowledge Creation Spiral (Nonaka & Takeuchi, 1995)](image)

There is a discussion in literature whether the concepts of tacit and explicit knowledge as they were introduced by Polanyi are similar to the concepts used by Nonaka. According to some they are not and give more value to Polanyi’s view. Hildreth & Kimble (2002) for example argue that if Polanyi’s view of tacit knowledge as being inexpressible is accepted, it cannot be converted into explicit knowledge because it can never be externalised and written down in explicit form. They claim that a flaw in the knowledge creation spiral is in the tacit to explicit stage (*externalisation*). In this stage, according to these authors, tacit knowledge is not articulated and shared through interpersonal interaction but the learner actually develops their own tacit knowledge by becoming immersed in the practice itself, under the guidance of a mentor and whilst situated in a particular environment. Boer (2003) following Brohm (2005) argues that Nonaka is mixing up explicit knowledge with codified knowledge. In short, he states that people are focally aware of the things they pay attention to, they focus on, and people are subsidiary aware of the things they do not focus on, but do contribute to understanding their focus. Since people’s attention can only hold one focus at a time, they are either focally aware of something or subsidiary aware of something. Thus, subsidiary awareness and focal awareness are mutually exclusive. Polanyi relates focal awareness to explicit knowledge and subsidiary awareness to tacit knowledge. Explicit
knowledge can become tacit knowledge when the focus shifts to a new focal point and tacit knowledge can easily receive the focus, and become explicit again.

In this research the critique of Hildreth & Kimble (2002) on the tacit-explicit stage of the knowledge creation model of Nonaka & Takeuchi (1995) is taken into account. However the forms of knowledge conversion of this model are still of use in designing the expert-apprentice relation: the described stages in knowledge sharing and the methods for working with the different types of knowledge can be applied in the expert-apprentice relation.

Besides the distinction between tacit and explicit knowledge, other categorisations of knowledge exist. One possible categorisation of knowledge is by Anderson (1989), who identifies (1) declarative knowledge (know what) which is about knowledge of facts, (2) procedural knowledge (know how) is knowledge about getting things done, (3) conditional knowledge (know-when-why) is knowledge about relevant background information, and (4) situational knowledge (know where, which). The last type (situational knowledge) in this categorization is about knowing where what knowledge is stored, which in the definition of knowledge as used in this research can only be inside a person, making it therefore comparable to social knowledge or know who.

To understand the value of knowledge sharing for organisations, it is important to understand the different types of knowledge which are present in an organisation. Blaauw (2005) distinguishes four types of knowledge at the organisational level: ‘required knowledge’; ‘specific knowledge’; ‘crucial knowledge’; and ‘scarce knowledge’. Required knowledge is necessary for the organisation to subsist. This knowledge is inherent to the existence of the organisation. For example basic knowledge on administration and communication. Specific knowledge is that type of knowledge within an organisation that is specific to the branch of industry the organisation works in. For example, the specific knowledge of a bakery consists of knowledge on how to bake bread. The third type of organisational knowledge distinguished by Blaauw, is crucial knowledge. This knowledge characterizes the way in which certain knowledge is available in a unique manner within a certain organisation. It is this type of knowledge that enables an organisation to distinguish itself from other ones. It is essential, because it determines the identity of the firm. Crucial knowledge is the base of the economic value added by the company. The last type of organisational knowledge is scarce knowledge. This type of knowledge can be related to the required and specific, as well as the crucial knowledge of an organisation. Knowledge is called ‘scarce’ when it is only present in a few workers within an organisation. Often, this scarce knowledge consists of tacit knowledge, making it harder to share with and transfer to other workers within the organisation. The value of this scarcity increases as the knowledge becomes more crucial for the organisation. When crucial knowledge is scarce, the organisation is vulnerable (Boersma, 2002; Blaauw, 2005). After all, when the scarce crucial knowledge perishes, this knowledge cannot easily be replaced, resulting in the
disappearance of the company’s raison d’être. Von Krogh and Roos (1996) indicate that crucial knowledge is often scarce as well as tacit. They state that some knowledge can be highly firm-specific and less diffusible across the boundaries of the firm. Residing in individual and social relationships in the firm, this knowledge is seen as tacit and personal. Blaauw (2005) concludes that it is for this reason that it is important for an organisation to identify its crucial and scarce knowledge, and share this knowledge within the organisation.

In the preceding section, the concept of knowledge and some of its categorisations were introduced. The following paragraphs discuss theories on the sharing of knowledge.

2.1.2. Knowledge sharing

This research is about the knowledge sharing between an expert and an apprentice. To be able to design expert-apprentice relations, the knowledge sharing processes have to be identified. Knowledge sharing goes beyond the simple information sharing and is about stimulating the exchange of experiences, ideas and thoughts between people (Van den Brink, 2003). Knowledge sharing implies that individuals should mutually adjust their beliefs and actions through more or less intense interaction (Von Krogh, 2002). Therefore, knowledge sharing by definition is a social process between individuals and cannot take place within one individual (Nonaka & Takeuchi, 1995). If person A decides to write a book about his specific expertise and person B decides to read this book, within this context this action cannot be qualified as knowledge sharing between person A and person B, because it is not a social process. Reading a book, here, is a form of data sharing (Weggeman, 2001). To conceptualize knowledge sharing further, this research follows Boer (2005), who specifies knowledge sharing by describing what differentiates knowledge sharing from the related concepts such as communication and learning.

In short, according to Boer (2005) knowledge sharing is based on the process of communication: without some kind of communication knowledge sharing cannot take place. On the other hand, not all communication results in knowledge being shared. For example, when someone gives an instruction that is not understood by the other, no knowledge has been shared, but the instructing person has been communicating. Therefore, knowledge sharing can be said to be a subset of communication. A similar argument can be made for comparing knowledge sharing and learning. Knowledge sharing implies learning, since without some kind of learning by either or both knowledge sharing participants knowledge sharing cannot take place. On the other hand, not all learning is a result of knowledge sharing. For example, when someone finds out by trial and error that it is unwise to touch a hot cup of tea, no knowledge is being shared while the person has learnt something. In this respect knowledge sharing is also a subset of learning (in the next section of this chapter, different learning theories will be described). To conclude, Boer (2005) states that knowledge sharing connects communication with learning and can be considered to be that area where communication overlaps with learning.
When discussing knowledge sharing, it is essential to acknowledge the distinction between explicit knowledge and tacit knowledge, because tacit knowledge is shared in a different way than explicit knowledge. Explicit knowledge can be expressed and transferred to others independent of its context – it can relatively easily be communicated. Because it is codified, it is easier to share explicit knowledge: whoever knows the words, has broken the code, speaks the language, can share in the explicit knowledge. Explicit knowledge is often theoretical knowledge and can be transferred through education. Because tacit knowledge is hard to formalise and not easily put in words, it is extremely difficult to share with others. Considering the fact that tacit knowledge cannot be made explicit, it can only be shared tacitly. This process, the socialisation process according to Nonaka & Takeuchi (1995), can take place without the presence of language and it results in shared knowledge. Socialisation is about experience. Because of the differences between tacit and explicit knowledge, other tools and methods are required to share tacit knowledge than are required to share explicit knowledge. Explicit knowledge can be shared by sending data in the form of, for example, telling it or writing it down. Tacit knowledge can be shared tacitly by creating shared experiences, for example by using methods like observation, imitation and practise to see and learn (i.e. share) someone else’s tacit knowledge.

Von Krogh (2002) names ‘apprentice training’ as an example of tacit knowledge sharing. According to this author, this process entails as much self-observation, reflection and indwelling in the routines of the master, as it does observation and imitative learning by the apprentice. This indicates that apprentice training involves considerable learning on the part of the master, indicating a two-directional sharing rather than one-directional transfer. According to Von Krogh (2002), ‘in master-apprentice relationships, the other [the apprentice or master] becomes an integral part of cognition and action, by knowing that there is a master of apprentice observing, commenting, helping, or maybe even ignoring the other who performs tasks’.

The methods described above for sharing tacit and explicit knowledge, indicate that it is not always easy to share knowledge. So why should someone share his knowledge with others? The possible motives for sharing knowledge are described in the following paragraph.

2.1.3. Motives for knowledge sharing

As stated above, people who are engaging in knowledge sharing, are involved in a social relation. Boer, Van Baalen and Kumar (2002) argue that the dynamics of knowledge sharing can be organised according to the relational models theory of Fiske (1992). The relational models theory claims that people are fundamentally sociable and postulates that people in all cultures use just four relational models to generate most kinds of social interaction, evaluation, and effect. People construct complex and varied social forms using
combinations of these models implemented according to diverse cultural rules. The four models of relation, as formulated by Fiske (1992), are briefly described here.

**Communal sharing**

Communal sharing (CS) relationships are based on a conception of some bounded group of people as equivalent and undifferentiated. In this kind of relationship, the members of a group or dyad all treat each other as the same, focusing on commonalities and disregarding distinct individual identities. People in a CS relationship often think of themselves as sharing some common substance (e.g., "blood"), and hence think that it is natural to be relatively kind and altruistic to people of their own kind.

**Authority ranking**

Authority ranking (AR) relationships are based on a model of asymmetry among people who are linearly ordered along some hierarchical social dimension. People higher in rank have prestige, prerogatives, and privileges that their inferiors lack, but subordinates are often entitled to protection and pastoral care. Authorities often control some aspects of their subordinates' actions. Relationships between people of different ranks in the military are predominantly governed by this model, as are relations across generations and between genders in many traditional societies.

**Equality matching**

Equality matching (EM) relationships are based on a model of even balance and one-for-one correspondence. People are primarily concerned about whether an EM relationship is balanced, and keep track of how far out of balance it is. The idea is that each person is entitled to the same amount as each other person in the relationship, and that the direction and magnitude of an imbalance are meaningful. Acquaintances and colleagues who are not intimate often interact on this basis: they know how far from equality they are, and what they would need to do to even things up.

**Market pricing**

Market pricing (MP) relationships are based on a model of proportionality in social relationships: people attend to ratios and rates. People in an MP relationship usually reduce all the relevant features and components under consideration to a single value or utility metric that allows the comparison of many qualitatively and quantitatively diverse factors. People organise their interactions with reference to ratios of this metric, so that what matters is how a person stands in proportion to others - for example, the ratio of what you pay to what the other person gives you in return.

There are four ways in which diversity based on the four models is established: (1) there are three variables on which each of the models can vary (intensity; formality; and the degree to which participants are relating for the sake of the relationship itself or as means to
asocial ends); (2) people commonly use a combination of models; (3) the models are not static, but may change over time, and; (4) cultural implementation rules play an important role in determining when each model applies and how to execute each model.

Boer et al. (2002) have specified the relational models theory for knowledge sharing. Below is explained how each model conceptualizes knowledge and how each model determines the principles behind knowledge sharing.

Within CS relationships, knowledge is perceived as a common resource rather than as one’s individual property: it belongs to the whole group and is freely shared among people belonging to the same group. The underlying assumption of people sharing knowledge within a CS relationship is that they expect an unspecified favour from an unspecified group member within an unspecified time span in return. By sharing knowledge one receives the potential helpfulness of the group in the future. The motivation for sharing knowledge is based on intimacy: knowledge is shared because someone asks for it or because one thinks that someone else might need it. The only reason for not sharing knowledge is when one is not capable of sharing or when the desirability for sharing knowledge is unknown. In order to share knowledge according to CS principles, a bounded group sharing some common substance is required, which can be based on different objects or different grounds for cohesion.

Within AR relationships knowledge is perceived as a means to display rank differences, whether rank is based on e.g. formal power, expertise or age. The higher a person’s rank, the better access to better knowledge. A person higher in rank who shares knowledge with someone lower in rank demonstrates his nobility and largesse and expects to get authority or status in return. A subordinate shares knowledge because either he has to or because he wants to chum up with his superior. In both cases the subordinate can expect a kind of ‘pastoral care’ in return. In this respect knowledge sharing is motivated by power differences. People are less or not willing to share knowledge when it can change their balance of power negatively.

Within EM relationships knowledge is perceived as a means of levelling out knowledge sharing efforts. The principle behind knowledge sharing within an EM relation is based on the exchange of knowledge for similar knowledge. It is the desire for equality that motivates knowledge sharing. One can morally oblige a person to share something in return by sharing knowledge oneself.

Within MP relationships knowledge is perceived as a commodity which has value and can be traded. Knowledge is being shared because one receives compensation for it (not being similar to knowledge or status). People are motivated to share knowledge by achievement.
When the perceived compensation is not high enough, people are less or not willing to share knowledge.

Cultural implementation rules determine what relational model is in use and how the settings are defined. This is because there are no culture-free implementations of the models: in every model there are some parameters that require some determinant setting. For example, within CS relationships one has to determine what is shared collectively and what is not. Besides these cultural rules, knowledge, technology, activity and division of labour also influence what relational model is in use. According to Boer et al. (2002), when knowledge is specific and uncodified, it is almost impossible to share it according to MP principles, whereas knowledge that is highly abstract and codified is less obvious to take place according to CS. Further, when some relational model is in use, only knowledge can be shared that fits this model. The effort to acquire knowledge also determines the relational model to be used: knowledge which is relatively easy to acquire is likely to be shared within CS, whereas knowledge that is relatively hard to acquire is more likely to take place in a social relation following EM or MP principles. Also, not all relational models are suitable for all types of work: different organisational settings could be characterized according to different relational models. Partly this can be explained by the time scope of the different settings – the more often people interact, the longer the relationship endures, and the greater the number and diversity of domains in which they interact, the less likely they are to use MP and the more likely they are to relate in a CS mode (Fiske, 1992).

Boer et al. (2002) state that in order to really understand knowledge sharing, one needs to know according to which model knowledge is being shared. Also, problems in knowledge sharing can be explained using this theory: when individuals interacting with each other are operating according to different social models, social conflicts can occur. The same holds for when there is a difference between the relational model being actually in use and the relational model people think is in place. Problems can also arise when the technology used for knowledge sharing is not in line with the relational model of its user. To overcome these problems, one can either adjust the (perceptions of) social relations, the used technology, or both.

Even when the participants are motivated to share their knowledge, it is not certain that knowledge sharing will take place. There are some conditions that have to be met. The conditions are the subject of the next paragraph.

2.1.4. Conditions for knowledge sharing

According to Abbing (1991) there are some basic conditions that have to be met in order for knowledge sharing to occur. The conditions Abbing identifies can be divided into practical and psychological conditions. There are three practical conditions, namely (1) the
presence of an infrastructure, (2) speaking of the same language, and (3) access to the sources of knowledge, and one psychological condition, that is (4) the willingness to share knowledge. The first basic condition for knowledge sharing is the presence of an infrastructure. According to Abbing, there has to be a channel of communication available through which the participants are physically able to communicate. Examples of these channels of interactions are personal face-to-face meetings, a conversation through telephone or through e-mail. All participants have to have access to this channel of interaction to be able to participate in the knowledge sharing process. To effectively use the channel of interaction, a second condition is that the participants of the knowledge sharing process speak the same language. This means that the knowledge sharers use the same spoken words or can understand each other by using, for example, mathematical symbols. As long as the participants are able to understand each other and respond effectively, all 'languages' can be used. The third practical condition is access to the sources of knowledge. When the participants cannot reach these sources, no effective knowledge sharing process can take place. The basic psychological condition is the willingness to share knowledge with the other participants. This last condition is, in contrast to the three conditions above, based on emotional, psychological factors. People may, for different reasons, not be able to or refuse to share their knowledge with others. This unwillingness may arise from various causes that are interwoven with the motives for knowledge sharing as discussed in the previous paragraph. For participants to be willing to share their knowledge with others, a new set of conditions has to be met. If one or more of these terms is not met, then the willingness to share knowledge will be absent. In general, it is less difficult to organise a working communication infrastructure than it is to ensure that both participants are willing to share their knowledge. There are two conditions identified which determine the willingness to share knowledge: (1) no conflicting interests, and (2) a good social (and professional) relationship. The participants’ interests need to be in reasonable agreement to accomplish knowledge sharing. When a participant has an interest that is conflicting with the interest of his knowledge sharing partner, no effective knowledge sharing can take place. A second important condition in establishing the willingness to share knowledge is the presence of a good social relationship, based on a professional relation between the knowledge sharing partners (Abbing, 1991). This condition was also identified by Liao et al. (2004). Liao found that when the relationship between employees is perceived as good, those employees would share working knowledge and experiences with colleagues unconditionally and voluntarily. But when the relationship between employees is perceived as not being good, the employees are reluctant to share working knowledge and experiences.

What makes a good social relationship (in business settings) was studied by Wathne, Roos and Von Krogh (1996). They distinguished four determinant factors which influence the relation between two or more cooperative partners within a company setting. The four factors that determine the quality of the social relation are (1) perceived openness, (2) used
interaction channel, (3) trust, and (4) prior experience and knowledge. The first condition for a good social and professional relation between knowledge sharing participants is the perceived openness of the knowledge sharing partner. Stata (1989) defines ‘openness’ as the willingness to put all the cards on the table, destroy hidden agenda’s, announce motives, feelings and prejudices and invite other opinions and points of view. This openness is also called ‘transparency’. The perceived openness of the knowledge sharing partner consists of the openness in dialogue and the extent to which the partner is assumed to hide or protect knowledge. Wathne et al. found that the higher the extent of openness in the sharing process, the more effective the knowledge sharing was in a cooperative context. A second condition which effects the relation of the knowledge sharing partners, is the channel of interaction that is being used. When knowledge sharing partners work together in projects they share their experiences in different ways. Examples of these channels of interaction are e-mail, telephone, computer conferences and face-to-face meetings. The context in which knowledge sharing partners interact is an important factor in the development of common, collective knowledge. Misinterpretations and hiding of intentions are less frequently present in face-to-face interactions then they are in other channels of interaction. The influence of the used channel of interaction on the knowledge sharing process is indirect: the consequences of the used channel of interaction influences the perceived openness of the knowledge sharing partner. Wathne et al. (1996) claim therefore that face-to-face interaction is the richest channel of interaction. This claim is derived from the ability to give direct feedback to the interaction partner and the presence of multiple clues about the openness of the knowledge sharing partner. This in contrast to e-mail, for example, which is a poor medium because of the lack of direct feedback opportunities and clues about openness. The richer the channel of interaction, the more openness is perceived in the social context of the knowledge sharing process.

A third factor identified by Wathne and his colleagues are the prior experiences and available information of the knowledge sharing partners. For a company to be able to internalise knowledge, the right ‘mental software’ to acquire and exploit knowledge must be present. The quality of prior experiences determines the extent to which the company can recognize the value of new external knowledge and the extent to which it can assimilate and use this new knowledge for commercial ends. The coherence between prior knowledge and the sought knowledge seems to be an important determinant factor in the knowledge sharing process. Related to this is the diversity of knowledge: learning is dependent on the complexity of present knowledge. Thus, the more prior experiences and knowledge are present within a company, the more effective the knowledge sharing process will be.

The importance of trust in business is generally agreed upon (see for example, Mayer, Davis and Schoorman, 1995; Ring and Van de Ven, 1994). Trust is one of the basics of business. Different operationalisations of trust are used, these can be divided into four categories which are briefly mentioned here: (1) trust as an individual attribute: the
individual trusts the motives of others, (2) trust as behaviour, based on cooperation and competition as determinants for the extent of trust, (3) trust as a property of the situation: trust is only needed in situations of interdependency and uncertainty, and (4) trust as an institutional agreement: the use of contracts and formal procedures as substitutes for trust. Important in all four categories is the perceived predictability and the perceived dependence of the knowledge sharing partner. Both are based on prior experiences with the sharing partner and based on the reliability of this previous evidence. Thus, when a knowledge sharing partner proved to be trustworthy in the past, chances are that this will also be the case in the present situation. Trust has an indirect effect on the knowledge sharing process. Trust influences the perceived openness of the knowledge sharing partner. The more trustworthy the knowledge sharing partner is thought to be, the more open the partner is perceived to be. The importance of trust in knowledge sharing is identified in numerous studies. Sharkie (2005) argues that employee trust is the essential element needed if the organisation is to access the tacit knowledge and skills of the human capital. According to Dirks & Ferrin (2001) trust is a key element in an individual’s decision to share knowledge. Therefore in order to facilitate knowledge sharing within an organisation, the level of trust is an important factor to manage.

Cross et al. (2001) identified four dimensions that appear to be key characteristics of relationships that were effective for acquiring information, solving problems or learning. These dimensions consistently predict whom people seek out for informational purposes. The four dimensions were knowledge (knowing what someone else knows); access (to the person who knows); engagement (people who actively think with the knowledge seeker); and safety (those relationships that are safe are often most effective for learning purposes).

According to Von Krogh (2002) a number of characteristics make communities particularly interesting for the problem of knowledge sharing. Communities can be derived from the premises that people form social bonds through shared norms, traditions, identity, and solidarity. Communities are interesting for knowledge sharing because they exist outside the formal organisation, are not regulated by formal structure, control, and they attract people around common tasks, work and experience, as well as affect and empathy. Von Krogh identifies three factors that positively impact the effectiveness of knowledge sharing in a community: opportunity structures, care, and authenticity. The opportunity structures refer to the occasion and benefits of sharing knowledge in the community. Care is a social norm in human relationships and involves the dimensions of trust, active empathy, access to help, lenience in judgement and the extent to which the former four dimensions are shared in the community. When interests are shared in the community, one can assume that the ‘best knowledge’ will be shared, because there is no reason why people should pass on false information. However, when interests are shared and distributed, the social norm of authenticity could possibly impact on the communal resource - legitimate power is shared directly with the source in a way that ensures its genuineness, accuracy, validity and
reliability. In expert-apprentice relations the social norm of authenticity works as follows: an apprentice directly observes the genuine know-how of the expert. Accuracy in turn depends on the apprentice’s ability to observe a certain level of detail in the work of the expert. Validity signifies the apprentice’s ability to appraise observations, interpretations and understanding of task performance with the expert. It also signifies the extent to which the knowledge shared with the apprentice can be extended to the same or different tasks (Von Krogh, 2002).

2.1.5. The social relation in knowledge sharing

It is assumed that psychological factors influence social interaction. Therefore it is useful to see if these factors also affect the relation between expert and apprentice. For example, the way learning occurs can be influenced by psychological factors. This section examines personality as an aspect of social relations that can influence knowledge sharing. The discussion of personality is followed by the theory of personal attraction.

In psychology the concept of personality is studied intensively. Numerous definitions have been identified. A generally accepted definition is of Allport (1937, p. 48), who states that ‘personality is the dynamic organisation within the person of those psychophysical systems that determine his unique adjustments to his environment’. An accepted taxonomy of personality is the Five Factor model, or the Big 5 dimensions of personality, first described by Norman (1963). The five dimensions of the Big 5 are briefly outlined below. After that the known influences of personality on social interaction and learning are described.

**Extroversion**

Extroversion is marked by pronounced engagement with the external world. Extroverts enjoy being with people, are full of energy, and often experience positive emotions. They tend to be enthusiastic, action-oriented. In groups they like to talk, assert themselves, and draw attention to themselves. Introverts lack the exuberance, energy, and activity levels of extroverts. They tend to be quiet, low-key, deliberate, and disengaged from the social world. Their lack of social involvement can not be interpreted as shyness or depression: the introvert simply needs less stimulation than an extrovert and prefers to be alone.

**Agreeableness**

Agreeableness reflects individual differences concerning cooperation and social harmony. Agreeable individuals value getting along with others. They are therefore considerate, friendly, generous, helpful, and willing to compromise their interests with others. Agreeable people also have an optimistic view of human nature. They believe people are basically honest, decent, and trustworthy. Disagreeable individuals place self-interest above getting along with others. They are generally unconcerned with others’ well-being, and therefore are unlikely to extend themselves for other people. Sometimes their scepticism about others’ motives causes them to be suspicious, unfriendly, and uncooperative.
Conscientiousness
Conscientiousness concerns the way in which people control, regulate, and direct their impulses. Impulses are not inherently bad: occasionally time constraints require a snap decision, and acting on our first impulse can be an effective response. Impulsive individuals can be seen by others as colourful, fun-to-be-with, and zany. Unconscientious people may be criticized for their unreliability, lack of ambition, and failure to stay within the lines.

Emotional Stability
Neuroticism refers to the tendency to experience negative feelings. Those who score high on neuroticism may primarily experience one specific negative feeling such as anxiety, anger, or depression, but are most likely to experience several of these emotions. People high in neuroticism are emotionally reactive. They respond emotionally to events that would not affect most people, and their reactions tend to be more intense than normal. At the other end of the scale, individuals who score low in neuroticism are less easily upset and are less emotionally reactive. They tend to be calm, emotionally stable, and free from persistent negative feelings.

Intellect / Openness to Experience
Openness to Experience describes a dimension of cognitive style that distinguishes imaginative, creative people from down-to-earth, conventional people. Open people are intellectually curious, appreciative of art, and sensitive to beauty. They tend to be, compared to closed people, more aware of their feelings. They tend to think and act in individualistic and nonconforming ways. People with low scores on openness to experience tend to have narrow, common interests. They prefer the plain, straightforward, and obvious over the complex, ambiguous, and subtle. They may regard the arts and sciences with suspicion, regarding these endeavours as abstruse or of no practical use. Closed people prefer familiarity over novelty: they are conservative and resistant to change.

As can be concluded from the descriptions of the five dimensions of personality, the personality of the participants in knowledge sharing can influence the way the participants enter the process of knowledge sharing and the way they act in the social interaction. A person with an introvert personality will be less likely to engage in a spontaneous social interaction than an extrovert personality. Agreeable personalities will tend to believe that the knowledge sharing partner is honest, whereas the person with a disagreeable personality will put his self-interest above getting along with others.

Personalities is a determinant factor in social relations with others. And, as discussed above, the liking of the knowledge sharing partner can be a factor in knowledge sharing between partners. Forsyth (1990) argues that different reasons exist why people feel attracted to one another. Many theorists believe that attraction depends on social exchange – the exchange
of rewards and punishments that take place when people interact. Here, social interaction is analogous to economic activity. In general, social exchange theory assumes the individuals’ preferences for interaction are based on a “minimax” principle: people will join groups that provide them with the maximum number of valued rewards while incurring the fewest number of possible costs (Forsyth, 1990). The broad orientation of this theory can account for a number of general tendencies that play a role in interpersonal attraction:

*The similarity / attraction effect*

The first tendency is the similarity/attraction effect. This effect refers to the tendency for group members to like people who are similar to them in some way. This can be kinship, ethical or national identities, the same place of birth, the same religion, the same hobby, or the same sexual orientation. The similarity principle appears to be caused by a number of interrelated processes. Firstly, people who adopt the same values and attitudes that we do reassure us that our beliefs are accurate. Therefore, association with such people is considered rewarding. Secondly, similarity serves as a signal to suggest that future interactions will be free of conflict. Thirdly, once someone discovers that he is similar to another person, he tends to immediately feel a sense of unity with that person. Forsyth (1990) uses the example of two strangers chatting casually on an aeroplane who feel united if they find that they share even the smallest similarity such as the same middle name or a favourite TV programme. Last, disliking a person who seems similar may prove to be psychologically distressing. After all, if a person is similar, it follows logically that he or she must be attractive.

*The complementary of needs principle*

The second principle is the complementary of needs principle. This refers to the tendency for people to be attracted to people who possess characteristics that fulfil, or gratify, our own personal needs. For example, if someone enjoys leading groups, he or she will not be attracted to other individuals who also strive to take control of the group. Instead, one will respond more positively to those who accept one’s guidance.

*The proximity effect*

The proximity effect refers to the tendency to become friends with people who live nearby: physical closeness is therefore an important determinant of attraction. This tendency has some resemblance with the principle of *mere exposure*: we like people whom we have been exposed to repeatedly.

*The reciprocity principle*

The last tendency that is identified is the reciprocity principle. This principle refers to the tendency for liking to be met with liking in return: if person A likes person B, then person B will tend to like person A as well. Negative reciprocity also occurs in groups: one dislikes those who seem to reject one.
Forsyth (1990) further concludes that people tend to avoid individuals who possess objectionable characteristics, people who are boring and those who are physically unattractive. Also, people prefer to associate with people who do not outperform them in areas that are very relevant to their self-esteem.

Allen and Eby (2003) found, consistent with prior research by Burke et al. (1993) that mentors with protégés perceived to be similar reported greater learning and higher quality relationships than did mentors with protégés perceived to be less similar. Their findings further suggest that perceived mentor-protégé similarity may be important in relationships of short duration. However, their results also demonstrate that it may be beneficial for mentors to continue to develop a relationship with a protégé who was initially perceived to be dissimilar, as the difficulty associated with such alliances appears to dissipate over a longer period of time. They did not find the same effect for gender.

Knowledge sharing is a social process between individuals. In the context of this research, knowledge sharing takes place within organisations. Therefore it is assumed that organisational factors influence the knowledge sharing process between an expert and an apprentice.

2.1.6. Organisational measures to facilitate knowledge sharing

In this research knowledge sharing within organisations through expert-apprentice relations is the central theme. The focus lies on knowledge intensive organisations. There are numerous opinions on what an organisation is and how it can be defined. Weggeman (2001) states that because of this ongoing discussion every researcher is obligated to specify his definition of organisations and to indicate in which context the concept is used. In this research the (prescriptive) definition of a knowledge intensive organisation is: ‘An organisation with predominantly knowledge workers in the primary process (or at least in the technological staff if they have a dominant influence on the functioning of the primary process)’ (Weggeman, 2001). Within knowledge intensive organisations, knowledge workers work with knowledge by making inventories, develop, integrate, share, apply and evaluate knowledge in order to achieve the goals of the organisation and satisfy internal and external customers as well as themselves. The identification of knowledge intensive organisations, is a next step in a long history of structuring and typifying organisations. Organisations, among other things, differ in structure, size, environmental influences and culture. According to Henry Mintzberg (1979), an organisation's structure is largely determined by the variety one finds in its environment. For Mintzberg, environmental variety is determined by both environmental complexity and the pace of change. He identifies four types of organisational form, which are associated with four combinations of complexity and change.
As a result of recent changes in environmental characteristics there is a shift in the direction of adhocracies. These are companies or institutions where ad-hoc organisational forms, like projects or task-forces, are more important than the standing organisation. The way organisations shape their training and education of employees is influenced by the characteristics of the environment – different organisations work with different types of knowledge and therefore require different forms of learning (Lam, 2002). Van den Bosch (2003) identifies four different concepts of learning which all apply to organisations with different environmental features. According tot Van den Bosch, the concept of courses is appropriate in working situations where standardisation is well carried through (machine bureaucracy). The functions within the organisation are crystallized and typified by qualifications. All qualifications can be trained by using specific courses. The concept of ‘learning in the working place’ applies for situations in which the environment may be relatively simple, but changes quickly (entrepreneurial start-up). Because of these quick changes in environment, there is no opportunity to set out specific training routes. Therefore, learning takes place on the work floor under supervision of experienced co-workers. In this type of learning, there is a focus on the changing environment. The concept of formal education is suited for organisations in a complex and knowledge intensive environment with a certain level of stability (professional organisation). Because of this relative stability, standardisation of the desired knowledge and skills is possible. Often the acquirement of the required skills is in the hands of vocational or interest groups and associations. The concept of learning in networks is aimed at maintaining the innovating skills and ability of the employees of an organisation (adhocracy). The employees work in interdisciplinary teams on ill-structured assignments. There are no textbooks available which contain the necessary content. Managers of all levels therefore require a form of learning occurring in situations from which they can construct relevant and useful knowledge themselves. The use of past experiences and of co-workers is of crucial importance in this type of learning in organisations. Because of the shift to adhocracies as a leading form of organisations, the network concept is more often the form of learning and the role of the concept of formal education is decreasing.

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<th>Complexity</th>
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<td>Pace of Change</td>
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Table 1  Four organisational forms by Mintzberg (1979)
Nonaka and Takeuchi (1995) emphasize that the organisation in which the knowledge sharing occurs, can be a positive instigator: the role of the organisation is significant as a facilitator of the knowledge sharing process. The authors identify five organisational conditions that have a positive effect on the process. These situations can be created or removed by the organisation. The role of the organisation or facilitator is therefore significant in this process.

- Organisational intention. Striving for the goals of an organisation, often seen in the strategy of the organisation. This intention is the most important criterion in judging the correctness of a certain knowledge field.
- Autonomy of the team its members increases the chance of unexpected possibilities. Original ideas of autonomous individuals spread through the team and become general ideas for the organisation as a whole: the organisation becomes a self-creating system.
- Fluctuation and creative chaos stimulate the interaction between the organisation and her external environment. Fluctuation can result in deliberate chaos within the organisation (creative chaos). It can lead to and encourage subjective individual involvement. It can also contribute to the externalisation of tacit knowledge.
- Redundancy concerns information that goes beyond the operational requirements of the members of the organisation. Sharing of this redundant knowledge contributes to the sharing of tacit knowledge.
- Required variety. The internal diversity of an organisation has to fit with the variety and complexity of the environment to be able to cope with the challenges set by that environment.

2.1.7. Overview of the relevant findings

Below, a short overview is given of the relevant findings of this paragraph. The relation with expert-apprentice relations is indicated.

Knowledge by definition is individual knowledge and consists of information, experience, skills and attitude. Knowledge can be divided into tacit and explicit knowledge, and can fall into different categorisations. Knowledge can be about knowing what, knowing how, knowing who and knowing why. Knowledge can be required knowledge, specific knowledge, crucial knowledge or scarce knowledge within an organisation. These distinctions and categorisations are all relevant in expert-apprentice relations. People have both tacit and explicit knowledge, they know that they have explicit knowledge, but are often unaware of their possession of tacit knowledge. This tacit knowledge, however, is the organisation’s most valuable knowledge.

The observation that knowledge sharing is a social process, indicates that a social relation exists between an expert and an apprentice within the expert-apprentice relation. Knowledge sharing is about sharing both explicit as well as tacit knowledge. Apprenticeship is a known method for tacit knowledge sharing. Tacit knowledge is hard to
share, and can only be shared by techniques like socialisation, whereas explicit knowledge can be shared in various ways. Thus, the different types of knowledge, require different methods for sharing both tacit and explicit knowledge. Expert-apprentice relations are two-directional: in expert-apprentice relations there will be a considerable learning effect on the part of the expert.

The theory of Boer et al. (2002) indicates that the relational models can identify the motives for knowledge sharing and determine what kind of knowledge is and can be shared. In order to make sure that all relevant knowledge is shared within expert-apprentice relations, the relational models that the participants use should be matching. According to this theory, it is not possible to share explicit and tacit knowledge in all the identified relational models. In MP-relations, tacit knowledge is hard to share. This can indicate that because tacit knowledge is an important aspect of expert-apprentice relations, expert-apprentice relations would not function if the participants work according to MP-principles. CS, AR and EM all seem relevant for expert-apprentice relations. This suggests that within expert-apprentice relations, both expert and apprentice should follow the same relational model in order to be able to share knowledge in a way that is suitable for both parties and that when it is observed that expert and apprentice use different models, an attempt should be made to adjust the used relational models.

According to the above theories there are some basic conditions that have to be met for knowledge sharing to take place. These conditions can also apply for expert-apprentice relations. These conditions are: there should be an infrastructure present, the participants should speak the same language and they should have access to the sources of knowledge. The characteristic ‘access’ identified by Cross et al (2001) relates to the condition of the presence of an infrastructure. In order to meet the condition that the knowledge sharing partners are willing to share their knowledge, the interests should not be conflicting and the social relation should be good. In order to create a good social relationship, people should perceive each other as ‘open’, using face-to-face interaction. They should have no negative prior experiences and they should trust each other. The factor ‘trust’ corresponds with the characteristics of ‘safety’ (Cross et al., 2001) and ‘care’ (Von Krogh, 2002), however ‘care’ is a broader term. In expert-apprentice relations the opportunity structures and ‘knowing what other people know’ seem less relevant because these terms refer to communities and groups. However, it is useful that people in knowledge sharing have an idea of what the other is capable of (Von Krogh, 2002). A last relevant finding which is a result of the literature above, is that the people involved in knowledge sharing should be engaged – active participants in the process of knowledge sharing.

The attraction factors can help explaining why some people are attracted to another and why others are not. The general tendencies in attraction can therefore also influence the social relation between parties who are active in knowledge sharing: when liking of others
and trust are basic requirements for knowledge sharing, it is important to include the factors that can predict or explain interpersonal attraction. Besides the theory on interpersonal attraction, the above findings suggest that personality can have an effect on the knowledge sharing because it influences the way people engage in the social relation.

Finally, Mintzberg’s structuring of organisations shows that different organisations require different approaches. Organisations that have to function in a dynamic environment are likely to benefit from different methods than organisations in stable environments, where for example standardized courses and formal education can suffice.

Other findings on the knowledge sharing process are the five organisational conditions previously identified. There is a positive effect on knowledge sharing when the intention of the organisation corresponds with the knowledge that is to be shared and has internal variety. Also, positive effects on knowledge sharing occur when knowledge sharing partners work autonomously within the organisation and create creative chaos. The condition of redundancy leads to the indication that all activities have to appear to be relevant at first sight: this redundancy can increase and create knowledge sharing.

The previous paragraph elaborated on theories on knowledge and knowledge sharing. The result of this knowledge sharing is learning (Weggeman, 2001). Learning is the subject of the next paragraph.

2.2. Learning
To fully understand the processes and outcomes of knowledge sharing, it is important to have knowledge of the relevant learning theories. The next section gives a brief overview of relevant learning theories which are suitable for the kind of knowledge sharing discussed in this research: that between an expert and an apprentice. In the discussion of learning theories the basic assumption is that knowledge is both the input and the output of learning. And learning is the result of knowledge sharing (Weggeman, 2001). The increasing importance of learning for knowledge workers is a result of the changing half-life of knowledge: within knowledge intensive organisations, knowledge workers deal with knowledge by making inventories, developing, integrating, sharing, applying and evaluating knowledge in order to achieve the goals of the organisation and satisfy internal and external customers as well as themselves. As was concluded in the first chapter, knowledge workers are employees whose job consists of using of and working with knowledge. They use little physical strength or special craftsman skills, but produce ideas, concepts, models and other information (Weggeman, 2001). A consequence of the observation that knowledge workers work with knowledge is that, for a knowledge worker to perform, he has to be permanently learning. The need for permanent learning is a result
of the shortening ‘half-life of knowledge’. In general, the half-life of a quantity is the time required for the quantity to decay to half of its initial value. The concept originated in the study of radioactive decay, but can also be applied to the concept of knowledge (Den Hertog & Huizenga, 1997). The half-life of knowledge is ever decreasing, and therefore knowledge is outdated sooner. This means that if the half-life of an engineer’s knowledge used to be about ten years, it is now only five years. As a consequence of this knowledge workers have to spend increasingly more time acquiring new knowledge to keep their knowledge relevant. In other words, if learning is an ongoing process for knowledge workers, the presence of an apprentice could serve not only as a learning method for the apprentice but also as a method for the expert to learn and gain new knowledge. The concept of the decreasing half-life of knowledge and the consequences of this observation for the expert-apprentice relation are further discussed in chapter 3 where the medieval master-apprentice relation is studied. The following paragraphs cover theories on learning in general and learning through socialising in particular.

2.2.1. Types of learning

Learning is a relatively permanent change in behaviour that occurs as a result of practice or experience (Cascio, 1998). Rogers (1969) identifies two ways of learning, cognitive learning and learning by experience. The former corresponds to academic knowledge such as learning vocabulary or multiplication tables and the latter refers to applied knowledge such as learning about engines in order to repair a car. The key to the distinction is that experiential learning addresses the needs and wants of the learner. According to Rogers the first way of learning, rational learning or cognitive learning is insignificant. Only learning by experience is of interest. The advantages of learning by experience are personal commitment, learning by self-initiation and the effects of convincing the student. When these ways of learning are combined with the four forms of knowledge conversion of Nonaka & Takeuchi, it is noticed that socialisation is a form of empirical learning (learning by experience) and that externalisation is a form of empirical as well as rational learning (cognitive learning). Combination is a form of rational learning and, finally, internalisation is both empirical and rational learning. Gagne (1985) classifies learning into more types and levels. This classification is made because all types of learning require a specific way of instruction. Gagne identifies five categories of learning: verbal information, intellectual capacities, cognitive strategies, motoric skills and attitudes. The internal and external circumstances under which each type can be learnt, differ per type of learning. When learning cognitive strategies for example, it is important that the student practises with finding new solutions for problems. With the learning of attitudes, the student must be exposed to a reliable role model or to convincing arguments. All these types of learning can be categorized in the basic model of Rogers.

Kolb (1984) created the experiential learning theory. This model suggests that learning requires abilities that are polar opposites, and that the learner must continually choose
which set of learning abilities he or she will use in a specific learning situation. In grasping experience some perceive new information through experiencing the concrete, tangible, felt qualities of the world. Others tend to perceive, grasp, or take hold of new information through symbolic representation or abstract conceptualization. Similarly, in transforming or processing experience some people tend to carefully watch others who are involved in the experience and reflect on what happens, while others choose to jump right in and start doing things. The watchers favour reflective observation, while the doers favour active experimentation (Kolb, 2000). These two dimensions interact, both resulting in a typology of learning styles and an experiential learning cycle that moves from experiencing to observing to conceptualising to experimenting and back to experiencing.

Marsick and Watkins (1990, 2001) divide learning into formal learning and informal learning. The authors describe these concepts as follows: formal learning is typically institutionally sponsored, classroom-based, and highly structured. Informal learning may occur in institutions, but it is not typically classroom-based or highly structured, and control of learning rests primarily in the hands of the learner. Marsick and Watkins further identify incidental learning which is defined as a by-product of some other activity, such as interpersonal interaction, sensing the organizational culture, trial-and-error experimentation, or even formal learning. Informal learning can be deliberately encouraged by an organisation or it can take place despite an environment not being highly conducive to learning. Whether something is being learnt in a formal or informal way not only describes how the learning occurs, but even more so it determines what kind of knowledge can and cannot be learnt. The point of Marsick and Watkins is that the major part of the learning of individuals and organisations is either informal or incidental, thus leaving formal learning as the minor part (Drejer, 2000). In their theory of individual learning Marsick and Watkins use the so-called Johari window, developed by Joseph Lufts and Harry Ingram, as their starting-point (Marsick and Watkins, 1990). The model consists of four quadrants. The four quadrants of the model represent an open area (which is known by the individual and openly shared by others), the blind area (which others may observe, but the individual is unaware of), the unconscious area (the part of the individual which is not known by the individual or others), and the hidden area (which is the part that people keep to themselves, e.g. their secrets and dreams). According to Drejer (2000), using the Johari window the growth of an individual can be seen as a process of learning about oneself and using the feedback of others, reflecting on what has been learnt, and making changes based on feedback and self-disclosure. The latter can be seen in relation to the learning process as explained by Kolb's model.

Rogers emphasizes the needs and wants of the learner. Vygotsky (1978) created a grounded theory that takes the needs of the learner as the starting point of learning. His theory concerns the appropriate level of learning. Vygotsky claims that in order to effectively teach a student new information or behaviour, it is necessary to adjust the objects to be
learnt to the level of the student. This is called learning in ‘the Zone of Proximal Development’. Vygotsky describes this zone as "the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers". In other words, a student can perform a task under adult guidance or with peer collaboration that could not be achieved alone. The Zone of Proximal Development bridges that gap between what is known and what can be known. Vygotsky claims that learning occurs in this zone. The Zone of Proximal Development is also called the Construction zone: it is the work place for learning. When the learning matter is placed too far outside the level of the student, it will be too difficult to learn and the student will drop out. When the learning matter is too close to the level of the student, it will not be a challenge and the student will be bored. It is therefore important to place the learning matter just beyond the level of the student. In this way the student will be challenged but not excessively. Related to the Zone of Proximal Development is the term ‘scaffolding’ which has is origin in language education. In scaffolding the tutor places the learning matter just beyond the level of the student, and therefore adjusts the task to the student. The tutor follows the level of the student, by always keeping the task just one step ahead (Winnips, 2001). Following this approach the student will become more and more independent of the tutor until the moment arrives that the tutor can withdraw. Scaffolding is individual learning: all students receive tasks that fit their level. Attention is given to the specific difficulties of the student when solving a problem or carrying out a task. This principle aims in particular at the student becoming independent of the tutor. When using scaffolding to learn, it is therefore important for the tutor to localise and use the student’s Zone of Proximal Development.

2.2.2. Learning through socialising

Related to experiential learning is the Social Learning Theory of Bandura (1977). In his theory Bandura emphasizes the importance of observation in learning from behaviour, attitudes and emotional reactions of people in the environment of the student. The core of this theory is that people learn by observing and imitating other people’s behaviour. The Social Learning Theory is equal to learning by imitation. The observation does not only focus on the behaviour of other people, but also on the consequences and results of this behaviour. By watching other people behave in certain situations, new ideas are made about one’s own possible behaviour in similar situations. An observed action can be understood and imitated whenever it becomes the source of representation of the same action within the observer (Decety et al., 1997). The method of Social Learning, or Social Modelling, consists of observing a role model and remembering the actions and reactions of the model in a particular task situation. Next, the student will apply this behaviour in practice and training and will eventually apply the behaviour in real life – the daily tasks of the job for example. This model appears to be a suitable method for working with tacit knowledge. By observing and imitating a role model tacit knowledge is shared tacitly: it can therefore be
categorised as socialisation, the knowledge conversion form identified by Nonaka & Takeuchi (1995). Dependent of the goal of the behaviour to be learnt, a positive or negative role model is used. When reproduction is the goal of the training (the student can literally copy the behaviour) it is most effective only to show a positive role model. Examples of reproduction goals are cooking class or gardening. Usually however, the goal of the training is for the student to learn general rules and concepts which can be applied in a broad spectrum of task and problem situations. Thus, when generalisation is the goal of observation, it is more effective to show both positive and negative examples. However, to acquire a type of behaviour this is not sufficient, as a student must be able to maintain the behaviour in the future as well. There are different approaches known to preserve learnt behaviour. Among them are putting definitions and procedures of the learnt behaviour in writing or to visualize the behaviour. Learning by observation proves to be an effective method of training. In a meta-analysis of seventy studies on the effect of management training, Behaviour Modelling turned out to be one of the more effective ones (Burke & Day, 1986). Critics question the durability of the learnt behaviour. It appears that it is necessary to follow and stimulate the student for a long period after the training to preserve the learnt behaviour: when there is no long term follow-up or continuation of practice, there will be no long term change in behaviour (Russell et al., 1984).

Although teaching and learning have rarely been the focus of mentoring relationship research (Allen & Eby, 2003), a few studies have been conducted that focused on this. Roughly, it can be argued here that expert-apprentice relations are an intensive form of mentoring and therefore the findings from literature on learning in mentoring relationships are relevant to this research. Hezlett (2005) reviewed research on learning in mentoring relationships and concluded that the research supports the proposition that mentoring enhances protégés’ cognitive, skill-based, and affective learning. These three types of learning reflect the types of learning that were described earlier. Hezlett further concluded that research suggests that protégés gain at least two kinds of verbal knowledge through their mentoring relationships: organisational knowledge and technical knowledge; several skills, including technical skills, interpersonal skills, time management skills, and self-organisation skills; and affective changes, particularly self-confidence (Hezlett, 2005).

Besides what is learnt, how members of mentoring relationships learn is also studied. Hezlett (2005) found that protégés reported learning most frequently through observing their mentors. Protégés also learnt from their mentors’ explanations and by interacting with their mentors. Protégés reported, although less frequently, that they also learnt from asking questions, shadowing, trial and error, working with their mentors, and receiving encouragement. Hezlett (2005) concluded that these results are consistent with the idea that the Social Learning Theory is an important framework for understanding, some but not all, protégé learning.
Support for learning through observation can also be found in neurosciences. A finding called the mirror system can serve as a neurological grounding for the Social Learning theory. Mirror neurons are a particular class of visuomotor neurons, originally discovered in area F5 of the monkey premotor cortex, that discharge both when the monkey does a particular action and when it observes another individual (monkey or human) doing a similar action (Rizzolatti & Graighero, 2004). Direct evidence for the existence of mirror neurons in humans is lacking. There is, however, a rich amount of data proving, indirectly, that a mirror-neuron system does exist in humans. For example, neurophysiological experiments demonstrate that when individuals observe an action done by another individual their motor cortex becomes active, in the absence of any overt motor activity (Rizzolatti & Graighero, 2004). Furthermore, for example Fadiga (1995) demonstrated that observation of an action increases the excitability of neural structures involved in execution of the action. Different modalities of the same action activate common neural mechanisms, although they do not rely on the same representations (Decety et al., 1997). Also, in their study involving the observation of meaningful and meaningless hand actions, Decety et al. found that observation with the intent to recognize activated memory-encoding structures, where, in contrast, observation with the intent to imitate was associated with activation in the regions involved in the planning and in the generation of actions. Thus, when observing action, the brain simulates the action mentally.

2.2.3. Overview of the relevant findings

Different theories on learning emphasize different aspects of how and when learning occurs. They agree in that different categories of learning require different types of internal and external circumstances and the method of learning should be chosen depending on what is to be learnt. The shortened half-life of knowledge indicates that it is important to keep learning. A specific method is learning by experience: it is informal learning and can be both intended as well as incidental. People can use different learning styles in informal teaching, they can be watchers of doers. A student can perform tasks under adult guidance or with peer collaboration that could not be achieved alone. The level of learning is determined by using the zone of proximal development and guidance is provided using scaffolding.

In learning by experience, the method of social modelling based on the Social Learning Theory of Bandura (1977) is important: it is assumed that this method can be used as a method for socialisation, the knowledge transfer from tacit knowledge into tacit knowledge. In learning through observation positive as well as negative models should be used. In research on learning in mentoring relationships, it was found that protégés primarily learnt through observation, explanations from their mentors and interactions with their mentors. Further, it was concluded that apprentice learning is cognitive learning, skill-based learning, and affective learning. This matches Weggeaman’s (2001) categorization of knowledge in information, skills and attitude, which is included in the previous paragraphs.
Also, when a person is observing an expert with the intent to imitate their behaviour, this has a different effect on the brain than when a person is observing with the intent to recognise the behaviour of the expert. An important notion is that of maintaining the learnt behaviour: it is not just about acquiring a type of behaviour, but also about maintaining it in the future.

Now that some basic theories on learning have been presented, the next section will discuss one outcome of learning: becoming an expert. The following paragraph looks at what expertise is made of and how it is organised within the brain.

2.3. Experts and expert knowledge

As was stated earlier, scarce and crucial knowledge within organisations is often only present within so-called experts. This paragraph describes theories on experts and expertise in order to determine how to identify experts and to study how expertise is built up.

Experts are the determinative factor in organisations, because they possess the expertise the company revolves around. In other words: experts possess the crucial knowledge that give the company its 'raison d’être’. This is the conclusion of research of Prietula and Simon (1989), who state that this expertise is crucial for the company’s performance. Boersma (2002) also concludes that the specific knowledge of experts is the determinative factor of the company’s success. These studies state that besides theoretical knowledge, expertise, which comes from experience through practice, is the key for successful application and solutions. This knowledge based on experience, is a form of tacit knowledge. Tacit knowledge is, as stated above, rooted in individuals and therefore these individuals who possess this tacit knowledge become of great value to the company they work for, because their knowledge is not easily transferred or shared.

Expert knowledge is not the same as having access to information. When an employee is the only person in an organisation who has access to certain information, this does not mean that this person can be named an expert. After all, when the information is made accessible to other employees, the first person no longer has the exclusive rights to this information and is therefore no longer the only one who possesses it; his expertise has turned into general information. True experts discern from non-experts not through the possession of knowledge, but through the use of knowledge (Weggeman, 1997). But what exactly is an expert? And when does one become an expert? The term ‘expert’ is often used to indicate highly experienced professionals, as for instance physicians or scientists. But the term has been broadened in recent years and nowadays also includes those in general who perform in a superior matter, for example, in art or sports. The term ‘expertise’ refers to the underlying mechanisms of the superior performances of an expert (Ericsson & Lehmann,
This does not explain why one employee is named an expert and another employee is not. The next paragraph describes some definitions of experts and expertise.

2.3.1. Experts defined

Numerous definitions and characteristics of experts can be found in literature. Before some general notions on the development of expertise are given, a few of these definitions are presented below, after which a categorisation of expertise is presented based on the definition of knowledge of Weggeman (2001).

**Professionals**

Weggeman (2001) uses the term ‘professionals’ for expert knowledge workers in organisations. He identifies a number of characteristics that an employee must possess to be named a professional. Firstly, knowledge must be attained by training and continual learning. Secondly, the employee must have autonomy: he has to decide on his own about how and with what means he performs his profession. A third characteristic is passion or enthusiasm which implies a high commitment to the job. Another characteristic is identification with professional colleagues. Also the moral values have to be taken into account: a professional provides services without special attention to finance or the customer. A last characteristic named by Weggeman is the professional standards which are concerned with maintaining the professional norms and check on the behaviour of other professionals.

**Deep smarts**

Leonard and Swap (2004) introduce the term ‘deep smarts’. According to these authors, throughout any organisation there are people with deep smarts. Their knowledge is essential: the organisation cannot progress without them. People who have deep smarts can see the whole picture and yet zoom in on a specific problem others haven’t been able to diagnose. Almost intuitively, they can make the right decision, at the right level, with the right people. Their knowledge is both explicit and tacit. The knowledge of deep smarts is essential to the organisation, but cannot easily be bought or acquired, making the organisation vulnerable (Leonard & Swap, 2004). Deep smarts are experienced based and not easy to transfer or even articulate. The confidence of deep smarts, however, can lead to myopia or arrogance. They can underestimate the extent to which knowledge is actually a set of beliefs and assumptions. Deep smarts can be blind to truly novel solutions, causing them to reject contributions from others (Leonard & Swap, 2004).

**Learning professionals**

Simons and Ruijters (2004) discuss learning professionals as a specific form of professionals. In their view a real professional should meet the following criteria: (1) have an explicit vision about the profession and its contributions to society; (2) develop a unique methodology (way of working); (3) be able to work with a set of tools and techniques that
fulfil quality criteria of the professional association; and (4) there should be alignment between the vision, methodology and tools and techniques. Thus: a professional is someone working in a professional field having an aligned combination of an explicit vision, a unique methodology and a set of high quality tools and techniques. Simons and Ruijters decided they needed a more dynamic concept of a professional because of the tacit skills needed in the profession, the fading boundaries between professions and the importance of innovation in present-day work, therefore they introduced the ‘learning professional’. A learning professional distinguishes himself from professionals by:

1. elaborating on his work-competences by learning from and in practice;
2. expending his theoretical knowledge and insights by learning explicitly from and in research;
3. externalising his practical and theoretical insights, which means contributing to the development of the profession and or to team and organisation learning. These three characteristics can be traced back to three forms of learning, namely: elaboration (1); expansion (2); and externalisation (3). These three forms of learning will be discussed here shortly.

**Elaboration.** This form of learning by a professional has to do with learning tacitly from and in practice. Simons and Ruijters state that this is not enough: it is also important for the professional to become aware of the outcomes of their tacit learning. Both the outcomes and the processes of learning can be tacit or explicit to the learner. When learning processes are tacit, people do not realise that the activities they undertake result in new knowledge, skills or attitudes. When the learning outcomes are tacit, people are not aware that they learnt something: that they are able to perform or know. When tacit learning is made explicit the learner may feel a sense of pride when he realises what he has learnt. Another consequence of explicating the learning is that the learner can share the outcomes. And thirdly, it makes it possible to reflect on tacit ways of learning. There are six ways to act on tacit learning outcomes: the first choice is between leaving the outcomes tacit or making them explicit. When the latter is chosen, one can use reflection in action or reflection on action. Again the latter can be performed by others or by yourself.

**Expansion.** Although tacit learning has its advantages, in some cases it will not be enough and more explicit learning processes are needed. Simons and Ruijters discuss three ways of explicit learning, namely (1) theoretical learning in which the learner decides to learn new concepts and ideas and connect pre-existing concepts and ideas with those of others or with existing theories and research outcomes by reading books, attending conferences or comparisons; (2) inquiry learning in which learners decide to find out whether hypothesis arising from experiential learning remain valid under varying conditions or can be tested (semi-) systematically on the job or in more scientific research; and finally (3) critical learning in which people look critically at their norms and values.
**Externalisation.** The third part of the learning model of the learning professional by Simons and Ruijters is ‘externalisation’, which refers to ‘the need […] for professionals to connect their learning to concrete and public milestones’. These milestones can be made visible and connected to a data and a place, for instance setting a deadline for publishing an article can be seen as a milestone for externalisation. The point is that concrete milestones make the outcomes of explicit and tacit learning visible and easy to plan and share.

By recognizing the role of emotion in learning and professionalisation, Simons and Ruijters extend their model of the learning professional. Safety is, according to these authors, a necessary and fundamental emotion in all kinds of learning, this emotion is placed in the centre of the model. With each form of learning, elaboration, expansion and externalisation, other emotions are important. The identified emotions are: curiosity, pride and confidence. Finally each stage has its own emotional outcome. Elaboration leads to a feeling of competence, expansion results in a feeling of mastery and externalisation leads to a feeling of satisfaction.

Based on the above conceptualisations of experts, it can be concluded that experts are crucial for the company’s performance and that the expert knowledge is often a determinative factor for the organisation. Most scholars agree on the importance of training, experience and skills in expertise, and therefore it is assumed that experts’ knowledge consists of for a large part tacit knowledge. Also, continual learning is a shared requirement. In this research the working definition of an expert is ‘an individual with a considerable amount of tacit knowledge based on extensive experience through practice and experience’. An expert is recognized within his organisation, by the public or their peers as being a reliable source of high-quality knowledge, resulting in authority and/or status.

2.3.2. Types of experts
The definition of knowledge by Weggeman (2001) suggests that there can be different types of expertise, based on the different parts of knowledge. Types of expertise refer to types of knowledge. To determine which types can be identified, Weggeman’s (2000) definition of knowledge is used. As was said in chapter 2, Weggeman defines knowledge as the – partly unconscious – capacity that enables someone to perform a particular task. The capacity is a metaphorical function of the Information, the Experience, the Skills and the Attitude which is at someone’s disposal at a certain moment in time.

Experts’ knowledge domains are all different: they are individually built from the components of the knowledge definition. In all knowledge, all four components (IESA) are present. However, some components can be more dominant than others. In some knowledge domains the I-component is more important, whereas in other domains the ESA-components are dominant. Therefore, the types of expertise can be identified by altering the different components of the definition of knowledge. Before discussing the
relevant expertise types for this research, the dominance of the E-component first needs to be examined. As was described in chapter 2, the expertise of experts is the result of experience. Experts often spend years training and practising and so build up their expertise (Ericsson & Lehmann, 1996; Chase & Simon, 1973; Prietula & Simon 1989). This indicates that in the typology there can be no relevant types of expertise without the E-component being a dominant factor: if the E-component was not a dominant factor, this would suggest that the knowledge of the involved ‘expert’ is below expert-level and that he can not be called an expert. Therefore, in the typology based on the different constructions of the knowledge domains of the expert, the E-component (experience) is dominant in all types.

This research distinguishes the types of expertise that are based on the primary types of knowledge constructions, that is, those knowledge constructions in which (besides Experience) one knowledge component is dominant in relation to the other two. The types that are based on knowledge constructions where more than one component of knowledge is dominant, the secondary types, can then be constructed by combining the relevant primary types.

Below, the three primary types of expertise are presented, using their specific knowledge definitions as illustration.

1. The I-dominant expertise: In this type of expertise, the Information-component of the expert’s knowledge, that is, the knowledge that is to be shared, is dominant. The knowledge in this relation concerns dominantly codified knowledge, and is about knowing. Combined with the dominant Experience-component, experts of this type can be described as being on a high-codified level, meaning that the knowledge that is to be shared has a high information density, in which experience plays a major part in interpreting the data. Often, the knowledge is on a highly abstract level.

2. The S-dominant expertise: In this type of expertise, the Skills-component of the expert’s knowledge is dominant. The knowledge in this relation concerns dominantly skills and crafts (technical dimension). In general these skills can be both in interacting with the environment, like communicative skills and manual skills, and skills which are present within the experts’ heads, like analytical and creative skills. However, in this type craftsman’s skills and techniques are dominant: this relation is about doing. Examples of S-dominant experts are a surgeon or a carpenter.

3. The A-dominant expertise: In this type of expertise, the Attitude-component of the expert’s knowledge is dominant. This component refers to the basic beliefs of the expert: values and norms that determine someone’s attitude and feelings in a situation and his perception and drives. The Attitude-dominance in this type appears in close relation with the internal skills of S-component: the skills that are about reflection, intuitive skills, and creativity. The knowledge in this relation is about approaching: it is about someone’s way of acting, managing and treatment of the environment. In
expertise this type, the personality of the expert seems to play an important role in his expertise.

In the above sections the working definition of experts as well as a typology of expertise was presented. When discussing knowledge sharing within expert-apprentice relations, it is important to get a better insight in the development of expertise. This is the subject of the next paragraph.

2.3.3. Expertise development

Now that some characteristics of experts in literature have been given, it is time to discuss the development of expertise. In theories regarding experts and their expertise, the nature-nurture debate is ongoing. Often, performances of experts look so easy that one has a tendency to attribute these performances to special natural (innate) talents. A study of Ericsson & Lehmann (1996) gives some other explanations. In prior studies it was demonstrated that the superior qualities of experts in, for example, memory and intelligence, do not result in higher results in psychometric tests. In other words, the superiority of experts turned out to be domain specific. Other results of the study of Ericsson & Lehmann were that (1) measurements of general basic capacities can not predict success in a certain domain, (2) the exceptionally good performances of an expert are often very domain specific and are difficult to transfer to another domain, and (3) systematic differences between experts and non-experts can almost always be attributed to attributes which are gained through long practice and training. According to this study, experts can only be named experts in a small, specific domain, without the qualities being transferable to other domains. Bédard and Chi (1992, 1993) studied expertise extensively. They conclude that a large body of domain knowledge is a prerequisite to expertise. This knowledge influences the perceptual processes and strategies of problem solving. By definition experts possess a larger quantity of domain-relevant knowledge than do novices.

Chase & Simon (1973) explain this domain specific expertise by focussing on the extended experiences an expert has in the expert domain. It is about attaining skills and a gradual improvement of the performances by gaining experience. In this approach the performances of experts are a direct function of the knowledge attained by training and experience in a specific domain. However, Ericsson & Lehmann (1996) found that the number of years experience in a certain domain did not result in better performances in that domain when compared to persons who only had a few years experience. These authors claim that continuous improvement of performances is not an automatic consequence of having more experience. Experts achieve their expertise by searching for specific events and ways to practise and train themselves. In other words, through deliberate practice. Deliberate practices are activities which are only and specially designed to effectively improve specific aspects of an individual performance. To summarize, the number of years
experience is not a sufficient condition to become an expert in a certain domain. To become an expert one must go through deliberate and extended training and practice.

Now that knowledge attainment of experts has been described, it is interesting to see how this knowledge is constructed in the brain. According to Prietula & Simon (1989), expert knowledge is built on years of experience with problem solving in the professional area. This knowledge is organised in such a way that it crosses the boundaries of reason. The core of this theory is the way the knowledge is stored in the brain. In general people have three limitations when it comes to the power of reason. First there is the limitation of attention: a person can only handle so many subjects at the same time. Another limitation has to do with the working memory. The working memory is the meeting place of information about the problem that is to be solved, the expected conclusions and the present knowledge of the person. The working memory, however, has a limited capacity – one person can only hold a certain amount of information at the same time, so-called chunks. A maximum of seven chunks is what a person normally can cope with. A third limitation of the power of reason is the limitation of the long term memory. Although much information is stored in long term memory, not all knowledge is easily accessible. The access to knowledge can get lost when it is not frequently used. Problem solving has to do with making relevant knowledge in long term memory accessible at the right time for use in the working memory. The construction of this process is what, according to Prietula & Simon, separates the experts from the non-experts. Experts use this process more effectively because they link frequent appearing patterns together in one chunk of information. This chunk is then seen as one separate part and takes up less space in the working memory and attention. Non-experts on the contrary do not link these chunks, with the result that the required information takes up too much space to be effectively used. This combining and linking of patterns is the base for the two forms of reason that are used by experts: analysis and intuition. Analytic reason by an expert is used in complex problem solving and has mainly to do with the gathering of information. It is about getting the relevant knowledge ready to be used, studying the situation and thinking about possible solutions. Analytical reason takes much time and mental capacity. The second form of reason used by experts is reason by intuition. With this form of reason the expert is unaware of using it. For example an expert would call it a ‘stroke of luck’ when he solves a problem, while it was really reason by intuition that was at the base of the solution. This intuition evolves during the expert’s long years of experience when different chunks of knowledge are formed. Because of these linkages, familiar situations are linked immediately to a possible next step or solution. It is about association which evolved in prior years and is kept active because of its proven effectiveness. Reason by intuition comes from experiences that were first understood by reason by analysis. Over the years the process of linking the information started when certain steps in thinking could be by-passed, with the result that intuition kept getting better and better. From this theory follows the conclusion that learning is a not to be underestimated factor in the organisation of expert knowledge. Bédard and Chi (1992)
agree with the assumption that it is the organisation of the knowledge in the brain that divides experts from non-experts. Experts have their knowledge organised in such a way that the knowledge is better accessible, functional and efficient. Like Prietula and Simon, Bédard and Chi found that experts’ knowledge is extensively cross-referenced, with a rich network of connections among concepts. Non-experts have fewer and weaker links among concepts. Besides that, experts have a greater tendency to base the organisation of their knowledge on meaning, whereas non-experts base their organisation on surface features of the information presented. Also, experts and non-experts differ in the way they solve problems: the representations of problems, the problem solving strategies and the quality of decision are done differently by experts in comparison to non-experts. To conclude, expertise is a combination of analysis and intuition, with intuition coming from experiences that were first understood by using analysis. This combination, as a result, is for a large part made up of tacit knowledge. Experience and intuition are not easily put into words, therefore expert knowledge is hard to share – and it costs lots of time and money, if it is possible in the first place. The only possible way to share and transfer expert knowledge is to follow and observe the expert intensively, only by this method can the tacit knowledge of an expert be taken into account (Prietula & Simon, 1989).

An unexpected pitfall of the theories mentioned above, is that the expert can be a victim of rigidity. An expert is often highly admired for his knowledge and skills and it is therefore not unthinkable that an expert could start to believe in his own ‘canonisation’. A result of this could be that the expert knowledge becomes static and the only true story. The expert then becomes rigid in his beliefs and is not able to see clearly: he has stepped in the pitfall of rigidity. A fresh view and a new sound are needed to break through this.

The previous section discussed the nature and organisation of expertise. When these expert theories are combined with the previous paragraph about learning, the path from novice to expert can be drawn. This is the subject of the next section.

2.3.4. From novice to expert

In the previous section expert knowledge was described in general. In this paragraph, the transition from novice to expert is analysed. As was seen in the discussion about the construction of expert knowledge, training and deliberate practice play an important role in the gaining of expertise. When this is combined with general learning theories, the road to expertise becomes clear. How does one develop from a novice to an expert? In literature, different models can be found to describe the development of expertise. For example, Anderson (1995) uses a three-stage model in the development from novice to expert. The first stage is the ‘cognitive stage’ where the novice learns the set of facts and rules that are relevant to the learning of the skill in a declarative and procedural representation. The second stage is called the ‘associative stage’ where two things happen: first there is the elimination of errors in the initial understanding of the rules and facts and second a better
understanding of the rules and facts used and a conversion to meaningful productions (e.g. ‘if this, then do that’). The final stage described by Anderson (1995) is the ‘autonomous stage’. In this last stage, the procedures become more and more automated and rapid. Other three-stage models are for example by Boshuizen (2004) who identifies three learning processes in the development of expertise in medicine (knowledge accretion, validation and integration; knowledge encapsulation; and illness-script formation), which are at the core of learning in respectively the novice; intermediate; and expert-stage. The development of expertise, according to Boshuizen, develops from long chains of detailed reasoning steps to automatic reminding.

In most expert-models the development from the learning of specific rules to more instinctive knowledge is reflected. In this research Dreyfus and Dreyfus (2005) model of the acquisition of expertise is used. This model is chosen because of its emphasis on the development of tacit knowledge, which is an important aspect of expertise in this study. Dreyfus and Dreyfus’ model explains the phases a person goes through to develop from being a novice to becoming an expert. According to Dreyfus, in the development of a skill a person passes through five levels of proficiency, namely:

Novice → Advanced beginner → Competence → Proficiency → Expertise

These different levels reflect changes in three general aspects of skilled performance: (1) a movement from reliance on abstract principle to the use of past concrete experience as paradigms, (2) a change in the learner’s perception of the demand situation, in which the situation is seen less and less as a compilation of equally relevant bits, and more as a complete whole in which only certain parts are relevant, and (3) a passage from detached observation to involved performer. The performer no longer stands outside the situation but is now engaged in the situation.

Dreyfus & Dreyfus (2005) describe their model of the acquisition of expertise by emphasizing the development from applying abstract rules to working with particular cases. This is just the opposite of what the traditional view claims (Piaget, Chomsky), which states that expertise is about identifying and applying general rules in different situations. In short, the five-stage model of Dreyfus encompasses the following phases: a person on the road to expertise starts off as a novice. Normally the instruction process begins by decomposing the task environment into context-free features that the novice can recognize without the desired skill. The beginner is then given rules for determining actions on the basis of the features, like a computer following a program. Because of a lack of understanding the context, mere following the rules will produce poor performance. As the novice gains experience actually coping with real situations, he will begin to develop an understanding of the relevant context during the stage of being an advanced beginner. Instructional maxims can then refer to the new situational aspects, recognized on the base
of experience, as well as to the objectively defined non-situational features recognized by the novice. Learning in this stage is still a detached activity: to progress to the stage of competence, according to Dreyfus & Dreyfus, one needs a special kind of involvement. Involvement is needed to cope with the overload of the number of potentially relevant elements and procedures the learner is able to recognize and follow. The authors state that in general, one will not get beyond the stage of competence if one seeks to follow general rules. It is merely a question of motivation if a student gets involved or not. Only if the detached, information-consuming stance is replaced by involvement, and the performer’s theory of the skill is replaced by situational discriminations, accompanied by associated responses, the stage of proficiency is possible: the reasoned responses have to be replaced by the intuitive reactions. The difference between the proficiency state and expertise, is that after spontaneously seeing the point and important aspects of the current situation, the proficient performer still must decide what to do by falling back on detached rule and maxim following, while an expert not only sees what needs to be achieved, but also immediately sees how to achieve the goal. The expert is able to make more subtle and refined discriminations (Dreyfus & Dreyfus, 2005).

According to the authors, the role of the teacher in this process is as follows: a student learns by small random variations in what he is doing, and then checking to see whether or not performance has improved. Of course, it would be better for learning if these small random variations were not random – if they were sensible deviations. If the learner watches someone good at doing something, that could limit the learner’s random trails to the more promising ones. So observation and imitation of the activity of an expert can replace a random search for better ways to act. In general, this is the advantage of being an apprentice.

A consequence of adapting this five-stage model, is that if one asks an expert to put into words the rules he is using in his expertise, this question will force the expert to regress to the level of a beginner and state the rules that were learnt at that stage. This is, in short, the criticism Dreyfus has on expert systems: ‘instead of using rules [the expert] no longer remembers, as knowledge engineers suppose, the expert is forced to remember rules he no longer uses’. What Dreyfus is saying is that the knowledge of experts cannot be made explicit: the knowledge has become completely internalised as tacit knowledge.

In expert-apprentice relations two knowledge domains are combined: two persons are combined who are at different stages on the scale to expertise. But how much more knowledge should the expert have for knowledge sharing to be optimal, or: how large should the gap be between the expert’s knowledge and that of the apprentice? According to Weggeman (2000), it has to be possible to bridge the knowledge gap between expert and apprentice, because when the distance is too large, no learning can take place. For an apprentice to be able to learn from (or: share knowledge with) an expert, he must have a
certain amount of knowledge in the knowledge domain of the expert. If the apprentice enters the expert-apprentice relation with no knowledge about the knowledge domain of the expert, the gap between the expert and the apprentice is too large. Weggeman gives an example to illustrate this requirement: after a concert, he once was invited into the dressing room of a famous violinist. A journalist who was also present, asked the violinist about the secret of his success. The violinist thought long about this question and finally said: “it is about my manner of striking the string with the bow: look,” he said, and took his violin and struck the string of his violin a couple of times, “I think I do this slightly different than most of my colleagues”. The journalist was not able to ‘turn this data into information’ (i.e. did not have the knowledge to understand the explanation of the violinist). A master class student who listened to the interview, afterwards spent about half an hour explaining to the journalist what it was her famous teacher probably meant. This example illustrates that the apprentice should have some basic knowledge in the knowledge domain of the expert to be able to learn from them. This theory is supported by Nonaka and Takeuchi (1995) who state that it is important that some mutual knowledge is already present in the individuals involved in the socialisation for the knowledge conversion to take place. Or, as Leonard and Swap (2004) describe it: “for someone to capture complex, experience-based knowledge, his brain has to contain some frameworks, domain knowledge or prior experiences to which current inputs can connect”. When comparing this observation with the Dreyfus’ model of the acquisition of expertise (1996), it can be concluded that the apprentice should be approximately in the third stage of Dreyfus’ model: in the stage of competence. This is the stage where a person evolves from being a detached learner into an involved learner and the knowledge begins to truly make sense to the student (Dreyfus & Dreyfus, 2005). To summarise: the ideal knowledge distance between an expert and an apprentice in an expert-apprentice relation seems to be when the apprentice is situated in the stage of competence in the knowledge domain of the expert.

2.3.5. Overview of the relevant findings

The different definitions of experts and expertise result in a working definition for this research. In this definition the concepts of experience and practice are important for the sharing of the expert’s knowledge, which will result in a large tacit component of the expert knowledge. The three forms of expert learning as identified by Simon and Ruijters also seem relevant for the research because they differentiate between possible learning outcomes. The definition of knowledge of Weggeman results in a categorisation of expertise. Three primary types of experts are identified, namely with expertise based on the Information component, the Skills component, or the Attitude component of knowledge.

The theories on experts and their expertise indicate that experts are not experts in all areas, but only in a specific knowledge domain. In working with expert knowledge, one should be aware of this. The observation that all expertise is built on deliberate practice and training to gain the necessary experiences, results in the indication that deliberate practice and
training are important aspects of expertise development. The deliberate practices and experiences result in tacit knowledge. The fact that expert knowledge consists for a large part of tacit knowledge was also the conclusion of the previous paragraph. Lastly, one should be aware for the pitfall of rigidity.

The task of the expert in the development of the apprentice’s expertise is to show him effective examples of skill use, and new variations to further his experience by modelling good examples and applications. The identification of the development from the use of general rules to situation-specific intuition indicates that if a person simply asks the expert to explain his skill, this will not be effective. A last finding of this chapter is that for the knowledge sharing to be optimal in expert-apprentice relations, the theory suggests that the apprentice should be in the stage of competence in the knowledge domain of the expert.

The next chapter elaborates on two examples of the use of the expert-apprentice method in other times and cultures.