Defining a knowledge exchange model:

Exploring knowledge transfer activities of internationally oriented high-tech SMEs

Master's Thesis

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Preface

This Master's thesis is a result of the graduation project for the Master's degree in Business Administration at the University of Twente, conducted at Micronit Microfluidics in Enschede, the Netherlands. Within the Business Administration program and International Management track specialization, I studied knowledge transfer activities of internationally oriented high-tech SMEs. It gave me the opportunity to learn from high-tech entrepreneurs about their view on high-tech entrepreneurship, knowledge transfer and cross-border activities.

It was a great time to work with wonderful and experienced professionals in science and business. I learned a lot from all who were involved within my graduation assignment and had a tremendous time during my thesis. I would like to express my appreciation to the graduation committee, supervisors from Micronit and all those who supported and participated within this study.

First, I would like to thank my supervisors from the University of Twente. Special thanks to Dr. de Boer for his guidance, conceptual ideas and critical feedback. I learned a lot from our discussion about the conceptual process and thank you for giving me the opportunity to attend the High Technology Small Firms conference at the University of Twente this year. It was a great pleasure working with you. I would also like to thank my second supervisor who is situated in Washington, United States. Dr. Steenhuis, it was a great pleasure working with you. Your in-depth feedback and insight on this research topic were valuable to me and helped me further during the graduation assignment.

My gratitude also goes to my supervisors from Micronit. Ronny, it was a great pleasure working with you. I learned a lot from our discussion about international entrepreneurship - your enthusiasm and vision about Micronit inspired me during the graduation. Thank you for giving me space to work and to learn from other assignments within the organization. Special thanks to Harmen, who helped me no matter time or day of the week. Our discussion and your support have been valuable to me. I also would like to thank all experts and managers from high-tech SMEs those who took their time to participate within the research.

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1. Introduction

1.1 Research background

High-technology (high-tech) small- and medium-sized enterprises (SMEs) of the past decades have developed themselves into global leaders nowadays. Some case examples include high-growth companies such as: Intel, Google, Microsoft and Apple. These companies have grown exponentially in a couple of decades and have set 'the standard' in their markets internationally. One of the factors influencing international business activities of high-tech SMEs includes inter-firm and intra-firm knowledge transfer. These companies have been able to organize their knowledge transfer activities successfully and developed themselves into market pioneers. So one may assume: being aware of knowledge transfer processes, influencing factors and organizing it successfully, can lead to improvements in international activities of high-tech SMEs.

Indeed, in a rapidly changing business environment, knowledge becomes one of the most important determinants of business success (OECD, 1996). It is explained that in order to succeed internationally, a firm must possess some advantageous knowledge-based assets (Martin & Salomon, 2003). Knowledge actually represents the main resource upon which competitive advantage is founded, and its transfer is widely emphasized as a strategic issue for the firm competition (Ramasamy, Goh & Yeung, 2006). Knowledge transfer is viewed as a critical factor for a firm necessary to rapidly respond to change, innovate and achieve competitive success (Albino, Garavelli & Schiuma, 1999; Cohen & Levinthal, 1990). This raises the issue that companies have to manage their knowledge by creating and transferring knowledge internally and by preventing knowledge transfer to their competitors (Argote & Ingram, 2000).

The larger body of literature discusses the importance of knowledge transfer for multinational enterprises (MNEs) and emphasizes intra-firm knowledge flow processes (Martin & Salomon, 2003; Tsai, 2001; Bresman, Birkinshaw & Nobel, 1999). However, some scholars have stressed the role of inter-firm knowledge transfer for MNEs in strategic alliances (Simonin, 2004; Simonin, 1999; Mowery & Oxley, 1996), and in international joint ventures (Lyles & Salk, 1996). To a lesser extent attention is given to inter-firm knowledge transfer activities of internationally oriented high-tech SMEs.

Also in international business literature, MNEs played a dominant role, while SMEs have only recently attracted broader interest (Ruzzier & Hisrisch, 2006). Due to continuing globalization and as a result of increasing international competition, international expansion is no longer the domain of large firms. SMEs have been observed to internationalize, sometimes at an early age of development (Pangarkar, 2008), and SMEs are considered as the engine of the global economic growth, because of their innovative capacity (Acs, Morck, Shaver & Yeung, 1997).

Knowledge transfer activities are studied thoroughly for larger enterprises, so it may bring problems for how internationally oriented high-tech SMEs should deal with knowledge transfer activities. Issues arising within these activities include cultural and language barriers, financial limitations, technology adaptation, training and

intellectual property protection. That is why, there is the need to identify factors and to understand underlying processes that influence knowledge transfer activities of internationally oriented SMEs. In this thesis it will be explored how internationally oriented high-tech SMEs organize their knowledge transfer activities within and across their organization's boundaries, and which factors influence this process. The next sections describe the research objectives, research question and the research strategy for this study.

1.2 Research objectives

The objective of this study is twofold. First, to identify the factors and processes that facilitate knowledge transfer activities of internationally oriented high-tech SMEs, resulting into a tentative model. The intention is to provide and to design an appropriate model for knowledge transfer activities of internationally oriented high-tech SMEs.

Second, since Micronit Microfluidics (Micronit) is the sponsor of this research project, the objective is to identify factors and processes underlying knowledge transfer activities concerning the firm itself. Micronit will be advised on how it could organize the knowledge transfer activities internationally, in order to improve the overall organizational performance. This has to result in economic benefits.

1.3 Research question

The theme of the current study is primarily focussed on high-tech based firms. High-tech SMEs are chosen, because of several interesting details:

1. These type of companies are relatively more internationally oriented;
2. High-tech SMEs have limited resources, and;
3. High-tech SMEs manage more knowledge-intensive operations than usual.

Considering the lack of literature and the need for Micronit to manage the inter- and intra-firm knowledge transfer process, the resulting research question is:

> ***What international knowledge transfer process is appropriate for internationally oriented high-tech SMEs and how can Micronit implement such a process?***

1.4 Research strategy

The research strategy follows a deductive approach (Saunders, Lewis & Thornhill, 2009). Therefore, the remainder of this thesis is organized as follows (Figure 1). Chapter 2 consists of an elaborated literature review, resulting in a research model. Chapter 3 explains the methodology. Then, chapter 4 presents the findings, followed by the case of Micronit in chapter 5. Conclusions and discussion will be provided in chapter 6.

Figure 1, Research Structure

2. Literature review

2.1 Internationally oriented high-tech SMEs

This section (2.1) describes literature on international business and factors influencing cross-border activities of high-tech SMEs. First, literature on international entrepreneurship will be discussed, followed by characteristics of internationally oriented high-tech SMEs. Then, the domain of knowledge transfer is elaborated (2.2). Furthermore, section 2.3 discusses dimensions and underlying factors that influence knowledge transfer activities, resulting in the research model adopted in this study (2.3.5).

2.1.1 International entrepreneurship

Conducting research into an international business environment, needs one to define the concept clearly. International entrepreneurship is defined as the discovery, enactment, evaluation and exploitation of opportunities – across national borders – to create future goods and services (Oviatt & McDougall, 2005). It is also related to the innovative, proactive and risk-seeking behaviour that crosses national borders, and intended to create value in organizations (McDougall & Oviatt, 2000).

Internationalization is a process in which the enterprise gradually increases its international involvement (Moen & Servais, 2002). This process evolves in the interplay between the development of knowledge about foreign markets and operations on the one hand and increasing commitment of resources to foreign markets on the other hand. It is also explained that elements such as size, age and prior experience affect the extent of internationalization (Andersson, Gabrielsson & Wictor, 2004).

Literature in the area of MNEs' cross-country knowledge transfer activities and best practices is dominated by two scenarios: *adaptation* and *standardization* (Yakhlef, 2007; Theodosiou & Leonidou, 2003). There are as many advocates of adaptation as of standardization strategies. Both strategies are regarded as strategic devices for competing in overseas markets (Jensen & Szulanski, 2004). Internationally oriented high-tech SMEs can also deal with the issue to adopt an adaptation strategy or a standardization strategy for its international activities.

Whether the firm will use an adaptation or a standardization approach depends on several factors that affect the cross-border activities of SMEs (Etemad, 2004):

1. *Push factors*, refer to the pressure on the firm from the inside (Jansson & Sandberg, 2008);
2. *Pull factors*, relate to the drivers in the environment and external to the firm (Andersson, 2004);
3. *Mediating factors*, which represent the basic characteristics of the firm and the circumstances under which the entrepreneur operates (Andersson, 2002; 2000), and;
4. *Firm's own characteristics,* such as decision making, strategy formulation and implementation dynamics.

The following subsection (2.1.2) discusses these four factors for internationally oriented high-tech SMEs.

2.1.2 High-tech SMEs

SMEs differ in many aspects from MNEs in their cross-border activities. SMEs can enjoy a number of behavioural advantages (e.g. rapid response to external threats and opportunities, efficient internal communication) and a number of material disadvantages (e.g. low resource commitment) over their larger counterparts (Rothwell, 1991). Factors influencing cross-border activities of high-tech SMEs, according to Etemad (2004), are defined as follows.

Push factors for internationally oriented high-tech SMEs are characterized by low resource commitment and the focus on commercialization (Burgel & Murray, 2000; Moen & Servais, 1992). Internationally oriented high-tech SMEs are directed toward commercialization rather than foreign production (Burgel & Murray, 2000). High-tech SMEs therefore should use a business area with homogeneous customers and minimal adaptation in the marketing mix (Moen & Servais, 1992). The argument is that these firms cannot take a multi-domestic approach as a large firm can, simply because they do not have sufficient scale in their operations worldwide (Moen & Servais, 1992). However, some scholars assume that resource constraints do not affect the SME's choice to internationalize (Perks & Hughes, 2008). That may be true, but still high-tech SMEs are short-term oriented which can affect current international business activities.

Pull factors for internationally oriented high-tech SMEs include natural differences, such as a different language, culture and a legal system (Acs *et al.*, 1997). These differences can make international business very risky for high-tech SMEs. Therefore, high-tech SMEs may have limited operations abroad. In contrast, some scholars assume that the cultural context and industry environment does not affect the SME's choice to internationalize (Perks & Hughes, 2008). Geographical and cultural distance may not be an issue for the choice to internationalize, but critical for current international business activities of high-tech SMEs.

Figure 2, Factors influencing cross-border activities of high-tech SMEs (Perks & Hughes, 2008; Etemad, 2004; Burgel & Murray, 2000; Acs *et al.*, 1997; Moen & Servais; Rothwell, 1991)

Firm's own characteristics of internationally oriented high-tech SMEs include a relatively small size, internationally oriented, high-tech oriented, imperfect information about the foreign market and knowledge-intensive activities (Burgel & Murray, 2000; Acs *et al.*, 1997). These factors also affect the cross-border activities of high-tech SMEs.

Mediating factors for internationally oriented high-tech SMEs include efficient internal

communication, an interactive management style, rapid response to external threats and opportunities and a short-term orientation (Rothwell, 1991). Because of these factors, high-tech SMEs can be relatively flexible and enjoy major advantages compared to larger enterprises. SMEs are also able to make decisions quickly and efficiently, whereas the strategy formulation of high-tech SMEs is based on commercialization. It is also said that the customer relation, tacit knowledge, vision and product-service complexity affect the decision to internationalize (Perks & Hughes, 2008).

In sum, several factors affect cross-border activities of high-tech SMEs. The four influencing dimensions of Etemad (2004) are illustrated in figure 2. As a result, these factors can also influence knowledge transfer activities of internationally oriented high-tech SMEs.

2.2 Domain of knowledge transfer

This section defines knowledge (2.2.1), knowledge transfer (2.2.2), inter-firm and intra-firm knowledge transfer processes (2.2.3), and its relation with organizational performance (2.2.4).

2.2.1 Defining knowledge

Before delving into concepts of knowledge transfer, first it will be explained how knowledge is different from information and data (Roberts, 2002).

Data could be considered as the input for information. Data are series of observations, measurements or facts in the form of numbers, words, sounds and/or images. It has no meaning and provides raw material from which information could be produced (Roberts, 2002).

Information is data that have been arranged into a meaningful pattern. Boisot & Canals (2004) describe information as the extraction of data. Information can possibly result from conducting a survey, or the analysis of reports, charts and graphs that give meaning to data (Roberts, 2002).

Knowledge is actually the application and productive use of information. Knowledge is more than information, since it involves the awareness or understanding through experience, familiarity or learning (Roberts, 2002). Takeuchi & Nonaka (1995) define knowledge as the meaning, beliefs and commitment, and of a particular stance, perspective or intention.

Knowledge can be broadly classified into *explicit knowledge* or *tacit knowledge* (Ramasamy *et al.*, 2006). *Explicit knowledge* is information that can be easily documented and shared through electronic or other media, such as manuals, reports and databases. It is also described as objective knowledge, knowledge of rationality, sequential knowledge and digital knowledge (Takeuchi & Nonaka, 1995). *Tacit knowledge* on the other hand is knowledge that resides in humans, such as beliefs, insights, intuition and values (Ramasamy *et al.*, 2006). This is referred to as subjective knowledge, knowledge of experience, simultaneous knowledge and analog knowledge (Takeuchi & Nonaka, 1995).

Whether knowledge is explicit or tacit, it should be accessible to the target audience. The diffusible feature of information establishes the availability of data and information for those who want to use it. This feature depends on the level of codification and abstraction (Boisot, 1998). Knowledge may be widely diffusible but remain unused (Boisot, 1998). A reason for not using the information might be that it is not recognized, or too much time and effort is needed to use it, and information can be subject to restrictions (Boisot, 1998). Another reason could be that information is not reliable or suitable.

In sum, knowledge is different from information or data. Knowledge can be classified into tacit and explicit knowledge. The diffusion of knowledge depends on the level of codification and the level of abstraction. The question is how the transfer of knowledge looks like and which concepts are related to this process.

2.2.2 Defining knowledge transfer

By defining knowledge transfer, ideas of several authors are presented below.

It is known that knowledge transfer seems to be appropriate when specific exchange conditions are set (Yang & Kim, 2007). Different conditions are needed in different situations. Yang & Kim (2007) explain that knowledge transfer can be used when the knowledge source and recipient are defined clearly. During knowledge transfer, a clear direction of knowledge flow from source to recipient is visible (Yang & Kim, 2007).

Knowledge transfer can also be considered within a broad definition of technology transfer (Roberts, 2000). Technology transfer is the diffusion of the complex bundle of knowledge, which surrounds a level and type of technology. It includes transfer of information and knowledge at micro- and macro-level between individuals, organizations, and economies (Roberts, 2000). So, this could also be true when high-tech SMEs send their knowledge about complex technologies and services to their customers internationally. In that case, high-tech SMEs are defined as a knowledge source, whereas their customers are defined as knowledge receiver. However, these roles of sending and receiving knowledge could also change during a partnership, joint venture project or interaction between both actors, since both actors can exchange knowledge about their technologies and products to each other.

Szulanski (1996) explains knowledge transfer as the dyadic exchange of organizational knowledge between a source and a recipient. During knowledge transfer, the recipient of knowledge needs to be motivated to gain knowledge, and the donor must have something worthwhile to offer (Easterby-Smith, Lyles & Tsang, 2008). The more features the actors share the more successful knowledge transfer is likely to be (Yakhlef, 2007; Kostova, 1999; Inkpen & Dinur, 1998; Lyles & Salk, 1996).

Argote & Ingram (2000) explain knowledge transfer as the process through which one unit is affected by the experience of another, which occurs through changes in knowledge of performance of the recipient unit.

A more appropriate definition of knowledge transfer for the current study is the transfer of knowledge between two actors by which the knowledge of one actor is acquired by another (Albino *et al.*, 1999; Cutler,

1989). Knowledge transfer can take place by means of different ways, such as interaction of personnel, patent disclosures, publications, assets and services exchanges.

As knowledge transfer is defined, now it is explained how the overall process of knowledge transfer is characterized.

2.2.3 Inter-firm and intra-firm knowledge transfer process

Two models dominated the domain of using, sharing and transferring knowledge: the *Communication-based* and the *Knowledge-creation* model (Yakhlef, 2007; Inkpen & Dinur, 1998).

First, the knowledge transfer process can be considered as a *communication process* with information processing activities (Albino *et al.*, 1999). Communication is defined as the process of giving and receiving information (Ramasamy *et al.*, 2006). In this case, knowledge owned by an actor (according to its specific characteristics) can be transferred to another actor by information flows through different media. The effectiveness and efficiency will partly depend on media choice (Albino *et al.*, 1999).

The transfer of knowledge, from a communication perspective, is regarded as a message encoded in a medium by a sender to a recipient in a given context (Yakhlef, 2007). Based on previous literature (Shannon, 1998), it could be assumed that an inter-firm knowledge transfer activity includes three stages: an *encoding stage*, a *transmission stage* and a *receiving and interpretation stage*. First, knowledge is codified by the source company. This stage is important and difficult. On the one hand a high level of codification increases the transfer of knowledge with the potential customer. On the other hand, knowledge with a high level of codification can also be easily captured by competitors (Albino *et al.*, 1999). After encoding information, it is transmitted towards the receiving actor, either verbally or written. In this stage it is essential to choose the most appropriate channel through which information is transmitted. In the third stage, information is interpreted and received by the receiving actor. In this stage information is decoded, acquired and shared throughout the company. This third stage is related to the receptive and absorptive capacity of the company. Eventually the receiving company sends feedback to the source company. In the overall process of transmitting a message, certain information that is not intended by the source is unavoidably added to the message. This noise can be internal (i.e. coming from own knowledge, attitudes, or beliefs), or external (i.e. coming from other sources). Such internal or external noise can either strengthen the intended effect of a message (if the information confirms the message) or weaken the intended effect (if the intended information contradicts the message).

In addition, Gupta & Govindarajan (2000) consider knowledge flows as any two-person communication, including:

1. *A message*;
2. *A sender*;
3. *A coding scheme*;

4. *A channel*;
5. *Transmission through the channel*;
6. *A decoding scheme*;
7. *A receiver*, and;
8. *The assignment of meaning to the decoded message*.

Since inter-firm knowledge transfer in this study primarily represents information processing activities between two firms, rather than creating knowledge together, it is considered as a communication-based process. The reason is that, in this study, it is assumed that high-tech SMEs send and receive knowledge from their relations internationally, primarily to stimulate international sales. However, it does not mean that high-tech SMEs do not learn from their customers internationally. In fact, when high-tech SMEs need to build a new product which requires new production processes, it can even improve its own knowledge on product and production level. So, knowledge creation can occur, but primarily facilitated by a communication-based process.

Second, knowledge transfer is also related to *organizational learning* (Albino *et al.*, 1999; Gilbert & Cordey-Hayes, 1996). Organizational learning occurs through individual learning and knowledge sharing. The process of organizational learning is stimulated by a shared vision (Walsh & Ungson, 1991; Senge, 1994; Kim, 1993). Therefore, knowledge through interaction transfers more readily within than between firms (Argote & Ingram, 2000). Knowledge transfer in this case occurs through socialization, education and learning, which may be either purposefully or as an outcome of other activities (Roberts, 2000). As a learning process knowledge transfer occurs in five stages:

1. *Acquisition*;
2. *Communication*;
3. *Application*;
4. *Acceptance*, and;
5. *Assimilation*, (Albino *et al.*, 1999; Gilbert & Cordey-Hayes, 1996).

Before knowledge is transferred internally, it is acquired from the source company. Prior experience determines how the acquired knowledge is interpreted (Gilbert & Cordey-Hayes, 1996). Subsequently, the acquired knowledge is communicated either verbally or written throughout the organization. Also here choosing the appropriate medium is essential to be aware of. The third step is the application of knowledge for it to be retained. The application of knowledge enables the organization to learn, rather than the knowledge itself (Gilbert & Cordey-Hayes, 1996). Then, the applied information needs to be accepted by individuals within the organization. The key to the process of knowledge transfer is assimilation of the results and effects of applying the knowledge gained, which is the last step in the process.

Knowledge transfer, from an organizational learning perspective, is also considered as the creation of knowledge through four modes of explicit and implicit forms of knowledge (Takeuchi & Nonaka, 1995). These modes include:

1. *Socialization* (from tacit to tacit knowledge);
2. *Combination* (from explicit to explicit);
3. *Externalization* (from tacit to explicit), and;
4. *Internalization* (from explicit to tacit).

Externalization and *internalization* are considered as appropriate modes for inter-organizational activities, whereas *socialization* and *combination* are considered as appropriate within the organizational boundaries (Takeuchi & Nonaka, 1995).

The intra-firm knowledge transfer activity of internationally oriented high-tech SMEs is considered as a *knowledge-creation* activity. The reason is that the intra-firm activity is associated with organizational development and overall performance of a firm (Van Wijk, Jansen & Lyles, 2008). Nevertheless, communication of knowledge also occurs during intra-firm knowledge transfer (Walsh & Ungson, 1991). As discussed before, knowledge creation can also be an inter-firm activity, since customers can come up with new product needs that have to be developed together, and whereby knowledge can be exchanged or created.

In this study, characteristics of both, the *communication-based* and the *knowledge-creation model* are integrated within the research model (Figure 3). The reason for using both approaches is that intra- and inter-firm knowledge transfer are highly related to each other (Holmqvist, 2003).

In sum, both inter-firm and intra-firm knowledge transfer processes are explained. Next, the relation between knowledge transfer and organizational performance are explained.

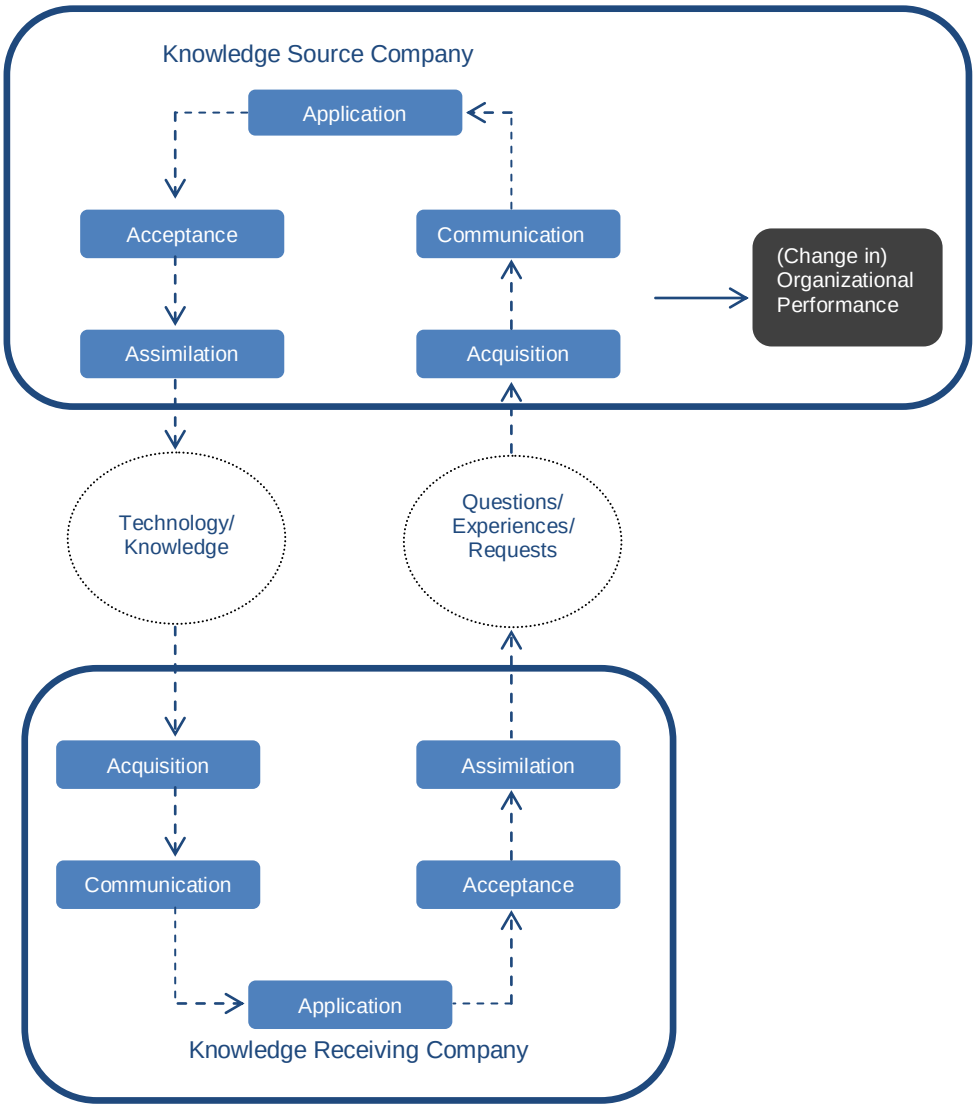
2.2.4 Performance evaluation of knowledge flows

It is known that knowledge transfer from both internal sources and external sources has important implications for a firm's organizational performance and innovativeness (Van Wijk *et al.*, 2008). Organizing knowledge transfer activities successfully can result into *qualitative* and *quantitative* organizational benefits (Chen & Chen, 2006). *Qualitative* indicators include: improving employees' skills, improving quality strategies, improving core business processes, developing customer relationships and developing supplier relationships. *Quantitative* indicators include: decreasing operation costs, decreasing product cycle time, increasing productivity, increasing market share, increasing shareholder equity and increasing patent income.

These benefits are essential to consider for internationally oriented high-tech SMEs. When these benefits are described clearly, companies understand the influence of such a process on their organizational performance. As a result, these type of companies could be more willing to adopt and integrate a 'knowledge transfer strategy' within its current business strategy. The reason is that high-tech SMEs emphasize the organizational performance

and short-term goals. As the overall knowledge transfer process is characterized, it is interesting to identify factors that could possibly affect the process.

Figure 3, Inter-firm and intra-firm knowledge transfer process



2.3 Factors influencing the knowledge transfer

This section explains a framework of factors, which can possibly influence the knowledge transfer process. Multiple factors can influence knowledge transfer activities. Boisot (1998) suggests that several elements affect the knowledge transfer:

1. The *availability of means* of communication;
2. The *sharing of codes* between sender and receiver;
3. The *prior sharing of contexts* between sender and receiver;
4. The speed with which messages diffuse;
5. *Cultural dispositions*, and;

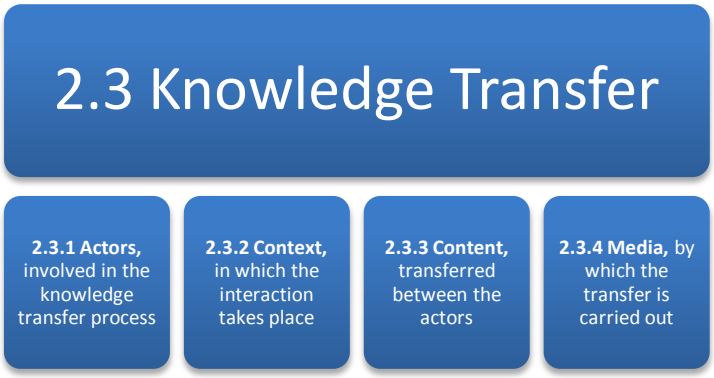
6. *Legal considerations*.

Other factors influencing the knowledge transfer process, distinguished by Boschma (2005), are:

1. The *distance* (geographical);
2. The *absorptive capacity* and *disseminative capacity* (cognitive), and;
3. *Trust* (social, institutional and organizational).

A more advanced framework for analyzing the knowledge transfer process is suggested by Albino *et al.* (1999). These scholars identified four dimensions of a framework, which influence knowledge transfer (Figure 4). Albino *et al.* (1999) assume that all knowledge owned by individuals or organizations defines their skills and core competencies, and enable them to carry out some tasks. In fact, every skills is always referred to a specific task defined as a goal. Thus, when knowledge transfer is analysed, it is always possible to find a knowledge-related task (Albino *et al.*, 1999). Therefore, particular attention has to be given to the transferred knowledge-related task.

Figure 4, Knowledge transfer framework (Albino *et al.*, 1999)



This knowledge transfer framework will be discussed deliberately, because it considers the most essential dimensions and underlying aspects very specifically. It could be assumed that the framework can be used for both inter-firm and intra-firm knowledge transfer analysis. The next sub sections clarify different dimensions that can influence knowledge transfer.

2.3.1 Actors

The first dimension refers to the role of actors during knowledge transfer (Figure 5). Actors are considered as either the individuals or the organizations. Analysing the knowledge transfer, some key factors can influence the effectiveness of knowledge exchange (Albino *et al.*, 1999) Factors influencing the *actors* dimension and, therefore, the effectiveness of knowledge transfer are: *openness*, *trust*, geographic distance, and *prior experience* (Easterby-Smith *et al.*, 2008; Ramasamy *et al.*, 2006; Albino *et al.*, 1999; Boschma, 2005; Nieminen, 2005).

Openness can be understood in terms of the partners' willingness to share knowledge in a collaborative interaction, which could also be referred to as the overall perceived openness of dialogue. A higher level of

openness allows a more effective knowledge transfer (Albino *et al.*, 1999). A related factor to openness is trust, which has a direct and positive effect on openness.

Trust can be characterized as the parties' ability to believe that the counterparts' behaviour will remain consistent in the future (Nieminen, 2005). It is said that tacit knowledge, for instance, is more easily enforced by trust than a contractual agreement (Roberts, 2000). When mutual trust is high, on the supply-side, business partners will share and exchange their knowledge with knowledge-seeking firms (Buckley, Clegg & Tan, 2006; Ramasamy *et al.*, 2006; Levin & Cross, 2004). On the demand side, if the knowledge-seeking firm does not trust its partner, the seeking firm would probably have no intention to learn from them, as the firm assumes the partner firm would not transfer any knowledge. The knowledge-seeking firm can even be suspicious about the accuracy and reliability of the information received from the partner (Ramasamy *et al.*, 2006). Strong long-term relationship is a strong enabler of effective coordination of inter-firm activities, which in turn leads to a higher degree of knowledge transfer for the source firm.

Knowledge transfer is possible when there is mutual trust, transparency and intents (Nieminen, 2005; Goh, 2002). The role of mutual trust is significant as the transferred knowledge is highly related to the organization's competitive advantage, and it can therefore raise the question of opportunism (Nieminen, 2005; Hamel, 1991).

According to Nieminen (2005), trust can be built on three sets of issues:

1. *Process-based trust* (i.e. level of trust between the firms regarding their mutual history and reputation for trust);
2. *Characteristics-based trust* (i.e. level of cognitive and cultural similarities, social relations and shared understanding) ,and;
3. *Institutional trust* (i.e. implicit certificates and contractual agreements).

Trust has a direct influence on knowledge transfer, but commitment does not directly influence knowledge transfer. That is, even when the relationship between two firms is weak, a certain minimum level of knowledge transfer still occurs (Ramasamy *et al.*, 2006).

It is said that geographical distance between two actors can influence the knowledge transfer (Boschma, 2005). Knowledge transfer can occur when there is a large geographical distance, but more easily when there is no or less geographical distance.

Prior experience of both actors also influences the capability of both conveying knowledge through information and internalizing new knowledge (Albino *et al.*, 1999). That is, every individual has his/her own view on the world and, therefore, also on how one should transfer knowledge (Senge, 1994). The process of knowledge transfer depends on the knowledge previously owned by the receiving organization and its efficiency is influenced by the receiving firm's expertise with similar acquired knowledge (Albino *et al.*, 1999; Teece, 1977). When the knowledge item to be acquired is related to something, which is already known, the learning

performance increases clearly (Albino *et al.*, 1999; Cohen & Levinthal, 1990). This can be true for both the receiving and the source company.

The structure of an inter-organizational relationship also refers to the context in which knowledge transfer takes place, and the transfer mechanisms, which are established within that context (Easterby-Smith *et al.*, 2008). The next section elaborates the role of the context, wherein interaction takes place.

Figure 5, Actors

2.3.2 Context

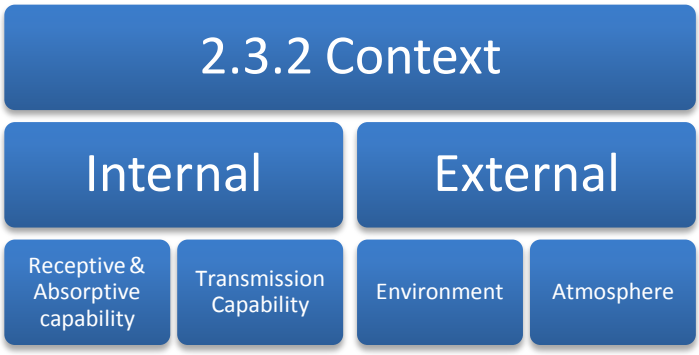
The second dimension in the knowledge transfer framework of Albino *et al.* (1999) refers to the *context* (Figure 6). Much attention has been given to the role of the context of the knowledge transfer process (Jensen & Szulanski, 2004; Lyles & Salk, 1996; Mowery, Oxely & Silverman, 1996; Almeida & Grant, 1998; Kostova, 1999, Simonin, 1999). Referring to organizations, it is possible to distinguish two kinds of contexts that influence knowledge transfer: the *internal* and the *external* context.

The internal context actually corresponds to the organizational culture and basically represents the set of behaviours, technical skills, resources and technology assets, attitudes and values belonging to and shared by the members of an organization. Albino *et al.* (1999) characterize it on the one hand by the receptive and absorbing capability of the learning organization. More specifically, Cohen & Levinthal (1990) explain that the firm's ability to recognize value of new external information, to assimilate it, and apply it to commercial ends is critical to its innovative capabilities. On the other hand, the internal context is characterized by the transmission capability of the organization (Albino *et al.*, 1999). The transmission capability refers to the ability of making tacit knowledge explicit, which is referred to as externalization by Takeuchi & Nonaka (1995).

The external context can be defined as a set of variables representing the conditions in which inter-firm relationships take place (Albino *et al.*, 1999). It influences the nature of the knowledge exchanged and is characterized by two dimensions*:* *environment* and *atmosphere*. The *environment* represents market characteristics in which organizations operate, such as market structure, its international scale, and the connected technologies. The *atmosphere* represents the combination of specific inter-organizational variables, such as cooperation, closeness, expectations and socio-cultural aspects.

The external context seems to have influence on several aspects of the internal context. For instance, if companies operate and cooperate in the same atmosphere, they tend to present similar culture (Albino *et al.*, 1999). Therefore, knowledge can be transferred more readily. The next section explains the role of the content.

Figure 6, Context



2.3.3 Content

The third dimension refers to the content (Figure 7). The content of the knowledge transfer on the one hand is the ability to perform a specific task distinguished by Albino *et al.* (1999) and content refers to the knowledge itself on the other hand.

Albino *et al.* (1999) assume that the knowledge transfer process is associated with a knowledge-related transfer task. The knowledge transfer is successful when the ability associated with the transferred knowledge is assimilated by the receiving actor. A distinction can be made between two types of content associated with the transferred knowledge: *Instrumental content* and *Cultural content* (Albino *et al.*, 1999).

The *instrumental content* is related to all knowledge necessary to do or to coordinate a job. The task associated to this knowledge concerns the individuals' ability, product and technology knowledge, technical operations, intra- and inter-organizational procedures and rules (Albino *et al.*, 1999).

The *cultural content* is associated with the knowledge capability of creating a specific organization's cognitive background. It includes organizational values and beliefs, individuals' cultural background and the 'language' used in the organization to communicate. During inter-firm knowledge transfer, it enables the creation of a common inter-organizational culture. Its task is to improve the understanding capability of the actors involved, for instance providing a common language, which increases the efficiency of communication (Albino *et al.*, 1999).

The knowledge content on the other hand also refers to the characteristics of knowledge itself. The content depends on the *diffusion* of knowledge and the nature of it (Boisot, 1998). The question is to what extent knowledge is codified, abstract – and therefore accessible to the target audience. Knowledge faces numerous barriers to its transfer from originator to user, and so it is relatively immobile.

The obstacles between knowledge sender and receiver are caused by knowledge attributes. This is referred to as knowledge ambiguity, which is caused by *tacitness* and *complexity* (Liao & Hu, 2007). Tacit knowledge cannot be described fully and articulable knowledge can be codified, which is also more easily to diffuse (Garud &

Nayyar, 1994). Transferring tacit knowledge would be more expensive across firm boundaries than within a firm (Martin & Salomon, 2003; Kogut & Zander, 1992). Furthermore, it is possible to describe simple knowledge with little information. In contrast, a larger amount of information is required to describe complex knowledge (Garud & Nayyar, 1994).

In addition, Steenhuis & De Bruijn (2004) identified that codified information is never completely accurate and explain that this depends upon the absolute and relative quality of information. The former is also called *reliability*, which on its turn depends on the *stability* of information. The latter is called *suitability* and depends on *ambiguity* and the *applicability* of information (Steenhuis & De Bruijn, 2004). The next section discusses the role of the media.

Figure 7, Content

2.3.4 Media

The fourth dimension (Figure 8) refers to media. This dimension is considered as every means useful for transferring data and information (Albino *et al.*, 1999). From a structural point of view, media are characterized by two elements: *code* and *channel*. The code is a particular representation of the information to be exchanged also discussed in the previous section. The channel is the means by which the code can be transferred. Important characteristics of the channel are the capability of immediate feedback, number and typology of items that can be used and the speed of processing (Albino *et al.*, 1999).

Two characteristics of media can be distinguished: *capacity* and *richness*. These characteristics can affect the efficiency and effectiveness of knowledge transfer. Media capacity can be defined as the ability of the media to process information, without noise or information lack and with transferred information redundancy (Albino *et al.*, 1999). Media richness is the capability of making the change of mental representations of actors. Media with high capacity are all those useful for processing information at a high quantitative and qualitative level. These media rely on the rules, forms, procedures and data bases, and use basically impersonal media sources, such as written and numeric documents, e-mail, telephone and fax (Albino *et al.*, 1999; Appleyard, 1996). Media characterized by a high level of richness are personal and involve face-to-face contact between actors.

Figure 8,Media

2.3.5 Research model

Considering literature review, the research model in this study is defined as follows. Knowledge transfer is characterized as an inter-firm communication and an intra-firm learning process (Figure 9). The knowledge source firm is regarded as a high-tech SME and the knowledge receiving firm is considered as a customer, whereby the role of sending and receiving knowledge may change during a project with a customer. Within these international relationships often knowledge exchange occurs, since high-tech SMEs work with young and complex technologies. High-tech SMEs need to know what their customers' needs are, whether their products and services fit with customers' needs, and how a new designed product needs to be produced.

High-tech companies exchange knowledge and information about their complicated technologies and related services with customers by different communication channels. Customers receive information and send it throughout their company. Customers respond to the high-tech SME as a result of interaction, and by explaining their current needs (Van Wijk *et al.*, 2008). High-tech SMEs receive knowledge and information and send it throughout their organization internally, which results into organizational learning and improvement of the overall organization performance of high-tech SMEs. In this study only high-tech SMEs will be investigated. It will be analysed how these companies have organized their knowledge transfer activities and which factors they think are important for knowledge transfer.

In the case of Micronit, knowledge transfer occurs as follows. First, the customer's needs are identified by sales engineers, which is a communication activity. Then, Micronit explains what Microfluidics is and what the technical capabilities are. During this introductory conversation, it is also identified whether the lab-on-a-chip product to be produced is:

(1) a standard prototype;

(2) has to be developed together with the customer for the next few years to come, or;

(3) whether many chips have to be manufactured according to specific customer's requirements.

So, knowledge is received from customers about the chip to be produced, and the characteristics of the chip and knowledge is sent towards customers about Micronit's technical capabilities and about Microfluidics.

This loop of interaction can take place a few times, before a project is defined. As a result of this exchange, the customer will set up a draft and send it towards Micronit, or the customer will ask some questions in order to

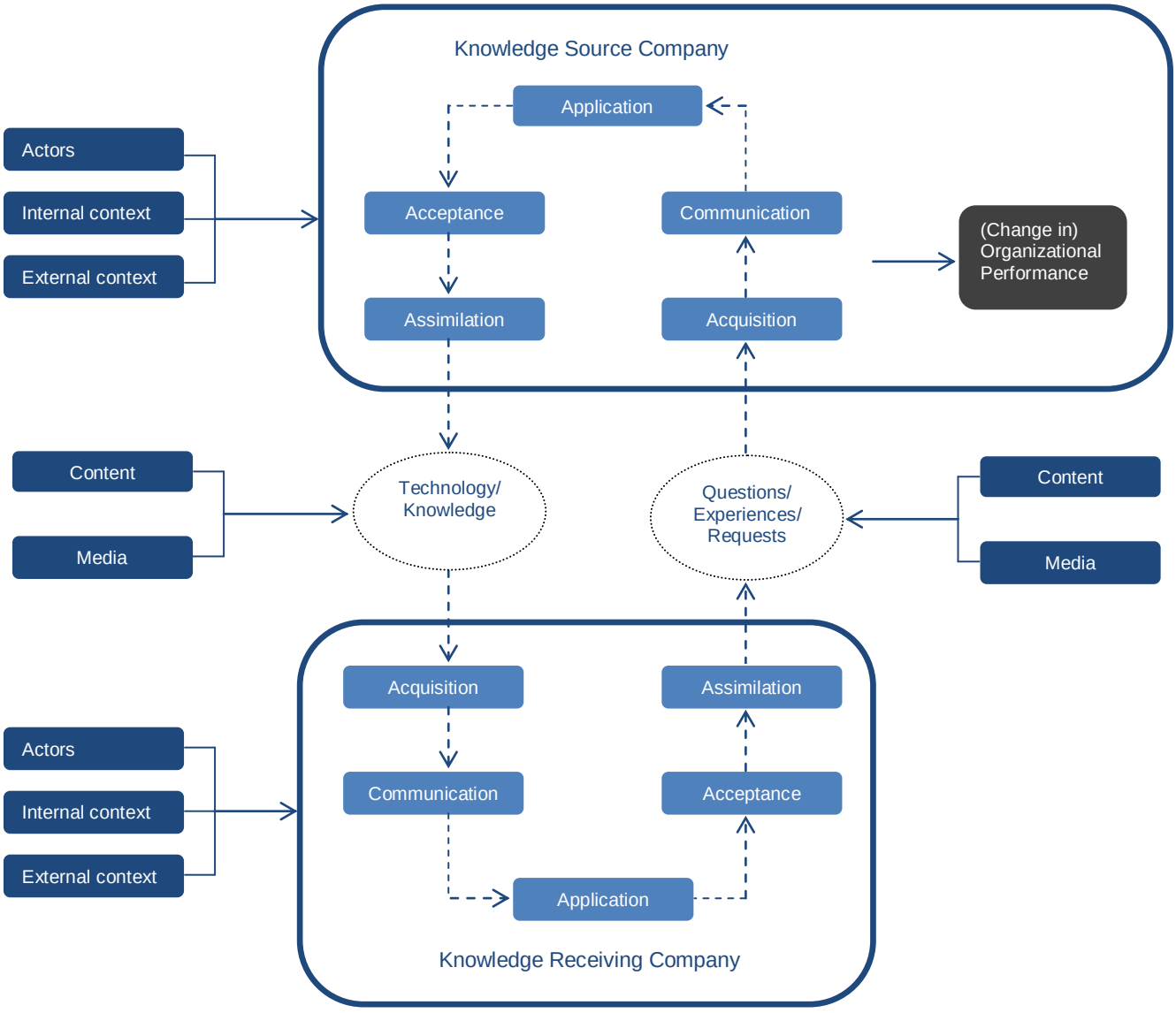
set up a draft. Micronit will produce and deliver the chip if it received a draft and when it is able to manufacture it. In that case, there is already a lab-on-a-chip that is developed by the customer, whereby fine-tuning takes place.

If the chip is not designed and developed by the customer yet, Micronit will, based on a request, design and develop the chip together with the customer. In that case, knowledge transfer occurs more intensively, because knowledge can be either created or existing knowledge can be exchanged in order to design and develop a new chip. Both wise, knowledge is exchanged about what exactly needs to be produced, and what the requirements and experiences are, since the lab-on-a-chip needs to fit with the application of the customer. The goal of knowledge transfer in this case is to manufacture and develop products for customers.

So, in both cases knowledge is transferred, whereas in the second scenario, new knowledge can be created together with the customer, and in the third scenario existing knowledge can be exchanged. In all cases, Micronit can learn from its customers. Even when the customer sends existing knowledge about a chip, Micronit may learn from that and apply the same knowledge for another customer in the same target segment.

"Influencing factors" "Knowledge transfer process"

Figure 9 Research model



3. Methodology

This chapter explains the methodology of this study, by describing the sample (3.1), semi-structured interviews (3.2) and data analysis (3.3).

3.1 Sample

The focus population of this study consists of internationally oriented high-tech SMEs situated in the Netherlands. Out of this population, a small sample of 19 high-tech SMEs is approached. The self-selection sampling technique is used, since there are no statistical inferences desired, it needs to be representative and no quota variables were available (Saunders *et al.*, 2009).

SMEs are selected based on the headcount (between 10 and 249 employees) and turnover (between EUR 2.000.000,- and EUR 50.000.000,-), which is defined by the European Commission (Verheugen, 2003). Since there is no broadly accepted definition for high-tech SMEs, the definition of OECD is partly adopted (Hytti, Heinonen & Oberholzner, 2002). According to them, a high-tech SME is a firm that has implemented technologically new or significantly technologically improved products or processes (OECD, 1997).

For the pre-test of the tentative model, four experts were asked for relevant cases. Although this sample may not be sufficient in size to result in findings that can be generalized to the population at large statistically, it is believed that this sample is sufficient in terms of providing findings that can be convincing or at least strongly indicative towards the theoretical assumptions adopted in this study.

3.2 Semi-structured interviews

This study is predominantly of an exploratory nature as it aims to explore which factors and processes are essential for knowledge transfer activities of internationally oriented high-tech SMEs. In line with the deductive approach and using the tentative research model, which is presented earlier, semi-structured interviews are conducted. Semi-structured interviews are likely to be used to reveal and understand the ‘what’ and ‘how’, and exploring the ‘why’ question (Saunders *et al.*, 2009).

This research design is chosen, because it can provide deeper understanding of the factors that influence the process of knowledge transfer for internationally oriented high-tech SMEs. It provides the opportunity to ‘probe’ answers, where interviewees are needed to explain, or build on, their responses (Saunders *et al.*, 2009). This means that several themes and the tentative model are presented and discussed, which is similar for most of the respondents. However, if needed and relevant, additional in-depth questions are raised and respondents are given space partly to answer to questions in the way they prefer (Saunders *et al.*, 2009).

Considering the work of Bohn (1994), a set of questions is formulated (Appendix A1). These questions should provide us insight into the importance of the knowledge transfer process and influencing factors, and the current and future knowledge level for each organization. Bohn (1994) acknowledges that knowledge growth can

be divided into eight stages: (1) Complete ignorance, (2) Awareness, (3) Measurement, (4) Control, (5) Process capability, (6) Process characterization, (7) Know why, and (8) Complete knowledge. The knowledge level of an actor with regard to the role of a key variable in a process determines to what extent one could control the process and its output (Bohn, 1994). A process can be influenced by multiple variables. That is, with a higher knowledge level, control of the variable and of the process can be increased (Bohn, 1994). Other scholars, such as Ricciardi, Barroso & Ermine (2005), and Alstete (2007) have worked with the framework of Bohn (1994) before.

First, open questions are asked about the respondent's view and experience with regard to the knowledge transfer process and surrounding factors. Next, the tentative model is checked by asking the respondent to review and provide comments on the model. Respondents are asked to describe their daily activities with regard to knowledge transfer with their customers internationally and with their colleagues internally. The semi-structured interviews consisted of several questions addressing:

1. Interviewees' general ideas about knowledge transfer activities of internationally oriented high-tech SMEs, how they deal with issues during knowledge transfer activities;
2. The current and future knowledge level on Bohn's (1994) knowledge growth scale;
3. The appropriateness and representativeness of the model and the essence of the underlying factors on a five-point Likert scale. This scale is used in order to indicate the level of importance per factor, and;
4. To what extent underlying factors need to be improved.

In sum, the tentative research model is reviewed by four experts specialized in the high-tech SME market (Appendix A1). Next, using feedback of the experts, semi-structured interviews among 19 individuals are conducted from different internationally oriented high-tech SMEs. Finally, eight employees of Micronit involved in knowledge transfer activities are interviewed, in order to gather data for the case of Micronit. For Micronit, the intra-firm knowledge transfer process and related bottlenecks are more elaborated compared to other cases.

3.3 Data analysis

The data are collected and analysed through *pattern matching*, which involves predicting a pattern of outcomes based on theoretical propositions to explain what we expect to find (Saunders *et al.*, 2009). The knowledge transfer process and factors are explored for high-tech SMEs by matching the pattern of the data with the tentative research model. Data are categorised based on the concepts derived from the research model (Figure 9). Based on the theoretical framework the analysis is categorized as follows. For all respondents the four dimensions and connected factors are analyzed, which include actors, context, content and media. Moreover, for Micronit the intra-firm knowledge transfer process is discussed thoroughly whereas for the high-tech SME group only the inter-firm knowledge transfer process is reviewed.

4. Findings

This chapter presents the results derived from the semi-structured interviews held among experts, managers of high-tech SMEs and employees at Micronit. First, the general view of the expert group (n=4), the managers of the high-tech SME group (n=19) and employees from Micronit (n=8) with regard to knowledge transfer is discussed (4.1). Second, current knowledge transfer activities and the knowledge level on Bohn's (1994) knowledge growth scale are elaborated (4.2). Subsequently, dimensions and underlying factors are reviewed (4.3), whereas for Micronit also internal bottlenecks are identified in chapter five. It is also discussed what factors are indicated to be improved by respondents (4.4). Finally, an overall conclusion is provided for internationally oriented high-tech SMEs (4.5) and for Micronit individually (5.3). The elaboration provides a valuable insight into what process is appropriate for internationally oriented high-tech SMEs and how Micronit could implement such a process.

4.1 Exploring the general opinion

Before the research model adopted in this study was introduced to respondents, they were asked to provide their general view with regard to knowledge transfer activities.

The expert group explained the essence and strategic importance of knowledge transfer activities for the organizational performance of internationally oriented high-tech SMEs. In order to provide valuable solutions to customers and to sustain the competitive advantage, experts stated that high-tech SMEs need to interact and exchange knowledge within their environment, and understand their customer's product and market intensively. The underlying idea is that high-tech SMEs need to create acceptance among their customers when providing customers with valuable solutions, whereby knowledge exchange is critical.

In addition, managers from the high-tech SME group acknowledged the importance and intensiveness of their international knowledge transfer activities within their overall international business operations. Respondents justified the intensive character of knowledge exchange with customers abroad and with employees internally in order to provide valuable and customized solutions. The intensive character of knowledge exchange is explained to be typical for internationally oriented high-tech SMEs, since they operate in knowledge intensive environments.

Employees at Micronit confirmed the importance and intensiveness of international knowledge transfer activities for their organizational performance. The case of Micronit could be considered as a situation wherein employees at Micronit face new and complex technological applications of customers, operating in new markets wherein intensive cooperation and knowledge exchange takes place. Micronit acquires complex knowledge and likewise sends complex knowledge about its technology and Microfluidic chips towards customers. For instance, Micronit needs to explore whether the chip is producible by acquiring knowledge from the customer in order to create a fit between the chip design and the customer's application.

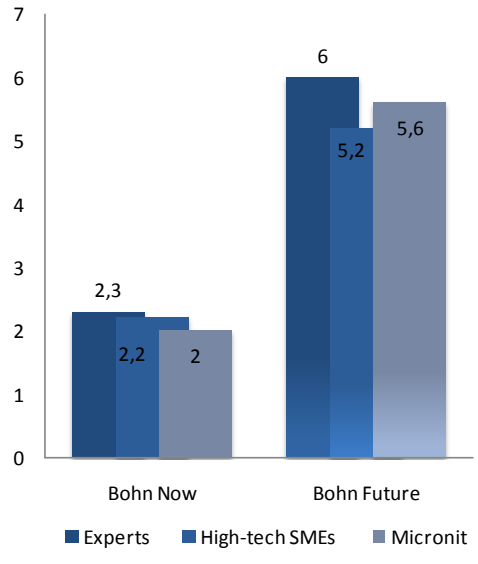
It could be concluded that all three groups underline the importance of knowledge transfer activities for the organizational performance of internationally oriented high-tech SMEs. However, the expert group emphasizes the interaction with the environment, whereas the other two groups underline the intensive interaction with customers during knowledge transfer activities.

4.2 Identifying current and future knowledge level

As all three groups confirmed the importance and intensiveness of knowledge transfer activities with customers internationally, they were asked to indicate the current and future knowledge level on Bohn's (1994) knowledge growth scale, see figure10. These results demonstrate how internationally oriented high-tech SMEs have organized their knowledge transfer activities currently and to what extent they would like to improve the knowledge transfer process.

The expert group indicated stage two as the current knowledge level of internationally oriented high-tech SMEs (*M* = 2.3 *SD* = 0.5) and the need to grow towards stage six (*M* = 6.0 *SD* = 1.4) in the future on Bohn's (1994) knowledge growth scale. The expert group clarified the awareness of internationally oriented high-tech SMEs of factors influencing knowledge transfer activities, without measuring factors explicitly as described by Bohn (1994). The expert group questioned the relevance for internationally oriented high-tech SMEs to explicitly measure factors influencing knowledge transfer activities. Respondents stated that internationally oriented high-tech SMEs have a lack of resources and feel the need to focus on core activities rather than optimizing management processes. The expert group, however, underlines the importance for high-tech SMEs to improve knowledge transfer activities in the future without measuring factors explicitly.

Figure 10, Bohn's (1994) knowledge growth scale



In line with the expert group, managers from the high-tech SME group underlined to be aware of factors influencing knowledge transfer activities. The respondents indicated stage two as the current level (*M* = 2.2 *SD* = 0.5) on Bohn's (1994) knowledge growth scale. Managers within the high-tech SME group acknowledged the ambition to improve the knowledge transfer process towards stage five (*M* = 5.2 *SD* = 1.3) on Bohn's (1994) knowledge growth scale in the future, whereas two respondents explained to remain at level two in the future. The underlying reason of these two respondents is that they seem to be satisfied with the current process of knowledge transfer. Furthermore, some respondents suggested that the firm's maturity level could be related to the knowledge stage of high-tech SMEs on Bohn's (1994) knowledge growth scale. These respondents

explained; the more mature a firm is, the higher the level one would reside on Bohn's (1994) knowledge growth scale. Also some respondents discussed whether it would be relevant to measure factors influencing knowledge transfer activities explicitly.

Employees at Micronit indicated stage two as the current level (M = 2.0 SD = 0.0) on Bohn's (1994) knowledge growth scale, since the organization seems to be aware of factors influencing knowledge transfer activities. Employees explained the ambition to improve the current knowledge transfer process towards stage six (M = 5.6 SD = 0.7) in the future. Respondents justified this ambition with the overall organizational ambition to increase both the turnover and number of employees. Similar to respondents in previously mentioned groups, employees at Micronit questioned the relevance to measure factors influencing international knowledge transfer activities explicitly, since it would not fit with the organizational activities.

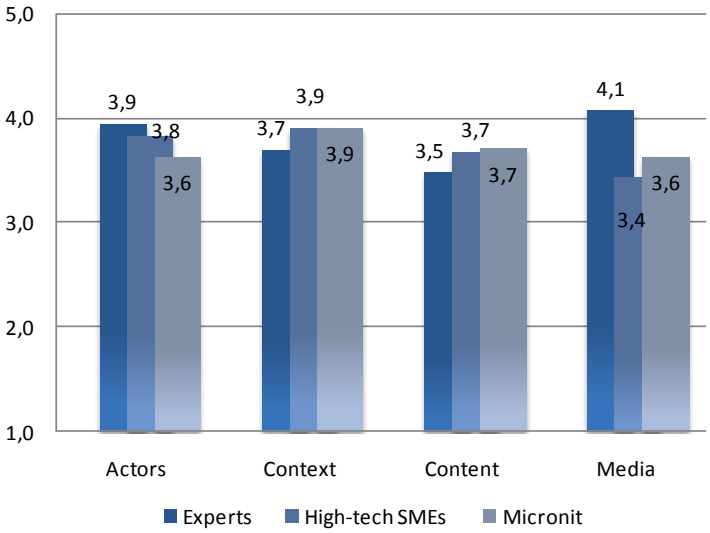
In conclusion, respondents indicated stage two as the current level on Bohn's (1994) knowledge growth scale. That is, respondents have acknowledged being aware of factors influencing knowledge transfer activities, without explicitly measuring influential factors. Bohn (1994) clarifies that variables in the first three stages are usually considered exogenous, in that it is impossible to control them. The underlying idea is that factors and knowledge about the factors influencing knowledge transfer activities are intangible, which make it difficult to manage and measure systematically (Bohn, 1994). However, influencing factors could be measured implicitly, characterized as passive, natural experiments to determine the relationship between a factor and the output (Bohn, 1994). Furthermore, respondents indicated their wish to improve their knowledge transfer activities towards a higher level on Bohn's (1994) knowledge growth scale. This confirms the relevance and importance for knowledge transfer activities to them. Although all respondents indicated the need to improve the process, a minor difference appears in this ambition. Employees at Micronit and the experts indicated stage six as a target, whereas the high-tech SME group indicated stage five as their ambition. The underlying reason is that some respondents within the high-tech SME group fear the consequences of a bureaucratic procedure for their organizational operations.

4.3 Influencing dimensions and underlying factors

After discussing the current knowledge transfer activities and the future ambition of internationally oriented high-tech SMEs, respondents were presented with the knowledge transfer model adopted in this thesis (figure 9). Respondents were asked to what extent the model was representative and appropriate for their knowledge transfer activities. Respondents acknowledged that the model adopted in this study is representative and appropriate for their cross-border knowledge transfer activities. Respondents were also asked to provide their ideas with respect to the importance of underlying factors for knowledge transfer activities. Participants were asked to review the factors within the dimensions on a five-point Likert scale (1 = not important – 5 = very important).

It is worth noting that the majority of the factors, and as a result, the dimensions illustrated in figure 11 are evaluated as above average important (≥ 3.7) for knowledge transfer activities of internationally oriented high-tech SMEs. This partly indicates the relevance of the framework, consisting of four overarching dimensions and underlying factors for knowledge transfer activities, suggested by Albino *et al.* (1999). That is, the actors involved in the knowledge transfer process, the context where the interaction takes place, the content transferred between actors, and the media by which the transfer is carried out (Albino *et al.*, 1999). However, there are some differences within some dimensions, primarily caused by differences in evaluations by respondents for the underlying factors. Since this study mainly concentrates on the influencing factors, rather than the overarching dimensions itself, the next subsections will elaborate these underlying factors.

Figure 11, overview of dimensions



In sum, all respondents indicated the research model in this study as representative and appropriate for their knowledge transfer activities. Furthermore, all dimensions are evaluated as above average important with a minor difference among the groups with regard to the media dimension. The expert group provides a relatively high evaluation for the media dimension compared to the other groups. The following subsections will discuss the importance of the underlying factors.

4.3.1 Actors dimension

Respondents were asked about the relevance of the factors within the actors dimension on a five-point scale, and their ideas with respect to these factors. Except for geographic distance, and prior experience by the expert group and high-tech SME group, other factors within the actors dimension are evaluated as above average important (≥ 3.8) for knowledge transfer activities illustrated in figure 12.

Figure 12, review of factors within the actors dimension

Actors dimension	Experts (n=4)		High-tech SMEs (n=19)		Micronit (n=8)	
	M	SD	M	SD	M	SD
Actors:	**3.9**	**0.9**	**3.8**	**1.0**	**3.6**	**1.1**
Openness	4.3	0.5	4.4	0.6	4.1	1.1
Trust	4.8	0.5	4.7	0.5	4.0	0.9
Geographic	3.3	0.5	2.6	0.8	2.6	0.7
Experience	3.5	1.3	3.5	0.6	3.8	0.9

Within the actors dimension, all groups believe that openness has a positive influence and an important role within knowledge transfer activities. The underlying reason is that respondents believe that a higher level of openness would improve transfer of

knowledge. Without openness, it is less easy to transfer knowledge since misinterpretations and different expectations could occur. Actors within an internationally oriented high-tech environment face new knowledge and technologies, whereby a high level of transparency and the willingness to collaborate improves knowledge transfer. Respondents indicate that an overall perceived level of openness improves the collaboration within an international product development project, which results into a more readily transfer of knowledge. This is also discussed in literature (Albino *et al.*, 1999). All groups, therefore, confirm that a higher level of openness improves the effectiveness of knowledge transfer. In fact, the high-tech SME group indicates that without openness, mutual trust will be low and knowledge transfer could take a long time. Although employees at Micronit evaluated openness as relatively important, some respondents within the group clarified that Micronit does not have to be open about patented or strategically important knowledge in order to do business internationally. However, respondents consider openness and trust as the starting point for an international business relationship, wherein knowledge transfer takes place.

Similar to the relevance of openness, respondents consider trust as essential for knowledge transfer. The expert group and high-tech SME group indicate that trust is even more important compared to openness. Trust increases the level of knowledge transfer and also the level of openness. The expert group explains that trust could be increased in long-term product development projects by being open about technological possibilities and limitations. According to the three groups more trust could improve knowledge transfer activities; whereas employees at Micronit explain that knowledge transfer could also occur if there is minimal trust between two actors. In that case, non-disclosure agreements are formulated. Trust and openness are explained to affect each other. More trust results into a higher level of openness, and a higher level of openness could increase the level of trust. Furthermore, respondents only indicated the role of two types of trust are important for knowledge transfer activities: characteristics-based trust and institutional trust.

Geographic distance is perceived as least important factor by all three groups, though evaluated relatively high by the expert group. The respondents from all groups explain that the larger the geographic distance, the less easy knowledge transfer occurs. However, information technology possibilities nowadays enable firms to cooperate over a large distance easily, whereby the geographical distance becomes a less important factor for knowledge transfer. The high-tech SME group confirms this idea, but indicates that the closer a customer is based near their organization, the better knowledge transfer would occur. The expert group assumes that a larger geographic distance could even affect openness and trust negatively. The cultural distance, which is related to the geographical distance, is assumed to be more important for knowledge transfer activities of internationally oriented high-tech organizations. Cultural differences could raise differences in interpretations, which could harm knowledge transfer.

All groups explained the importance of prior experience for knowledge transfer activities. If the receiving actor is familiar with the knowledge to be transferred, its transfer would occur more easily. Prior experience is

regarded as a moderator, rather than a required factor. Furthermore, one respondent discussed that prior experience of actors could also be different and biased, and in that case prior experience could affect knowledge transfer negatively.

In sum, all groups provide a comparable evaluation for the importance of the factors within the actors dimension. Openness and trust are evaluated as essential, whereas geographic distance is evaluated as least important factor because of the availability of different means. Furthermore, some respondents indicated the relation between trust and openness, whereby a high level of openness could affect the level of trust positively, and a high level of trust could affect the level of openness positively. Literature has described the direct and positive influence of trust on openness (Albino *et al*., 1999). Less is known about the role of openness on trust within cross-border knowledge transfer activities.

4.3.2 Context dimension

Respondents were asked about the relevance of the factors within the context dimension on a five-point scale, and their ideas with respect to these factors. Except for receptive and absorptive capability by the expert group, and environment by all groups, other factors within the context dimension are evaluated as above average important (≥ 3.8) for knowledge transfer activities, which is illustrated in figure 13.

Figure 13, review of factors within the context dimension

Context dimension	Experts (n=4)		High-tech SMEs (n=19)		Micronit (n=8)	
	M	SD	M	SD	M	SD
Context:	**3.7**	**0.5**	**3.9**	**0.9**	**3.9**	**0.8**
Receptive	3.5	0.6	4.3	0.8	4.5	0.5
Transmission	4.0	0.0	4.2	1.0	4.4	0.5
Environment	3.5	0.6	3.3	0.9	3.0	0.5
Atmosphere	3.8	0.5	3.9	0.7	3.8	0.7

With regard to the receptive and absorptive capability, the experts provide a slightly lower evaluation compared to other groups. The expert group, however, indicates the relevance of the receptive and absorptive capability for knowledge transfer activities. The same group suggests that one needs to listen, identify and absorb knowledge from customers with regard to their needs and products, so that internationally oriented high-tech SMEs can provide valuable solutions and transfer knowledge effectively. The high-tech SME group confirms this point of view. All groups explained the essence and positive influence of the receptive and absorptive capability on knowledge transfer. In addition, employees at Micronit perceive it as a requirement for transfer of knowledge.

All groups underlined the importance of transmission capability for knowledge transfer activities. The ability to make tacit knowledge explicit by codification is essential to transform customer needs into technological solutions. Moreover, the expert group suggests that the transmission capability is related to the receptive and absorptive capability of internationally oriented high-tech SMEs. The high-tech SME group explains that in order to transform customer's needs into technological solutions, high-tech SMEs need to receive, identify and absorb knowledge first.

Within the context dimension, overall the environment is evaluated as least important factor for knowledge transfer activities of internationally oriented high-tech SMEs. The expert group provides a relatively high evaluation for the environment compared to the employees at Micronit, since the experts believe that the market has a more dominant role in knowledge transfer compared to other groups. The international scale, for instance, could affect knowledge transfer negatively because of the geographical distance between high-tech SMEs and customers. In contrast to the expert group, employees at Micronit have an inside-out approach, whereby they explain that the market has little direct effect on knowledge transfer activities. The underlying reason is that environmental aspects are considered as abstract items, and difficult to manage compared to characteristics within the internal context. The expert group indicates that internationally oriented high-tech SMEs are technology-driven rather than market-driven, which could harm knowledge exchange and the deliverance of valuable solutions.

The atmosphere is quite similarly evaluated by the three groups. The majority of the respondents believed that cooperation, closeness, expectations and socio-cultural patterns are essential for knowledge transfer. The high-tech SME group confirms that similar expectations, a high level of closeness and cooperation, and similar socio-cultural patterns would affect knowledge transfer positively. Differences in socio-cultural patterns could affect knowledge transfer negatively, since different interpretations could be given to the knowledge to be transferred.

In conclusion, respondents show a comparable rating for the factors within the context dimension. Although the experts confirm the essence of the receptive and absorptive capability, they provide a relatively low evaluation compared to the other groups. Furthermore, the receptive, absorptive, and transmission capability are regarded as important and connected aspects, whereas the environment is evaluated as least important factor. The expert group provides a relatively higher evaluation for the environment compared to other groups, since they emphasize the role of the market for knowledge transfer.

4.3.3 Content dimension

Respondents were asked about the relevance of the factors within the content dimension on a five-point scale, and their ideas with respect to these factors. Except for instrumental content, codification, complexity and reliability by the expert group, diffusibility, complexity and reliability by employees at Micronit and abstraction by all groups, other factors within the content dimension are evaluated as above average important (≥ 3.6) for knowledge transfer activities illustrated in figure 14.

With regard to instrumental content, employees at Micronit characterized the factor as essential for knowledge transfer, whereas the high-tech SME group acknowledged the essence of the factor, and the expert group characterized instrumental content as an important factor. Employees at Micronit explained that all knowledge needed in order to coordinate a project or task is essential for the success of knowledge transfer.

Noise or lack of knowledge in performing a task could lead to misinterpretation and ineffective knowledge transfer. The high-tech SME group agrees with this point of view, whereas the expert group suggested that this type of knowledge could gradually increase during a project

or task.

Figure 14, review of factors within the content dimension

Content dimension	Experts (n=4)		High-tech SMEs (n=19)		Micronit (n=8)	
	M	SD	M	SD	M	SD
Content:	**3.5**	**0.7**	**3.7**	**0.8**	**3.7**	**0.8**
Instrumental	3.8	0.5	4.0	0.9	4.6	0.5
Cultural	4.3	0.5	3.7	0.7	3.9	0.6
Diffusible	3.8	0.5	3.6	1.0	3.4	0.5
Codification	3.0	0.8	3.7	0.7	3.6	0.9
Abstraction	3.3	1.0	3.4	0.6	3.3	0.7
Complexity	3.0	0.8	3.6	0.9	3.5	0.8
Reliability	3.5	0.6	3.7	0.9	3.4	1.1
Suitability	3.8	0.5	3.7	0.7	4.0	0.5

All groups indicated the cultural content as an important aspect for knowledge transfer activities, since insufficient understanding of the customer's organizational background could lead to misinterpretation easily. Creating shared understanding improves inter-organizational values and language, which prevents misinterpretation and increases a common goal (Albino *et al.*, 1999). By doing so, knowledge transfer occurs more readily. In addition, respondents within the expert group explained that the capability to understand the organizational background of the customer is crucial for knowledge transfer activities and, as a result, in order to provide valuable solutions. The expert group evaluates the cultural content as most important factor among other factors, whereas the high-tech SME group and employees at Micronit provide an above average evaluation.

The expert group and high-tech SME group have confirmed the importance of the diffusible feature of knowledge for knowledge transfer, whereas employees at Micronit clarified that not all knowledge needs to be diffusible. Only knowledge that is relevant for a project in a specific situation needs to be diffusible for the receiving actor.

Respondents within the high-tech SME group and employees at Micronit show a similar evaluation for codification, whereas the expert group provides a relatively low evaluation. The expert group clarified that a high level of codification could increase knowledge transfer activities and decrease the competitive advantage simultaneously. Therefore, experts favour a low level of codification, which also increases the risk of misinterpretation. All respondents, however, suggested codification could increase knowledge transfer, whereas the level of codification needs to be based on the customer's need.

With regard to abstraction, respondents among the groups indicate a quite similar review and acknowledge that customer's need is important for the level of abstraction. Some could prefer concrete knowledge, whereas others favour abstract knowledge. According to respondents the level of abstraction could therefore depend on the goal and context of knowledge transfer.

The high-tech SME group and employees at Micronit show a relatively high and comparable review for complexity compared to the expert group. The expert group clarified that complexity depends on knowledge level

and knowledge need of the receiving actor. The other groups confirmed and explained that the level of complexity could improve knowledge transfer if it corresponds with the knowledge level and knowledge need of the receiving actor.

Respondents provide a relatively high evaluation for the role of reliability for knowledge transfer activities. It is explained that knowledge and information needs to be applicable, unambiguous and stable over time, whereby respondents indicated that reliability could even affect the openness. The reliability improves knowledge transfer. Employees at Micronit agreed, and explained that knowledge and information also changes over time. However, if the receiving actor is being updated about essential changes, expectations could remain similar. The high-tech SME group and experts confirmed this idea.

All respondents confirmed the importance of suitable knowledge and information for knowledge transfer. However, several respondents within the high-tech SME group clarified that often unsuitable knowledge is sent towards customers, which does not harm the relationship and knowledge exchange. Overall, the more suitable knowledge is, the more effective its transfer is regarded to be.

In sum, the three groups show a similar evaluation for the factors within the content dimension. However, some differences appeared on factor level with regard to instrumental content, cultural content, diffusibility, codification, and complexity. Furthermore, semi-structured interviews provided interesting insight, whereby respondents assumed that the customer's need is partly a determinant for the level of codification and abstraction, whereas the knowledge level of actors is partly a determinant for the level of complexity within knowledge transfer activities of internationally oriented high-tech SMEs.

4.3.4 Media dimension

Respondents were asked about the relevance of the factors within the media dimension on a five-point scale, and their ideas with respect to these factors. Except for capacity by the high-tech SME group and employees at Micronit, and code and channel by the high-tech SME group, other factors within the media dimension are evaluated as above average important (≥ 3.7) for knowledge transfer activities (figure 15).

With regard to the code, all groups assumed the importance of the representation of information for knowledge transfer. The level of codification, abstraction and complexity partly determines the representation of information itself.

Figure 15, review of factors within the media dimension

Media dimension	Experts (n=4)		High-tech SMEs (n=19)		Micronit (n=8)	
	M	SD	M	SD	M	SD
Media:	**4.1**	**0.8**	**3.4**	**1.0**	**3.6**	**1.3**
Code	4.3	0.5	3.6	1.0	3.8	1.5
Channel	3.8	1.3	3.5	1.0	3.9	1.0
Capacity	3.8	0.5	2.7	0.8	2.6	1.3
Richness	4.5	0.6	3.8	0.8	4.3	0.7

All groups confirmed the role of the channel for knowledge transfer. The need for immediate feedback and type of channel, however, depends on the need of the receiving actor and the situation.

Some respondents assumed that the type of channel has a minor influence on knowledge transfer activities, since the code and the need for richness could determine the type of channel. Other respondents acknowledged the significant role of channel type for knowledge transfer regardless of other factors.

The media capacity is evaluated as relatively low by the high-tech SME group and employees at Micronit compared to other factors and compared to the expert group. The underlying reason is that these respondents assume that the quality of knowledge transfer is not influenced by media capacity. The capacity of a channel to transfer a minimum level of knowledge is considered as a requirement. However, Albino *et al.* (1999) discuss that media with high capacity enable to transfer knowledge at both qualitative and quantitative level.

Richness is evaluated relatively high by the expert group and employees at Micronit compared to the high-tech SME group. All groups, however, believe that richness is the most important factor within the media dimension. The underlying reason is that personal meetings improve knowledge transfer. A high level of richness is explained to reduce misinterpretation among actors.

In conclusion, the high-tech SME group and employees at Micronit provided a comparable rating for code and richness. Within the media dimension, richness is evaluated as most important factor, whereas media capacity is evaluated as least important. The underlying reason is that the high-tech SME group and employees at Micronit perceived capacity as the amount of information and knowledge to be transferred, rather than the capacity to prevent lack of information and to process a high quantity of knowledge at the same time.

4.4 Improving factors within knowledge transfer activities

Respondents were asked to indicate factors to be improved within knowledge transfer activities, by selecting a maximum of three factors out of the factors elaborated previously. The factors to be improved primarily reside within the context (receptive, transmission, environment and atmosphere) and partly within the content dimension (instrumental, cultural, abstraction, complexity), which is illustrated in figure 16.

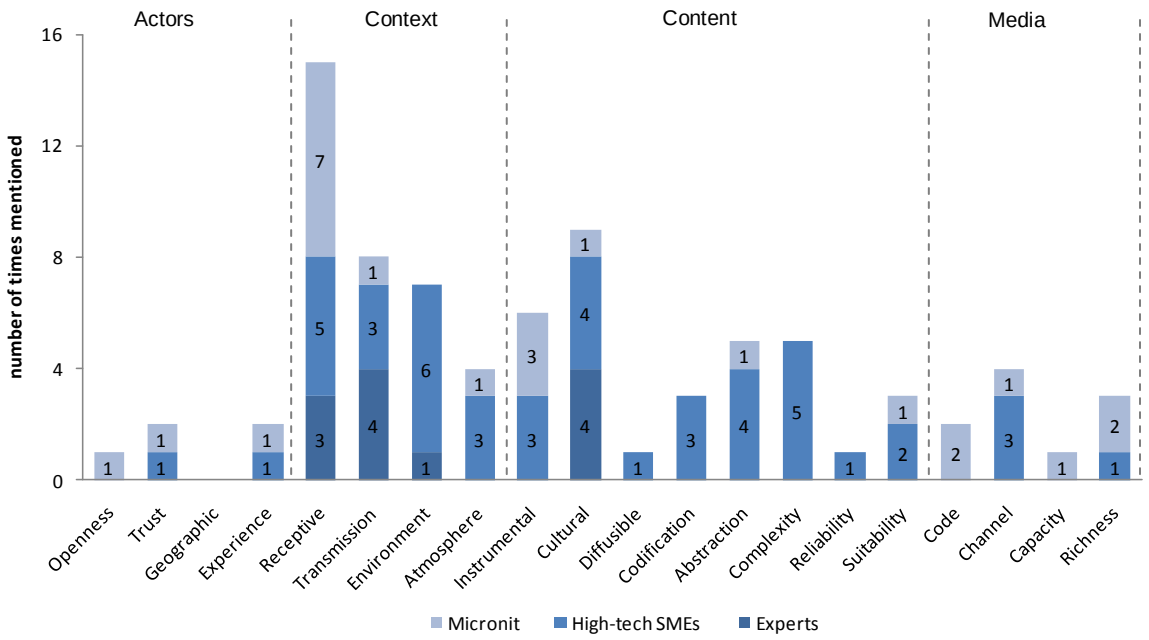
The expert group indicated different factors to be improved, such as receptive and absorptive capability, transmission capability and cultural content.

The high-tech SME group indicated the willingness to improve different factors such as receptive and absorptive capability, transmission capability, environment, atmosphere, instrumental content, cultural content, codification, abstraction, complexity and channel.

Employees at Micronit indicated the receptive and absorptive capability as an essential factor to be improved.

In sum, there is a strong need to improve the interface with the customer's organization which is the underlying idea of improving the receptive and absorptive capability, transmission capability, environment, atmosphere, instrumental content and cultural content. Since there is no defined level of codification within the majority of the firms, knowledge transfer occurs less effectively. However, in order to define the level of codification, abstraction and complexity, underlying aspects need to be defined, such as the knowledge need and knowledge level of the receiving actor, the thorough understanding of the context and organizational background of the customer.

Figure 16, improving factors



4.5 Conclusion

Now that the findings have been presented, a conclusion will be given in order to provide an answer to the first part of the main question in this thesis. The first part of the question is formulated as follows: What international knowledge transfer process is appropriate for internationally oriented high-tech SMEs? The answer to this question is threefold.

First, respondents acknowledged that the knowledge transfer model adopted in this study is representative and an appropriate process for their international knowledge transfer activities. Semi-structured interviews with respondents revealed that none of the internationally oriented high-tech SMEs had a well-defined process for knowledge transfer activities.

Second, high-tech SMEs indicated the need to adopt a process that would structure their knowledge transfer activities, since these organizations cope with knowledge intensive interactions with customers abroad about complex products and technologies. Respondents indicated the ambition to improve their knowledge transfer activities towards stage six on Bohn's (1994) knowledge growth scale. That is, the need to optimize current knowledge transfer activities so that it reduces costs and improves the quality of the process output (Bohn, 1994). In order to reach stage six, Bohn (1994) stresses the need to control factors through measurement. However,

respondents explained that the explicit measurement of factors has no fit with their organizational characteristics. Therefore, the improvement of factors and learning about factors that influence knowledge transfer activities has to occur through implicit measurement, such as by observation and asking for feedback.

Third, high-tech SMEs were asked to explain the role of different factors for knowledge transfer activities within an appropriate knowledge transfer process. Within the actors dimension, it is explained that a high level of openness, trust and prior experience leads to effective knowledge transfer. In fact, a high level of trust, openness and prior experience enables knowledge transfer more readily. In that way, acquisition and communication of knowledge becomes easier. The geographic distance has been characterized as less influential, since multiple communication means could be used nowadays. However, cultural differences associated with the geographic distance need to be considered. For instance, cultural differences could result in different perceptions with regard to openness and trust. Within the context dimension, high-tech SMEs discussed that receptive, absorptive capability and transmission capability are important factors for knowledge transfer activities within knowledge-intensive environments. Furthermore, a high level of firm cooperation, closeness, similar expectations and socio-cultural patterns would increase the effectiveness of knowledge transfer. In addition, the more features two actors share, the more readily knowledge transfers (Albino, *et al.*, 1999). Since, many cross-border activities of internationally oriented high-tech SMEs concern long-term projects, aspects such as closeness, similar expectations, firm cooperation, and understanding socio-cultural patterns are essential for knowledge transfer. Furthermore, environment is classified as a factor that indirectly affects knowledge transfer activities, since high-tech SMEs could not acknowledge the influence of the market structure on knowledge transfer. However, the international/national scale is believed to affect knowledge transfer activities, whereby cultural differences need to be considered for international knowledge transfer activities. Within the content dimension, respondents indicated that instrumental content, cultural content, a high level of codification, reliability, and suitability would be necessary for an appropriate knowledge transfer process. Within a high-tech environment, instrumental content is needed in order to perform a knowledge intensive task. Cultural content is needed in order to reach better understanding of the customer's organizational background, so that high-tech SMEs can provide valuable solutions. The reason is that every project with a customer is different, since the culture, language used within the customer's organization and individual's backgrounds could be different per organization. So, the interface with the customer's organization and the effectiveness of knowledge transfer, especially for high-tech SMEs, needs to be optimized by the cultural content. In addition, respondents acknowledged that a high level of suitability, reliability, and codification would result in effective knowledge transfer. A high level of codification would prevent misunderstandings due to misinterpretations. A high level of reliability is needed, since a continuous change of knowledge, would make it difficult for high-tech SMEs to provide valuable solutions. The same is true for suitability. Abstraction depends on the knowledge need, since some customers would prefer concrete knowledge whereas others would prefer an abstract presentation of knowledge. Complexity depends on the knowledge level,

whereby an engineer would appreciate a high level of complexity and a business manager with a non-technical background would appreciate a low level of complexity. The fit with the knowledge level enables effective knowledge transfer. Within the media dimension, code has to be defined clearly, whereby an appropriate channel needs to be chosen. Richness needs to be high, if one needs to transfer tacit knowledge. Capacity is explained to be less important for knowledge transfer. However, knowledge transfer needs to take place without noise or lack of information, whereby the role of media capacity becomes important. Capacity and richness depend on the code and type of channel (Albino *et al.*, 1999).

In conclusion, respondents acknowledged the knowledge transfer model as appropriate and the majority of the factors presented in this thesis as relevant to their knowledge transfer activities. Considering the role of factors, characteristics of cross-border activities of high-tech SMEs and the ambition to improve knowledge transfer activities, the findings have provided insight into an appropriate process for knowledge transfer activities of internationally oriented high-tech SMEs.

5. The case of Micronit

This chapter presents the case of Micronit, which will provide a valuable insight into importance of knowledge transfer activities for Micronit (5.1), and identification of bottlenecks within the knowledge transfer process of Micronit (5.2). Finally, Micronit is advised how to implement a knowledge transfer process (5.3).

5.1 Applying the model

In order to provide an answer to the research question, first the appropriateness of the knowledge transfer model, Bohn's (1994) knowledge growth scale, and review of factors will be discussed for Micronit.

First, similarly to the high-tech SME group, semi-structured interviews with employees at Micronit revealed that there is no existing structure or well defined process for knowledge transfer activities. Respondents acknowledged that the knowledge transfer model adopted in this study is representative and an appropriate process for the organization of international knowledge transfer activities.

Second, employees at Micronit indicated their need to adopt a process that would structure their knowledge transfer activities, in order to improve knowledge intensive interactions with customers abroad about complex products and technologies. In line with the high-tech SME group, employees at Micronit indicated to be aware of factors influencing knowledge transfer activities. Respondents indicated the need to reach stage six on Bohn's (1994) knowledge growth scale, without explicitly measuring these factors. That is, decreasing the costs and increasing the quality of the output of knowledge transfer (Bohn, 1994). Employees at Micronit prefer to improve the process by identification of bottlenecks, and feedback from colleagues and customers with regard to elements within the knowledge transfer process.

Third, employees at Micronit were asked to explain the role of different factors for knowledge transfer activities within an appropriate knowledge transfer process. Within the actors dimension, it is explained that a high level of openness, trust, and prior experience leads to effective knowledge transfer. Micronit often has intensive business relationships during long-term projects with customers abroad, whereby openness, trust and experience are key aspects to the success of knowledge transfer. However, one does not have to be open about its strategic knowledge. Therefore, often non-disclosure agreements are formulated within a project. Geographic distance is considered as less important for knowledge transfer, since various means could be used for the transfer of knowledge, such as teleconferences, videoconferences, online presentations, screen sharing or email exchange. Within the context dimension, the capability to receive and absorb knowledge is essential for knowledge transfer, since Micronit serves different types of customers in different markets. Complex and unknown knowledge needs to be acquired from the customer in order to provide a valuable solution, and complex tacit knowledge needs to be transformed into explicit solutions. By doing so, knowledge transfer towards customers becomes more effective and suitable. Knowledge also needs to be absorbed, so that it could be re-used within other projects,

which results into efficient knowledge transfer and solution delivery. Transmission capability is considered as important for knowledge transfer. The underlying idea is that it enables employees to make tacit knowledge explicit, and therefore to provide valuable solutions to customers. Employees at Micronit perceive environment as moderate important, because of its minor influences. However, the market non-transparency is considered as a major issue, both for knowledge transfer activities and for strategic business planning. Atmosphere is essential for knowledge transfer activities at Micronit, since long-term projects require a high level of closeness, firm cooperation, management of expectations and the understanding of socio-cultural patterns. Within the content dimension, instrumental content is considered as essential for knowledge transfer. All actors involved within a project need to understand and possess the required knowledge in order to provide the customer with solutions. Cultural content is indicated as an important factor for knowledge transfer, since the understanding of the organizational background and structure of the customer enables to transfer knowledge efficiently and effectively. For instance, within a specific project employees need to acquire as much as organizational background information in order to provide specific knowledge and solutions. In addition, the more features actors share, the more readily knowledge is transferred (Albino *et al.*, 1999). Employees at Micronit underlined that a high level of codification and suitability is needed for effective knowledge transfer. The reason is that both customers and Micronit could be unfamiliar with the knowledge received. In order to prevent misinterpretations, knowledge needs to be codified and confirmed by the actors involved within a project. Abstraction and reliability are both considered as important aspects for knowledge transfer, since abstraction depends on the knowledge need and since knowledge and information changes over time. However, it is more important to consider the knowledge need and to update customers when knowledge or information changes. This could prevent misunderstanding or dissatisfaction among actors. Complexity is regarded as important for knowledge transfer, since it could create misinterpretation. Complexity of knowledge needs to fit with the knowledge level of the receiving actor. For instance, a highly educated person with a technical background could understand complex technical knowledge, whereas a general manager with a non-technical background prefers a low level of complexity. Within the media dimension, code and channel are considered as important factors for knowledge transfer. Employees explain that a specific message and characteristics of a channel determines whether transfer of knowledge is effective. Tacit knowledge could be transferred more easily through a personal conversations compared to email exchange. Capacity is considered as less important, since employees explain that media capacity does no directly affect knowledge transfer. However, the amount of knowledge sent per interaction needs to be considered, so that overcapacity is prevented. Richness is considered as an important aspect for knowledge transfer, since the ability to make a change within the customer's perception is important for the efficiency of knowledge transfer. Within large and complex projects, it is often preferred to meet each other personally.

In sum, employees at Micronit acknowledged the appropriateness of the knowledge transfer model, whereby they indicated to be aware of factors that influence knowledge transfer and their wish to improve knowledge

transfer activities. Furthermore, employees at Micronit indicated the role of the factors within an appropriate knowledge transfer process.

5.2 Identification of bottlenecks

Employees at Micronit were asked to indicate bottlenecks within knowledge transfer activities. Respondents indicated that bottlenecks exist over four different stages within the knowledge transfer process.

First, knowledge acquired from customers is not stored and assimilated, which result into an inefficient procedure. There is a lack of a structured and organized knowledge absorption mechanism within the organization. In order to be a learning organization and to effectively transfer knowledge, knowledge needs to be stored structurally so that it could be re-used in a specific situation.

Second, communication of knowledge occurs inefficiently and ineffectively since knowledge is not codified. An employee could move through the knowledge transfer process several times, before a suitable product is designed. The underlying reason is that a low level of codification could increase misinterpretation, lack of information or noise during knowledge transfer activities. A higher level of codification of subjective and objective information and knowledge could improve both internal communication and external communication. By doing so, noise, lack of information and misinterpretation of knowledge is prevented (Albino *et al.*, 1999).

Third, there is often a lack of uniformity and misinterpretation among actors during knowledge transfer activities, which harm the level of acceptance. A low level of acceptance and shared values might decrease the speed and quality of knowledge transfer. If there is no acceptance, an actor could either move back in the process by acquiring more detailed knowledge or discuss the possibilities with other actors in order to create acceptance.

Fourth, customers and employees at Micronit often have a low knowledge level of each other's application and technology, which harms the knowledge acquisition. This is primarily caused by market non-transparency and complex technologies.

In sum, Micronit faces different bottlenecks regarding the stages within the knowledge transfer process: acquisition, communication, acceptance and assimilation.

5.3 Conclusion

This section provides an answer to the second part of the research question in this thesis by considering the findings in chapter four, and the application of the model and identification of bottlenecks discussed in chapter five. The second part of the research question is formulated as follows: How can Micronit implement such a process? The answer to the question is twofold.

First, semi-structured interviews with employees at Micronit have identified inefficient knowledge transfer activities. This is primarily caused by inefficient coding and encoding of knowledge and information, which on its turn affects transmission, reception and interpretation negatively (Shannon, 1998). In fact, if encoding and coding

occurs inaccurately or inefficiently, it could have a negative influence on subsequent stages within the knowledge transfer process, which eventually could harm the solutions provided by Micronit. The codification of knowledge and information enables Micronit to efficiently transfer knowledge both externally and internally. The underlying reason is that it improves the acquisition of knowledge, since misinterpretations are prevented. In addition, codification of knowledge enforces employees to think about additional (subjective) questions to be asked during the acquisition stage. Codification improves the communication, since misinterpretation and misunderstanding will be prevented due to the sharing of values and codes (Boisot, 1998). Therefore, application of knowledge will occur accurately, since knowledge received from customers is codified and confirmed by different actors within the process. Acceptance could be improved by codification, since codes could be shared and a shared view among employees is created (Senge, 1994). If codes cannot be shared because of misinterpretation of tacit knowledge, acceptance would occur less readily. Codification of knowledge improves assimilation and storage of knowledge, since knowledge is structured, and could be classified and stored easily due to its codification. That is, organizational learning and as a result, innovativeness would be improved by sufficient coding and encoding activities of knowledge and information.

Second, in order to implement the process within the organization, tasks have to be defined, communicated and related to every stage within the process. From an operational point of view, different documents could be created and attached to every stage within the process and connected tasks, so that employees know what to do at a specific stage within the process. Within these documents, it could be formulated what knowledge and information is needed before it could be forwarded to another colleague in a subsequent stage within the process. For instance, a sales engineer needs to identify, receive both subjective and objective criteria of the chip to be designed, so that it could be communicated with a project leader during a kick off meeting. That is, tasks and roles of employees at every stage within the knowledge transfer process need to be defined and communicated with all actors involved. If all employees have an overview of tasks and activities, they could anticipate on specific events and acceptance could occur more readily. The overview of tasks and activities also enables the management to control the quality of the knowledge transfer process.

In sum, employees at Micronit have acknowledged the knowledge transfer model and the majority of the factors presented in this thesis as relevant to their knowledge transfer activities. Employees indicated to be aware of factors that influence knowledge transfer activities, and suggested the need to improve knowledge transfer activities in the future. The recommendation for Micronit is based on the analysis of knowledge transfer activities and identification of bottlenecks within the acquisition, communication, acceptance and assimilation stage. Micronit is recommended to improve the knowledge transfer activities by implementing a knowledge transfer process. That is, improving and implementing coding, encoding activities, and formalization of tasks and stages related to knowledge transfer activities.

6. Conclusions and recommendations

This chapter provides an overview of conclusions and recommendations. Section 6.1 provides a discussion and an answer to the main research question. Furthermore, reflections are provided with regard to the results and objectives, research process and limitations of this study (6.2). Finally, recommendations are given to future researchers and internationally oriented high-tech SMEs (6.3).

6.1 Conclusions

This section will give a discussion and an overall conclusion of the thesis. First, a discussion is provided, followed by an overall conclusion.

Discussion. From a theoretical point of view, it could be concluded that the results confirm the importance of the majority of all influencing factors. However, there are some differences to be discussed. For instance, geographic distance and media capacity are considered as less influential factors compared to other factors and what scholars have studied before. Media capacity is considered as the quantity of knowledge and information to be transferred rather than the quality. Albino *et al.* (1999), however, indicate that media with high capacity enable to transfer knowledge at both qualitative and quantitative level. The underlying reason for the relevance of geographic distance is that high-tech SMEs emphasize the availability of different means to exchange knowledge. Respondents, however, acknowledged that the shorter the distance, the easier knowledge transfers. Boschma (2005) explains that a large distance makes it difficult to transfer tacit knowledge. This may even be true for codified knowledge, because its interpretation and assimilation may still require tacit knowledge and, thus, spatial closeness (Boschma, 2005). High-tech SMEs, however, explained that only in urgent or important situations, customers are visited abroad. This may be caused by a low resource commitment, and short-term orientation (Burgel & Murray, 2000; Moen & Servais, 1992; Rothwell, 1991). In fact, Boschma (2005) explains that geographic proximity enables interactive learning, which is relevant to internationally oriented high-tech SMEs collaborating in long-term development projects. Furthermore, some respondents assumed the role of culture on the interpretation of several factors such as openness, trust and prior experience, suggesting that culture affects the efficiency of knowledge transfer. Much attention has been given to the role of different types of cultures on business and individual behaviour (Leung, Baghat, Buchan, Erez & Gibson, 2005). However, to a lesser extent attention is given to the role of culture on openness and trust within knowledge transfer activities and organizational learning. The underlying idea is that different cultures could have different perceptions with regard to the role of openness and trust in business relationships, wherein knowledge exchange takes place. These differences could harm the effectiveness of knowledge transfer. Furthermore, some respondents explained; the more mature a firm is, the higher the level one would reside on Bohn's (1994) knowledge growth scale. In that case, one could discuss what factors and interventions could be more essential for a specific firm's maturity level.

Semi-structured interviews also revealed that respondents assumed the influence of openness on trust, and the influence of trust on openness. Albino *et al.* (1999) have acknowledged the influence of trust on openness and characterize it as a fundamental factor within a business relationship. However, the direct role of openness on trust has not been studied for knowledge transfer activities. Furthermore, one respondent explained that prior experience could also harm knowledge transfer, since one could have a different and biased perception compared to another actor with less prior experience. So, there could be an indication that prior experience could also affect knowledge transfer negatively. Albino *et al.* (1995) underline prior experience as the capability of both conveying knowledge through information and internalizing new knowledge. Knowledge owned by an actor and its connections affect the effectiveness with which new information can be acquired, used and transferred (Albino *et al.*, 1999). The question is to what extent knowledge transfer is effective, if the actor with prior experience differs in point of view due to that experience.

Conclusion. Respondents have acknowledged the relevance of knowledge transfer activities for the organizational performance of internationally oriented high-tech SMEs and the awareness of several factors affecting knowledge transfer. Results indicated the need to improve knowledge transfer activities, however, without the explicit measurement of influencing factors. Experts, high-tech SMEs and employees at Micronit have confirmed the relevance of the knowledge transfer model designed in this study and its appropriateness for their knowledge transfer activities. Except for geographical distance and media capacity, the majority of all factors is evaluated as relevant for knowledge transfer activities. Internationally oriented high-tech SMEs are provided with an appropriate knowledge transfer process. Micronit is recommended how to implement such a process. The recommendation for Micronit is based on the analysis of knowledge transfer activities and identification of bottlenecks within the acquisition, communication, acceptance and assimilation stage of the knowledge transfer process. Micronit is recommended to improve the knowledge transfer activities by implementing a knowledge transfer process. That is, improving coding, encoding activities, and formalization of tasks and stages within knowledge transfer.

6.2 Reflections

This section provides an overview of reflections for this study. First, reflections will be given on the results versus the research objectives. Second, reflections will be given on the research process and eventually on the research limitations.

Results versus objectives. The objectives of this study were twofold. First, to identify factors and processes that facilitate knowledge transfer activities of internationally oriented high-tech SMEs, resulting in a tentative model. The objective was to provide and design an appropriate model for knowledge transfer activities of internationally oriented high-tech SMEs. Second, the objective was to advise Micronit how to organize international knowledge transfer activities. The underlying idea is that both from a theoretical perspective and

practical perspective, there was no existing knowledge transfer model for inter-firm activities of internationally oriented high-tech SMEs. This study provided a knowledge transfer model, which is representative and relevant for knowledge transfer activities of internationally oriented high-tech SMEs. It provided insight how internationally oriented high-tech SMEs could manage such a process and to what extent knowledge transfer activities could be improved. The results provided insight into the role and underlying idea of influencing factors within knowledge transfer activities of internationally oriented high-tech SMEs. However, this study did not investigate the influence of cultural and language differences on knowledge transfer thoroughly. This study did also not investigate the direct role of knowledge transfer on the organizational performance. However, theoretical assumptions were made in order to clarify the role of knowledge transfer activities on the organizational performance.

Research process. Several reflections could be given with regard to the research process. First, respondents were asked to indicate the knowledge level with regard to the overall process on Bohn's (1994) knowledge growth scale. However, Bohn (1994) explains that also the knowledge level of factors needs to be measured individually. By doing so, one could assign the knowledge level per factor and, thus, the output of the process more accurately. Second, respondents were asked to what extent the knowledge transfer model was representative and appropriate for knowledge transfer activities within their firm. However, this was only an indication and not tested in practice. In order to confirm the appropriateness of the knowledge transfer model practically, respondents could have been asked to implement a pilot. After the implementation, respondents could have been asked to indicate whether knowledge transfer activities have been improved clearly by the structure and role of factors. The evaluation of a pilot would provide more understanding into what the results and difficulties are of implementing a knowledge transfer process within the organization of internationally oriented high-tech SMEs. Furthermore, this study explored how internationally oriented high-tech SMEs organize their knowledge transfer activities, and which factors influence this process. Since some similarities and differences are identified among the respondents with regard to the evaluation of knowledge transfer activities, future researchers could use a survey in order to confirm or reject the similarities and differences more specifically.

Research model. Several comments could be provided on the research model adopted in this study. First, semi-structured interviews revealed that some factors could have overlap in meaning. For instance, geographic distance is comparable to the international scale within the environment factor. Geographic distance could be considered as an external factor rather than a personal factor as categorized currently. Second, cultural difference has not been included as an individual factor, but as an integrative underlying aspect. It would be useful to add cultural difference as an independent factor. Third, respondents indicated knowledge level and knowledge need as important underlying aspects for knowledge transfer activities.

Limitations. This study has a number of limitations. First, international knowledge transfer activities are only studied for internationally oriented high-tech SMEs, where knowledge transfer primarily involves interaction between two or more actors. For instance, knowledge transfer is not efficient if it is organized efficiently within the

organization of the internationally oriented high-tech SME and inefficiently within the customer's organization. A balanced interface between the actors improves knowledge transfer. Second, in this study no distinction was made between the types of company, type of collaboration, and whether it delivers services or produces products. This could affect the intensiveness of knowledge transfer. Furthermore, no distinction was made between market types and firm maturity. For instance, an internationally oriented high-tech SME of 235 employees could organize the knowledge transfer activities differently compared to a high-tech SME with 45 employees. Third, the direct relationship between the knowledge transfer process and the organizational performance has not been studied, but theoretical assumptions have been made and respondents have indicated the importance of knowledge transfer for the overall organizational performance.

6.3 Recommendations

This section gives recommendations for future research and for practice. First recommendations for research are provided, followed by recommendations for practice.

Recommendation for research. As this study aimed to explore and design an appropriate model, future research could investigate the direct influence of knowledge transfer activities on specific organizational performance indicators. These could be qualitative indicators such as, improvement of employees' skills, improving quality strategies, improving core business processes, developing customer relationships and developing supplier relationships (Chen & Chen, 2006). These could also be quantitative indicators such as, decreasing operation costs, decreasing product cycle time, increasing productivity, increasing market share, increasing shareholder equity and increasing patent income (Chen & Chen, 2006). Furthermore, future research could investigate knowledge transfer activities both from a receiving and source point of view. In addition, the role of the interface between the receiving and source actor during knowledge transfer could be explored. By doing so, researchers could identify whether a similar organization of knowledge transfer results into a more efficient and effective knowledge transfer compared to differences among the receiving and source actor. Future researchers could also emphasize the explicit role of cultural difference on the effectiveness and efficiency of knowledge transfer, and thus the organizational performance.

Recommendation for practice. Internationally oriented high-tech SMEs and Micronit are provided with a model how to structure knowledge transfer activities. However, in order to improve the process continually, high-tech SMEs are recommended to openly discuss the role of factors with actors involved within the process. That is, all employees involved within knowledge transfer activities need to be aware of factors influencing knowledge transfer activities. High-tech SMEs are also recommended to search for a fit between the model proposed in this study and current business processes within the organization, and to continually strive for improving the model adopted in this study.

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Appendices

A1 Interview protocols

First, open questions are asked about the respondent's view and experience with regard to the knowledge transfer process and surrounding factors. Next, the tentative model is checked by asking the respondent to provide comments on the model and to indicate to what extent the model is appropriate.

A1.1 Expert interviews

Introduction: *Many internationally oriented high-tech SMEs have relations outside their home country. Within these international relationships often knowledge exchange and knowledge sharing occurs. This study tries to create understanding of how such a process could look like. Based on your expertise with internationally oriented high-tech SMEs, I would like to ask you some questions.*

1. How do you think that such a knowledge transfer process looks like for internationally oriented high-tech SMEs and could you provide your general view?
2. Which issues are internationally oriented high-tech SMEs possibly dealing with during such a process?
3. Could you indicate current and future knowledge level of factors influencing knowledge transfer activities on Bohn's (1994) knowledge growth scale? To what extent do you believe high-tech SMEs are managing knowledge transfer well with their current knowledge level of the influencing factors?

Based on previous literature within the knowledge transfer domain and the international business domain a tentative research model is formulated. I would like to ask you some questions about this model.

1. Could you provide me your first ideas about this model with regard to the representativeness and appropriateness?
2. To what extent do you believe factor (x, y, z) is important for knowledge transfer and why? Could you also give your opinion on a five-point scale (1 = not important, ..., ..., ..., 5 = very important)? To what extent do you believe that more of factor (x, y, z) will lead to better knowledge transfer? What factors need to be improved?

A1.2 Interviews among internationally oriented high-tech SMEs

Introduction: *Many internationally oriented high-tech SMEs have relations outside their home country. Within these international relationships often knowledge exchange and knowledge sharing occurs. This study tries to create understanding how such a process could look like. Based on your international expertise within this company, I would like to ask you some questions.*

1. How do you think that such a knowledge transfer process looks like for your organization and could you provide your general view?
2. Which issues is your organization dealing with during such a process?
3. Could you indicate your organization's current and future knowledge level of factors influencing knowledge transfer activities on Bohn's (1994) knowledge growth scale? To what extent do you believe that your organization is managing knowledge transfer well with the current knowledge level of the influencing factors?

Based on previous literature within the knowledge transfer domain and the international business domain a tentative research model is formulated. I would like to ask you some questions about this model.

1. Could you provide me your first ideas about this model with regard to the representativeness and appropriateness?
2. To what extent do you believe factor (x, y, z) is important for knowledge transfer and why? Could you also give your opinion on a five-point scale (1 = not important, ..., ..., ..., 5 = very important)? To what extent do you believe that more of factor (x, y, z) will lead to better knowledge transfer? What factors need to be improved?

A.1.2.1 General check

1. Could you confirm whether your company is an internationally oriented high-tech SME (according to the definition of OECD)?

A.1.2.2 Questions regarding the factors influencing knowledge transfer on a five-point scale and why that factor is important or not (second part of the interview)

Actors

1. Openness: To what extent do you believe openness is important for knowledge transfer?
2. Trust: To what extent do you believe trust is important for knowledge transfer?
3. Geographic distance: To what extent do you believe geographic distance is important for knowledge transfer?
4. Prior experience: To what extent do you believe prior experience is important for knowledge transfer?

Context

1. Receptive & Absorptive capacity: To what extent do you believe receptive and absorptive capacity is important for knowledge transfer?
2. Transmission capability: To what extent do you believe transmission capability is important for knowledge transfer?

3. Environment: To what extent do you believe the environment is important for knowledge transfer?
4. Atmosphere: To what extent do you believe the atmosphere is important for knowledge transfer??

Content

1. Instrumental: To what extent do you believe instrumental content is important for knowledge transfer??
2. Cultural: To what extent do you believe cultural content is important for knowledge transfer?
3. Codification: To what extent do you believe level of codification is important for knowledge transfer?
4. Reliability: To what extent do you believe reliability is important for knowledge transfer?
5. Suitable: To what extent do you believe suitability is important for knowledge transfer?
6. Abstraction: To what extent do you believe level of abstraction is important for knowledge transfer?
7. Complexity: To what extent do you believe level of complexity is important for knowledge transfer?

Media

1. Code: To what extent do you believe the code is important for knowledge transfer?
2. Channel: To what extent do you believe channel is important for knowledge transfer?
3. Capacity: To what extent do you believe media capacity is important for knowledge transfer?
4. Richness: To what extent do you believe information richness n is important for knowledge transfer?

Overall

1. What is the most important dimension in your view, and why?
2. What are three most important factors for knowledge transfer?
3. Which three factors should your company pay more attention to and how? How can you learn in order to increase your knowledge about factors influencing knowledge transfer?
4. What are the threats and opportunities of such a knowledge transfer model?
5. Do you have any other recommendations or remarks?