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Datum: 14.12.2009

Globalization of R&D as a driver for Open Innovation

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promotor :
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Eindverhandeling voorgedragen tot het bekomen van de graad
master in de toegepaste economische wetenschappen:
handelsingenieur technologie-, innovatie- en milieumanagement

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Foreword

This master thesis is the culmination of our studies of Applied Economics – Business Engineering at the University of Hasselt. It was our final chance to gain more in-depth knowledge about a business related subject. We chose open innovation as the subject of our thesis. Since innovation is one of the key drivers of economic growth, we were immediately attracted to this subject. The international dimension that this topic has is of special interest to us.

The realization of this master thesis required a lot of effort and dedication not only from the authors of this master thesis, but also from everyone near to them. Therefore we would like to say a few words of thanks to all the people who gave us the support we needed to finish our thesis.

A special thank you goes to our promoter Prof. Dr. Wim Vanhaverbeke, whose advice, patience, motivation and constructive feedback, helped to raise the standard of the thesis to its present level. Also the support we got from each other in the course of writing this thesis together, helped us on the one hand to stay focused and motivated, and on the other hand to provide the needed distraction when the going was rough.

We are also indebted to our friends, family and girlfriends for their unflagging moral support while writing our master thesis. They were always there when we were going through a bad patch and helped us to recharge our batteries. A last word of thanks goes to our parents for giving us the opportunity to study at this university, letting us experience an unforgettable time during ERASMUS, and in general for their unconditional support during our five year adventure with economics.

Executive Summary

The aim of this master thesis was to explore the new challenges that would arise when the open innovation literature was being linked to the globalization of R&D strategies of MNEs. In order to solve this central research question, we first examined the reasons why MNEs were starting to internationalize. Profiting from specific cost advantages and the ability to better adapt products and services to local needs were the first motives for MNEs to set up R&D facilities abroad. Nowadays however, MNEs are locating R&D abroad in order to tap into knowledge and technology sources in centers of excellence around the world. They aim to either improve their existing assets, or to acquire completely new technological assets. The special organizational structures for MNEs, like the local-for-local and the center-for-global models were no longer useful for this new purpose. From the four traditional models described in the literature, the transnational structure was found to be the most suited to tap into knowledge throughout the whole operational network. But the knowledge that was located outside that operational network was left unexploited. Therefore we finalized the first part of our literature research with searching the organizational structure that was best fit to benefit from external sources that are scattered across the world. According to our research, this was the metanational structure of Doz, Santos, and Williamson (2001). This structure advised MNEs to set up a sensing network, with the special task of identifying and accessing knowledge that can be found across the world. These pieces of knowledge were then being integrated into special projects, in a process called mobilizing. In a final stage, the product was operationalized across the world.

In the second part of the literature research, we explored the open innovation theory. We concluded that open innovation argues that firms should no longer only make use of the knowledge that resides internally in the company, but should also make use of external technology sources. The theory however, never placed these external sources in a geographical setting. External ideas might be sourced locally, but also abroad in centers of excellence where leading edge research is available in particular technologies. After having explored both the R&D globalization literature on the one hand and the open innovation literature on the other hand, we concluded that both the metanational and open innovation theory have never been linked to each other and that making a link between both theories could increase our understanding of the current R&D globalization of large firms.

Linking and integrating both theories should give us the required insights to answer our research question of how the open innovation literature can be enriched by giving it an international dimension. The purpose of making this integration is not only to enrich the open innovation literature, but also to make open innovation more relevant for MNEs who are developing or changing their international R&D network in order to profit optimally from external sources of innovation.

Integrating both literature streams was possible because both the metanational theory and the open innovation literature have complementary strengths and weaknesses. Open innovation theory shows how firms can profit the most from external partners, while this was not that extensively discussed in the R&D globalization literature. The R&D globalization literature however, pays more attention to the location of external sources that MNEs can tap from than the open innovation literature does. A MNE structured as a metanational taps into knowledge sources originated in headquarters, subsidiaries and external partners located in the rest of the world. After making this comparison, we tried to complement open innovation with this geographical dimension which is completely absent in the open innovation theory. We asked ourselves what kind of managerial and organizational challenges are likely to appear when a MNE intends to implement open innovation using it to tap in an optimal way into external R&D that is available around the globe. It is important to remark that in the scope of this master thesis our aim is to open up the research agenda for open innovation; the challenges and possible recommendations that we propose are only illustrative. An exhaustive analysis of these challenges and recommendations could be the topic of an interesting doctoral thesis.

We concluded that there are four main challenges MNEs face when they want to make use of external sources that are scattered across the world. The first two challenges were related to the search of knowledge. In a first step we presented a new open innovation model that demonstrates that the search for knowledge is more difficult than the original open innovation literature suggested. We argued that the search should be initiated by a defined need that usually flows out of the vision and strategy of the MNE. This need helps MNEs determine which R&D locations could be interesting for them. Previous contributions to the literature pointed out that a separation of ‘research’ and ‘development’ locations could be necessary. According to us, the requisites for being an interesting location were: the availability of scientific labor, the proximity to academic centers of excellence, and the availability of a robust IP protection system. In the next step, MNEs should decide what the effective number of R&D locations should be.

To answer this question, MNEs should make a tradeoff between adding a new sensing location, which adds value to its innovation process, and the extra cost of coordinating this network of sensing units. Furthermore, the question will also depend on the nature of the knowledge involved.

The third important challenge MNEs will face when applying open innovation is how to get access to external knowledge sources. In our opinion, this will depend on the type of source a MNE wants to tap knowledge from. We discussed four types of sources: lead users, start-up companies, universities and research centers, and knowledge brokers. Despite the fact that tapping from these sources will require different strategies for each, the ability to establish trust is crucial when working together with these external sources. Developing an understanding of the needs of the party that controls IP are also of importance for a MNE when trying to gain access to knowledge imprisoned in organizations or people. The fourth, and last challenge we explored was the ability of the MNE to integrate the technology it gained from its external partners. In a first step the MNE has to transfer the acquired knowledge from the local environment to its local subsidiary, in a second step it has to transfer knowledge from the subsidiary to the headquarters and to its whole network of subsidiaries around the globe. We concluded that this is a very important challenge when MNEs want to apply open innovation. Being able to cope with cultural differences was also found to be crucial when trying to transfer knowledge in a global setting. Additionally, promoting continuous learning is necessary to ensure a high level of absorptive capacity.

The complexity of answering these four questions confirms our proposition that open innovation will be heavily challenged when applied to a MNE. In this master thesis we only revealed a tip of the iceberg of questions and problems MNEs will face when introducing an open innovation strategy. We gave some recommendations that could facilitate the implementation of open innovation for a MNE. But we would like to emphasize that further research on each of these topics is vital to the applicability of open innovation in an international context.

Table of Content

Chapter 1: Definition of the problem and aim of the research

1.1 Problem Statement

Globalization took a prominent role in the innovation literature as more and more firms are shifting towards a globally networked R&D strategy (Gerybadze & Reger, 1997; Kuemmerle, 1999; Narula & Zanfei, 2003; Doz, et al., 2006). Jaruzelski and Dehoff (2008) prove in their annual Global Innovation 1000 study, that multinational companies (MNEs) are spending a significant and growing share of their research and development money outside the countries in which they are headquartered. They found that in 2007 the Global Innovation 1000 companies were spending on average 55 percent of their innovation budget outside their home country. This demonstrates that the former home-based *R&D activities are getting more internationalized*. Traditionally (almost) all R&D activities were concentrated in the home country of the MNEs, while their sales, manufacturing and other operations were global (Bardhan, 2006; Sun, Von Zedtwitz, Simon, 2007; Sashwald, 2008). Firms started to change in the nineties, and by the end of the decade many large companies had already established R&D centers in foreign locations. This allowed them to attract scientific talent present in this location, lower the costs of R&D, and be more responsive to local markets (von Zedtwitz & Gassmann, 2002; Doz et al., 2006; Sashwald, 2008; OECD, 2008; Jaruzelski & Dehoff, 2008). In 2007, 91 percent of the world's 1,000 largest R&D spenders conducted innovation activities outside the countries in which they are headquartered (Jaruzelski & Dehoff, 2008).

The focus of R&D globalization is rapidly shifting from lowering the cost of R&D and adaptation to local needs towards the asset-augmenting motive of R&D internationalization (Dunning & Narula, 1995; Kuemmerle, 1999). Asset-augmenting motive of R&D states that firms will locate R&D abroad to tap into knowledge and technology sources in centers of scientific excellence around the world. Their aim is to either improve their existing assets or to acquire completely new technological assets. A growing number of empirical studies have provided support for these drivers of R&D investment abroad (Chiesa, 1996; Florida, 1997; Kuemmerle, 1999; Serapio & Dalton, 1999; Frost, Birkinshaw & Ensign, 2002; Almeida & Phene, 2004; Iwasa & Odagiri, 2004;

Criscuolo, Narula & Verspagen, 2005). Innovating firms look for the best technology and knowledge available to build a lasting competitive advantage in their markets.

Technology (transport infrastructure improvements, ICT, etc…) reduces the cost of distance which, in turn, squeezes the profitability of arbitraging things that are easy to transfer (raw materials, products, capital, systems, and information). Codified knowledge is easy to transfer and to sell, and will therefore not generate a sustainable competitive advantage. Tacit knowledge, on the contrary, is embedded in a local context (Szulanski, 1995, 1996, 2000; Doz, Santos, & Williamson, 2001). Doz, Santos, and Williamson (2001) argue that because of the uneven distribution of knowledge in the world, there exist pockets of unexploited, tacit knowledge that are scattered around the world. This knowledge is locally imprisoned because of its tacit nature. These pockets of knowledge represent a big untapped opportunity for innovating firms. Since this knowledge is locked in the local context, innovating firms have to globalize their R&D activities in order to gain access to this knowledge. They derive value from networks that extend *beyond their subsidiaries* and allow them to tap into the most innovative resources worldwide. These networks link large innovating firms with local upstream partners like universities, research-labs but also knowledge intermediaries and high-tech startups or SMEs.

To tap into these pockets of knowledge, innovating MNEs have to adapt their structure (Doz, Santos, & Williamson, 2001; Doz, 2006a). Doz, Santos, and Williamson (2001) came up with the following three-fold structure for MNEs to profit maximally from external technology that is imprisoned in local innovations systems. First they need to develop *a sensing network* to identify and access new competencies, innovative technologies, and lead market knowledge. Next, firms have to mobilize that knowledge through major projects (e.g. Airbus 380) to integrate the scattered capabilities and promising market opportunities to initiate new products and services. Finally, MNEs have to optimize the size and configuration of operations for efficiency, flexibility, and financial discipline, once the product or new business has been developed. The classical MNEs and transnational companies are focusing almost exclusively on the last level.

Establishing R&D activities abroad in order to tap into local pockets of scientific knowledge does not mean that MNEs will be automatically successful in getting access to and leveraging external knowledge from their local knowledge partners abroad. Most valuable knowledge is tacit (Doz, Santos, & Williamson, 2001) and MNEs face a considerable task to tap into knowledge that is locally embedded and have sufficient absorptive capacity to learn effectively from local pools of knowledge (Cohen & Levinthal, 1990; Singh, 2006).

Next, global R&D activities have been analyzed from the focal MNE's perspective obscuring the fact that the majority of these global R&D activities are joint activities with local R&D partners (e.g. universities, research labs, other firms, etc…). Consequently, the trend towards global R&D should be related to *open innovation* which focuses on the benefits of tapping into external technology sources (Chesbrough, 2003, 2006; Chesbrough, Vanhaverbeke, & West, 2006). Open innovation combines internal and external ideas into architectures and systems whose requirements are defined by a business model (Chesbrough, 2003). The geographical dimension however, has never been explored in detail in open innovation. On the one hand, external ideas might be sourced locally in centers of excellence where leading edge research is available in particular technologies. On the other hand, an innovating firm might look abroad for companies that want to license its technology. Hence, globalization of R&D and the establishment of international networks of collaborative R&D are topics that go to the core of open innovation.

However, globalization of R&D and open innovation have not been connected so far (Cantwell (2007) and Maccormack, Forbath, Brooks, and Kalaher (2007) can be considered as notable exceptions), although they should be intertwined as open innovation shows how firms can profit from sourcing external knowledge (partnering), while globalization describes a specific way to source external knowledge. Linking the literature about internationalization of R&D with open innovation will be beneficial for both of them. The internationalization literature will benefit from the insights about collaborative and open innovation and how a firm can tap into local pockets of tacit and contextual knowledge (Chesbrough, 2003, 2006; Bamford, Gomes-Casseres, & Robinson, 2003). Conversely, the open innovation literature did not focus yet on the international or geographical dimension of open innovation. Although most attention goes to large, technology user firms which are all MNEs, open innovation so far never focused on the growing internationalization of R&D sites. They cannot explain why companies tap into local or global partnerships and how a firm should be organized to execute this in an optimal way.

In this master thesis we try to link the globalization of R&D theory and open innovation with each other. This is possible because open innovation shows how firms can *profit* from sourcing external knowledge, but it also has a weakness as it does not indicate where these external partners are located. Hence, the geographical dimension is completely absent. On the contrary, the literature about R&D globalization describes where *to source* external knowledge, but it only vaguely indicates how MNEs have to interact with the local partners abroad to detect and assimilate this knowledge effectively. Hence, the strength of one approach is the weakness of the other and vice versa. This comparison is summarized in Table 1.1.

Table 1.1 - Strengths and Weaknesses of Globalization of R&D and Open Innovation

	Globalization of R&D	**Open Innovation**
Source externally?	YES	YES
Where to source into external sources?	YES	NO
How to insource knowledge from external sources?	YES but very limited	YES

1.2 Central research question and subquestions

Introducing the international dimension in open innovation will increase the relevance of the latter for the R&D and innovation management of large multinational companies. We are interested in the question how should multinationals structure themselves to get the maximum benefits from introducing open innovation in an international setting.

These issues give rise to our *central research question*:

"How does the open innovation theory change when it is applied to and integrated in the R&D globalization strategy of MNEs?"

To give an answer on the central research question mentioned above, it is important to first discuss the following subquestion:

"How should a MNE structure itself to make optimal use of its globalized R&D network in order tap into local pockets of specialist knowledge?"

After exploring different structures a MNE can apply to make use of dispersed knowledge, we will try to answer the next subquestions:

"What is open innovation?", and

"How can we link the globalization of R&D strategy of MNEs with the open innovation theory?"

By answering these three subquestions, we will be ready to formulate new challenges that will arise when applying open innovation in an international context. Therefore, our next and last subquestion is:

"Which managerial and organizational challenges do MNEs face when they apply the open innovation theory to their R&D globalization strategy?"

1.3 Research approach

By the use of an extensive literature study we will try to present an overview of the different R&D globalization strategies that have been taking place in the last decennia. Afterwards, we analyze in detail the existing literature about open innovation in order to integrate both theories that seem to be highly complementary, but are currently developed in isolation from each other. The integration of these different literature streams should lead to new insights and challenges about our main topic: open innovation. These challenges will then, via a combination of other literature streams be explored in order to get a better understanding of how the open innovation framework should be adapted when it is applied in an international context.

1.4 Structure of the master thesis

To be able to integrate the globalization of R&D strategies of MNEs with the open innovation theory, both literature streams will be the discussed. Therefore, in the second chapter, we will give an overview of the existing globalization of R&D literature. The third chapter will discuss the organizational structure that is best suited to make use of the globalized knowledge dispersion, namely the metanational structure. In the fourth chapter the open innovation literature will be discussed. In the fifth chapter we will integrate both literature streams and discuss some new important challenges that open innovation will face when both theories are combined. In the last chapter, we will briefly discuss the major findings of our research, its limitations and recommendations for further research.

Chapter 2: Globalization of R&D

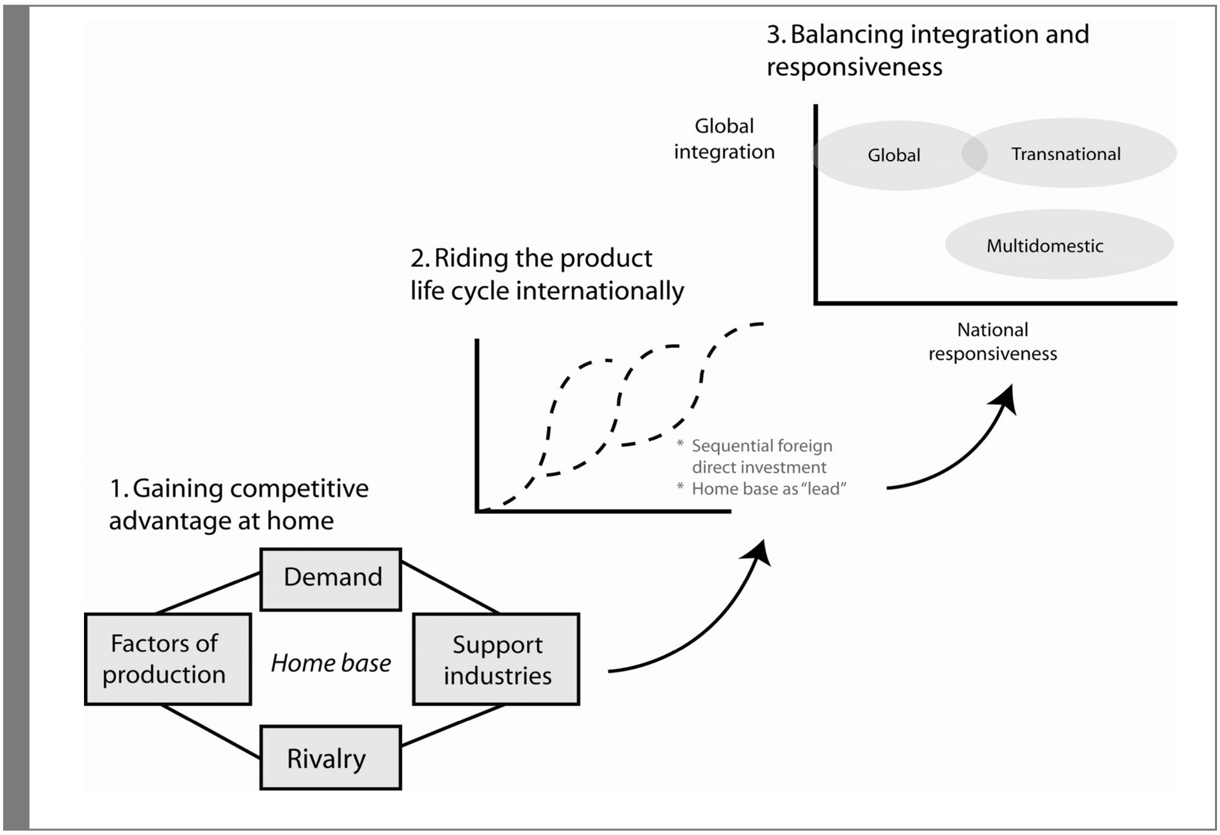
2.1 Introduction

In this chapter we will discuss traditional and more recent internationalization strategies. In time, we witnessed a shift from home-based R&D to an international network of R&D units to tap optimally into external pockets of specialist knowledge. That globalization of R&D is an important topic to discuss is proved by the yearly studies of Booz & Company. In a survey conducted for the year 2007, Jaruzelski and Dehoff (2008) show that companies that are internationalizing their R&D footprint in a more aggressive way, enjoy a stronger financial performance. We will describe four different roles that R&D units can play in improving the innovativeness of the MNE (Bartlett & Ghoshal, 1998). Because knowledge is unevenly spread across the world, there are local pockets of specialist knowledge that are scattered across the world. This presents a huge opportunity for MNEs that try to build up a sustainable competitive advantage by making use of those pockets of knowledge. But as we will see, this requires a complete restructuring of the MNE’s structure (Doz, Santos, & Williamson, 2001).

2.2 Internationalization Strategies

Traditionally, most multinationals followed three steps in their way to become a global company. They first started nationally by exploiting the advantages they found in their home market (Vernon, 1966). Afterwards, they projected these home advantages globally to become a global leader. In a last step the company needed to define which global strategy it was going to choose by making a trade-off between global integration and national responsiveness (Doz, Santos, & Williamson, 2001). These three steps are illustrated in Figure 2.1.

Figure 2.1 - Traditional multinational projecting strategy



Source: Doz, Santos, & Williamson, 2001.

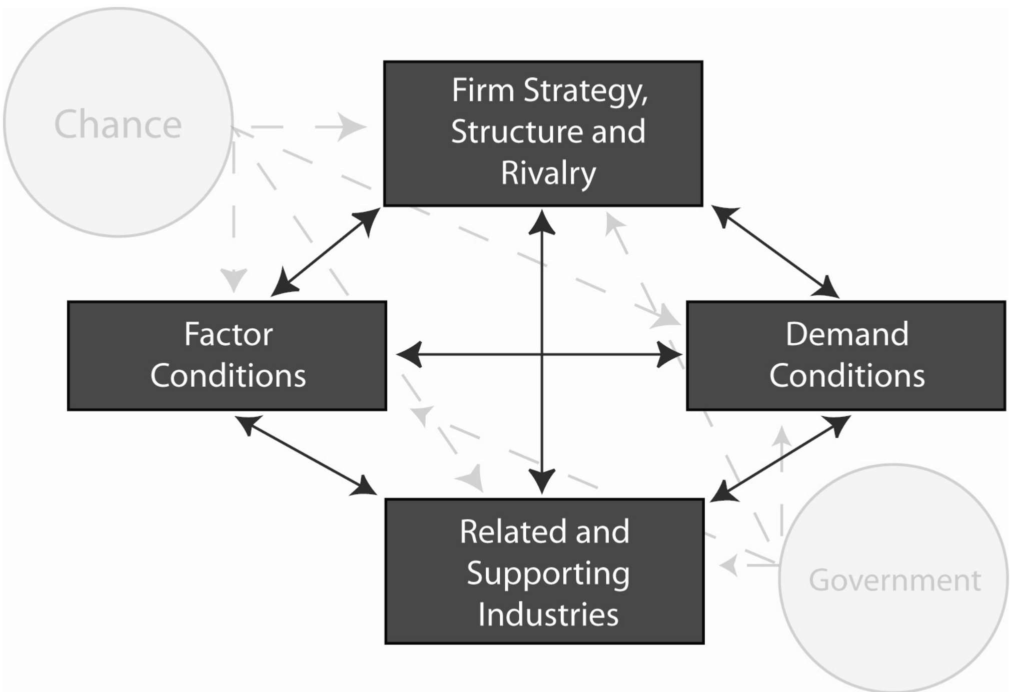
2.2.1 Step 1: Build On The Core Strengths From Your Home-Base

Before becoming a successful leading MNE, most national companies were large and successful companies in their home country. This national leadership allowed them to build on the strengths of their *home land* to gain an international advantage. The competitive advantages of these companies evolved from the critical capabilities and opportunities that were found in their home base, which were then leveraged internationally (Vernon, 1966; Porter, 1998; Doz, Santos, & Williamson, 2001). The multinational company was almost viewed as a mechanism for exploiting home-based advantages in an international market (Vernon, 1966; Frost, 2001). That is why, in the early days, it was very important for companies to be established in a top location.

Michael Porter (1998) introduced in his book "The Competitive Advantage of Nations" a diamond model that helps to understand the comparative position of a nation in global competition. This model can also be used for major geographic regions. Porter (1998) shows that there are superior locations or clusters of knowledge in the world that offer very specific benefits for companies located there. He called these superior locations 'diamond clusters'. The model of Porter (1998) states that the competitive advantage of regions is based on four factors and activities in and between companies in these clusters. These four factors are (Porter, 1998): the business strategy, structure and rivalry; demand conditions; related supported industries; and factor conditions (Porter, 1998; Ball et al., 2006). "*Chance*" and the "*government*" are two other factors that influence these four factors, but are not factors themselves (Porter, 1998).

Together these six factors (see Figure 2.2) form a system that is location depended, thus explaining why some firms (or industries) succeed in a particular location. The more or greater the attribute, the higher the chance will be of success. It is however not necessary that all six factors are optimal for firms or industries in order to be successful (Neven & Dröge, 2001).

Figure 2.2 - Variables Impacting Competitive Advantage: Porter's Diamond



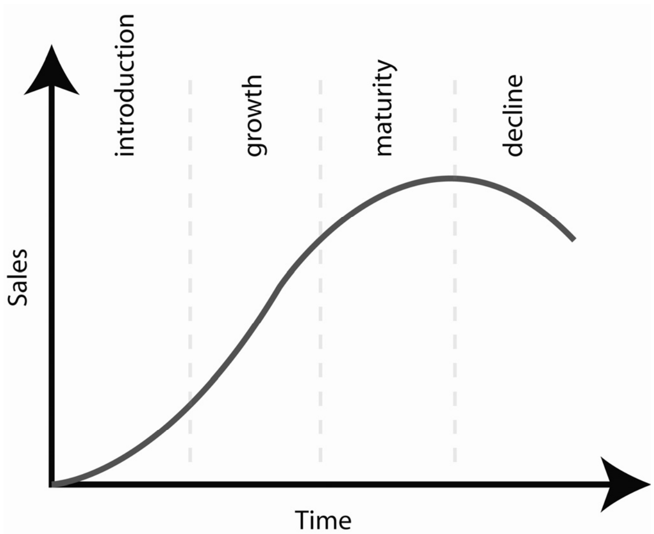
Source: Porter, 1998.

Companies located in such a diamond cluster had everything they needed available at home, so they sourced their activities only from the home base (Doz, Santos, & Williamson, 2001; Frost, 2001). Their competitive advantage was fully determined by the input they got from their home base location. Because a lot of companies wanted to locate themselves in such a cluster, competition between them was fierce. All of these companies needed the best people to work for them, so they attracted their workforce by giving them high salaries. This money incentive attracted skilled workers from other places too. Therefore the cluster began to grow and increased the knowledge available in the location. These locations rapidly became rich pools of knowledge which attracted other companies, related industries, service providers, customers, and so on. Thanks to the clustering of all these companies in the same area, the sharing of knowledge became more easy (Swann & Prevezer, 1996). The knowledge sharing, together with the competition of rivalry firms, made these clusters a good place for product differentiation and the creation of new innovations (Porter, 1998). Because the companies were located in such a superior knowledge pool, they merely had to look in their backyard to source their new innovations (Doz, Santos & Williamson, 2001).

2.2.2 Step 2: Project Along The International Product Life Cycle

When the company had successfully exploited the advantages they found in their home market, they started to project these strengths globally along the international product life cycle (see Figure 2.3) (Vernon, 1966).

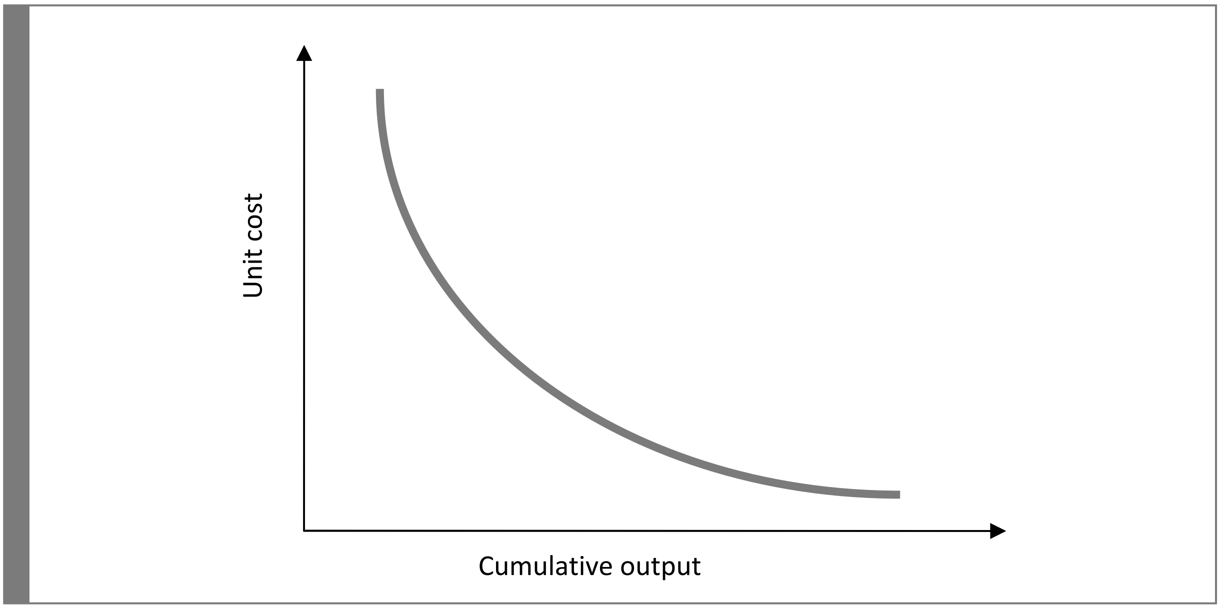
Figure 2.3 – International Product Life Cycle Curve



Source: Vernon, 1966.

The *location* where the product is produced, *depends on the stage of the cycle* (Vernon, 1966; Ball, et al. 2006). In general the international product life cycle theory argues that when the demand for a new product in other companies becomes significant enough, it will be worthwhile for the innovating firm to set up production facilities in those countries. In the first stage, the new product will be manufactured in the innovating country and will be sold primarily in the home market. In order to achieve sales growth, new products are introduced to meet local, national needs, or are first exported to countries nearby that were more or less similar than the home market. Focusing on a similar, but new market was done in order to minimize implementation problems regarding the local culture or local context (Doz, Santos, & Williamson, 2001). In the second stage, the product cost will decline because of economies of scale and learning, allowing new lower priced markets to be targeted for growth. This is shown by the experience curve (see Figure 2.4), which describes the inverse relation between the cumulative output and the unit cost of a product. Because of poor global ICT and limited mobility of key personnel the company keeps profiting from their early advantage over competitors, and thus has the possibility to expand their market even further (Doz, Santos, & Williamson, 2001).

Figure 2.4 - Experience Curve



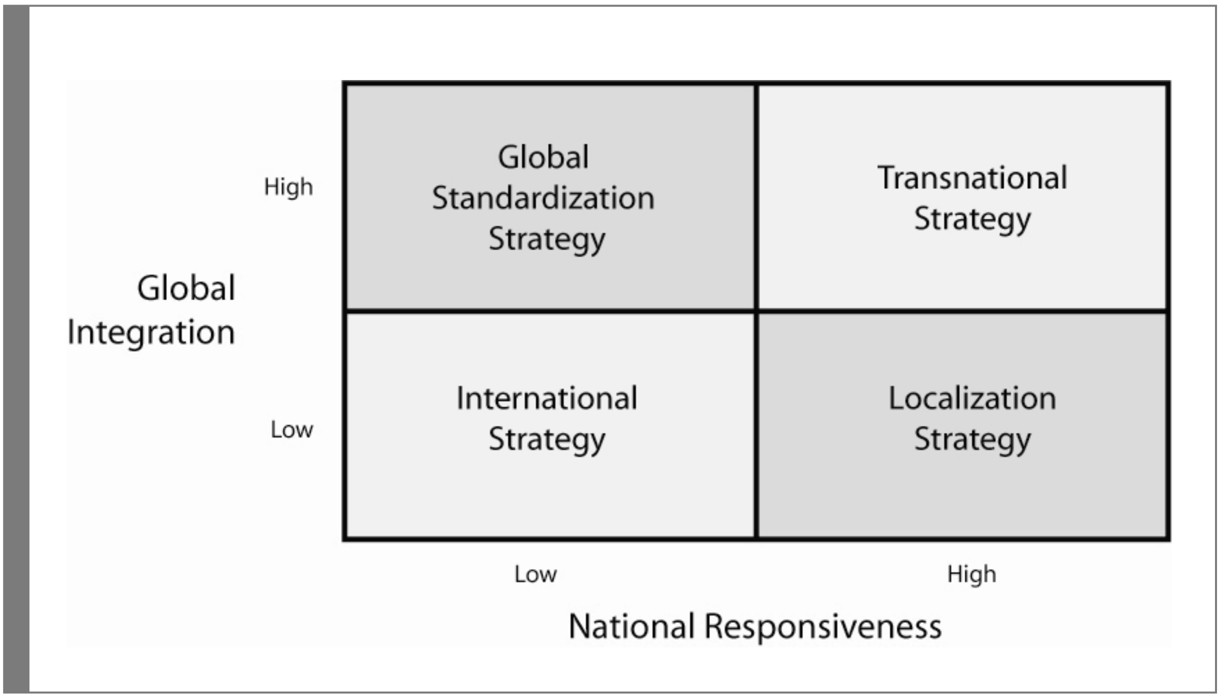
Source: Boston Consulting Group, 1972.

When the product reaches the maturity stage, the company could consider to produce the product elsewhere, usually on the basis of a lower cost of production. The diamond model of Porter (1998) and the product life cycle theory (Vernon, 1966) both argue that as a company went global to benefit from the bigger market, lower production cost, labor cost, or to profit from less stringent government regulations; only the high value adding processes (like R&D) were kept at the home base. Subsidiaries were set up in other countries to handle the low value adding processes in such ways that they could financially benefit from their location. Resource intensive processes were thus put at locations where those resources were readily available and cheap, while labor intensive processes were put in locations where cheap labor was available. Later on, the sales will decline because competitors will have achieved economies of scale that are equal to those of the innovating company. The main reason to go global was to *increase efficiency* in their operations. Overall, the company's success in the global arena depended for almost exclusively on the geographic advantages of the home base (Doz, Santos, & Williamson, 2001). The projecting strategy helped companies to maximize revenue and minimize cost on a global scale. This efficiency-driven strategy helps the company to maintain the competitiveness of the domestic operation (Doz, Santos, & Williamson, 2001).

2.2.3 Step 3: Local Responsiveness Versus Global Integration

After the second step the organization consists of a worldwide network of operations, as they expanded into more markets and built more sourcing plants. The company now has an important strategic decision to make (Doz, Santos & Williamson, 2001): Should the company put emphasis on *global coordination and integration* of its activities or on *responsiveness* to national characteristics, or can it do both? Each option has certain advantages. Being global gives the company the opportunity to lower cost by generating economies of scale and scope, while being local raises revenue by differentiating its product offering from those of competitors by focusing the product more on customer needs (Doz, Santos, & Williamson, 2001). Figure 2.5 describes this integration-responsiveness trade-off in a two-by-two matrix (Prahalad & Doz, 1987) and the new corporate forms that originate from this model (Bartlett & Ghoshal, 1998; Doz, Santos & Williamson, 2001; Venaik, Midgley & Devinney, 2001).

Figure 2.5 - Multinational Strategy: Standardization versus Adaptation



Source: Prahalad & Doz, 1987.

The four quadrants on Figure 2.5 represent four basic strategies that MNEs can follow (Prahalad & Doz, 1987; Bartlett & Ghoshal, 1998). A MNE following an *international strategy* will be influenced by low integration and low responsiveness pressures. The MNE will first produce for the local market, and will afterwards sell these product internationally with minimal customization. The top left quadrant is the *global standardization strategy*. MNEs use this strategy when there is a need for maximal integration, and there is (almost) no need to differentiate. The MNE produces a standardized product for sale in all markets. The automotive sector is an example of a sector where this strategy is applied. The MNE generally focuses on cost reductions that result from having economies of scale. The *localization strategy* is the opposite of the global standardization strategy. Each product or service is customized for local tastes and preferences. By maximal differentiation of the product it tries to add value in the local market, but it will not be able to benefit from economies of scale or scope (Bartlett & Ghoshal, 1998). The most interesting and therefore the most difficult strategy is the *transnational strategy*. When applying this strategy, the MNE tries to realize economies of scale via R&D and manufacturing activities, while differentiating on other value adding activities like after sale services. As competition becomes fierce over time, an MNE following an international strategy will be forced to change this to a more global and standardized strategy, or to a transnational strategy. An MNE following a localization strategy, will be in the same way forced to follow a transnational strategy (Ball et al., 2006). Each of these strategies will have implications for the organizational form of the MNE and the strategic role that subsidiaries fulfill for the MNE.

2.3 Innovation strategies

There are traditionally four forms of how a MNE can be organized (Bartlett & Ghoshal, 1998), which are more or less aligned with the different strategies a MNE can pursue as described in the previous section. A MNE can be organized as a center-for-global company, a local-for-local company, a locally leveraged company or a globally linked company (also called a transnational). Each organizational form will have different attributes. Organizations operating under each form will manage their network in a different way. Even more important, each organizational form will assign *different roles to their national subsidiaries*. A first overview of these characteristics is summed up in Table 2.1. We will discuss these roles more in debt in the next paragraphs.

Table 2.1 - Organizational Characteristics of four types of MNEs

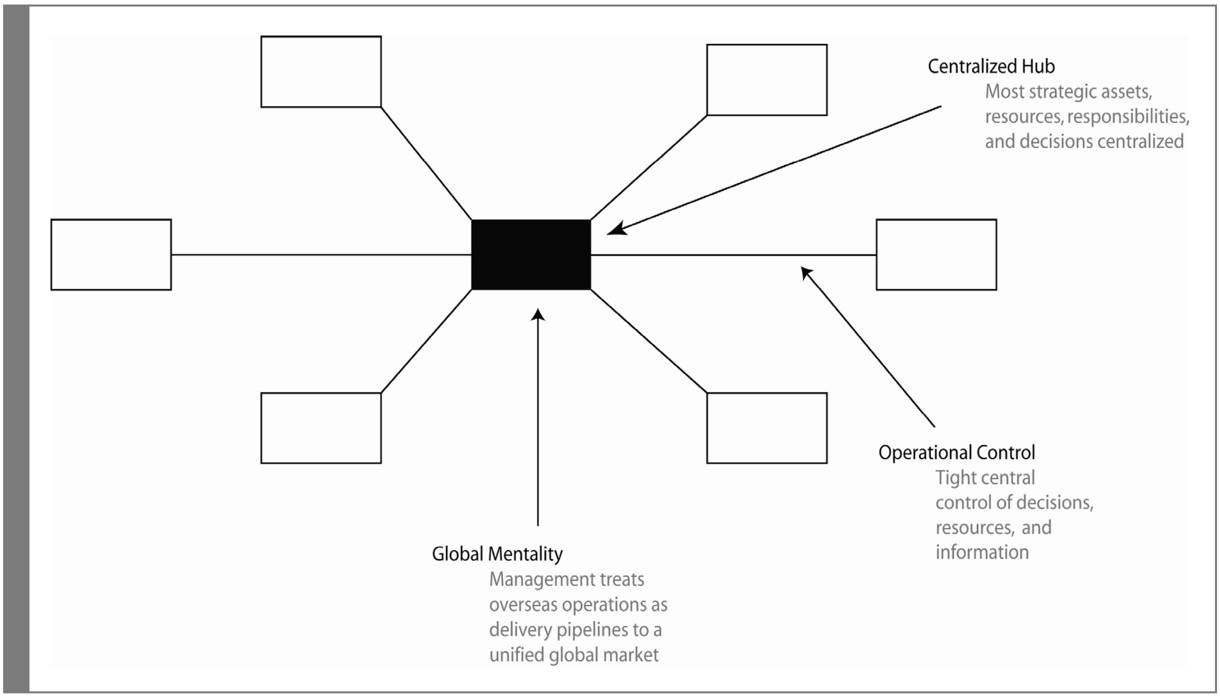
Organizational Characteristics	Center-for-global	Local-for-local	Locally-leveraged	Transnational (globally linked)
Configuration of assets and capabilities	Centralized and globally scaled	Decentralized and nationally self-sufficient	Sources of core competencies are centralized, others decentralized	Dispersed, interdependent, and specialized
Role of overseas operations	Implementing parent company strategies	Sensing and exploiting local opportunities	Adapting and leveraging parent company competencies	Differentiated contributions by national units to integrated worldwide operations
Development and diffusion of knowledge	Knowledge developed and retained at the center	Knowledge developed and retained at the center	Knowledge developed at the center and transferred to overseas units	Knowledge developed jointly and shared worldwide

Source: Bartlett & Ghoshal, 1998.

2.3.1 Center-for-global model

The center-for-global model is focused on leveraging the *innovations made by the headquarters* on a global scale. The organizational structure of a center-for-global company is given in Figure 2.6. The straight line between the headquarters and the subsidiaries demonstrate the tightly controlled central strategy (Bartlett & Ghoshal, 1998). The MNE only uses the *centralized* resources of the headquarters to innovate. The subsidiaries have the only task to assemble and sell products and to implement the parent company's strategy. They are solely used to reach foreign markets in order to build a global scale. (Bartlett & Ghoshal, 1998). In comparison with the other models that will be described later on (local-for-local, locally-leveraged, and the transnational), the subsidiaries have no freedom to create new products or strategies or even modify existing ones. The MNE does minimum effort to meet the needs of the local customers (Florida, 1997; Bartlett & Ghoshal, 1998). They follow the earlier described global standardization strategy, and by this run the risk of becoming too market insensitive. McDonalds, or the automotive industry are textbook examples of companies that use this global standardization strategy.

Figure 2.6 - Center-for-Global model



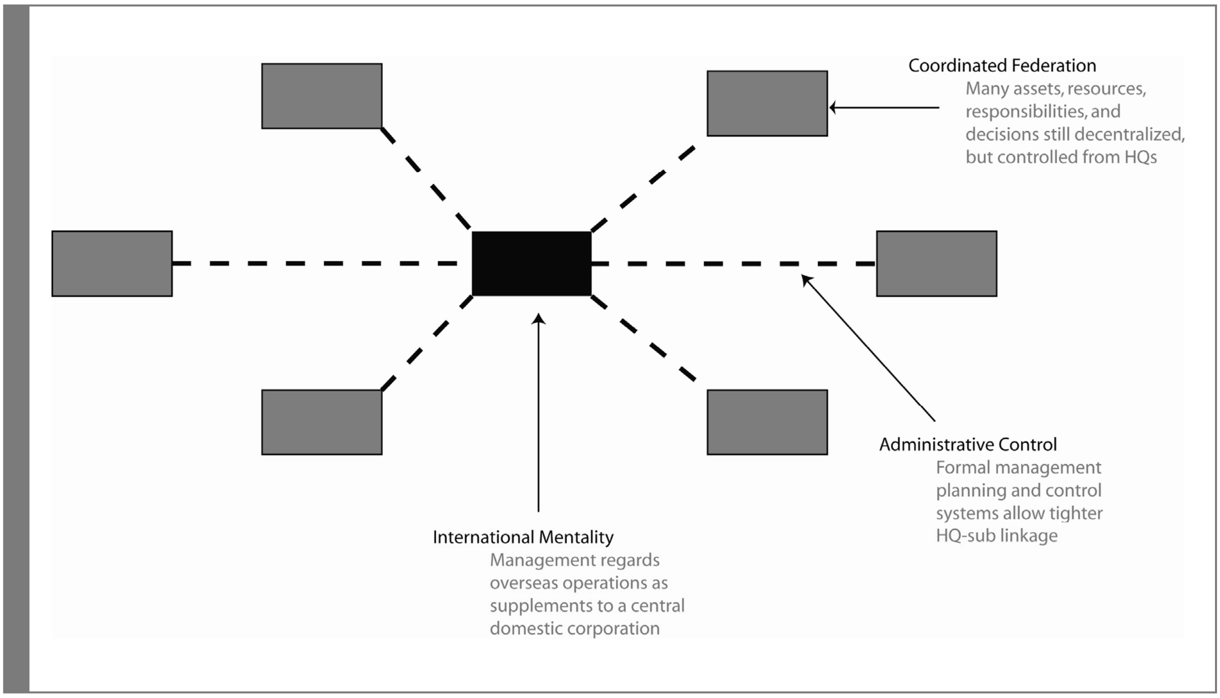
Source: Bartlett & Ghoshal, 1998.

2.3.2 Local-for-local model

Local-for-local companies are companies that choose for a high national responsiveness. In comparison to the centralized center-for-global model, these companies *decentralize* their organizational assets and capabilities to allow foreign subsidiaries to respond to the differences that distinguish national markets (Bartlett & Ghoshal, 1998). They follow the localization strategy. Unlike center-for-global companies, they differentiate themselves by adapting to local preferences. The subsidiaries have the task to sense and exploit local opportunities, but the knowledge that is developed locally, remains local within each unit (Bartlett & Ghoshal, 1998).

Each subsidiary is managed as an *independent entity* with the only objective to optimize its situation in the local environment. These companies sometimes run the risk of making their product needlessly differentiated, because there is no transfer or integration of the knowledge between a subsidiary and the headquarters, or between the separate subsidiaries (Bartlett & Ghoshal, 1998). This is demonstrated in Figure 2.7 by the dotted line between the headquarters and the different subsidiaries.

Figure 2.7 - Local-for-local model



Source: Bartlett & Ghoshal, 1998.

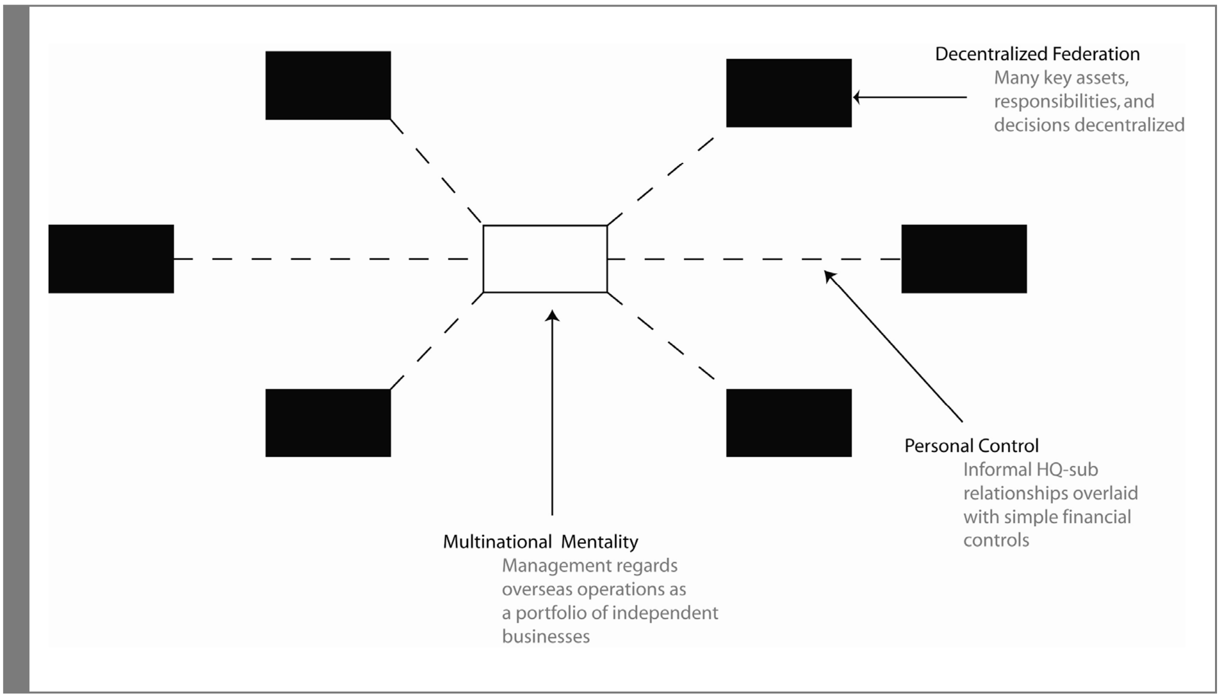
Unilever (Unilever, 2008) and Procter & Gamble (Bartlett & Ghoshal, 1998) are companies that traditionally have used this strategy in an effective way. This strategy works well when local adaptation of products or services is important to create a competitive advantage. The production of laundry detergents is for example, influenced by differences in hardness of the water, by perfume preferences, by phosphate legislation, and so on. This forces the MNE to make their product country specific (Bartlett & Ghoshal, 1998).

Both the center-for-global and local-for-local organizational models have one thing in common. In both there is a perfect symmetry between the different subsidiaries. In the center-for-global and the local-for-local model, each subsidiary is treated in the same way. In the two new organizational models that will be described now, there will be no longer symmetry.

2.3.3 Locally-leveraged model

The locally-leveraged model uses resources of subsidiaries to create innovations for exploitation on a world-wide basis (see Figure 2.8). In this model a *subsidiary can be responsible for the R&D of the whole company* (Bartlett & Ghoshal, 1998). The model has the risk that it can foster the not-invented-here syndrome (NIH-syndrome) between the subsidiaries. This means that a subsidiary is already negatively biased towards an innovation that is invented somewhere else. This model requires a lot more coordination and transfer mechanisms of innovations than in the previously described models. A good link between the subsidiary and the headquarters is therefore necessary. Bartlett and Ghoshal (1998) however mention that it is often the case that the headquarters still consider themselves superior compared to their national subsidiaries.

Figure 2.8 - Locally-leveraged model

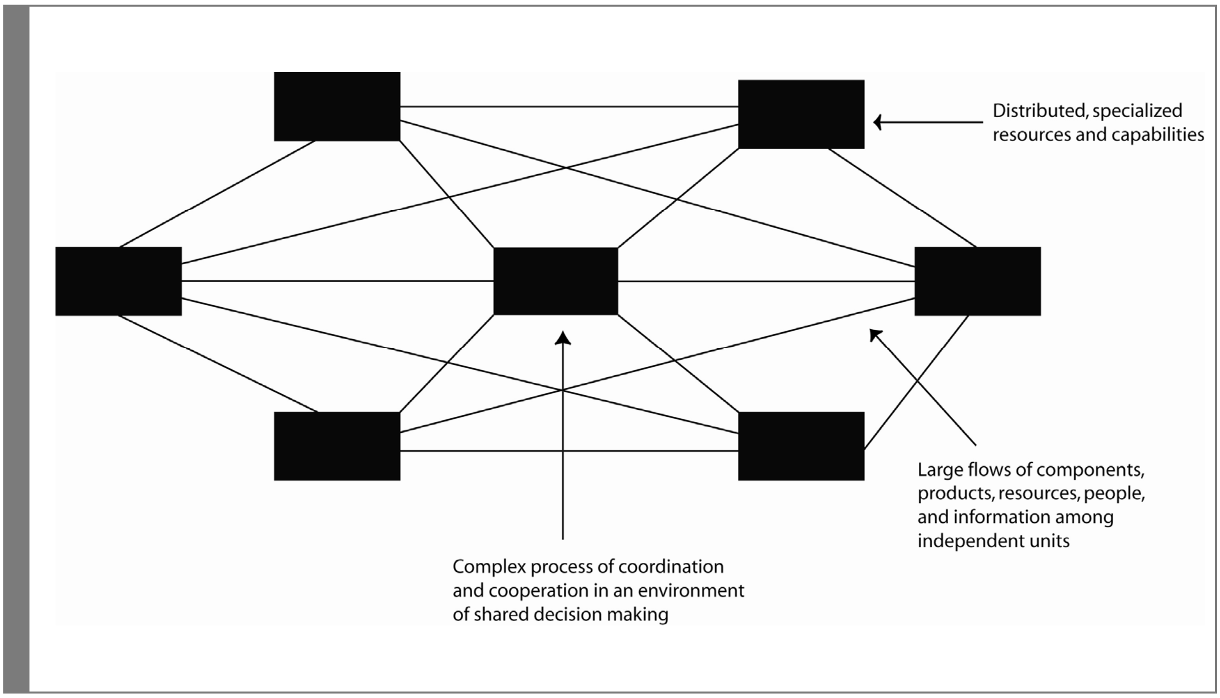


Source: Bartlett & Ghoshal, 1998.

2.3.4 Globally-linked model (transnational)

The last model described by Bartlett and Ghoshal (1998) is the globally linked model. Here the headquarters and the subsidiaries group resources and capabilities from their different units to develop a truly collaborative innovation process. Figure 2.9 illustrates the globally-linked model (also called the transnational). The goal of these companies is to be both sensitive to local needs and to global coordination, which is not an easy task. The transnational recognizes that certain resources and capabilities are best centralized within the home country operations, while other operations can also be centralized but not necessarily at home (Bartlett & Ghoshal, 1998). This gives the company the opportunity to enjoy the benefits of scale economies with the advantages of low input costs or ready access to scarce resources. Other resources will be decentralized when the company cannot profit from potential economies of scale, or when these advantages are small compared to the benefits of differentiation. The need to create flexibility and to avoid the risks when depending on a single facility, could also be reasons to decentralize (Bartlett & Ghoshal, 1998).

Figure 2.9 - Globally-linked Model

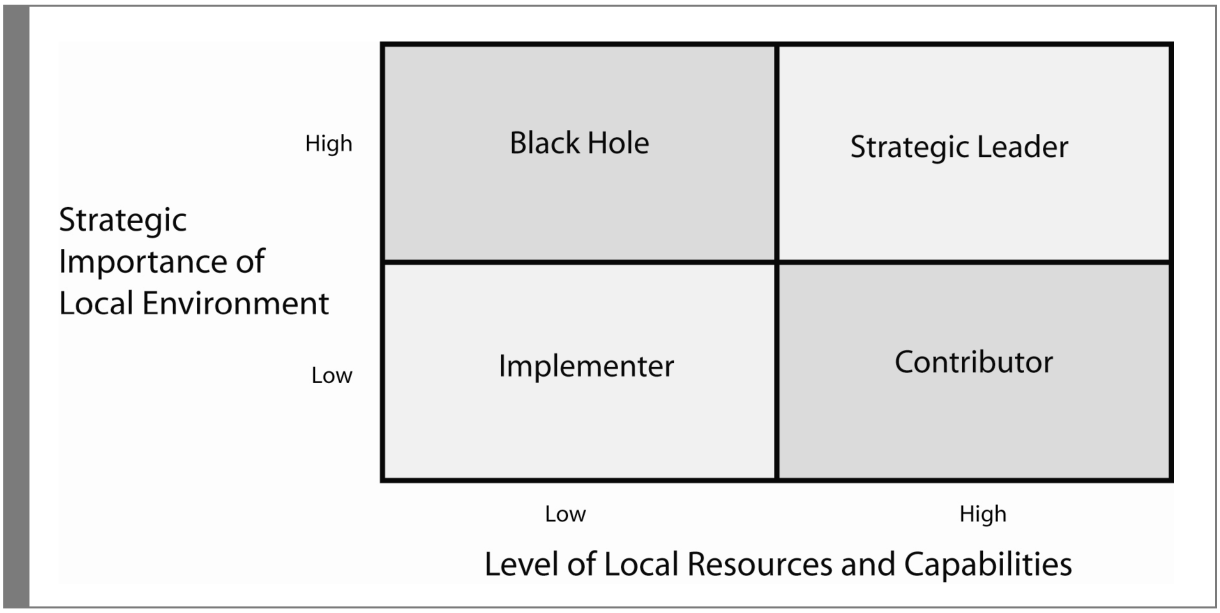


Source: Bartlett & Ghoshal, 1998.

Bartlett and Ghoshal (1998) argue that the strength of the transnational is that "its subsidiaries are dispersed, specialized and interdependent at the same time". Dispersion helps the MNE to be more responsive to local market needs, plus it gives them the opportunity to make use of factor cost differentials. Moreover, it allows the MNE to *tap into an international pool of increasingly scarce technological and managerial resources* (Doz, Santos, & Williamson, 2001; Bartlett & Ghoshal, 1998). The transnational creates in this way an integrated network of national subsidiaries where each subsidiary could have different roles (Bartlett & Ghoshal, 1998).

The problem in most MNEs is that they assumed that their organizational structure and management processes must me symmetric and homogeneous (Bartlett & Ghoshal, 1998). This results in a dichotomization within the MNE: there is a local role for subsidiaries and a global role for headquarters, where their relation is either local autonomous or centrally controlled. This prevents companies to develop more complex global innovation processes. So the logical next step is to *differentiate the roles* and responsibilities of the different subsidiaries. Figure 2.10 shows four different roles and responsibilities that MNEs can use for their national subsidiaries: strategic leader, contributor, implementer or black hole.

Figure 2.10 - Generic Roles of Subsidiaries



Source: Bartlett & Ghoshal, 1998.

Subsidiaries should be *strategic leaders* when they have a lot of internal strengths while being located in strategically important markets. It is important that the ties between the national subsidiary and the headquarters are very strong to make transfer of knowledge possible. The subsidiaries who are strategic leaders, should be aware of signals for change and they must participate fully in strategic decision making. This means: analyzing the resulting threats and opportunities, and the development of the appropriate organizational responses that are needed (Bartlett & Ghoshal, 1998).

When companies are trying to capture the benefits of local facilities or capabilities and are applying them to their worldwide operations, the subsidiaries are called *contributors*. It is important for MNEs to be aware of these subsidiaries and to invest resources in them, nonetheless they are located in a noncritical environment. The MNE can run the risk of losing their capabilities when these subsidiaries are not managed actively (Bartlett & Ghoshal, 1998).

In the lower left part of the matrix the subsidiary has the role of an *implementer*. As the subsidiary is located in a nonstrategic market as they have no access to critical information and their capabilities are just enough to maintain local operations, they will have the only task to be the implementers of the added value the companies has. This task is not unimportant. These subsidiaries are responsible for a part of the market that will generate sales for the company. These sales result in extra resources that can be used to support the strategic and innovative processes that are done somewhere else in the network (Bartlett & Ghoshal, 1998).

Strategically important markets in which a MNE has minimal capabilities are called *black holes*. For a MNE, the black hole is not an acceptable strategic position (Bartlett & Ghoshal, 1998): the subsidiary should be playing the strategic leader role, but does not have the competence to do so. One common response to this challenge is according to Bartlett and Ghoshal (1998) to create a small sensory capability to make use of the learning potential of this location just to monitor technologies, market trends and competitors. In this way, MNEs can at least prevent erosion of their positions in other markets by analyzing the global implications of the trends they witness locally.

A subsidiary that has the role of a contributor or a strategic leader can really contribute to the innovativeness of the MNE as a whole. These subsidiaries should be regarded as important sources for innovations.

2.4 Subsidiaries as a source for innovations

As described in the international product life cycle theory of Vernon (1966) and the cluster model of Porter (1998), companies traditionally depended on their home base for creating and exploiting innovations. When an opportunity was sensed in the home country, the centralized R&D of the headquarters was used to create a new product or service. Afterwards the innovation was adopted by their different subsidiaries (Kuemmerle, 1997; Bartlett & Ghoshal, 1998). R&D was clearly not globalized. Later on, the local-for-local model introduced the globalization of R&D activities, but only for *market-orientated* reasons (Kuemmerle, 1997; Bartlett & Ghoshal, 1998). They went abroad to adapt products to local tastes and to find special manufacturing capabilities (Florida, 1997). Transnational companies on the other hand are moving ahead by allowing subsidiaries to create innovations as well (Doz, 1992; Hedlund, 1986; Nohria & Ghoshal, 1991; Westney, 1990). Transnationals are still international projectors, but are thinking ahead by letting leading or complementing subsidiaries as well as headquarters project their competitive advantages. Transnationals build centers of excellence with the task of absorbing and spreading local skills and knowhow (Doz, Santos, & Williamson, 2001). Instead of finding a central solution to an emerging global opportunity (central-for global) or different local solutions in each environment (local-for-local), the transnational will combine the resources of central headquarters and many national subsidiaries to develop a worldwide solution that will be used in their whole organization (Bartlett & Ghoshal, 1998).

Having such a globally linked innovation process is ideal when you want to learn from your subsidiaries and use this new knowledge to generate more and better innovations. But it *comes at a cost* as it requires an extensive degree of *internal coordination* (Bartlett & Ghoshal, 1998). They need to find a *balance between overall corporate coordination and* the *autonomy* required for R&D. Another problem is that there is a need for linkages to other corporate units and to the home base. But these linkages imply complex reporting tools. Moreover, the perception of external control can have a negative impact on organizational performance. There is also the question how the MNE should *internally organize* their foreign R&D laboratories, because there is a need for transfer of management and organization systems from the R&D location in the home country (Bartlett & Ghoshal, 1998).

This *technology-orientated* approach, where MNEs are investing in foreign R&D to get access to external sources of technology has become more important (Florida, 1997; Kuemmerle, 1997), and is for a great part stimulated by a greater dispersion of specialist knowledge across the world (Doz, Santos, & Williamson, 2001; Doz, 2006a; Bartlett & Ghoshal, 1998). The reasons why knowledge is getting more dispersed, and why they should make use of these globally distributed pockets of specialized knowledge are the subject of the next section.

2.5 Global dispersion of specialist knowledge

Storper (1990) and Frost (2001) argue that advanced nations are becoming more equal in terms of capabilities in science and technology, but are also becoming more specialized and differentiated. This leads to various centers of excellence in technology districts around the world (Lundvall, 1992; Nelson, 1993; Carlsson, 2006). We will now explain the reasons why this trend of dispersion of knowledge is occurring.

2.5.1 Drivers of global dispersion of specialist knowledge

The traditional economy transferred to a *global knowledge economy*. Doz, Santos, and Williamson (2001) argue that companies should make actively use of the opportunities that this new global knowledge economy presents. MNEs should benefit from the potential valuable packages of knowledge that are globally dispersed.

The global knowledge economy is characterized by:

- Competitive advantage is primarily based on knowledge;
- Not all the knowledge a global company needs to prosper is to be found in one place; instead, it is increasingly scattered around the world;
- The cost of distance is falling rapidly for commodities that are mobile (capital, goods, and information) so that they are readily accessible by all.

(Doz, Santos, & Williamson, 2001)

This global knowledge economy forces companies to distinguish themselves by combining unique pockets of globally dispersed knowledge in a better way than other companies. This challenge will not be limited to knowledge-intensive industries. MNE of SME, every company will have the challenge to create innovative products and services by combining knowledge coming from non-traditional sources (Doz, Santos, & Williamson, 2001).

In the knowledge economy, global efficiency and local adaptation are no longer a distinctive source of competitive advantage. The competitive advantage for companies will be based on knowledge. The *knowledge* that you need to create this advantage will *not be found in one place*, instead the knowledge is increasingly scattered around the world. This knowledge dispersion is driven by several forces, influencing the dispersion of technological knowledge on one hand, and the dispersion of market knowledge on the other hand (Doz, Santos, & Williamson, 2001). In Table 2.2 these forces are listed by category.

Table 2.2 - Forces Driving Global Dispersion of Knowledge

Forces Driving Global Dispersion Of Knowledge:	
Technological Knowledge	**Market Knowledge**
Industry Convergence	New Customer Interactions
Technology Transfer	Globalization Of Customers
Offshore Sourcing	Solution Selling
Technological Complexity	
"Random" Breakthroughs	

Source: Doz, Santos, & Williamson, 2001.

We will now discuss these forces one by one.

2.5.1.1 Forces driving dispersion of technological knowledge

The first force that drives the dispersion of technological knowledge is *industry convergence*. When industries come together the streams of technology that are important for these industries will also converge. Companies will therefore need to learn how to deal a more diverse range of technologies. Because it is likely that these industries and technologies are located in different areas around the world, companies that want to access this new knowledge to integrate it in their industry, will have to tap knowledge from a wider range of locations (Doz, Santos, & Williamson, 2001).

Technology transfer is a second driving force. When multinationals educate their subsidiaries by transferring competencies, they are developing new pools of competencies in these new locations. This again results in a dispersion of specialists knowledge where companies can tap from (Doz, Santos, & Williamson, 2001).

Another force that drives the dispersion of technological knowledge is *offshore sourcing*. Companies are nowadays more and more using contract manufacturing that is located outside traditional clusters. Therefore the knowledge that flows from manufacturing improvements will again become more globally dispersed (Doz, Santos, & Williamson, 2001).

Products become more complex. Therefore, the relevant sources of knowledge needed to research, develop and commercialize them are becoming more dispersed too. This *technological complexity* is another driver for technological knowledge dispersion. Simple, standard products may require knowledge that comes from a single source, but creating a new breakthrough innovation often requires knowledge that comes from the geographical integration of knowledge (Doz, Santos, & Williamson, 2001). This force explains for a great part why Porter's cluster model[1], is getting outdated. Porter (1998) assumed that all the knowledge necessary for a particular innovation is found at one place, which is not the case anymore when dealing with more complex products like laptops or mobile phones. Nowadays when Nokia for example wants to create a mobile phone, it needs to get knowledge from batteries, ICT, displays, photo lenses, etc. They will have to tap into several, different Porter-like clusters around the world.

A last driver for the dispersion of technological knowledge is the occurrence of *random breakthroughs*. Because random discoveries can occur everywhere, they does not necessarily have to occur in the traditional hotspots (Doz, Santos, & Williamson, 2001).

[1] Porter's cluster model: see Section 2.2.1,

2.5.1.2 Forces driving dispersion of market knowledge

New customer interactions is the first driver for the dispersion of market knowledge. Because companies are selling and introducing products and services into new, geographically dispersed markets, the knowledge they gain there about tastes, local habits, new applications, etc, will also be more geographically spread (Doz, Santos, & Williamson, 2001).

The *globalization of customers* is another driver for dispersion. Transportation infrastructure makes customers, distributors and retailers more mobile and enables them to locate themselves wherever they want. Therefore the knowledge that is situated in these companies will become more spread over the world (Doz, Santos, & Williamson, 2001).

The last force that drives the dispersion of market knowledge is *solution selling*. Companies are nowadays not only selling their product or service, but also complete 'solutions'. Just like in the case of increasing product complexity, companies need to combine more dispersed pieces of knowledge, because it is expected that the know-how that is needed will not be found in one location (Doz, Santos, & Williamson, 2001).

Doz, Santos, and Williamson (2001) however remark that companies are not making use of the dispersed pockets of specialist knowledge that are available. We will now continue by giving reasons why companies should make use of this opportunity.

2.5.2 Why should companies make use of the dispersed specialist knowledge?

There are a lot of reasons why companies should start making use of these dispersed knowledge pools (Doz, Santos, & Williamson, 2001; Goldbrunner, Doz, Wilson, & Veldhoen, 2006). First of all, and as mentioned before, it is not a competitive advantage anymore when a company has the capabilities of global efficiency and local adaptation. There is a need for a new competitive source. A second reason is that the *technologies* and customer knowledge that a global leader must absorb are becoming *more diverse* (Brusoni, Prencipe, & Pavitt, 2001). Nowadays, a new innovation contains technologies of different sources. Therefore, designing a product around the needs of one local customer base is no longer sufficient to create the latest blockbuster product. A Smartphone is a good example of this: it combines internet Wi-Fi, camera technology, GPS, and more technologies in one product. The more differentiated and heterogeneous the knowledge base required, the more likely key elements of this kind of knowledge base will be dispersed across the globe (Doz, 2006a). The third and last reason is that the knowledge a global company needs to win is becoming increasingly dispersed around the world. *It is no longer possible to find a single hotspot or diamond cluster for a major market*. Apart from Silicon Valley, for example, there are the Bangelore (the Silicon Valley of India); Austin, Texas; Sofia-Antipolis in France; Helsinki, Finland; Singapore, ... (Doz, Santos, & Williamson, 2001).

Despite the fact that companies are convinced that there are a lot of untapped and underexploited pockets of potentially valuable knowledge scattered across the world, they are not making use of it. Why are they only tapping from knowledge that lies within their own operations network, and are they not looking for knowledge that is situated somewhere else? Why do companies fish in a small lake, when they can fish in the ocean?

2.5.3 Why are companies not using the dispersed specialist knowledge?

There are specific reasons or problems why companies are not using, or why companies are not able to use the dispersed knowledge that is available across the world. We can divide these reasons in two groups: problems within the company and problems with the knowledge itself.

2.5.3.1 Problems within the company

A first reason why companies often ignore the potential valuable pockets that are available all over the world, is because they still think that all the knowledge they need will be provided by the central cluster they are located in. These companies will only scan the traditional well-known hot spots (the traditional diamond clusters) to find new emerging trends, or knowledge. But this is not sufficient anymore. Products are becoming more and more complex, therefore companies need to tap from more dispersed pools of knowledge (Doz, Santos & Williamson, 2001). Additionally as companies contract manufacturing plants that are located outside traditional clusters, there is a great possibility that in these places new knowledge will emerge. This again is a reason why it is not sufficient to solely scan the traditional hotspots. A second reason why companies do not use the potential of dispersed knowledge pockets, is that they do not know how to reach for it. They do recognize the potential of it, but they lack the capability to do so.

Breaking free of geography is often very hard to do, even when a company recognizes the opportunities that the global knowledge dispersion brings there are many forces that keep a company from acting (Doz, Santos, & Williamson, 2001). A first reason why they are unable to break free could be that the company sees their home base as superior, and doesn't want to believe that a place other than their birthplace could be a source of competitive strength. This feeling is often intensified by emotional attachment of the employees and stakeholders of the company to their home country. A second reason is that the subsidiaries with the largest sales, or largest market volume, believe that they are superior to a small subsidiary located in a periphery. A third reason could be the failure to recognize that the knowledge used to adapt a product locally could be used to create a new stream innovations that could be leveraged globally (Doz, Santos & Williamson, 2001).

2.5.3.2 Problems within the knowledge

Innovation is one of the few activities of MNEs that still extensively depend on the distinctive knowledge of people and their unique skills (Doz, 2006b). Skills and knowledge tend to be for a great part 'locked' in education systems, national innovation systems, local competence clusters, cultures and social structures. This embedded nature makes the knowledge often both unique and immobile (Doz, 2006b; Szulanski, 1996). That is the main reason why a lot of these pockets of knowledge remain unexploited. Because the knowledge is *imprisoned in their local context*, it is difficult to utilize it globally (Doz, Santos & Williamson, 2001; Szulanski, 1996). Another reason could be that the knowledge contains some *tacit information*. Tacit information is knowledge that has not yet been codified, like knowledge in a persons' mind (Doz, Santos & Williamson, 2001). This kind of knowledge is very hard to transfer inside a company.

2.6 Towards a synthesis

As has been explained in the previous sections, there has been a move towards a more globally spread business activity. In many industries, however, a international projection strategy is nowadays not enough to create a competitive advantage. Because of the falling cost of distance and improved transport and communication technologies, the ability to project a homegrown formula to the rest of the world is not longer enough to distinguish a company from its competitors (Doz, Santos & Williamson, 2001; Doz, 2006a; Goldbrunner, Doz, Wilson, & Veldhoen, 2006). That is why multinationals need to create new sources of differentiation. A possible strategy could be speeding up the innovation process at the home base. Companies following this strategy however risk missing the next critical innovation (Doz, Santos & Williamson, 2001), particularly one that emerges in non-traditional location that lays far away from the company's headquarters.

Doz, Santos, and Williamson (2001) note that "While the outward move for advantages within the materially and more easily quantifiable returns of labor and resources already took place a long time ago, *the outward move for knowledge is only just happening now*." Even though transnationals acknowledge the potential of learning from their subsidiaries, and are not just relying on their parent company to create new innovations, they are still missing a huge opportunity. As knowledge is getting more dispersed, transnationals should also make use of potentially valuable pockets of specialist knowledge that are scattered across the globe that lie *outside their traditional operations network* (Bartlett & Ghoshal, 1998; Doz, Santos & Williamson, 2001; Doz, 2006).

While companies are already scanning the world for the most beneficial locations for their production, they should now do the same effort to find the best locations to find useful knowledge and optimize the process of bringing it into the organization. This may *not necessarily be in the countries in which you are already active*. The world is bigger than your own operations network and the valuable pockets of knowledge that lie outside of this network should not be overlooked. As we have discussed in the previous sections, most MNEs are not making use of the huge opportunity to differentiate themselves by learning from the world (Doz, Santos & Williamson, 2001; Goldbrunner, Doz, Wilson, Veldhoen, 2006). MNEs should locate R&D abroad to tap into knowledge and technology sources in centers of scientific excellence around the world, with the aim to either improve their existing assets, or to acquire completely new technology assets (Dunning & Narula, 1995; Kuemmerle, 1999). This asset-augmenting motive of R&D internationalization is getting more important. Innovating companies that are able to do so, will create a new sustainable competitive advantage based on knowledge. We will call this kind of companies *metanationals* (Doz, Santos & Williamson, 2001). In contrast to the center-for-global, the local-for-local, and the transnational companies, metanationals are MNEs who make use of their headquarters, their subsidiaries and the rest of the world, to develop new products and services (see Table 2.3). We will elaborate on the metanational organization in the next chapter.

Table 2.3 - Center-for-Global, Local-for-Local, Transnational and Metanational

	Center-for-Global	Local-for-Local	Transnational (Globally linked)	Metanational
Internationally orientated?	Yes	Yes	Yes	**Yes**
Headquarters learn from subsidiaries?	No	No	Yes	**Yes**
Headquarters learn from the whole world?	No	No	No	**Yes**
Origin of Innovation?	Headquarters	Subsidiaries	Headquarters & Subsidiaries	**Headquarters & Subsidiaries & The rest of the world**

Chapter 3: The Metanational Structure

3.1 The Need to Globalize R&D Activities

As we described in the previous chapter, most companies already have a global supply chain as a result of a cost reduction strategy (Bardhan, 2006; Sun, 2007; Sashwald, 2008). In contrast to the supply chain, most companies have no innovation process that is equally global. Many companies however, do have research and development centers scattered around the world, but these centers are usually solely focused on leveraging the knowledge that is available at their doorstep (Doz, Santos & Williamson, 2004).

To build a lasting competitive advantage in their markets, MNEs should look for the best technology and knowledge that is available in the world (Doz, Santos, & Williamson, 2001). Driven by technology improvements, like transport infrastructure and ICT, the cost of distance is falling. This squeezes the profitability of arbitraging things that are easy to transfer (raw materials, products, capital, systems, and information). Codified knowledge is easy to transfer and to sell. But, only relying on this kind of knowledge to create a competitive advantage will not be sufficient any more (Doz, Santos, & Williamson, 2001). Tacit knowledge on the other hand, is embedded in a local context (Szulanski, 1995, 1996, 2000), which makes it far more difficult to transfer. Because of the uneven distribution of knowledge in the world, there exist pockets of unexploited, tacit knowledge that are scattered across the world (Doz, Santos, & Williamson, 2001; Chesbrough, 2003). This knowledge is locally imprisoned because of its tacit nature, but represents *a big opportunity for MNEs* that can make use this knowledge to create new innovations. Since this knowledge is deeply embedded in particular contexts, innovating firms have to globalize their R&D activities in order to get access to this knowledge. MNEs should be able to derive value from networks that extend *beyond their subsidiaries* that allows them to tap into the most innovative resources worldwide. Doz, Santos, and Williamson (2001; 2004) argue that in order to tap into these pockets of knowledge, innovating MNEs have to adapt their structure. We will describe this structure more into dept in the next section.

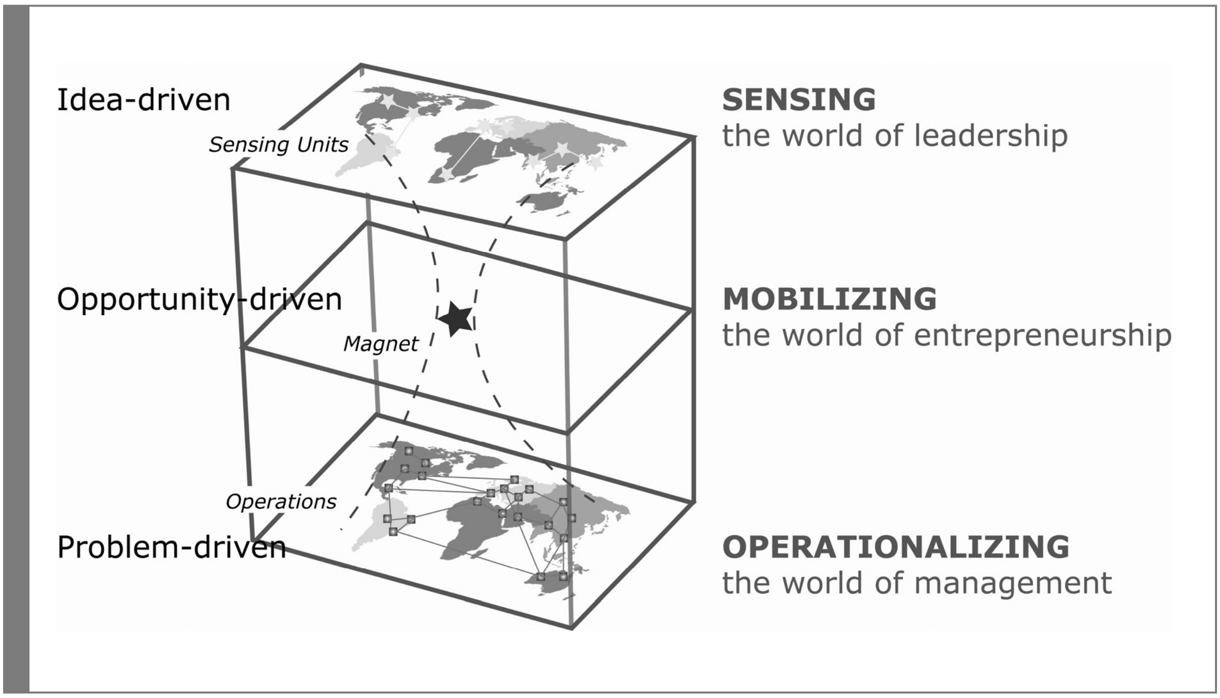
3.2 The Metanational Company

In order to tap into local pockets of knowledge, and to connect globally dispersed knowledge, MNEs need structures and processes to access, repack, and mobilize this sophisticated, complex knowledge and reach those who can use it (Doz, Santos & Williamson, 2001; 2004). MNEs that are able to create a globally integrated innovation chain are dubbed by Doz, Santos and Williamson (2001) as *metanationals*. The authors used the prefix 'meta', from the Greek term for 'beyond', to emphasize the key point that metanationals innovate by connecting local pockets of technology, market knowledge, and capabilities that lie beyond their traditional operations network (Doz, Santos & Williamson, 2001).

Metanationals not only profit from finding more diverse kinds of knowledge, but they get more, higher-value innovations at a lower cost by accessing knowledge from *non-traditional locations* where it is cheap to obtain (Doz, Santos & Williamson, 2004). Like a transnational company, metanationals will adapt their products to local needs, but they will also learn from these local needs, to eventually create new innovations. But on top of that, metanationals will also look *beyond their existing operational network* and search for new sources of knowledge or technology. This was not the case with the transnational company (Bartlett & Ghoshal, 1998). The advantage of innovations that spring from the *integration of dispersed sources of specialist knowledge,* is that they are *very difficult for competitors to copy*. This will definitely give a company a sustainable competitive advantage over companies that only rely on local innovations (Doz, Santos, & Williamson, 2001).

Doz, Santos and Williamson (2001) have come up with a *three-fold structure* that allows MNEs to profit maximally from external technology that is imprisoned in local innovation systems. According to the authors, MNEs should start by developing a *sensing network* to identify and access new specialist knowledge. Afterwards the MNE should *mobilize* this dispersed knowledge through major projects by integrating the scattered pieces of knowledge to pioneer new products and services. In a last step, MNEs have to *harvest value* from these innovations by determining the optimal size and configuration of operations for efficiency, flexibility and financial discipline, once the product or new business is developed. The classical MNEs and transnational companies are focusing almost exclusively on the operationalizing level (see Chapter 2). These three different levels or planes, are illustrated in Figure 3.1 (Doz, 2006b).

Figure 3.1 - The Three Levels of Competition in the Global Knowledge Economy



Source: Doz, Santos, & Williamson, 2001; Doz, 2006b.

3.3 A Three-fold Structure: Sensing, Mobilizing, Operationalizing.

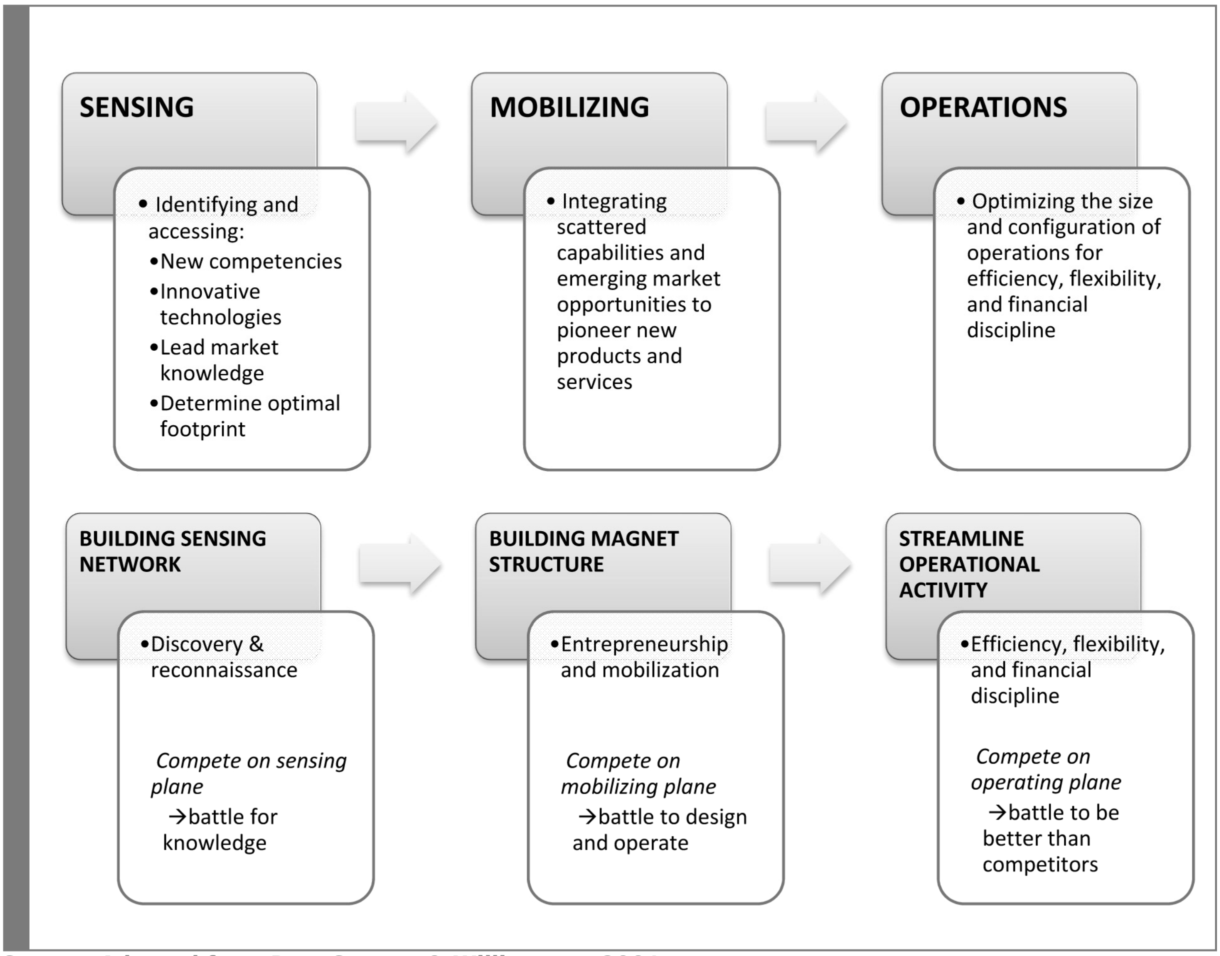
As described in previous section and illustrated in Figure 3.1, MNEs have to beat their competitors in three ways (Doz, Santos, & Williamson, 2001). The first level of competition is to *identify and access* new and relevant technologies, competencies, and specialist knowledge of lead markets emerging in locations dotted around the world. In a later paper of Doz, Santos and Williamson (2004), these authors add an extra challenge to this plane. They argue that a MNE also has to *assess the value-cost ratio of including an additional location* (determining the optimal 'footprint' for a metanational innovation process)[1]. The second level of competition is the effectiveness and speed with which companies can *connect these globally scattered pieces* of specialist knowledge by finding a cost-effective mechanism to move distant knowledge without destroying its integrity, and use them to create innovative products, services, and processes. The third, and last level of global competition is "optimizing the efficiency of the global sales, distribution, marketing, and supply chain to leverage these product, service, and process innovations across global markets rapidly and cost-effectively" (Doz, Santos, & Williamson, 2001). Nowadays companies only attempt to realize this last challenge (Doz, Santos, & Williamson, 2001).

[1] We will discuss this topic more in detail in Chapter 5.

It is important to recognize that a company cannot just try to force-fit an existing organizational structure and its staff into a metanational way of behaving (Doz, Santos, & Williamson, 2001). It could have catastrophic consequences. Globalizing a company's R&D sites can, for instance, transform the company into a "global debating society". When a MNE just invests in IT and communication systems to connect the dispersed pockets of knowledge, everybody in the company gets linked to each other. But this simplistic way of dealing with the problem just creates an excess of networking and consultation. It could make the company inefficient and is likely to handicap decision-making. Another possibility is that when a MNE keeps its organizational structure, and starts to globalize their R&D, it could overload managers and staff with more work, when they are suddenly getting a huge list of new responsibilities on top of their regular tasks. Most of the time the company will then become too complex and will witness an increased overhead. These arguments show that a company should *restructure itself* completely when it wants to make use of the untapped potentials of pockets of technology, capabilities, and market knowledge that are scattered around the world. The company cannot just keep its existing multinational structure when it wants to become a metanational company (Doz, Santos, & Williamson, 2001). Most of the time MNEs fall in either of two categories: or they are very globally integrated MNEs, where the knowledge flows from the headquarters to the subsidiaries; or they are local-for-local companies (Bartlett & Ghoshal, 1998), where the knowledge flows are weak and the MNE is split up into series of independent national units (Doz, Santos, & Williamson, 2001). Neither approach offers much hope for metanational innovation.

In order to make use of the knowledge that lies beyond the MNE's existing operational structure, a special organizational structure should be set up. This consists of three levels, or 'planes', from identifying an idea to turning the idea into a profitable product. These planes are, as described by Doz, Santos and Williamson (2001), the sensing plane, the mobilizing plane, and the operating plane. On each plane, MNEs need certain competencies at in order to succesfully compete against other companies that are operating on the same plane. This structure together with the competencies that are required at each level are summarized in Figure 3.2.

Figure 3.2 - The three planes and their operational meaning



Source: Adapted from Doz, Santos, & Williamson, 2001.

3.3.1 The First Plane: Sensing

3.3.1.1 Sensing Network

To surpass competitors in the new knowledge economy, companies have to scan the world for new potentially valuable pockets of knowledge. The knowledge that most companies will be looking for are new competencies, innovative technologies and lead market knowledge. MNEs will specifically be looking for those pieces of knowledge that other companies have not acquired yet or are not able to acquire, because it can give them a competitive advantage. These pieces of knowledge will contribute the most to the MNEs own innovation process. It will not only *augment* their existing know-how base (Kuemmerle, 1997), but will also *add diversity* to it. These new pools of knowledge are however, most of the time located outside the firm's existing R&D or product development network (Doz, Santos, & Williamson, 2001).

That is why, when a company wants to scan the world for knowledge that can give the company a competitive advantage, it has to extend its reach by scanning further than the typical environment that they are used to work in (Doz, Santos, & Williamson, 2001; 2004). To increase this reach, they have to set up a *sensing network*. The purpose of this network is exploring the external environment in order to find useful knowledge and getting access to it. This network is likely to be *different than the existing operating network*. MNEs have to search further than the traditional knowledge pools, because the chances are great that their competitors are also scouting there, which diminishes the chance of finding knowledge that will stimulate the innovation process in a way that competitors are not able to copy. These companies should set up, what is called by Kuemmerle (1997), a home-base-augmenting site. This site has the primary objective to tap knowledge from competitors and universities around the globe. In a home-base-augmenting R&D site, knowledge has to flow from the foreign site to the central hub at home. Their R&D site should be *"located in regional clusters of scientific excellence in order to tap into new sources of knowledge"* (Kuemmerle, 1997). To make this network succeed in its purpose and to be able to compete on the sensing plane, discovery and reconnaissance skills are required. These skills are needed to be effective and efficient in exploring the environment and being able to discover and uncover potential valuable knowledge (Doz, Santos, & Williamson, 2001).

3.3.1.2 Three Challenges of the Sensing Process

Building a metanational advantage is for a great part influenced by the MNE's capacity to innovate by tapping and connecting pockets of knowledge that are scattered around the world. This means having the ability to sense new pockets of knowledge before competitors recognize them, and to access this new knowledge more effectively than the competition does. Building this *sensing capability* (the ability to learn from the world) is therefore a critical prerequisite for winning in the global knowledge economy (Doz, Santos, & Williamson, 2001; 2004).

3.3.1.2.1 Challenge 1: the capacity to identify a sensing need

In order to focus the sensing process, it is important to determine what exactly you are looking for. This is called identifying a sensing need. Because setting up a sensing network requires a high investment, MNEs have to choose the location that will offer the best return. MNEs have to make choices related to three aspects of the sensing problem: what to sense, where to look for it and who might provide a fertile source (Doz, Santos, & Williamson, 2001).

Sensing is not a random process. The MNE has to start with a vision before setting up this sensing network (Doz, Santos, & Williamson, 2001). In some cases the MNE will know what it wants and will have a good target, but in other cases it will have a less precise defined target. It seems logical that the more incremental the innovation is, the better the target the MNE will have to look for, will be defined. With radical innovations on the other hand, MNEs will have a more vaguely defined target to look for. Novartis, for instance, locates itself in Singapore to learn about the next tropical diseases, without exactly knowing what they will learn or discover. They may first search the traditional hotspots in order to find the knowledge they need, but for some other very new scientific and technologic innovations, it is more likely that it will be found in a location outside the existing MNEs network (Doz, Santos, & Williamson, 2001). When applying this to the stage-gate model for product development, described by Cooper (1986), this means that the closer the product development is to the market, the better the needed knowledge and the location where the MNE has to look for this knowledge will be defined. It is true that in some cases new successful knowledge locations and innovation ideas are found by pure chance, but having an intensive sensing network will improve the chances of success (Doz, Santos, & Williamson, 2004). Managers throughout the world need to continuously ask themselves: "What distinctive knowledge do I see in this local cluster?" and "How can it contribute to our global innovation effort?" (Doz, Santos, & Williamson, 2004).

MNEs should have an open mind when trying to prospect new locations where the knowledge might be found that could stimulate their company's innovation engine. Most companies however, only pay attention to the knowledge about markets and technologies that are coming from the headquarters, or from the most profitable subsidiaries (Doz, Santos, & Williamson, 2001). But diverse, new knowledge is more likely to come from the periphery of an organization where very different environments create different technological breakthroughs and market behavior. Keeping this in mind, companies should try to be as objective as possible when new ideas are generated, and should not first check if knowledge is coming from a profitable area in their innovation network or not (Doz, Santos & Williamson, 2004).

A MNE can follow two strategies to determine where to look for knowledge (Doz, Santos, & Williamson, 2001). The first option is to look where established industry leaders are already present, and fish in the same knowledge pool as they do. This strategy will be less costly, but will not provide the MNE with a competitive advantage. When you keep following, you will have great difficulties to ever get ahead. The second option is to look for new, yet to be discovered areas to find pockets of knowledge that your competitors have overlooked; or to predict where new technological hotspots may emerge, and establish a presence in these locations. This same logic can be applied when deciding with which partners you should collaborate. Working together with the large and dominant partners will only give your MNE the knowledge that their competitors already have identified, while partnering with customers or other companies that are experimenting with new applications can offer more valuable knowledge (Doz, Santos, & Williamson, 2001).

3.3.1.2.2 Challenge 2: the capability to prospect the world for sources of relevant knowledge

After having defined a sensing need, a MNE has to start the actual search for sources of knowledge that will help solve their problem. These sources can be found in new or existing hotbeds of technology all over the world. These hotbeds can arise around leapfroggers, lifestyle leaders, in locations where technologies converge (Doz, Santos, & Williamson, 2001).

Leapfroggers are laggards that become leaders. They often threaten the market leadership of big companies with disruptive innovations (Christensen, 1997). Market leaders often have a cumulative technological path. This means that they build on their existing knowledge to make new innovations and are biased by what they were doing. Leapfroggers on the other hand, can be small firms that dispose over different knowledge that could enable them to leapfrog other firms. Leapfroggers see things in a new way, have new customer insight, etc… and as a result, are able to outperform the traditional market leaders. A MNE cannot know in advance that another company will become a leapfrogger and threaten their business. And if they only look at the usual businesses or locations, they will never find or see the leapfroggers. MNEs have to look for things that are completely new or look a little bit strange (underground movements, young people) that are not the mainstream.

Lifestyle leaders can indicate changing market trends and will be ahead of the rest of the population, and thus be able to give you a head start as new lifestyles can lead you to new technologies (Doz, Santos, & Williamson, 2001).

Locations of technology convergence: when two or more technologies evolve in the same direction, it is likely that new technologies will emerge. An example of this could be when mobile internet evolves to make the modems used to connect to the internet smaller, and cell phones evolve to become a more all round product, that both technologies are combined to introduce internet on a cell phone (Doz, Santos, & Williamson, 2001).

Many more ways exist to uncover future technology hotbeds. More developed metanationals can monitor several factors in order to keep expanding their reach. The following activities can help the MNE uncover future technology hotbeds:

- Keep a close eye on government and university science centers as new hotspots may emerge in these locations (Doz, Santos, & Williamson, 2001);
- Locate the areas where disruptive technologies emerge (Christensen, 1997);
- Look for growth in long-distance phone traffic and internet nodes. This indicates an increasing concentration of well educated and curious communities ((Doz, Santos, & Williamson, 2001; von Hippel, 2001);
- Look for locations that provide complementary skills. Factories and research centers may settle next to factories that produce an input to the production process (Doz, Santos, & Williamson, 2001);
- Monitor changes in regulations that promote innovation within a certain region or allow more rapid market introduction (Doz, Santos, & Williamson, 2001);
- Monitor rapid changes in disposable income, as it may lead to the creation of new needs (Doz, Santos, & Williamson, 2001);
- Track the movement of interesting people to see if patterns emerge (Doz, Santos, & Williamson, 2001).

The ability to prospect for new pockets knowledge requires a special kind of people, with the right role and a special incentive system. Prospecting is like Doz, Santos, and Williamson (2001) state: "an art, not a science, it requires having a global view, informed by a good understanding of the world, as well as creativity and a sense of the future".

3.3.1.2.3 Challenge 3: the capacity to access new knowledge once its location is identified

After the prospectors have found the knowledge they were looking for, the MNE needs to access it. Sometimes knowledge can be accessed quickly and at low cost, but in other cases it requires substantial long term investments. The difficulties lay within the nature of the knowledge and the willingness of the owner of the intellectual property to share the information (Doz, Santos, & Williamson, 2001; Cohen & Levinthal, 1990; Doz, Santos, & Williamson, 2004; Szulanski, 1996, Nonaka, & Takeuchi, 1995; von Hippel, 1994)

The nature of the knowledge can be simple or complex. Simple knowledge is knowledge that can be easily transferred, because it is possible to codify it to a generally understood form without misinterpretations regardless of the context in which it is viewed.(Doz, Santos, & Williamson, 2001). A chemical formula is an example of such knowledge. It can be made explicit by writing it down on a piece of paper and is easy to transfer (by email for example). Relying on this type of knowledge only is not sufficient anymore to create a sustainable competitive advantage. MNEs should make use of more complex, tacit and sticky knowledge (Doz, Santos, & Williamson, 2001).

Complex knowledge is knowledge that can only be understood when its context is taken into account. In some cases it may be difficult to access knowledge because the holders are not able to articulate it; they are not conscious of what they know, and hence cannot explain it. Their knowledge is tacit, and because it has a more tacit nature it cannot be fully codified and transferred (Doz, Santos, & Williamson, 2001). Tacit knowledge however can be seized by feeling and living it, through experience and practice, in the context where it resides. Tacit and context-dependent knowledge is often unique which is ideal to gain a competitive advantage, but most of the time immobile because it is locked in a local context (Doz, 2006b). Another barrier, for both simple and complex knowledge, will present itself when the knowledge holders are not willing to reveal what they know, or lack the time to communicate it (Doz, Santos, & Williamson, 2001). In these cases there will be a strong need for collaboration.

A MNE should set up an external network of people or instances that facilitate gaining access to important sources of knowledge. These partners can be outsiders like: customers, distributors, suppliers, local universities, local insiders, other partners, venture capital funds, knowledge brokers, emigrant populations, competitors, etc... All of them can help the MNE gain access to local sources of knowledge. A MNE should however be aware of the danger of relying too much on third parties (Doz, Santos, & Williamson, 2001).

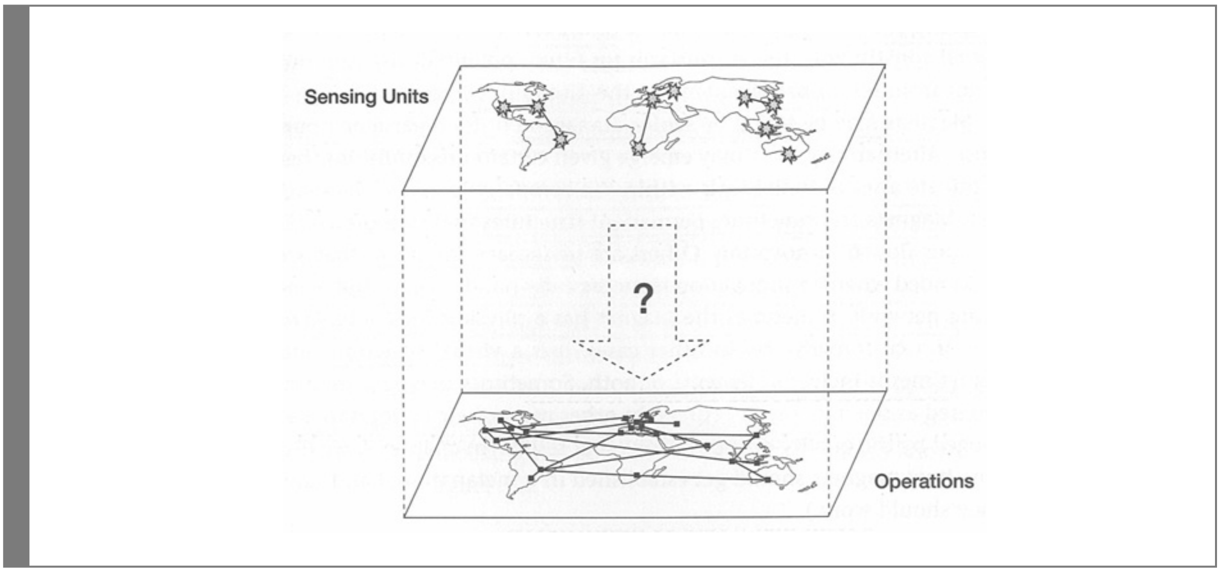
Even when a company has identified valuable pools of knowledge, they have to bear in mind that integrating it into their innovation process will imply extra costs (Bartlett & Ghoshal, 1998), especially when the knowledge has to be accessed from a distant location (Doz, Santos, & Williamson, 2004). This is why companies should try to find the ideal 'footprint'. It represents the trade-off between the cost of an additional location and the benefits gained from this location (Doz, Santos, & Williamson, 2004). This trade-off will be discussed in chapter 5, when we discuss what the optimal number of R&D locations should be for a MNE.

3.3.2 The Second Plane: Mobilizing

After the company has indentified and obtained access to useful sources of knowledge, and established an appropriate footprint to create a metanational innovation process, the second challenge is now *mobilizing and integrating knowledge from different location*s that has been acquired through the sensing strategy, and transform this into usable innovations (Doz, Santos, & Williamson, 2001; 2004; Doz, 2006).

The previous steps can be summarized in the following figure. When a MNE has a lot of dispersed pieces of knowledge, the knowledge still has to be transformed into innovations. To do this, the MNE has to bridge the gap between the sensing plane and the operating plane (Doz, Santos, & Williamson, 2001).

Figure 3.3 - Gap between Sensing and Operating



Source: Doz, Santos, & Williamson, 2001.

3.3.2.1 Entrepreneurial insight

The knowledge that the company accessed after the sensing process is still enormously dispersed. Therefore, the MNE needs a trigger to get the innovation process started. They need a team or individual that is able to see a valuable opportunity in the combination of the dispersed pieces of knowledge. This is what Doz, Santos, and

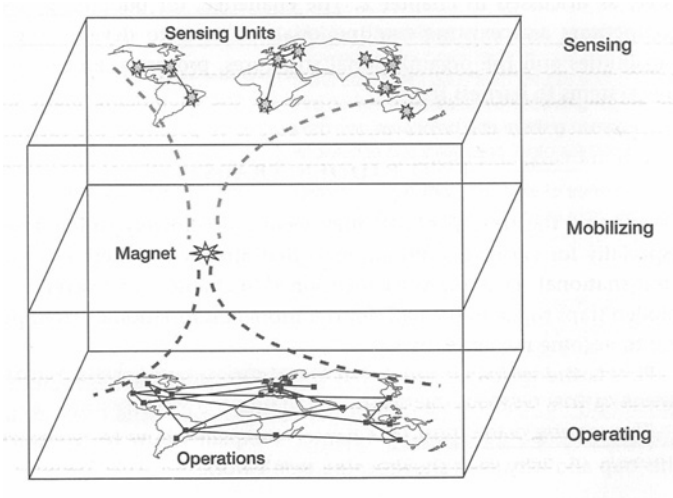
Williamson (2001) call the *entrepreneurial insight*. It is obvious that having this insight is not evident. You need to have a complete overview of all the knowledge that the sensing network found all over the world, and then the enterpreneur needs to combine that knowledge and create a new valuable product or service. That is why most of the breakthrough innovations that currently arise evolve from combining knowledge that is found locally, and not from combining knowledge that lies far away from the local R&D site (Doz, Santos, & Williamson, 2001). To foster such an entrepreneurial insight, companies can do a number of things.

Doz, Santos, and Williamson (2001) argue that the *senior management* plays an important role in fostering insight. These authors have witnessed that the pioneering metanational companies have a top management that has a lot of international experience. This gives them a headstart in knowing where to find certain capabilities or where certain lead market needs might emerge. A company should also stimulate the innovativeness of their workforce. This can be done by for example asking subsidiaries to solve problems that do not lay within their theoretical or practical capacity. It will force them to think out of the box to find a suitable solution (Doz, Santos, & Williamson, 2001). Another example is arranging meetings between people from different business areas. When you put people with different backgrounds or from different business areas together, they will learn from each other and will become more able to combine different pieces of knowledge. A second important tool to enhance the entrepreneurial spirit among people is the creation of a *corporate knowledge map* (Doz, Santos, & Williamson, 2001). This is a list of the all the IP, technologies and market knowledge that are availibale within the global organization. With this map it is easier to connect the knowledge or capabilities that lie in the company with each other and find new valuable opportunities. A third tool can be defining *challenging but fuzzy goals* for the staff. This will trigger the creativeness of the people and will foster their enterpreneurial spirit, because they are not stringent by procedures (Doz, Santos, & Williamson, 2001).

3.3.2.2 Magnets

Having entrepreneurial insight is not enough to create a tangible result. A company should create an *organizational form*, to attract dispersed knowledge and bring this knowledge together by defining a common goal. The result of this focus should be new products or services. Doz, Santos, and Williamson (2001) call mechanisms that perform these activities magnets. Magnets form the missing link between the sensing activity and the operations network.

Figure 3.4 - The Metanational Process



Source: Doz, Santos, & Williamson, 2001.

We will describe two kinds of magnets that can pull together the dispersed technologies, skills, and market knowledge that are captured through the sensing network (Doz, Santos, & Williamson, 2001):

- A global lead customer, and;
- A global product (or service) platform.

(Doz, Santos, & Williamson, 2001)

3.3.2.2.1 Global lead customer

A company can use a global lead customer to access complex knowledge. It is important that the company chooses a customer who is on the *leading edge* of its own industry or a company that wants to *leapfrog the existing business leaders* with new innovations. When a company just follows the business practices of another company, there is little chance that they will be able to provide valuable knowledge. An ideal candidate would be a company that strives to improve the efficiency of their business practices or seeks to find new ways of differentiating their own products (Doz, Santos, & Williamson, 2001; 2004).

When a firm works together with lead customers, it will not immediately be able to solve or even understand the problem or needs that these customers have. To overcome this, the company needs to increase their own knowledge base with knowledge that is scattered across its own international operating network and competitors; and knowledge from other customers. They should combine this knowledge and meld it with the knowledge over which the lead customer disposes or that resides within the network of this lead customer . By combining these pockets of knowledge in an innovative way, a firm will be able to serve its customer. The need of a lead customer acts as a magnet that forces the company to be creative with the knowledge that resides in its existing network and also forces the company to search beyond its network to fill the knowledge gap (Doz, Santos, & Williamson, 2001; 2004).

3.3.2.2.2 Global platform

A second kind of magnet is a global platform. By platform we mean the core architecture of a product or service, of a process, or even of a business model, that may be adapted to serve different global customers or to compete in different global market segments. An example of a product platform is the A380 Airbus. The architecture of the A380 Airbus brings together knowledge from various sources like engineering teams, customers, and suppliers from all over the world. The use of a global platform as a magnet has the advantage that the pieces of knowledge that are required (and the ways in which they are fit together), are strictly defined. This helps to make the innovation process more predictable. A more predictable innovation process, however, will most of the time impose restrictions on the further development of the innovation. As a result, the final product will be completed in a more timely fashion, but will be of lower quality than it could have been. This approach will thus will lead to less breakthrough innovations compared to innovations by a global lead customer (Doz, Santos, & Williamson, 2001; 2004).

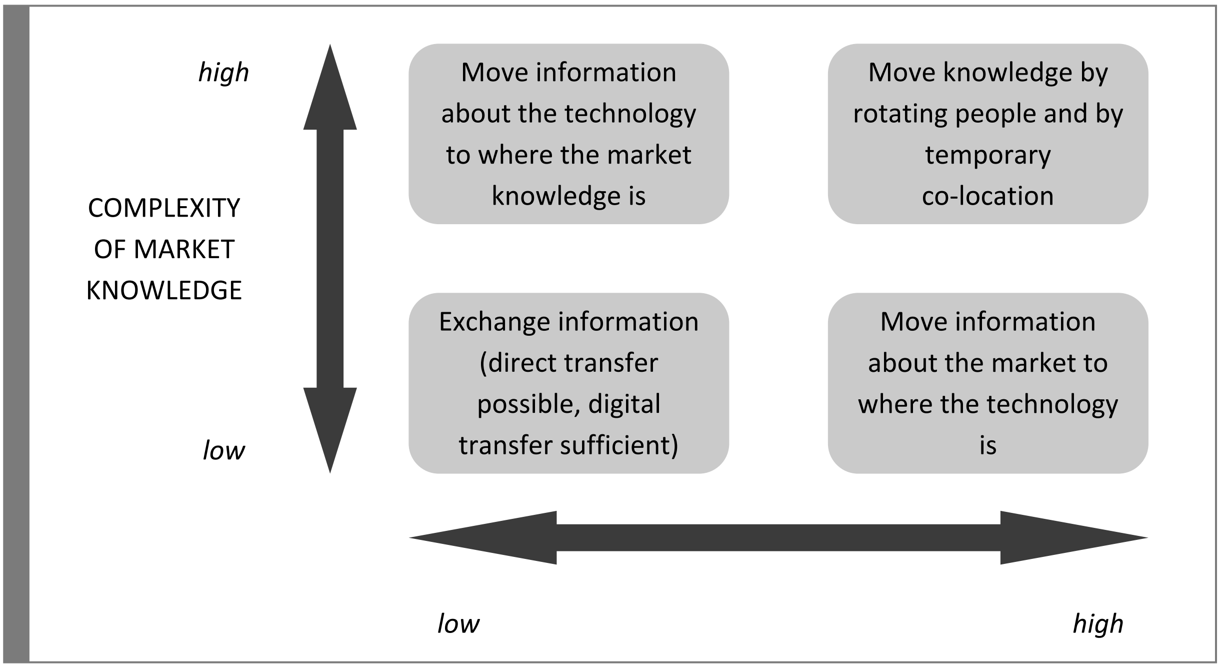
Once the MNE has their magnet in place, the work is not finished yet. The sensing department has discovered a lot of specialist knowledge that the MNE could use for its innovation, but this knowledge is still scattered around the world. The challenge for the magnet team is now to identify and locate the knowledge that it needs to deploy (Doz, Santos, & Williamson, 2001). The magnet team first needs to know what pieces of knowledge they need for a particular innovation. It is possible that they can come to the conclusion that there are still some parts of knowledge that they need, but have not found yet. This need has then to be communicated to the sensing department so that they can focus their search on that area. It is therefore of great importance that there is a good dialogue between the magnet and the sensing units (Doz, Santos, & Williamson, 2001).

3.3.2.3 Mobilizing the knowledge

If all the pieces of knowledge are found, the next challenge is to figure out how to move the scattered pieces of knowledge. In that way the knowledge can be shared with the magnet team who has the task to create innovative products and services. This is the second challenge the magnet team faces. It has to be stressed that moving dispersed knowledge needs to be done by the magnet team, not by the sensing unit, which has the task to prospect for new knowledge and access it. Doz, Santos, and Williamson (2001) therefore argue that the magnet team needs to include people who can act as brokers to make the transfer of knowledge between the sensing unit and the magnet team more easy.

To move the dispersed knowledge, a MNE first needs to be aware of the nature of the knowledge. As explained earlier, knowledge can be simple, thus easy to move. But knowledge could also be complex, which means that it is sticky, and deeply embedded in a local culture, which makes it difficult to transport (Doz, Santos, & Williamson, 2001, 2004; Szulanski, 1996; Nonaka & Takeushi, 1995). Fortunately it is possible to simplify some knowledge by making it explicit and then codify it. Some other knowledge however, cannot easily be simplified, and needs personal interaction for months or even years before it is completely understood. Doz, Santos, & Williamson (2004) presents a framework that suggests what the best way is to move a particular kind of knowledge (see Figure 3.5). Most innovation projects will require a combination of knowledge that is simple to move and other pieces of knowledge that are complex. Therefore, to make a metanational innovation process work, it will demand a mix of mobilization strategies (Doz, Santos, & Williamson, 2001; 2004).

Figure 3.5 - How to Move Knowledge in the Metanational Innovation Process



Source: Doz, Santos, & Williamson, 2004.

The magnet team has to start with rating both the market and technological knowledge they need to fuel their innovation process on a scale of complexity: from knowledge that can easily be codified and transferred, to knowledge that is tacit and difficult to understand in the context of a different location (Doz, Santos, & Williamson, 2001; 2004). When both the market understanding and the required technology are simple, it is easy to share the knowledge (lower-left quadrant of Figure 3.5). The knowledge can be transformed into data and information without loss of content. Simple communication tools and IT will be sufficient to let this knowledge flow through the network. When the required market knowledge that has to be shared is complex (e.g. understanding of customer behavior that depends on deep understanding of the local context), but the technical expertise is readily codified, it is better to relocate the innovation team to the place where the key market knowledge resides, and transfer the technological knowledge to there (upper-left quadrant of Figure 3.5). In the third scenario, when the technology is very complex (e.g. the design of complex software that involves large teams of engineers), and requires spontaneous, close interaction with suppliers, universities, and other partners, but the market knowledge is available through data and research reports; it is advised to codify the market knowledge and transport it to the home of the complex technical knowledge, letting the innovation team work in the clusters where the technology originates (lower-right quadrant of Figure 3.5). In the most difficult case, when both market and technical knowledge are very complex, sharing knowledge will involve a succession of short periods of co-location (upper-right quadrant of Figure 3.5). People should be moved continuously throughout the different sites. Co-location is a very expensive option, and should only be chosen when absolutely necessary. A problem with co-location is that a lot of subtle knowledge can be forgotten or lost when people are relocated to an unfamiliar context for long periods of time (Doz, Santos, & Williamson, 2001).

Nonaka and Takeuchi (1995) pointed out that in a way all knowledge is contextual because new knowledge can only be created in a context-dependent process. However, the magnet team can also try to make the knowledge context neutral (Doz, Santos, & Williamson, 2001). Doz (2006b) argues that context neutral knowledge may be articulated, and could be made fully explicit, but will however not be truely independent of the context in which it was created. Therefore, *"trying to make complex knowledge independent from its originating context will be self-defeating"* (Doz, 2006b). Making knowledge more neutral can be done by either translating into a neutral language, or by breaking the knowledge down into components (Doz, 2006b). A neutral language is a language that everyone with a similar educational background should be able to understand. The origin of the location where the knowledge was created is therefore not important. Companies should however be careful to not oversimplify complex knowledge (Doz, 2006b). Companies have to deal with a trade-off, they have to find a balance between complexity and simplicity when packaging the knowledge.

A company also has to decide what kind of knowledge sharing instrument or 'knowledge carrier' should be used to transfer the different types and mixes of knowledge among units and people (Doz, 2006b; Doz, Santos, & Williamson, 2001). Knowledge on its own cannot flow between two places, what actually moves is a carrier of knowledge, like a tool, a machine, a person, a blueprint, and so on. It is important for a MNE to realize that knowledge degrades when it is moved, and that is will be reinterpreted in a new context, or recontextualized, when it reaches its destination (Doz, Santos, & Williamson, 2001; Nonaka & Takeushi, 1995). How the knowledge will change after it is moved will depend on the knowledge carrier that was chosen. A first carrier of knowledge is *information*. This can be a spreadsheet, a formula or a blueprint. It has the advantage that it is relatively cheap to transport it to another location. Information however also has limitations: it cannot deal with the tacit elements of knowledge, nor is it resistant to the problems related to recontextualization. With the current ICT infrastructures it is possible to send information across the world in a nick of time. But ICT however can only deal with knowledge that is well articulated, which is a great disadvantage as the greatest competitive advantage is realized by integrating complex knowledge that is tacit and context-dependent (Doz, Santos, & Williamson, 2001). *People* are another knowledge carrier. In contrast to information, they are able to carry rather complex knowledge. The problem however is that when people are located in a different environment, the quality of the knowledge they posses decays. The original context in which the knowledge was created or viewed is an important part of the knowledge as well, this part however is lost when the person moves to a different context. (Doz, Santos, & Williamson, 2001).

With respect to the knowledge carriers, the company faces a tradeoff between the impersonal, but efficient way of communicating by simple and inexpensive channels like email and net meetings; and the effectiveness of face-to-face communication. Personal communication however, implies high travel costs and the need for personal stamina of the people involved. Here again the MNE needs to find a balance between effectiveness and costs (Doz, Santos, & Williamson, 2001).

3.3.2.4 Melding the dispersed pieces of knowledge

The third and final task the magnet team has, is what Doz, Santos and Williamson (2001) call to "*meld*" the previously dispersed packages of knowledge. Melting means making the dispersed pieces of knowledge fluid so they can be mixed with each other. Afterwards the whole mix can be welded together to make an integrated package of knowledge. Melding is more than just clicking the different knowledge pieces together, it is a transformation process in which new knowledge is created by the interaction and integration of knowledge that was preciously dispersed and diverse. When your innovation process is so difficult, that you need to meld millions of different pieces of knowledge together, it is recommended to create a knowledge architecture. It tells you what pieces of knowledge need to be used where and how they interrelate with one another. According to Doz, Santos and Williamson (2001) it is almost always necessary to bring all the key members of the magnet team together in one place to develop an initial version of the knowledge architecture. The melding task has some different characteristics when using different kinds of magnets. When using a global lead customer as a magnet, a lot of face-to-face interaction is required, making the travel costs high. Using a global platform as a magnet made the melding problem more easy because you can divide the problem in sub problems, each focusing on a particular module (Doz, Santos, & Williamson, 2001).

A magnet can be called effective, when it is able to form the missing link between dispersed specialist knowledge, and harvesting value from the innovation that results from it. The magnet has to be able to attract the scattered pockets of specialist knowledge that are found by the sensing network, focus this knowledge on a clear innovation objective, and create new innovative products and services by mobilizing knowledge that was locally imprisoned (Doz, Santos, & Williamson, 2001).

Doz, Santos and Williamson (2001) argue that it is important for a company to *separate* the sensing and magnet organizations from the operations department. In that way people can focus on their specific roles: prospecting for and accessing new knowledge, and mobilizing that knowledge to create innovations. It allows the top management's involvement, structures, staffing, performance measures and incentives to be customized to the needs of the separate sensing and magnet organizations.

The final step the company has to take to gain a metanational advantage, is "creating conditions in which the day-to-day operations can *leverage innovations to maximize the return on investment in a global market"* (Doz, Santos, & Williamson, 2001). This will be done by the third organizational layer: the operating network. This network has the task to leverage the innovations to create wealth.

3.3.3 The Third Plane: Operationalizing

Ultimately, every company has the same objective, it has to create real shareholder value in order to survive. To achieve this, the MNE has to pass its innovations on to the operating network, where they can be leveraged and exploited for profit on a global scale (Doz, Santos & Williamson, 2001).

The design of an efficient operations network entails that the operations network has to be aligned with its goal: "leveraging the steam of innovative products and services in markets across the globe, guided by the principles of operational efficiency, flexibility, and financial discipline" (Doz, Santos, & Williamson, 2001). The operations network of a metanational company will resemble a lot to the one of a traditional multinational as it will consist of production, distribution, sales, marketing and service departments. It also has to find a balance between global efficiency and local adaptation. But there are *fundamental differences* too. These differences stem from the fact that, unlike traditional multinationals, the metanational views the world as consisting of two canvases. Doz, Santos and Williamson (2001) explain that "one global canvas views the world as dotted with pockets of specialist knowledge that the metanational can access and mobilize to fuel its innovation process. The second global canvas views the world as dotted with distinctive pockets of operational capabilities and capacities that it can use to exploit and leverage the innovations it creates”. From this second canvas the metanational creates its operations network. This fundamental dissimilarity causes the metanational company to differ from the traditional multinational, as the metanational will be organized around different locations and the capabilities of teams and people present in these locations, instead of around national subsidiaries (Doz, Santos & Williamson, 2001). It are the operating capabilities that are globally available that are important for metanationals. It is the quality of the capabilities that count, not the location itself. This quality can come from accumulated experience or from the natural geographical advantages of sites, like for example Antwerp as a logistics center. Each site will be considered as a bundle of capabilities, as well as local suppliers and partners, and the operations they own in any location. Here again tradeoff between the cost of coordination and benefits of gaining distinctive capabilities has to be made (Doz, Santos, & Williamson, 2004). The MNE should select optimal number of sites that allow to access all of the distinctive bundles of capabilities that are needed.

Every site will get a place in the operations network because of the unique bundle of operational capabilities they contributes to the whole network. Each location will constantly improve its own knowledge pool, by benefiting from *co-location*. When a lot of people are working together in a particular site, they will create over time a local culture and identity, which together with the possibilities of chance encounters and frequent, easy interaction, will enhance the exchange of tacit knowledge and the integration of capabilities within a site. Because of these benefits of co-location, it could make sense that a metanational company concentrates its operations in a particular location and a single site, rather than having them scattered around a city or a local region (Doz, Santos, & Williamson, 2001). Many products however, still require local adaptation. This implies that it could be the case that the operational network (e.g. sales and marketing) can still be location based, but the upstream activities like R&D and manufacturing might be globalized. For the airplane industry this will not be the case, because the plane that flies over Europe is the same that flies over the Asia. Products made by Procter & Gamble on the other hand have to be adapted to local needs. Like for instance detergents for washing powders that are invented on a global scale need to be adapted locally because of differences in aroma, color, different package sizes, and so on. Each site has unique capabilities that contribute to the overarching goal of leveraging the innovations from the magnet organization. But none of these sites can individually run an independent operation, so each site has to accept that they are also dependent on the other sites in the network. Each site has not only to accept, but needs to value the *interdependence* with others.

Because each site is part of the operations network because of its distinctive skill it contributes to the whole, it is imperative for each site to keep learning. They have to keep improving their distinctive local skills, because when a site no longer adds a unique capability to the total network, it will be closed; or in the case of suppliers or alliance partners, the arrangement will be ended. Each site manager should focus on maximizing the site's unique contribution to support the goal of leveraging innovations globally and to keep its site unique enough to stay open. This puts pressure on the site to keep contributing to the whole, and to as much distinctiveness as possible out of the local environment (Doz, Santos & Williamson, 2001).

When the senior operations management has assembled a set of world-class operational capabilities and deployed them in a coordinated way that optimizes global efficiency, quality, and customer satisfaction; the metanational company will have finalized their third and, last sub organization: the operations network (Doz, Santos & Williamson, 2001; 2004).

3.4 Internationalization: a first sign for a different way of innovating?

Traditionally, companies were working through a centralized R&D lab, where scientists were inventing new products, which were then developed in-house. This is what is called the closed innovation way of creating new products or services. Every product was created through vertical integration inside the MNE. This means that the internationalization as such, is a first sign that MNEs are getting less interested in developing everything at home, but prefer searching in their operational network for technology that is available somewhere else. When the right technology is found the MNE tries to in-source it. So implicitly, there is already a more 'open innovation' way of thinking when a MNE decides to set up a R&D site in for example China. The MNE will locate itself there because there are partners and institutes from which the R&D site can learn and in-source technologies from. This is the same viewpoint as the open innovation theory, which states that internal knowledge should be complemented by external knowledge (Chesbrough, 2003; 2006). This was already stated by Bartlett and Ghoshal (1998), when they explained the transnational company. These authors stated that: "Licensing will become an important source of funding, cross licensing provides a means to fill technology gaps, and joint development programs and strategic alliances are emerging as a strategy for building global competitive advantage rapidly." That is why we could say that internationalization reflects that closed innovation is getting replaced by a more open way of innovating. In the following chapter we will describe the open innovation theory more into depth.

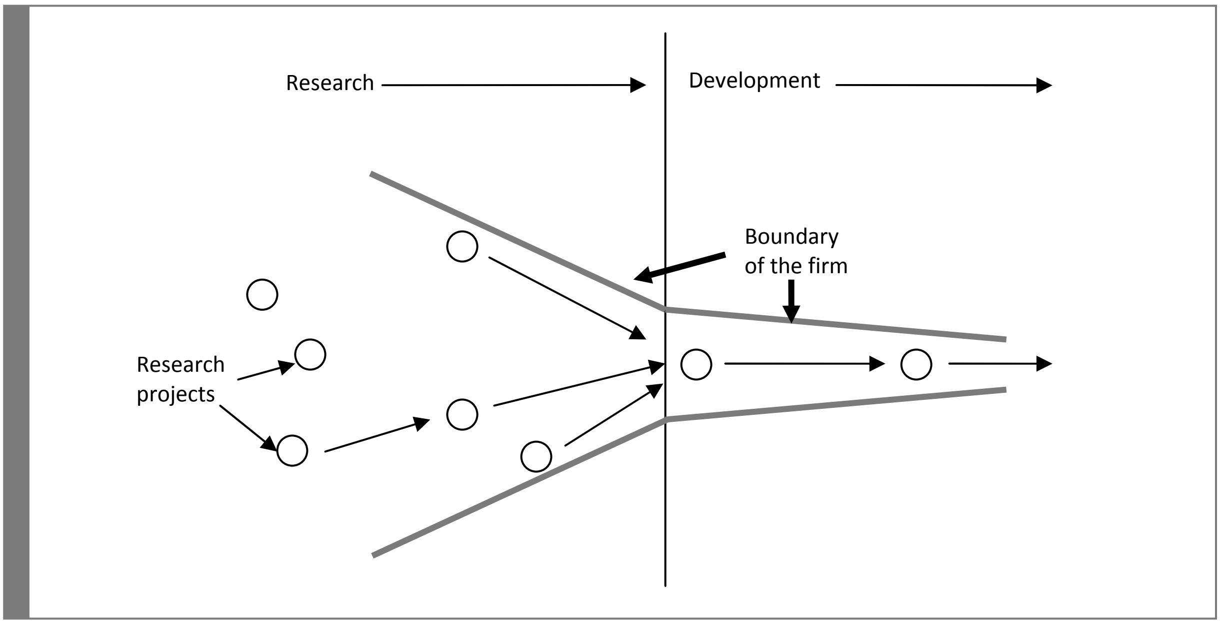
Chapter 4: Open Innovation

4.1 Centralized R&D and Closed Innovation

Closed innovation is the innovation infrastructure which can be found in large globalised corporations with central R&D facilities (Chesbrough, 2003). Traditionally, most MNEs generated all the knowledge they needed internally and did not exploit the pool of knowledge that could come from their national subsidiaries. They were certainly not making use of the knowledge that lied beyond their operational network. In chapter 2 we referred to these companies as having a center-for-global organizational structure. In these corporations *all R&D is kept centralized* and there is no transfer of the generated knowledge to the subsidiaries. The subsidiaries do not serve as knowledge generating nodes, they have the only task of implementing the strategies determined by the headquarters.

The innovation process in these firms looks like the innovation funnel that is depicted in Figure 4.1. At the beginning of the funnel there exist many research projects. As different projects further evolve, the most promising projects are continued, the others are cancelled. Eventually, a research project that is likely to have a good chance to succeed in the market will enter the development stage. Once this development stage has been completed, the project or product will be released onto the market. What characterizes the closed innovation approach, are the boundaries of the firm. In Figure 4.1 these boundaries are represented by a full line to indicate that there is no knowledge flowing into, or out of the company. The company is isolated from its surroundings and covers the whole process from idea to profit itself (Chesbrough, 2003).

Figure 4.1 - Closed Innovation

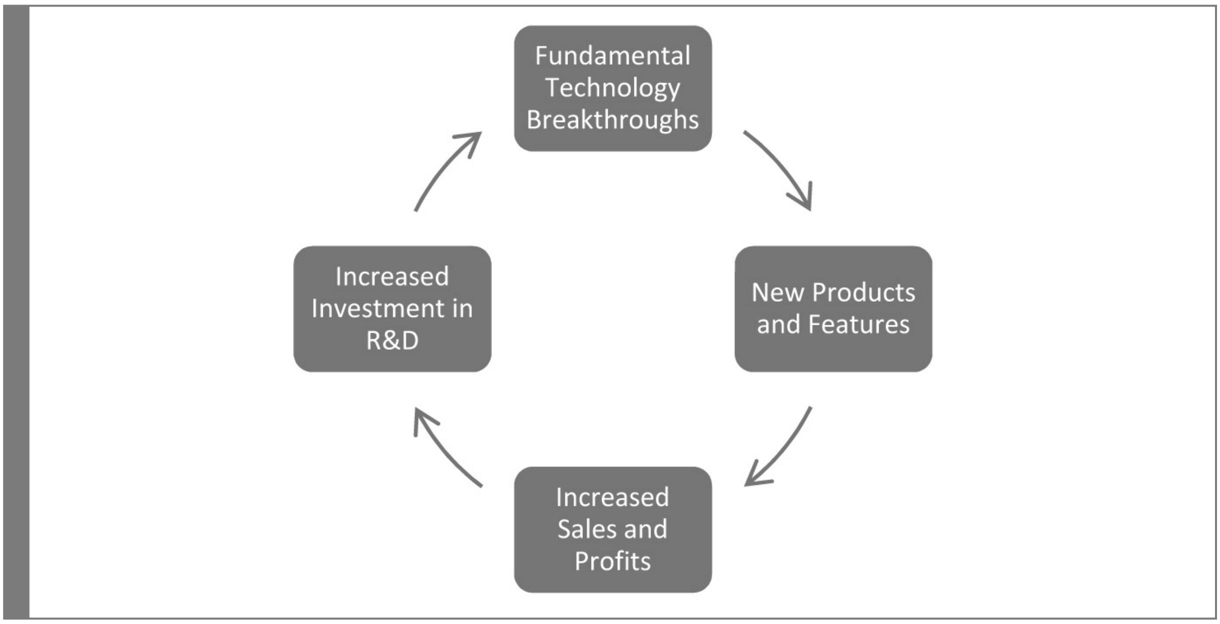


Source: Chesbrough, 2003.

This closed innovation model has worked with success for many companies in the twentieth century (Chesbrough, 2003; 2006). The use of the closed innovation model to organize the innovation process turns companies almost totally self-reliant. These companies in fact wanted to be self-reliant, for two simple reasons. First of all, they wanted to protect their intellectual property. Therefore, by organizing their R&D completely internally they could minimize the amount of knowledge spillovers. Secondly, companies believed that only they, and not someone else, had the necessary capabilities to do things the right way. They were often unsure (whether they have a good reason to be so or not) of the quality, performance and availability of a particular technology when the technology was not produced in-house. This is often referred to as the 'not invented here' syndrome. To be able to develop everything in-house, companies needed the best people available. The ability for big companies to attract the best people was considered to be an important barrier for other startup companies who also tried to recruit people, but had fewer resources to do so (Chesbrough, 2003; 2006).

The logic of closed innovation creates a virtuous circle, as can be seen in Figure 4.2. Companies invest in their internal R&D which leads to many breakthrough discoveries. These discoveries enable those companies to bring new products and services to market, which results in more sales and higher margins thanks to these products. The company then reinvests this money in more internal R&D, which again leads to more breakthroughs. Because the whole process was running *within the company walls*, other companies did not have access to the intellectual property that was created by the internal R&D. This prevented competitors to use this knowledge for their own profit (Chesbrough, 2003).

Figure 4.2 - The Virtuous Circle of Closed Innovation



Source: Chesbrough, 2003.

As noted before, the closed innovation model was working well for many companies during the twentieth century. However as time passed, the world changed, and several factors eroded the efficiency of the closed innovation model. This on one hand turned the closed innovation model incompatible with the environment in which companies currently operate, and on the other hand ignored valuable opportunities (Chesbrough, 2003; de Jong, Vanhaverbeke, Kalvet, Chesbrough, 2008).

In the next section, we will explain the factors that have changed and eroded the efficiency of the closed innovation model, and led to a break in the virtuous circle.

4.2 Erosion factors

The current (corporate) environment differs substantially from the one in the twentieth century. It is characterized by an increasing presence of private venture capital to support innovations, an increasingly fast time to market for many products and services, and a worldwide availability and mobility of highly experienced and skilled people (Chesbrough, 2003; de Jong, Vanhaverbeke, Kalvet, Chesbrough, 2008; Doz, Santos &, Williamson, 2001). Together with these changes, knowledge has become the differentiating factor in gaining a sustainable competitive advantage (Houghton & Seehan, 2000). In the following sections we will discuss these characteristics one by one.

4.2.1 The knowledge economy

After the agricultural and industrial economy, we have now entered the time of the *knowledge economy*. In the knowledge economy, knowledge is the determining factor for a company to build a lasting competitive advantage. Of course, knowledge has always been an indispensable part of business activity, but never before there was so much knowledge incorporated in business activities as now (Houghton & Sheehan, 2000). Houghton and Sheehan (2000) further argue that there are two big antecedents that have led to the rise of the knowledge economy. These antecedents are the rise of knowledge intensity within economic activities, and globalization. Both of them partially stem from changes in ICT, more specific: changes in how we communicate, and how fast we are able to transfer information. Transferring, manipulating, or storing (simple) knowledge is nowadays possible at virtually no cost, which has facilitated the application of knowledge in different areas of economic activity (Doz, Santos, & Williamson, 2001). This leads to a higher intensity of knowledge in all areas of economic activities. Because of the improvements in ICT, the kind of knowledge that is easy to codify and to transfer is no longer providing a competitive edge to companies. (Houghton & Sheehan, 2000; Doz, Santos, & Williamson, 2001, 2004). Being able to use tacit knowledge, which cannot be codified and transmitted so easily, is nowadays becoming more important for companies. Together with the rise of knowledge intensity, the economic deregulation has led to a strong increase of companies with a global operations network. An increasing amount of global activities of firms contributes to the transformation of the global economy.

For the innovation process, the most important attribute of the knowledge economy is the uneven distribution of knowledge across the world, and that this knowledge usually is embedded in centers of excellence (Carlsson, 2006; Doz, Santos, & Williamson, 2001). This spread of knowledge is for a great part the result from the education driven policy of several countries (Yao, et al., 2008). People all over the world are developing themselves in a specific environment which results in the appearance of different knowledge pools in different locations (Doz, Santos & Williamson, 2001; 2004). This means that the people who are located in one place will be likely to deal with a problem in another way than others will do who are located somewhere else. Therefore, when a MNE has access to different partners located in different places, it is likely that they will have access to different solutions for their problem. The MNE can then choose the solution that provides the best answer to their problem or it can mix different solutions together to create the best one. In contrast to what many companies may think, the best solution does not necessarily have to come from their home base (Doz, Santos, & Williamson, 2001; Bartlett & Ghoshal, 1998). Making use of different viewpoints and combining them in new ways can lead to different, and maybe better solutions than when a company only makes use of knowledge from one single source.

4.2.2 Venture capitalists and researchers

Venture capitalists are constantly on the lookout to invest in new firms that commercialize research, hoping to convert them into successful and valuable companies. Researchers realize this and will take their inventions elsewhere when they do not find the necessary support within the company. They may get in contact with venture capitalists who are willing to give them the financial support they need, and help them to start up their own company to further develop and market their invention (Chesbrough, 2003). A company is thus no longer sure that when it invests in their internal R&D, they will also reap the benefits of the resulting innovation. This is one of the challenges that closed innovation faces, and it shows how the virtuous circle as we described earlier can be broken.

4.2.3 Mobility and availability of skilled workers

Whenever employees move jobs, they will take a part of the knowledge they gained on the job with them to their new employer. As workers are increasingly mobile (Chesbrough, 2003), this knowledge is getting more and more spread to other companies. This is what is called a knowledge spill-over (Teece, 2000). The mobility of workers and know-how leads to a greater *diffusion of knowledge*. Companies now have the possibility to access knowledge at only a fraction of the cost, compared to what it would cost if they developed it themselves. This knowledge would not be available if employees were locked-in into companies which made them for a part immobile. Instead, employees now offer their knowledge and talents to the highest bidder (Chesbrough, 2003).

4.2.4 Time to market and the budget

Companies need to introduce products to the market faster. However a faster introduction of new products leads to a *lower shelf-time*, which makes that products have less time to earn back the investment that was required to develop them. To safeguard a high return, either the R&D which takes up a vast amount of company resources, has to earn its investment back in a shorter time; or companies have to lower the cost of R&D, preferably without losing effectiveness (Chesbrough, 2003). Getting the same end result with a lower budget is easier said than done. While the virtuous circle supposed an increasingly growing budget, resulting in new breakthrough innovations, the pressure on a company's R&D budget can lead to less true innovations and more incremental improvements (which are less costly to develop). This strategy of incremental improvements cannot assure success in the future. At any given moment a small start-up company can leapfrog a leading MNE by developing a true breakthrough innovation that targets the same market as the firm is currently active in, which will make their product worthless. Besides, how will a MNE defend the policy of full in-house R&D when the same knowledge to be generated can be acquired from external sources? Especially when this knowledge is of higher quality, and available at a lower cost (Chesbrough, 2003).

4.3 The virtuous circle broken

The previously discussed erosion factors demonstrate that the virtuous circle which existed under the closed innovation model is no longer sustainable. Engineers that make a new breakthrough discovery realize that they have an outside option when the company that funded the discovery does not pursue it on time. They can now leave the company to further develop breakthrough research on their own in for instance a new start-up company. If these engineers are succesful, the only way for the company to acquire this knowledge in a later stage, is to buy it back. This means that the company that invested in the research in the first place, is not always the one reaping the benefits and is thus not able to reinvest the gains into new projects. On top of this, the company that acquires this knowledge would often not reinvest in a second round to develop new breakthrough discoveries to lead to new products and more funds (Chesbrough, 2003).

These problems lead to the rise of a new paradigm, the open innovation paradigm. The issues that pose threats to the functioning of the closed innovation model, can be turned into opportunities within the open innovation model. In what follows, we will explain the logic of the open innovation model.

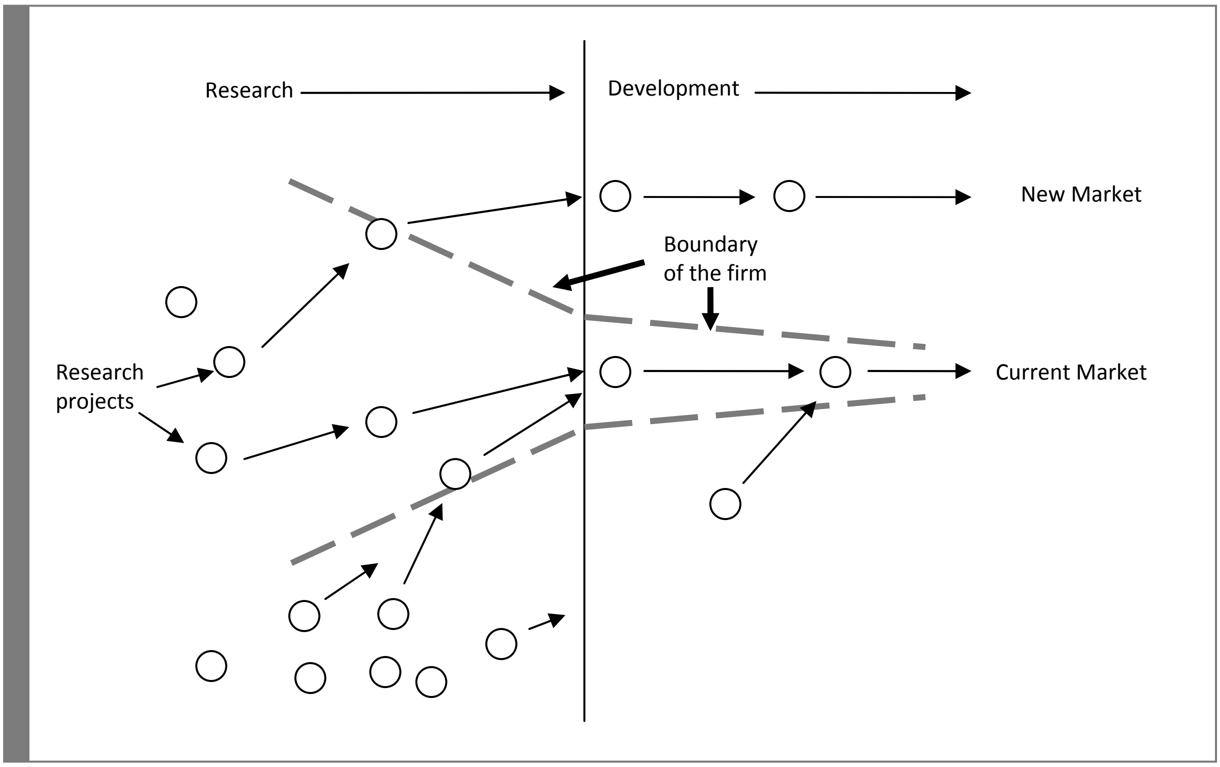
4.4 Open innovation

The starting point of the open innovation paradigm introduced by Henry Chesbrough (2003), is the same as that of the globalization of R&D theory as we have explained in chapters 2 and 3, namely that there is an abundance of knowledge available all over the world and that companies should therefore *look beyond their borders* to find the best knowledge to innovate. Open innovation shows that a company can commercialize both external and internal ideas or technologies, and use both external and internal resources to create new innovations. In this open innovation process, projects can be launched from internal or external sources and new technology can enter the company at various stages, this is termed the outside-in movement, and is depicted in Figure 4.3 (Chesbrough, 2003). The open innovation theory also explains how companies can benefit from the outflow of ideas and knowledge (the inside-out movement). This is however beyond the scope of this master thesis and will not be discussed into detail.

Just like in the closed innovation model (see Figure 4.2) many research projects can originate at the beginning of the funnel. The most promising ones will be further developed to eventually be released onto the market. What however characterizes the open innovation model, and is different from the closed innovation model, are the boundaries. In Figure 4.3 the boundaries are now represented by a dashed line, in contrast to the full line in the closed innovation model. The dashed line leaves gaps for knowledge to flow into, or out of the company.

The lower half of the open innovation funnel (see Figure 4.3) shows how knowledge can flow into the company. This knowledge can be used for the development of new products or services that can later be released onto the market where the company is currently active in. Note that it is not only in the research stage that knowledge can flow into the company. Also in later stages the company can in-source knowledge. The upper half of Figure 3.4 shows the opposite movement. Knowledge can also flow out of the company. A company may choose to do this when valuable discoveries are being made that do not fit with the current business model or market the company is active on. The company may then decide to sell off this knowledge so it can be further developed by another company. As mentioned earlier, this master thesis will mainly focus on the inflow of external knowledge, thus the lower half of Figure 4.3.

Figure 4.3 - Open Innovation



Source: Chesbrough, 2003.

The central ideas behind open innovation differ substantially from those behind closed innovation. The principles of both approaches are summarized in Table 4.1. The most important difference between the closed and the open innovation model is that open innovation focuses on the use of *internal and external* knowledge to strengthen the internal innovative capacities of a company.

Table 4.1: Contrasting Principles of Closed and Open Innovation

Closed Innovation Principles	Open Innovation Principles
The smart people in our field work for us	Not all the smart people work for us. We need to work with smart people inside *and* outside our company
To profit from R&D, we must discover it, develop it, and ship it ourselves.	External R&D can create significant value; internal R&D is needed to claim some portion of that value.
If we discover it ourselves, we will get it to market first.	We don't have to originate the research to profit from it.
The company that gets an innovation to market first will win.	Building a better business model is better than getting to market first.
If we create the most and the best ideas in the industry, we will win.	If we make the best use of internal and external ideas, we will win.
We should control our IP, so that our competitors don't profit from our ideas.	We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model.

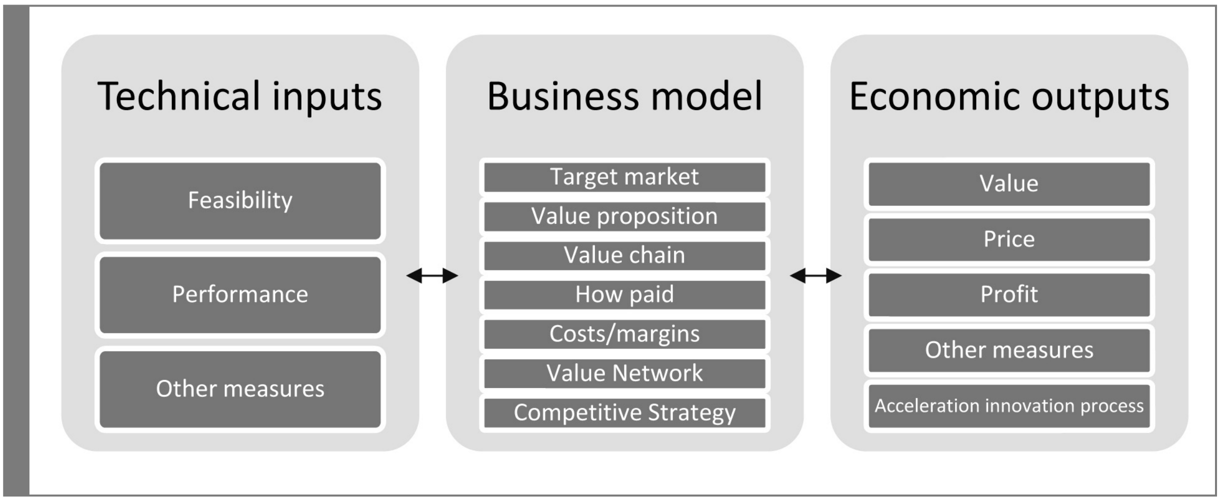
Source: Chesbrough, 2003.

We will now discuss where a company may find knowledge in its environment and how the use of external knowledge will reshape the role of the internal R&D department.

4.5 Creating Value with Open Business Models

Within the open innovation model, firms need to complement their internal research with external ideas to fuel their own innovation engine. These technical inputs need to be converted into something valuable. This conversion from technical input to economic value will be done by the business model (see Figure 4.4) (Chesbrough, 2003). We will start our discussion with the first part of the transformation process that is depicted in Figure 4.4: the technical inputs. Where can a MNE find the technical inputs they need?

Figure 4.4 - The Business Model Mediates Between the Technical and Economic Domains



Source: Rosenbloom & Chesbrough, 2002.

4.5.1 Technical inputs

4.5.1.1 Sources of external knowledge

To find external knowledge, the logical answer is that companies should scan their surroundings in order to find sources of potentially valuable knowledge. Because there are many sources of external knowledge (Chesbrough, 2003), there are also many ways to access them. Each way of accessing and each source itself has their own benefits and drawbacks. In the next paragraphs, we will discuss five possible sources of external knowledge (see Table 4.2).

Table 4.2 - Sources of external knowledge

Sources of external knowledge
Alliances
Lead users
Universities
Venture capital funded companies and startups
Recovery of cancelled projects

Source: Chesbrough, 2003.

Alliances

In order for firms to be both innovative and tackle the rapid technology change, they should exploit both their existing internal capabilities, firm-specific capabilities of external firms, and develop new capabilities (Teece, et al., 1997). The need to exploit firm-specific capabilities from external firms results in the need to form partnerships and alliances in order to collaborate. An advantage of collaboration is that through networks, firms can access certain knowledge without having to incur massive costs to develop this knowledge themselves (Chesbrough, Vanhaverbeke, & West, 2006). The greater the network in which firms operate, the greater the amount of knowledge that will be available to make use of.

In a strategic alliance the partners also agree to work together, but they will typically work closer together than in the case of a mere collaboration (Bamford, Gomes-Casseres, & Robinson, 2003). In a strategic alliance, the companies will contribute significantly to the strategy of the partnering company with the purpose of gaining strategic advantages they cannot achieve on their own (Suarez-Villa, 1998) by combining their capabilities (Kolk, 2007). Within the open innovation model a strategic alliance means that two or more companies will work closely together and share knowledge or other capabilities and resources. This would allow them to create products or innovations that they would not be able to create on their own. Companies should watch out for free riding companies when working together in an alliance. Free riders are companies who do not contribute to the innovation process but do take advantage of it. A second thing companies should bear in mind is that even though the companies within the alliance are heavily dependent upon each other, they still have to make sure they create and can appropriate a piece of the value created (Chesbrough, Vanhaverbeke, & West, 2006).

Lead users

Customers also prove to be a valuable source of knowledge. The most demanding customers will usually push products to their limits, and will not necessarily use the product in ways it was intended to be used. These customers are referred to as lead users (von Hippel, 1986). Lead users are innovators, they find new ways to use a product or are creative in combining it with other products. These new ideas can enrich the knowledge already present in a company, and help researchers to develop new or improved products (Chesbrough, 2003; Von Hippel, 1986). Lead users cannot always achieve their goals on their own and often need the help of companies to do so. Although these customers form only a very small percentage of the total customer group, they should be involved in the innovation process of companies (Kolk, 2007) as the added value they could create can be very high. Consider for example the applications that are being developed for devices like the Apple iPhone. Users who are able to write code and have the desire to get more out of their iPhone write specific pieces of software to achieve their goals. Some of these users may feel limited by the possibilities the device offers, and could suggest improvements. Among the many suggestions, some of them could be very innovative that may be worthwhile for the company to pursue.

Universities

Universities are increasingly contributing to industrial innovation (Chesbrough, Vanhaverbeke, & West, 2006). Companies can source knowledge from universities by cooperating with them and investing in their research programs. Also hiring a professor that is a field expert to work with internal researchers could be one of the options (Chesbrough, 2006). Cooperating with universities does not guarantee that a firm will own the inventions generated there, but getting to access this knowledge before anyone else does, could give the firm a head start when they apply these results to their industry. If companies cooperate with universities and invest in their research frequently, they could establish a good reputation in a certain area or industry. This reputation can even incite researchers to approach the company on their own when they are looking for funds. When a company receives a lot of these requests, they can select the most promising projects. The same result might be obtained by investing in start-up companies that are developing a promising technology. It is obvious that the importance for a company to build up a trust relationship with its partners over time cannot be underestimated. The ultimate goal for the company should be to get the reputation of being a very trustworthy partner (Chesbrough, 2003) which could encourage researchers to share their knowledge with them.

Venture capital funded companies and start-ups

Venture capital funded companies are also a valuable source of knowledge. These companies are good indicators of whether or not a newly introduced technology is going to succeed. Venture capital funded companies are offering real new products with new technology incorporated in them on a real market, and therefore offer a far better indication of success than a simulation could offer (Chesbrough, 2003).

Start-ups often do not possess the compatible technologies that could improve their innovations. They are therefore looking for funding in order to grow. Given their lack of resources and lack of reputation (Chesbrough, Vanhaverbeke, & West, 2006), they may be more willing to share IP in return for the assets they require than larger and more resourceful companies. Large firms will be most of the time more looking into selling off their IP instead of sharing it (Chesbrough, 2006).

Recovery of cancelled projects

The last possible source of external knowledge we will discuss is the recovery of projects that were cancelled in the past. This is a new opportunity in the open innovation model. The closed innovation model typically weeds out false positives. These are ideas that seemed promising at first, but in later stages were found not to be so. But when weeding out false positives, also false negatives can get weeded out. These are ideas that seemed worthless, but actually would have succeeded on the market. In the open innovation model, false positives are still weeded out, al be it now that they can come from internal and external sources. But the interesting thing about the open innovation model is the possibility to recover false negatives by acquiring them again in a later stage after they were sold (De Jong, Vanhaverbeke, Kalvet, & Chesbrough, 2008).

4.5.1.2 Problems with external knowledge

Open innovation urges companies to complement internal knowledge with external sources. There are however some problems that arise when companies are making use of external knowledge: the outcome of research on external knowledge is less certain compared to internal R&D. Chesbrough (2006) notes that:

> "[…] an externally sourced technology may have the same average estimated time to complete, but it may have a wider range or variation in that estimated time relative to an internally created technology".

The main reason for this wider variation in estimated time is simple. There is just more knowledge available about something that is completely developed in-house, compared to knowledge that is developed externally (Chesbrough, 2006). A second thing to bear in mind when making use of external sources is the effect in-sourcing will have on the internal R&D department. When researchers incorporate external research into the internal R&D, management may conclude that for future projects less internal researchers are required and more external sources should be consulted. This results in downsizing of the R&D staff, and will put a lot of stress on the researchers. Downsizing could thus result in rejecting the use of external technology in the organization. This is an important issue for companies that already have an established R&D department that relied solely on internal R&D. For start-up companies that have recognized the importance of using external knowledge sources, this is less of a problem because these companies can organize their internal R&D staff so it matches to their use of external sources (Chesbrough, 2006).

As these previously discussed issues already indicate, the role of internal R&D changes when companies apply open innovation and are using external sources of knowledge. We will now discuss the new and changed role of internal R&D more into detail.

4.5.1.3 The role of the internal R&D department

Operating an internal central R&D lab like in the closed innovation system only makes sense in a world where there is only little external knowledge available. After all, if no external knowledge is available, the only way companies can create new products or services is by doing the research and development themselves. In the current corporate landscape however there is an abundance of external knowledge available (Doz, Santos, & Williamson, 2001; Chesbrough, 2003). Companies that want to increase the efficiency of their innovation process should therefore first scout the world to find external knowledge from existing pools, before spending time trying to generate a solution themselves. It would be very inefficient for a company to spend a lot of resources on something that already exists. (Chesbrough, 2003).

Sourcing from external sources does not mean that internal R&D becomes irrelevant. Chesbrough (2006) states that: "Not all the smart people work for you, but you still need your own smart people to identify, recognize, and leverage the work of others outside your company". This means that the internal R&D department should focus on leveraging the external knowledge by adapting it in a way that it can be used to complement the internal R&D projects. Knowledge that was not available externally can then still be created internally. In order to successfully select the needed knowledge and incorporate it into the project, researchers from the internal R&D department need to be able to see the bigger picture. They need to understand how to integrate external knowledge into projects that are running internally (Chesbrough, 2003). This ability to absorb external knowledge within the company is referred to as absorptive capacity (Cohen & Levinthal, 1990; Chesbrough, Vanhaverbeke and West, 2006). Absorptive capacity is defined by Cohen and Levinthal (1990) as "an organization's ability to value, assimilate, and apply new knowledge". We will now explain more into detail how absorptive capacity is influenced.

Absorptive capacity

Cohen and Levinthal (1990) argue that a firm's ability to evaluate and utilize external knowledge, largely depends on the firm's level of prior related knowledge possessed. Prior related knowledge can go from simple knowledge such as basic skills or a shared language, to the most recent scientific or technological developments in a given field

(Cohen & Levinthal, 1990). Possessing prior knowledge related to the subject of interest will help companies to recognize the value of new knowledge, assimilate this knowledge and apply it to current projects.

When an individual already possesses knowledge about a subject, it is easier to put more information into their memory and to recall this information. Prior knowledge also enhances learning as the storage of knowledge is developed by associative learning. Events are memorized by establishing links with previously recorded memory fragments. The more different these pieces of prior knowledge are, and the more links are present, the easier it will be for a person to understand and acquire new knowledge (Cohen & Levinthal, 1990). The more prior knowledge a person possess, the higher its absorptive capacity will be.

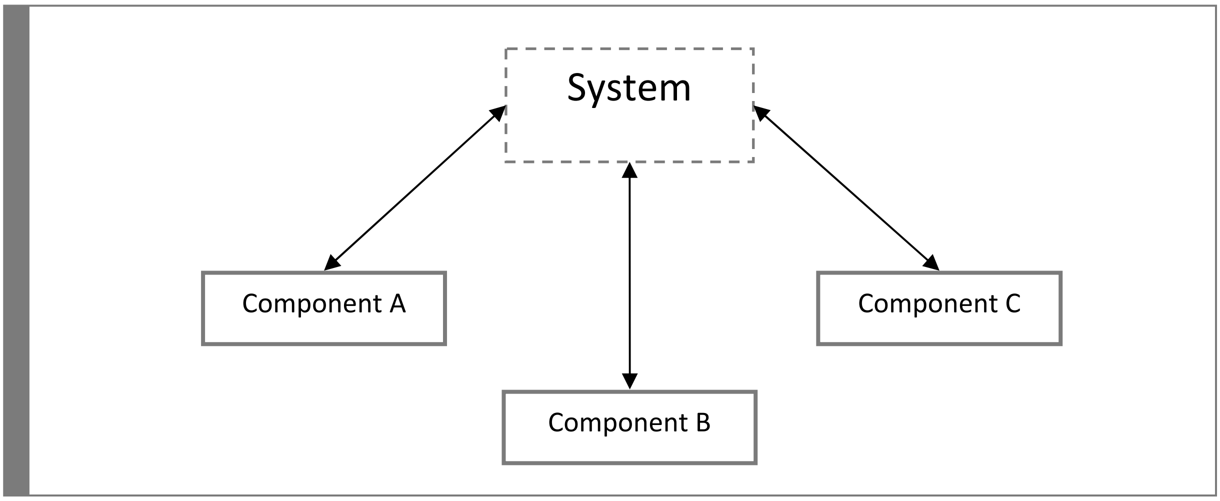
The absorptive capacity of an organization will be influenced by the absorptive capacity of the individual members, but the absorptive capacity from the organization is however not simply the sum of the absorptive capacities of its members. This is because the absorptive capacity is also determined by the ability of the organization to exploit the knowledge. Knowledge has to travel through different departments in order to exploit it, and will be worked with by different people with specific knowledge of different fields. The ability to transfer knowledge across the organization will therefore affect an organizations' ability to exploit acquired knowledge. A good communication structure that is able to effectively transfer knowledge from external sources into the company, as well as to transfer this acquired knowledge and newly developed knowledge through the company is required. Overlap of knowledge among people working in one company may greatly facilitate the internal knowledge transfer. However knowledge transfer also happens when accessing external sources of knowledge (Cohen & Levinthal, 1990).

To facilitate the transfer of knowledge between two people, a good overlap between the knowledge bases of these people is necessary (Cohen & Levinthal, 1990). It is obvious that a chemist will be able to understand how a new virus works better than an economist or psychologist. Because companies are often not sure which kind of technology they want to tap from, they will not be sure what kind of internal people are needed to create this important knowledge match with its external partners. Cohen and Levinthal (1990) therefore suggest that companies that have a diverse workforce (chemists, IT specialists, financial people, …) will be more likely to find a match with the external partner. This overlap in knowledge bases will facilitate the transfer of knowledge.

Modular architecture

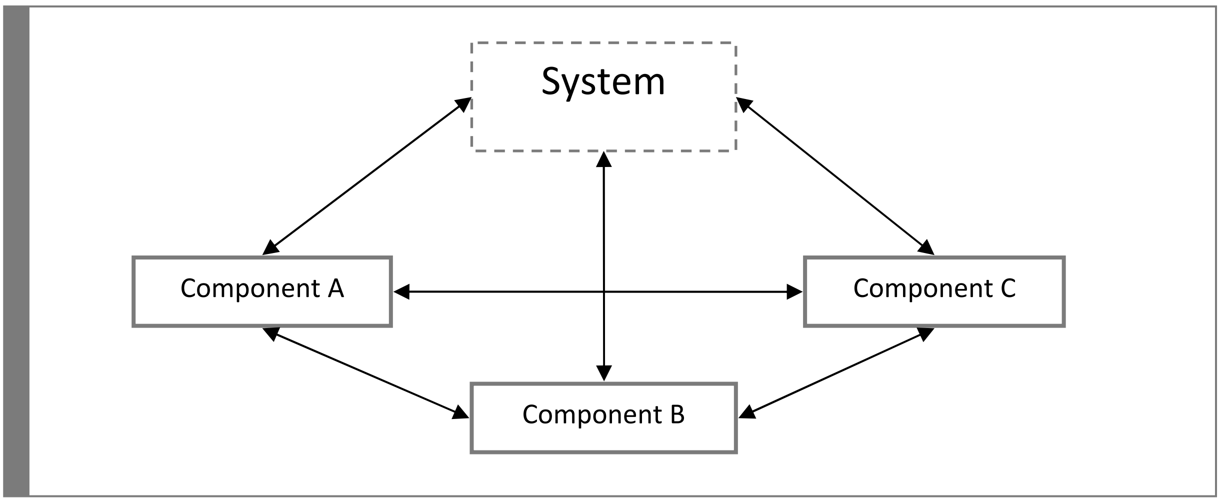
One of the critical roles of the internal R&D department is to develop an architecture. An architecture joins all the different technologies and knowledge into one useful system. To be able to integrate several pieces of separate knowledge, a company has to develop a structure where different pieces of knowledge can be "plugged-in". An architecture consisting of several pieces of different knowledge is called a modular architecture and is represented in Figure 4.5 (Chesbrough, 2003). The opposite architecture is displayed in Figure 4.6, and is called an interdependent architecture (Chesbrough, 2003).

Figure 4.5 - Modular Architecture



Source: Chesbrough, 2003.

Figure 4.6 - Interdependent Architecture



Source: Chesbrough, 2003.

Consider the development of a mobile phone. With an interdependent architecture (see Figure 4.6), all parts still depend on each other. Replacing the camera for instance, by another one that requires more power could result in the need for a bigger battery. The bigger battery however could block the display connector and affect the available space for the display itself. But to change those, also the motherboard needs to be replaced. In this example, changing one component leads to the need to changes others as well due to the interrelations among the components. By performing research and uncovering how the camera exactly works and how its power requirements can be adjusted, it may be possible to develop a way to connect the camera to the motherboard without having to change anything to the motherboard. This would result in a modular architecture as shown in Figure 4.5. Now parts can be replaced or exchanged without compromising the entire system.

A modular architecture does not only allow a firm to plug in different kinds of knowledge into a greater system; it also lowers the pressure suppliers of certain pieces of knowledge can put on the firm. Suppliers of a certain piece of knowledge will typically want to gain some sort of power in the value chain in order to appropriate a bigger part of the value created. A way to do this is not sharing critical information about the component that they deliver, making the company dependent on them, as they cannot replace it themselves. A company can thus not simply rely on information provided by its sources. It will need its own internal R&D department to perform own research on the provided knowledge as well, to gain deep knowledge over all the components. With the information acquired from this research, the internal R&D department can untangle the interrelations between several components and better divide the functions of the system. This allows a firm to build a modular architecture which in turn allows them to work with each part of the system separate. Making certain parts replaceable and in turn lowering the power a supplier may have in the value chain. With this modular approach, companies are ready to accept specialist knowledge at modular level (Chesbrough, 2003).

As the firm using a modular architecture is ready to accept specialist knowledge, other parties can now compete with each other to create the best component A, and plug their superior technology into the system (Chesbrough, 2003). As can be seen in the modular architecture, a firm is working together with other companies and knowledge is moving between them. In order to control this process, companies have to perform active IP management.

Active IP management

Within the open innovation model, knowledge will flow between companies rather than just within one company, as it was the case in the closed innovation model. The way firms use and manage their intellectual property (IP) will therefore change. Companies will be only willing to transfer IP when some sort of protection is in place (Chesbrough, Vanhaverbeke, & West, 2006; Kolk, 2007). Among the many forms of protection, patents are the most commonly used form (Chesbrough, 2003).

Companies applying the open innovation principles are aware of the availability of external knowledge. They interact with the external pool of knowledge by buying and selling IP. They will manage their IP actively in order to help create value, instead of merely protecting it. Knowledge allows a firm to capture created value within the value chain, and thus should be protected. But knowledge that helps improve complementary products or services should be released as it creates value for the company. This stands in contrast with the closed innovation approach, where a company will try to protect all IP generated (Chesbrough, 2003).

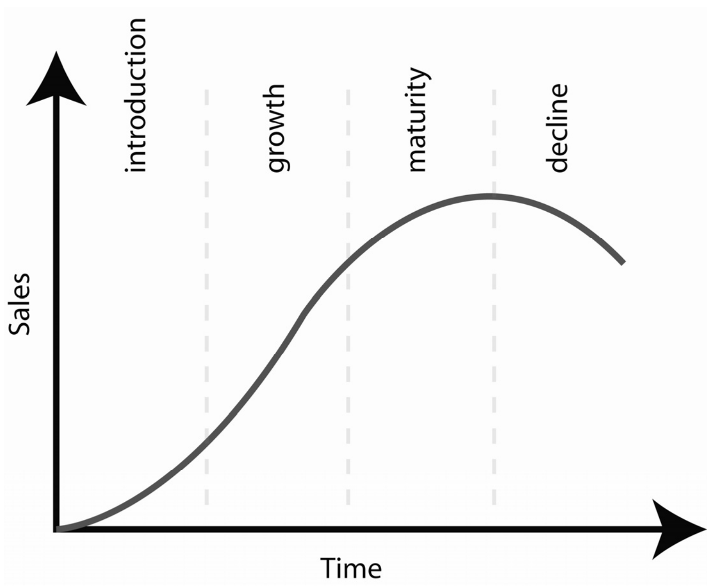
A common way to share IP is through licensing. Although Chesbrough (2003) notes that most companies are only interested in selling their IP and are much less interested in buying, it is clear that they should be paying attention to both aspects. In order to determine which IP should be bought and which IP should be created, companies have to assess which knowledge is present outside of the firm. Once this is known, they can align their internal R&D with the knowledge available externally. By doing this, they will acquire all the IP they need by both extracting from outside what is needed, and filling in what is not present outside of the company (Chesbrough, 2003).

Licensing is an interesting way to generate returns on technology that is laying on the shelves. When technology is licensed, brought to the market and used; new information becomes available to the researchers (for instance through lead users who use the product). This allows them to learn and further develop the technology and incorporate it in new products. A second benefit from licensing IP is that companies can prevent a situation to occur where researchers would become demotivated when they find out that their hard work is just laying on the shelf, and is not being used by anyone. This is especially a problem when researchers are very excited about their discoveries, and may cause them to exit the company to pursue their research elsewhere when they do not find the needed support inside the company (Chesbrough, 2003).

As technology runs through the different stages of its lifecycle (emerging, growth, maturity, decline), IP should be managed in different ways. First we will briefly describe the technology lifecycle (see Figure 4.7). Thereafter we will discuss the different ways to manage IP in each stage.

In the emerging stage, technology is only just beginning to emerge. Many possible technologies that are substitutes of each other exist, and improvements to the technology occur at a very slow pace. If the technology manages to survive the emerging phase and is chosen as the dominant design, it will enter the growth phase. All innovative efforts are now being focused on this technology, causing its performance to grow rapidly. As more and more people make use of the technology, the market takes off, resulting in a rapid increase of sales. Many new companies will try to enter the market to benefit from the growing market. After the growth phase, the market growth slows down. By now the technology has already been well researched and is generally well understood. Almost no new firms try to enter the market, however niche markets start to develop and offer new opportunities. After the maturity phase, the technology enters the declining phase. The rate of performance improvement reaches a plateau, and new technologies take off and substitute the former technology (Chesbrough, 2006). The stages in the technology lifecycle are displayed on the graph in Figure 4.7 where the performance is plotted over time.

Figure 4.7 - Stages in the technology life cycle



Source: Chesbrough, 2006.

When a company finds itself in the *emerging stage*, and the technology fits with its existing business model, IP management is straightforward. The company should try to protect its IP as good as possible and aggressively develop the technology so it has a chance to become the dominant technology. If however the company does not possess a business model in which the technology can be exploited, they should first try to find a business model in which it can be exploited. (Chesbrough, 2006).

When the technology becomes the dominant technology, and finds itself in the growth phase, other companies will try to copy the business model. The company now has to focus on the integration of their technology within the operations of their customers where the technology often will be incorporated in a larger system. By further improving the technology, a considerable amount of (tacit) knowhow is being developed. While in the first phase, the company may have chosen to share some of the IP with others in order to win the competition for the dominant design, it will now try to use the IP to capture a piece of the value created. However if the company lost the rally for the dominant design, it may now be time to consider acquiring the technology through for instance licensing (Chesbrough, 2006).

After the growth phase, the company enters the mature phase. Most of the technology improvements and market growth have already occurred, companies will now look for other uses of the technology in new emerging segments or even completely different industries. IP management should no longer be focused on defending the company's business model, it should now support the application of IP in new areas. In most cases, it is not the company that developed the IP itself that will pursue the application of the technology in these new areas. It will mostly be realized by other companies with other business models. To be able to find other companies that could still exploit the technology in different business models, the IP cannot be managed to strict. A good example of this is the move of a software producer to publish the software code to be freely used and adapted (open source). By doing this more people will be building on the software and make use of it in different fields. Something that would not be possible if the code was kept secret (Chesbrough, 2006).

The technology now enters the final stage, the decline. By now it has lost about all of its value (in the original market). There can be many reasons for this to happen, it can be replaced by a newer technology, legal protection has expired, .. However, companies may still possess IP that even though it looks worthless is still valuable. When a company for instance made a name for itself during the years it was active on the market, it may allow the distribution of products from another company under its name against a fee (Chesbrough, 2006).

Having discussed all the issues surrounding the use of external knowledge, we will now discuss how a business model turns technological knowledge into economical returns.

4.5.2 The Business Model

The business model specifies how a company will generate money by converting technical inputs into valuable products (see Figure 4.4). According to Chesbrough (2003) there are three major ways for companies to create and capture value from their technology. These are:

1. Incorporating the acquired technology into their own business;
2. Licensing the technology;
3. Launching new ventures so they can make use of this new technology in new business areas.

   (Chesbrough, 2003)

There are different ways through which a business model can commercialize a technology. The yields from the commercialization process will depend on the business model that is used to convert the technology into economic value. Sometimes the company will already have the right business model to commercialize the technology. In that case, the company can incorporate the technology in its own business. When the company does not possess a fitting business model it has two options. Firms can either license out the technology and generate financial returns through licensing fees, or they can launch a new venture with a business model that matches the technology (Rosenbloom & Chesbrough, 2002; Chesbrough, 2003). Chesbrough (2003) emphasizes the importance of a business model by stating that “a mediocre technology pursued within a great business model may be more valuable than a great technology in a mediocre business model”. Rosenbloom and Chesbrough (2002) defined the functions of a business model. These authors state that a business model should:

1. Articulate the value proposition;
2. Identify a market segment;

3. Define the structure of the firm's value chain;
4. Estimate the cost structure and target margins of producing the offering;
5. Describe the firm's position within the value network;
6. Formulate the competitive strategy.

   (Rosenbloom & Chesbrough, 2002)

We will now shortly describe these six functions that a business model performs.

4.5.2.1 Value Proposition

Articulating a value proposition is the first step in the process. The value proposition defines what the product offering will be and in what form a customer may use it. Because the same technology can be used in many applications, each application will most likely offer a different value to the end-user. The value a product offering delivers to a customer is one of the factors that determines how much the customer will be willing to pay for the offering. Different applications of technology will thus lead to different financial returns (Rosenbloom & Chesbrough, 2002; Chesbrough, 2003).

4.5.2.2 Market Segment

After articulating the value proposition, companies need to determine the market segment to which it is aimed at. In every market of reasonable size there will be different technological aspects of products that can be targeted. Determining the market segment will help providing focus for the development of the product offering. It will prevent that the resulting product offering is overloaded with features the customer is not willing to pay for. Defining the market segment will also help the company determine which players in the market could be their possible competitors. (Rosenbloom & Chesbrough, 2002; Chesbrough, 2003).

4.5.2.3 Value Chain

Because we know what the product offering will be and to which market segment it will be aimed, the company can now focus on determining the firms position in a value chain. The value chain needs to achieve two goals. It has to create value, and it must allow the firm to obtain a sufficient piece of the created value. This ability to claim value will depend on how powerful the firm, its customers, its suppliers and its competitors are. Also the availability of complementary goods or services that increase the value of the firm's offering can increase the company's ability to appropriate some of the value created (Chesbrough, 2003).

4.5.2.4 Cost Structure and Target Margins

After having defined the value proposition, the market segment and the value chain, it is now possible to determine the "architecture of the revenues". This defines how customers will pay, what the price should be, and how the created value will be divided among the several groups of interest (customers, firm, suppliers).

Once the general layout of the value chain has been specified, it is possible to determine the cost structure it implies. An understanding of the cost structure allows the company to determine the target price, which also leads to the specification of the target margins. The target margins provide justification for the required resources to realize the product offering (Rosenbloom & Chesbrough, 2002; Chesbrough, 2003).

4.5.2.5 Value network

The value network is wider than the value chain. The value network also considers the external parties who do not participate in the value chain, but are connected to the commercialization of the innovation. These parties will influence the value captured from the commercialization. A strong value network can for example lead to more complementary goods, which will make the technology or product offering more attractive to customers. In that way, having a strong value network can increase the potential value of a technology (Chesbrough, 2003). A good example of the additional value created by external parties is software that is developed for a certain operating system. The more software that is available, the higher the value of the operating system itself will be.

4.5.2.6. Competitive Strategy

The competitive strategy will determine how a company will compete in the chosen market. According to Chesbrough (2003) key factors for sustaining competitive success are: "[…] the ability to gain differential access to key resources, the creation of internal processes that are valuable to customers and difficult for competitors to imitate, and the past experience and future momentum of the firm in the market."

4.5.3 Economic Output

The choice of business model will affect the economic value of a technology, rather than only the technology itself (Chesbrough, 2003). All of the previously made decisions will result in economic outputs, which can be measured as value, price, profit, return on investment, etc… By using external knowledge, companies can speed up their innovation process. For this reason we also add “acceleration of the innovation process” as one of the economic output indicators. The ability to innovate is crucial for the survival of a firm. For this reason we think the acceleration of the innovation process should be included as an important measure of economic success.

4.6 Conclusion

In this chapter we have demonstrated that closed innovation is no longer suitable to make optimal use of resources that are available to companies. In a world of abundant and geographically dispersed knowledge, firms have to realize that relevant knowledge is available beyond its borders. This abundance of globally dispersed pockets of knowledge leads to the emergence of the open innovation model. This model shows how a company can turn the knowledge available from external sources into value. The current literature on open innovation however limits itself to technical knowledge, while there is no need do so. Companies can gain other kinds of valuable knowledge as well like market insights and customer insights. This knowledge is available externally as well, and it is globally dispersed. The open innovation model however minimizes the challenges MNEs face when they want to structure themselves to tap into these globally dispersed pockets of knowledge, and does not take into account the geographical dimension of external knowledge sources. The open innovation theory states that a company should source from external sources, but does not give a clue where external knowledge sources may be located. Is it at 5 km from the focal firm, at 100 km, or at 10.000 km? Do geographical and cultural distance play a crucial role in tapping into external knowledge sources, and do they influence the validity of open innovation for MNEs? The open innovation paradigm also assumes that the knowledge that is available outside the company is readily available; in practice it seems to be quite difficult to tap effectively into external sources of knowledge especially when those sources are situated abroad. We will therefore use the open innovation model as a base, and propose an extension that links the open innovation model to the challenges related to tapping external knowledge across the globe. This extended open innovation model will be discussed in chapter 5 where we link open innovation with the globalization of R&D.

Chapter 5: Linking the globalization of R&D literature to Open Innovation

5.1 Introduction

As discussed in the previous chapters, companies have made a shift in their innovation strategy in the last decades (Bartlett, & Ghoshal, 1998; Jaruzelski & Dehoff, 2008). Multinational companies are no longer only depending on their home based advantages to create new products or services (Doz, Santos, & Williamson, 2001), but they acknowledge that there is a huge potential in embedded pockets of knowledge that are scattered across the world (Chesbrough, 2003). Initially, MNEs started to use their national subsidiaries to increase sales and profit (Bartlett, & Ghoshal, 1998), but later on they were also using these subsidiaries for other reasons. The new roles that MNEs have set up for their subsidiaries (strategic leader, implementer, contributor, black hole) were explained in chapter 3 (Bartlett, & Ghoshal, 1998). In that chapter we concluded that MNEs could use their subsidiaries to augment the knowledge base of the whole company by learning from them (Bartlett & Ghoshal, 1998; Kuemmerle, 1997).

Nowadays some MNEs are going a step further by trying to make use of the knowledge that lies *beyond their company walls* (Doz, Santos, & Williamson, 2001). They are setting up research and development labs to tap into local resources. The metanational theory as described in chapter 3 introduces an organizational structure for MNEs that want to make use of these new pockets of specialist knowledge (Doz, Santos, & Williamson, 2001, 2004; Doz, 2006). This theory advises a MNE to set up a sensing network that is independent of their existing operational network to perform R&D activities. It implies that MNEs should choose a new foreign location with the purpose of learning from it. Once this network is set up, all the knowledge that is gained should be combined in an innovative way to create a new breakthrough innovation. This second step was called mobilizing. In the last step this new product or service should be leveraged globally (Doz, Santos, & Williamson, 2001; 2004; Doz, 2006). Executing R&D activities on a global scale implies having joint activities with local R&D partners (e.g. universities, research labs, other firms, etc…). Consequently, the trend towards global R&D should be related to open innovation which focuses on the benefits of tapping into external technology sources (Chesbrough, 2003, 2006; Chesbrough et al. 2006). We expect that linking both literature streams will have a mutually beneficial effect on them. Table 5.1 presents some of the potential benefits when linking the R&D globalization literature to open innovation.

Table 5.1 - Company theories about R&D internationalization and open innovation

	Transnational	Metanational	Open Innovation
Internationally orientated?	Yes	Yes	No
Headquarters learn from subsidiaries?	Yes	Yes	Multinational organization is not included
Headquarters learn form the whole world?	No	Yes	Location of partners is not made explicit
Origin of innovation?	Headquarters and Subsidiaries	Headquarters and Subsidiaries and the rest of the world	External + Internal sources of IP: no geographical dimension
How to profit from external partners?	Not relevant	Somewhat developed in terms of knowledge characteristics (tacitness & contextualized knowledge)	Strongly developed

Because nowadays there is an abundance of knowledge available and this knowledge is getting more dispersed over the world, Chesbrough (2003) concludes there is a growing need for open innovation. Open innovation implies that companies should make use of external sources, wherever and who that source might be (Chesbrough, 2003, 2006). Because this external sourcing is essential for the open innovation strategy to work, it is important that companies set up a special structure solely dedicated to sensing the world for new knowledge. Looking at Table 5.1, we can see that the metanational company described by Doz, Santos and Williamson (2001) was the best framework to apply open innovation within the context of a MNE. This is because these authors advised MNEs to set up, apart from their traditional operational network, a sensing network with the task of scouting the world for new knowledge. After this sensing process, all the dispersed pieces of knowledge that were gathered needed to be mobilized and united in the form of special projects. In a last stage, this project should be operationalized on a global scale. These phases were all three separated from each other, and needed to be done one step at a time (Doz, Santos, & Williamson, 2001).

The metanational theory of Doz, Santos and Williamson (2001) makes use of the pockets of specialist knowledge that are scattered across the world, but once their sensing phase is finished they make according to us the same mistake as the traditional closed innovation authors do. Their sensing phase is strongly aligned with the open innovation philosophy, because they acknowledge that MNEs should not only make use of the brains in their internal network, but should also look externally. However, once this sensing phase is over, MNEs should according to Doz, Santos and Williamson (2001) go on with the next step by trying to mobilize this knowledge and later operationalizing it on a global scale. Thus as one can see, after the sensing phase, the MNE should follow again the traditional closed innovation strategy, where no extra external knowledge can flow inside the company. This idea strokes with the open innovation philosophy, which stresses that companies should make use of external sources throughout the whole innovation process: from sensing a need to the commercialization phase.

MNEs should make use of the best knowledge available in the world. Although Chesbrough's open innovation theory gives this advice to companies, the geographical dimension of locating where this knowledge should come from was never discussed in the existing open innovation literature. From our point of view, the existing open innovation theory thus overlooks a lot of important challenges when it is applied to the R&D globalization strategy of MNEs. This makes it difficult for MNEs who already have an international network of subsidiaries to apply open innovation. Without an international dimension, the questions: 'Where in the world should we look for new ideas?' and 'How many R&D locations should we tap from?' were not important. According to Chesbrough we should just make use of external sources. Furthermore, cultural issues that play a role when acting on an international stage were again not discussed, while it is self-evident that these are important questions that need to be answered. Also the tacit and contextualized nature of knowledge, together with the need for integrating the knowledge found within the whole network of a MNE was underestimated by traditional open innovation scholars. As a result, our two last questions: 'How to tap effectively into local R&D-communities around the globe?' and 'How to integrate effectively knowledge from different parts of the world in a MNE?' were never discussed within the open innovation framework. These are challenges that will be discussed in section 5.3. We will first continue in the next paragraph by trying to adapt the open innovation funnel of Chesbrough (2003) to make it more applicable to international firms.

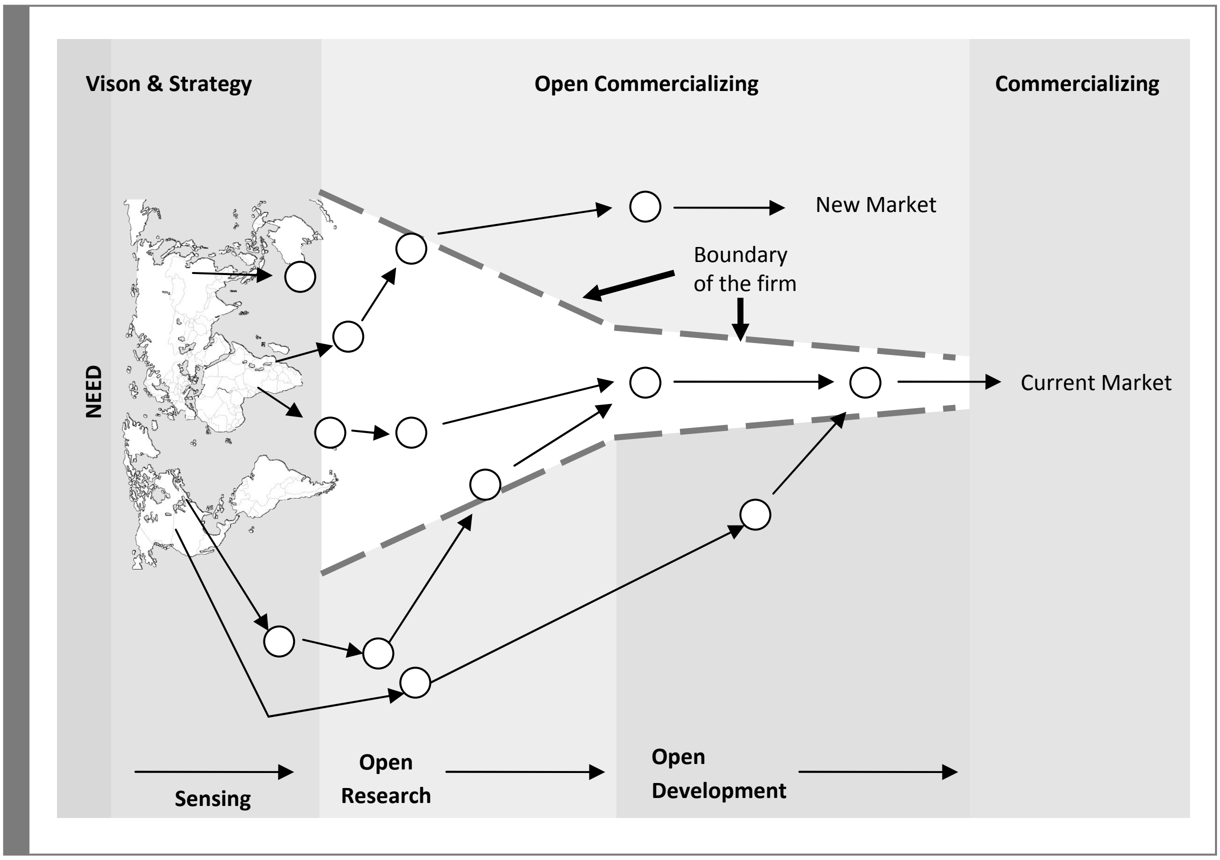
5.2 International Open Innovation Model

As can be seen in Figure 5.1, the innovation process should, according to us, start from a particular *need* of the MNE. We argument that MNEs should not try to sense every technology that is available in the world, but they should have a clear focus on what they are searching for. This need is most of the time aligned with the vision and strategy of the firm. Once this need is defined, MNEs should set up a *sensing network* to search across the world and determine if this need can be satisfied by already available technologies. To set up this network, the metanational theory of Doz, Santos and Williamson (2001) can be used. By having a clear target of what we are looking for, the MNE will be able to limit their coordination costs by preventing adding unnecessary nodes in their network[1]. If there is technology available that can satisfy the need, MNEs should try to acquire this knowledge. In this way a sensing network lowers the risk for a company to develop something that is already available on the market. On the other hand, if no technology is available throughout the world to fill this need, MNEs should develop this technology themselves. Adding this sensing process to the traditional innovation funnel is the most important change we propose. According to us, Chesbrough (2003) downplayed in his funnel the difficulty of searching a particular piece of external knowledge. Thus, when open innovation is applied by a MNE, the sensing activity will have a more prominent role in the whole innovation process.

Unlike Doz, Santos and Williamson (2001) we will not close our innovation process after the sensing stage. When performing more research on the pieces of knowledge found in the sensing phase, it is important that MNEs keep their innovation process 'open' in that phase as well. It is still possible that extra information can be found or new locations should be added to the network to complement the existing knowledge base. This stands in contrast with the mobilizing stage of Doz, Santos and Williamson (2001) who keep this process completely within the company walls. That is why we call this process: '*open research'*.

[1] This will be further explained in section 5.3.2

Figure 5.1 - The International Open Innovation Model



Source: Adapted from the original open innovation model of Chesbrough (2003).

After this stage, MNEs should still continue their open innovation strategy by also developing new products in an open way. To further develop a technology, MNEs should, according to us, again make use of their own internal knowledge base, but also search the world for external sources that can help further development of the technology. They can thus again make use of their sensing network to find the knowledge they need. By for example in-licensing technology or by project acquisition MNEs can complement their innovation funnel with external sources. This is what we call: '*open development*'. The traditional stage gate process where the project is evaluated before it can acquire extra resources still counts. Only the projects that seem promising enough to become the next blockbusters for the MNE will be released on the market.

One of the questions that remains unanswered is: 'Should the open research and open development network be the same or not?'. Companies like Novartis, for example, have set up their research and development network apart from each other. Their development locations were more aligned with the traditional manufacturing locations, while their research network was more focused on scouting the world for specialist knowledge at universities and research labs (Novartis, 2008).

In order to present a more accurate picture , it is important to stress that just like in the open innovation theory, there is always the 'inside-out'-option of selling, out-licensing, etc… the project to external parties. In this '*open commercialization'* phase, MNEs can again make use of their external network that they have set up during their innovation process. But when the MNE decides to market the product or service themselves, this *commercialization* process can be done in the same way as described by Doz, Santos and Williamson (2001) in what they called the operationalizing plane.

As indicated in the previous sections, applying open innovation in an international dimension will lead to new managerial and organizational challenges. This will be the focus of our next paragraphs.

5.3 Challenges when applying open innovation in an international context

The combination of the R&D -internationalization and OI literature will lead to a richer understanding of external knowledge use in MNEs. However, there are some major *challenges* that will have to be dealt with before we can apply open innovation in an international context. It is important to note that these challenges are not exhaustive, and that further research on these topics is needed. Our aim is to show academic researchers that applying open innovation in a multinational context poses a lot of challenges (see Table 5.2). In this chapter we discuss some of these challenges. The first challenge for MNEs is to decide *how widely to look* for new knowledge. Furthermore, MNEs have to decide about the number of R&D sites and where they should be located. A second challenge relates to the ways MNEs can *tap into locally embedded external knowledge*. This is a central theme in open innovation but has to be adapted to intercultural and international settings, because open innovation is not discussed in an international environment. A third challenge for MNEs deals with the *in-sourcing of knowledge*. Since foreign R&D centers or subsidiaries are the main organizational vehicles to in-source knowledge, MNEs should have a closer look at the technological competencies and absorptive capacity of these globally spread local R&D communities. A fourth and last challenge for a MNE when it wants to apply open innovation is about the *integration of knowledge* that goes with a geographically dispersed network of R&D centers. Unless firms are able to combine the knowledge sources, that are developed throughout their network, with the existing knowledge base in the company, they will not be able to profit from the geographical distribution of knowledge creation. In the table below, we give an overview of these challenges that we described above, and some other important challenges that MNEs will be confronted with when they want to apply open innovation in an international setting.

Table 5.2 - Challenges for MNEs when applying open innovation

Important challenges for MNEs when applying open innovation.	
Challenge 1	What are interesting R&D locations for a firm?
Challenge 2	What is an effective number of R&D locations?
Challenge 3	How to tap effectively into local R&D-communities around the globe?
Challenge 4	How to integrate effectively knowledge from different parts of the world in a MNE?

In the last chapter we will bring together these issues to answer the central research question of this master thesis, namely: 'How does the open innovation theory change, when it is applied to the R&D globalization strategy of MNEs?' We will now continue by discussing our first major topic, i.e. where should a MNE look for new knowledge?

5.3.1 What are interesting R&D locations for a firm?

Once a MNE chooses to change its traditional innovation process into a more open way of doing innovation, they have to decide *what* to look for. This is however not a new challenge for a MNE. Most of the time the technology MNEs are looking for will be determined by their vision and strategy. When a pharmaceutical company has for example the ambition to find a new way of curing cancer, its researchers will have a clear idea of what they have to look for. There is however a new challenge attached to it. When the researchers of a MNE know what they have to look for, they will not immediately know *where* to look for it. After knowing where to locate and how many R&D sites need to be set up, this knowledge needs to be accessed and integrated in the whole network (see Figure 5.2). This location problem was not an issue in the former open innovation literature. But when open innovation is applied in an international setting, MNEs will have to know where in the world they have to locate their MNEs R&D activities. This is the first challenge that we will discuss.

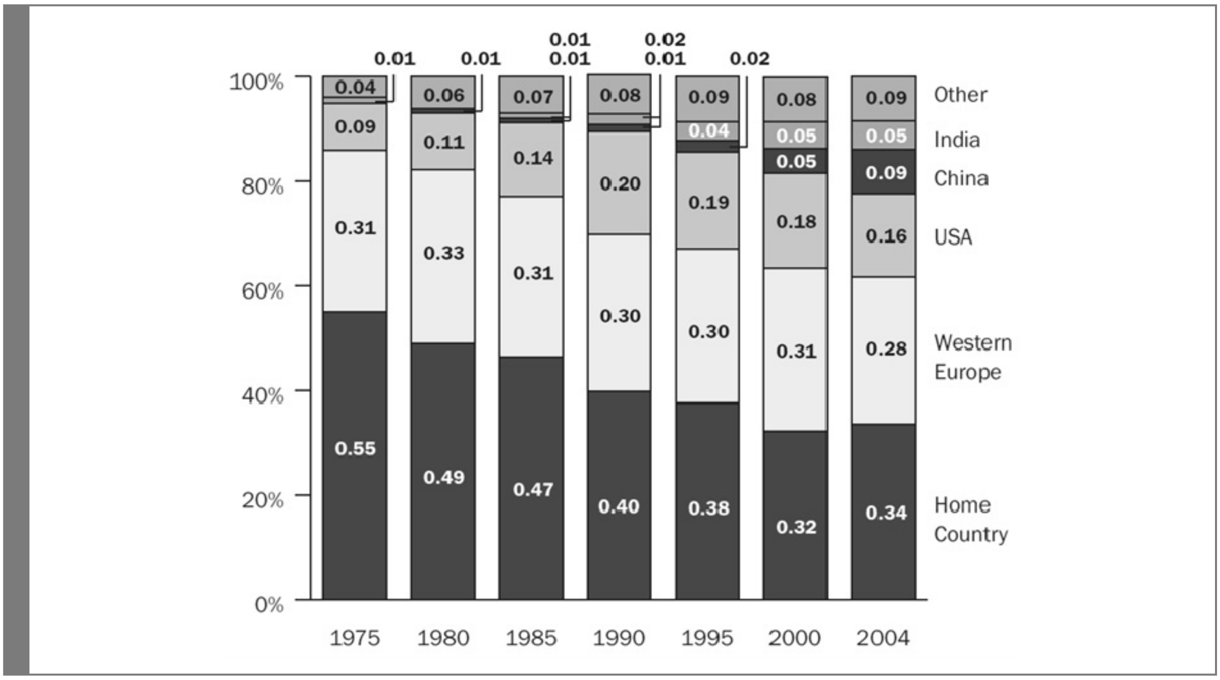
Figure 5.2 - Location, access and integration

That MNEs are conducting their innovation activities outside the countries in which they are headquartered is illustrated by the most recent Global Innovation 1000 report of Booz & Company (Jaruzelski, & Dehoff, 2008). They found that 91% of the world largest R&D spenders are globalizing their R&D activities. But why are MNEs doing this? A study conducted by the Economist Intelligence Unit (2004) showed that 71% of their sample of MNE executives considers the possibility to exploit available pools of *scientific labor* as a the key benefit of globalizing their R&D. More recent studies of Booz, Allen and Hamilton (2006); Van Pottelsberghe (2008); and Goldbrunner, Doz, Wilson, and Veldhoen (2006) echo these findings. Also the business environment of the foreign country turned out to be important in deciding where to locate R&D. The study from the Economist Intelligence Unit (2004) also shows that the *quality of the local education system* and the *proximity to major universities and research labs* are important when making this choice. These are three important requisites for a location to become a foreign R&D site. Regions that have these attributes are often the traditional R&D hot spots like Silicon Valley. A R&D hotspot is defined as a center of innovation where companies can tap into an existing network of relevant scientific and technological expertise, good links to academic research facilities, and environments where innovation is supported and easy to commercialize (Economist Intelligence Unit, 2004). These are important factors to consider when choosing a location. As open innovation implies complementing internal ideas with external ones, it is very important to locate R&D centers in particular locations where useful ideas are abundant.

Once a particular location is considered to be an interesting location for a particular type of research, often whole industries begin to settle there, making this location even more attractive. As a result, "the more knowledge-based clusters thrive, the more spatially imbalanced the economy is likely to become" (Cooke, 2005; Chesbrough, Vanhaverbeke, & West, 2006). Knowledge is in fact getting increasingly scattered across the world, because of the rapid growth of the knowledge economy in the BRIC countries.

As a result, there is no single location that excels in every type of research (Doz, Santos & Williamson, 2001; Chesbrough, 2003). Nowadays there are specific locations that are attractive for MNEs to locate in (Economist Intelligence Unit, 2004; Jaruzelski, & Dehoff, 2008). The traditional hotspots were located in the US, UK, Germany and Japan, but nowadays we seem them popping up in Brazil, Russia, India and China as well (Economist Intelligence Unit, 2004). Figure 5.3 depicts the changing distribution of R&D sites in 2004. It illustrates that the relative share of R&D sites by location are shifting towards China and India.

Figure 5.3 - Changing distribution of R&D sites



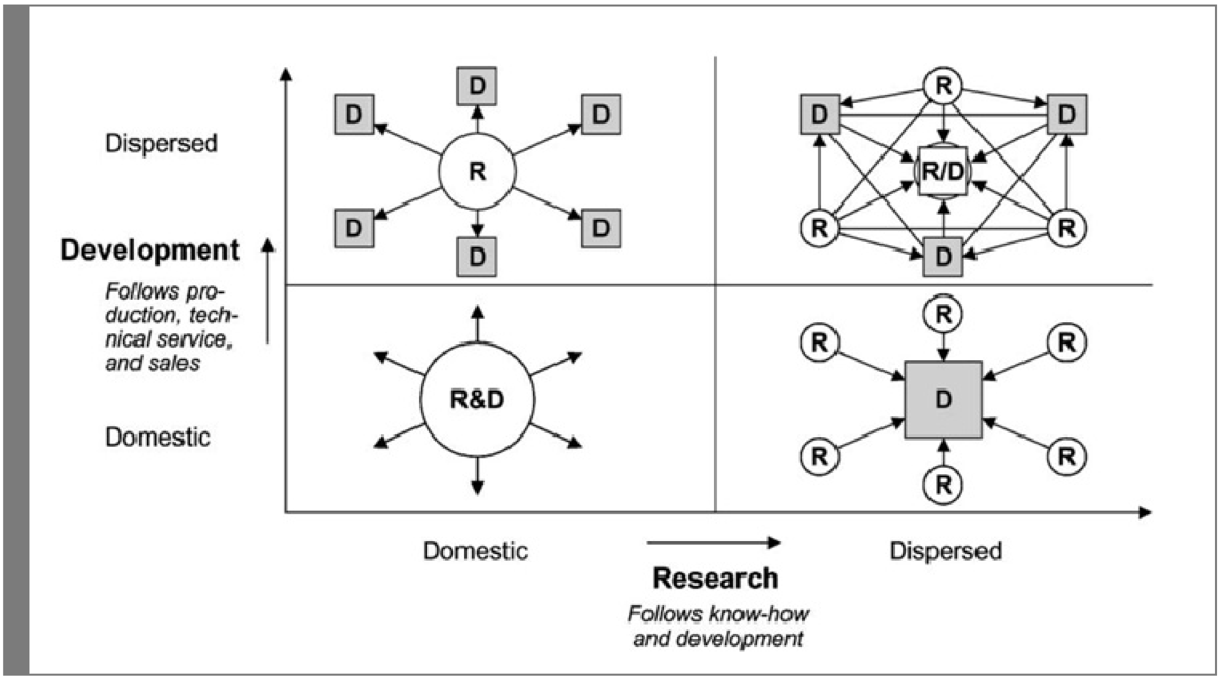
Source: INSEAD and Booz, Allen & Hamilton, 2006.

The US, UK and Germany have a history of R&D success, established infrastructure, strong academic links, and robust IP laws, which make these countries very attractive to locate a R&D site there (Goldbrunner, Doz, Wilson, & Veldhoen, 2006). China has the advantage of being a huge market of nearly 1.3 billion people, having a large number of qualified staff, together with a lower cost of R&D (Edler, 2007). The only problem in China is the poor execution of *IP protection* (Economist Intelligence Unit, 2004; von Zedtwitz, 2006). This poses a great problem for MNEs that want to apply open innovation in China. As a result, MNEs should be wary of locating research centers in a country where IP is hard to protect. Robust IP protection is another important requisite that MNEs should take into consideration when solving the location problem. Keeping hold of know-how is one of the reasons why companies prefer their R&D close by their headquarters.

Companies working in countries with weak IP protection will need to develop other strategies to safeguard valuable ideas. Motorola for example, encourages its staff to generate ideas that can be patented. Other countries that are becoming more attractive are South Korea, Singapore, Brazil, and the Nordic countries (Economist Intelligence Unit, 2004). Van Pottelsberghe (2008) studied the R&D activities in Europe and observed that Europe suffers from a lack of market integration in the way the innovation system works. The European patent system is according to him too fragmented. Once a patent has been granted by the European Patent Office (EPO), it must be validated, translated, monitored, and enforced in all relevant national patent offices (Van Pottelsberghe, 2008). This implies that a patent examined by the EPO and then enforced in 13 European countries costs about 11 times more than a patent granted by the United States Patent and Trademark Office (USPTO), and 14 times more than a patent granted by the Japanese Patent Office (JPO). Therefore, European innovators and entrepreneurs have a comparative disadvantage compared to the US and Japan (Van Pottelsberghe, 2008). This again illustrates the importance and benefits of having a good patent system when locating a R&D facility abroad.

By making use of the three-fold organizational structure described by Doz, Santos, and Williamson (2001), MNEs should be able to maximize their ability to make use of the pockets of specialist knowledge that are scattered across the globe. MNEs have to set up a sensing network that consists of foreign R&D locations that are independent of the traditional operational network. But should MNEs focus on the traditional hotspots, or should they choose other locations which could give them a more competitive advantage over others? Another issue MNEs have to deal with is the separation between research and development locations. These locations do not necessarily have to be the same (von Zedtwitz, & Gassmann, 2002). Pharmaceutical giant, Novartis (2008) for example, is a MNE that applies open innovation in an effective way. They spend 30% of their R&D budget on external collaborations with 120 biotech firms and 280 academic centers (Novartis, 2008). Their research locations are not the same as their development locations. In Novartis, the development locations are more aligned with the traditional manufacturing locations (thus, the operations network), while the research network is more focused on open innovation, namely on tapping into external sources like universities and research labs (Novartis, 2008). This is because research and development are subject to different location drivers (von Zedtwitz, & Gassmann, 2002). Von Zedtwitz and Gassmann (2002) argue that there are two principal location rationales as principal determinants for R&D internationalization, i.e. the quest for external science and technology and the quest for new markets and new products. These give rise to four forms of international R&D organization (see Figure 5.4): (1) domestic research and domestic development: national treasure R&D; (2) dispersed research and domestic development: technology-driven R&D; domestic research and dispersed development: market-driven R&D; and (4) dispersed research and dispersed R&D: global R&D.

Figure 5.4 - Organizational structures of internationalized R&D



Source: von Zedtwitz, & Gassmann, 2002.

MNEs have the option to globalizing research, development, or both. When the MNE is very technology-driven, research will be more internationalized than development. For these MNEs, access to local centers of scientific excellence drives their research activities abroad, because their home country is relatively weaker in technologies that are important for the company. Other MNEs that follow customer demands, and are less interested in scientific exploration could consider solely internationalizing their development activities to respond to customer requirements. The global R&D model is the most complicated model. These companies have distributed research as well as development worldwide. Their research labs are located where there is high-quality scientific input available, mostly in local centers of excellence. Development labs are located to be able to adapt their products to local demands and standards. These four models show that when MNEs have to make a location decision for their research and/or development site, the choice will depend on the *type of MNE they are*, and which *strategy* they wish to follow. Are they more market-driven, more technology-driven, or do they want to pursue both (von Zedtwitz, & Gassmann, 2002). After deciding whether to separate research and development or not, MNEs still have to make the choice where to locate their research or development labs. According to von Zedtwitz and Gassmann (2002) there are separate location drivers for research and for development. Reasons for locating research in a particular location are for example: proximity to local universities and research parks, the ability to tap into informal networks, proximity to centers of innovation, and access to local specialists. Also adhering local regulations and local patenting issues are mentioned by von Zedtwitz and Gassmann (2002). Reasons to establish development in a particular location could be the proximity to customers and lead users, market access, the possibility to cooperate with local partners, and country-specific cost advantages.

Because research is more focused on discovery rather than innovation, and development aims at invention rather than discovery, management of both research and development will be different too (von Zedtwitz, & Gassmann, 2002). Technology transfer between research and development could become very difficult when the research function is separated from the company's other technology activities (von Zedtwitz, & Gassmann, 2002; Gassmann, Reepmeyer &, Von Zedtwitz, 2008). The separation of 'R' and 'D' matches to the metanational theory of Doz, Santos and Williamson (2001). They suggested that a MNE should set up a separate network to sense new technologies or market trends, which in this case corresponds to the research network. From an open innovation viewpoint it could be interesting to separate the research location from the development location, because it gives research some autonomy, which stimulates their innovativeness. But these previous arguments also show that separation makes the management of the organization more difficult.

This sections shows that a MNE has to make important considerations before it chooses where to locate its R&D labs. The considerations that we have discussed are summarized in Table 5.3.

Table 5.3 - Considerations when choosing a location to apply Open Innovation

Considerations before choosing a location to apply Open Innovation.	
Requisite 1	Availability of scientific labor.
Requisite 2	Quality of educational system.
Requisite 3	Proximity to academic centers of excellence.
Requisite 4	Robust IP protection system.
Requisite 5	Focus on traditional hotspots or not?
Requisite 6	Separation of research and development locations?

Knowing where to locate R&D activities is however not enough. MNEs have to decide in *how many foreign locations* they want to be physically present. This will be the subject of our next section.

5.3.2 What is an effective number of R&D locations?

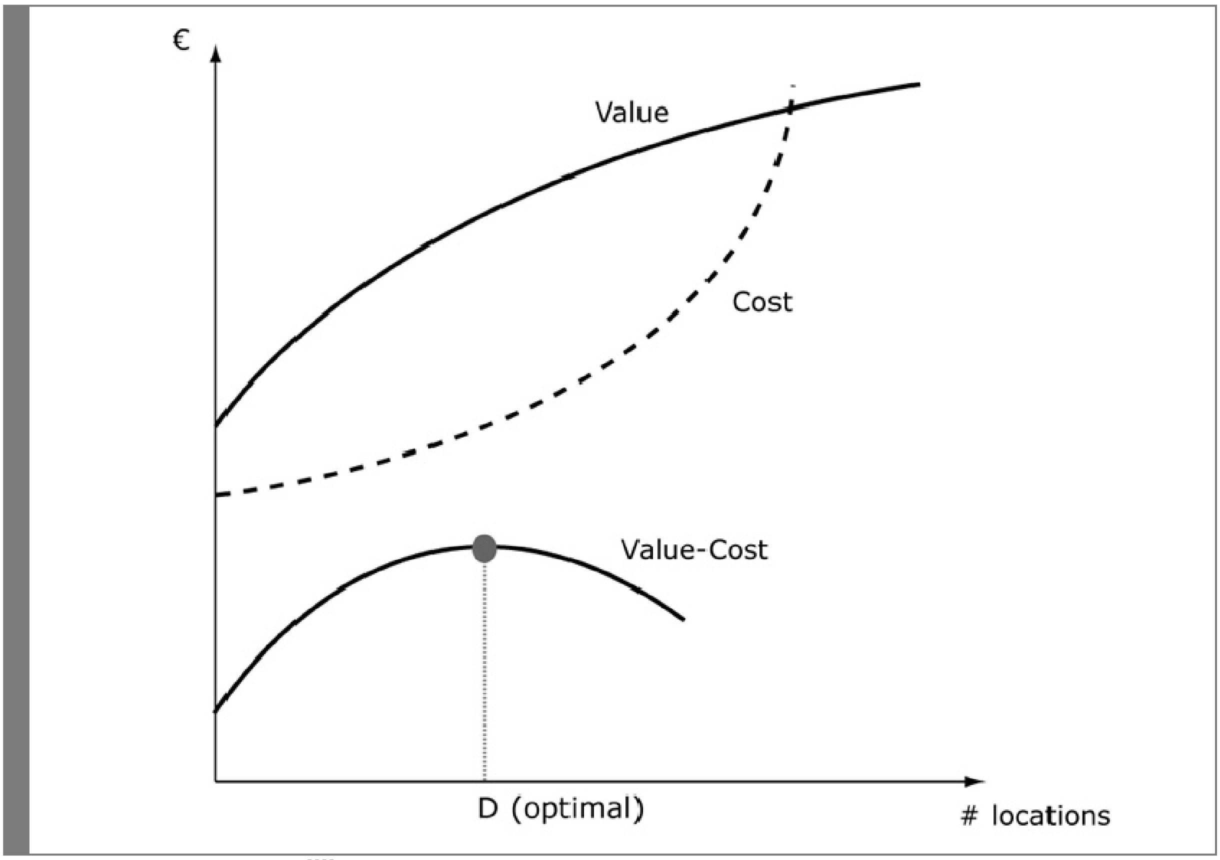
MNEs should globalize their R&D activities in order to make use of the pockets of specialist knowledge that are scattered across the globe. This is the main argument that of the globalization of R&D literature by Doz, Santos, and Williamson (2001). This is in line with the open innovation literature which advises MNEs to make use of external knowledge. But if we apply open innovation in an international context, one of the problems is that Chesbrough (2003) does not question *how many R&D locations a MNE should tap from*. So should a MNE have a R&D facility in every interesting location across the world? The previous section gave us already the idea that there are locations that are more favorable than others to set up a R&D laboratory. There is however another argument, MNEs should be careful when adding an extra node into their R&D (or sensing) network. Jaruzelski and Dehoff (2008) indicated in a study of Booz and Company that having a very large number of external sources is not good for the financial performance of a MNE. Jaruzelski and Dehoff (2008) found that a network of fewer, larger R&D facilities supports stronger performance results and that the companies with a more concentrated and focused global R&D footprint perform 30% better on three year operating income growth and total shareholder return. This is because in MNEs with a more concentrated R&D network, they can make better use of resources, manage their R&D networks more effectively and improve communication and collaboration. We will now discuss the second location challenge, i.e. determining the effective number of R&D locations.

5.3.2.1 'Value-cost'-based footprint

The optimal footprint is the optimal level of globalization of a MNE's innovation process. There is a *tradeoff* between adding a new location, which adds value to the innovation process, and extra costs due the increased complexity of the network. A company should only choose a new location to tap knowledge from when it complements the knowledge base that is already installed within the company (Doz, Santos, & Williamson, 2004). However, finding a lot of complementary knowledge around the world is not enough. This knowledge also needs to be mobilized and integrated into the company afterwards. The more knowledge is found in different places, the more difficult it becomes to coordinate this scattered pool of knowledge and successfully integrate it into the company. Each additional location brings an extra cost and adds complexity to the company. As a result, the additional gains for these extra locations are not the same for each location. The marginal gains tend to decrease for each additional location. This is because not every location is as important, and companies will obviously start with the most attractive locations. This implies that a company should try to find an optimal amount of locations to tap knowledge from that maximizes the gains (Doz, Santos & Williamson, 2004; Doz, 2006b). This relation is illustrated in Figure 5.5, where 'D' is the optimal degree of dispersion: the optimal footprint.

The optimal footprint depends on the slope of the value and cost curves. Doz, Santos and Williamson (2004) however point out that a company has to be very careful in assessing where this optimum lies. Adding locations with significantly different cultures is sometimes considered as a 'curse' that needs to be avoided when going global. However, it may actually be an advantage in globalizing a firm's innovation process because it fuels diversity, which in turn strengthens the innovation engine. These cultural difficulties will be discussed more into dept in the next section, when we question how a MNE should tap into local pockets of knowledge. Doz, Santos and Williamson (2004) also draw attention to the fact that the slope of the value curve is uncertain, but in general they conclude that the more diverse the knowledge sources a MNE is tapping from, the greater the chance will be that this knowledge will deliver a big added value to the innovation process and the higher the chance that the innovation will be considered disruptive for competitors. The cost curve on the other hand is easier to predict (Doz, Santos & Williamson, 2004). The curve will go up quickly as greater dispersion complicates the process of mobilizing and integrating diverse knowledge from several sources, each with a different local context. Summing up both cost and value curves, lead to the value-cost curve which reaches an optimum at point D, being the optimal degree of dispersion.

Figure 5.5 - Value of an Innovation, Cost of Innovating and Dispersion



Source: Doz, Santos, & Williamson, 2004.

Doz (2006b) argues that in order to create a global innovation network that is able to provide differentiated contributions, several conditions have to be met. First, distinctive local skills need to present like a well educated workforce, or specialized knowledge should reside in the area. Second, local operations need to make sure that they are in contact with the environment in order to be able to gain access to the knowledge that resides in their environment. To do this, they *should be part of knowledge creating activities and work together with local partners* (partnering). Third, the learning and innovative knowledge the local environment has to offer has to be matched to the needs of the global company. These levels of competition were already discussed, although implicitly, in the previous section where we discussed the question of what interesting R&D locations could be for a MNE.

Doz (2006b) also notes that each location within the multinational network experiences competition at two levels: competition between firms and between R&D centers within the same MNE. The first level of competition is an external competition against other companies to tap into local knowledge creation capabilities and local sources of knowledge. The second level of competition is a race against other locations within the own multinational company network. The company could tap similar or superior knowledge from for particular projects from different nodes in the network.

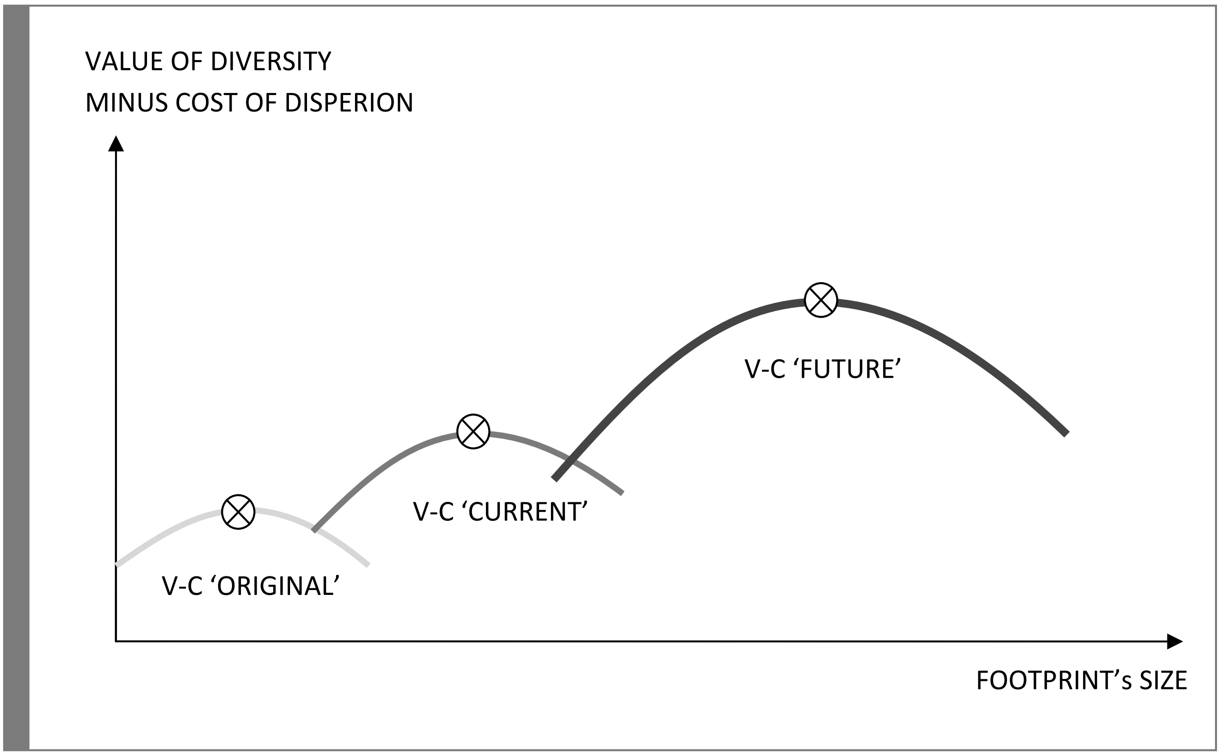
MNEs benefit when they configure their innovation network for cost and manage them for value (Goldbrunner, Doz, Wilson, & Veldhoen, 2006). An innovation network *configured for cost* means that MNEs should only add an extra node to the network when it allows to cost-effectively access critical knowledge that otherwise could not be tapped. It should determine which locations might be absolutely necessary to obtain the required knowledge that will complement their existing knowledge base (Doz, Santos, & Williamson, 2004; Doz, 2006b; Goldbrunner, Doz, Wilson, & Veldhoen, 2006). This argument already assumes that MNEs have a database of all the knowledge that is available within company walls. For some MNEs this may not be the case, which makes open innovation more difficult, because when a MNE 'does not know what is knows', it will have no clue about what it wants to source from external partners. Secondly, MNEs should add a node when it enables them to locate locations where capabilities are present that allow them to deliver results more efficient than anywhere else in the network. MNEs should thus configure their innovation networks as efficient as possible. This means always checking if knowledge or capabilities can be acquired throughout the world in a less costly manner, they should make use of it. The third question the MNE has to consider is how radical their innovations should be. More radical innovations increase the likelihood that the footprint will be larger (Doz, 2006b).

Another factor that will affect the footprint is the company's strategy (Doz, Santos, & Williamson, 2004; Doz, 2006b). The more advanced the strategy, the larger the footprint will be. Nokia's current emphasis on new-application development and market creation, for instance, calls for a 'farther-flung' footprint than the company's earlier focus on excellence in hardware (Doz, Santos, & Williamson, 2004). Finally, the right footprint can evolve as the innovation process unfolds. When the MNE wants to create incremental innovations, they are likely to have an initial good understanding of the knowledge bundle that they need (and by this the optimal footprint). When dealing with breakthrough innovations, the footprint might be adapted when the description of the innovation process becomes more precise and clear, and the MNE learns from exploring new areas (Doz, Santos, & Williamson, 2004).

A geographically diverse R&D network should however also be *managed for value*. This means making sure that there are processes and tools available that encourages innovation and cooperation across geographies, cultures, and organizational silos (Goldbrunner, Doz, Wilson, & Veldhoen, 2006). Some of these managerial issues will be discussed in the next section, where we focus on how firms tap from external sources and integrate the knowledge into the MNE.

Because of learning effects and best practices that will be distilled from a lot of MNEs, it is likely that the footprint size of MNEs will become bigger and bigger, and that the value of diversity minus the cost of dispersion will also become greater over time (Doz, Santos, & Williamson, 2004). This evolution is graphically depicted in the Figure 5.6.

Figure 5.6 - Possible Evolution of Footprint size

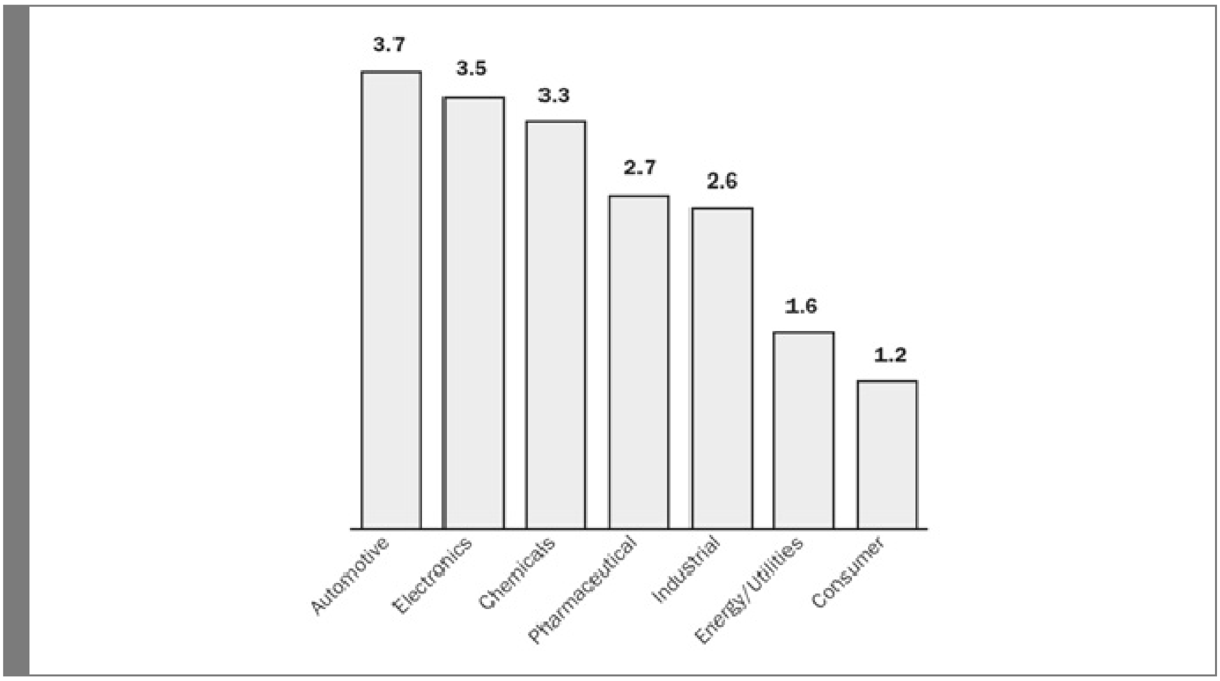


Source: Doz, Santos, & Williamson, 2004.

5.3.2.2 'Nature of knowledge'-based footprint

A study of INSEAD and Booz, Allen, Hamilton (2006) showed that the nature of knowledge is another important factor that influences the global footprint. They found that sectors that rely more heavily on complex knowledge which is difficult to move had less dispersed innovation footprints. This phenomenon is shown in Figure 5.7.

Figure 5.7 - Dispersion of innovation footprint by sector[1]



Source: INSEAD and Booz, Allen & Hamilton, 2006.

The automotive sector, electronics and chemical sector have the most dispersed networks. These sectors are more suited to have a more distributed R&D network than others because the primary source of their knowledge base is codified (Booz, Allen, Hamilton, 2006). Codified knowledge is knowledge that travels easily, provided that both sender and receiver have a scientific background in common. It is therefore easier to communicate over a larger geographic distance. This argument is supported by the same figure, when we look at the sectors that have a less distributed R&D network. The industrial, energy and utilities, and consumer goods sectors rely more on complex knowledge. This is knowledge that is embedded in a local context. Transferring this type is difficult because it requires often a 'see and do' experience which is very difficult to articulate (Doz, Santos, & Williamson, 2001; INSEAD and Booz, Allen & Hamilton, 2006).

These issues in determining the optimal degree of dispersion are new for the open innovation literature. Because this theory was not applied in an international context, there was no need to focus on these issues. However, they are important considerations for a MNE when it decides to use its globalized R&D network to apply open innovation.

[1] Dispersion is represented on a scale of 1 to 4, with "1" indicating a non dispersed sector, and "3" or above a dispersed sector.

The considerations related to how many subsidiaries a MNE should establish are summarized in Table 5.4.

Table 5.4 - Considerations before adding an extra location when applying Open Innovation

Considerations before adding an extra location when applying Open Innovation.	
Requisite 1	Perform a value-benefit analysis before adding an extra location.
Requisite 2	Database of the knowledge that exists within the MNE.
Requisite 3	Having insight in the nature of the knowledge will help to decide if adding an extra location is needed.
Requisite 4	Type of innovation (radical versus incremental).
Requisite 5	Company's strategy.
Requisite 6	The external knowledge needs to complement the ideas which are generated internally.

Because the optimal footprint is in most cases composed of different R&D centers, MNEs will have to overcome problems related to geographical and cultural distance. These are issues that we will focus on in the next section.

5.3.3 How to tap effectively into local R&D-communities around the globe?

As previously discussed, when MNEs want to successfully apply open innovation, they have to go through three phases. Firstly, the *locations* where the necessary IP can be found have to be identified. After having addressed this challenge, they need to gain *access* to this IP. The final step is then to *integrate* the IP into the MNE. These three phases a company has to go through in order to in-source external IP are depicted in Figure 5.8. Accessing IP is however not as obvious as one may think. Having established a sense of where a certain piece of IP can be found, and being able to make use of it, are two very different management challenges.

Figure 5.8 - Location, access and integration

The difficulties of accessing IP are very apparent when considering IP embedded in a competitors' organization. In this situation, it is clear *where* the IP is located, but as it is under control of a competitor, it is unlikely the firm will get *access* to it. Other difficulties arise when dealing with different parties. When a university for instance possesses ownership of relevant IP, they may be only willing to allow a company to use this IP under certain conditions. Universities may for example be interested in getting access to further research that will be performed in that technological area within the company, and/or on the other hand want to receive royalties or a licensing fee in exchange for their IP. Companies, however, may prefer exclusive licensing agreements with a university, which implies that the potential royalties the university will receive will depend on the success of a single company. This reduces the probability of a good return on investment for the university. Universities may thus only select licensees that have a higher chance of success in commercializing the technology. This may result in selecting a company that is willing to make a commitment to substantial investments in the commercialization of the technology (van den Berghe & Guild, 2007). These conflicts of interest demonstrate that gaining access to technology owned by other organizations is a complex management challenge which will only become more challenging when operating internationally. A requisite for the MNE when working with external partners is therefore the ability to develop good insights in the interests of the party that controls the intellectual property rights.

Apart from knowledge that is embedded in organizations, knowledge is also embedded in the minds of people. Like companies, individuals will only be willing to share this knowledge in return for certain benefits. In the same way that MNEs can acquire other companies in order to get access to a particular technology, MNEs can also 'acquire' people. Attracting people to work for a company is an effective way to gain access to their knowledge. A requisite for a company to get access to knowledge can therefore be the ability to attract highly skilled workers. This illustrates the importance of good human resources management when a MNE wants to apply the open innovation principles. Apart from being an attractive company to work in, companies also have to be able to retain their workforce. However, trying to attract and retain people on a global scale is very difficult. Motivating people to move from their current location to the country where the company is located requires some effort. Also moving people to different countries may imply learning new languages to be able to communicate with local team members (Doz, Santos, & Williamson, 2001).

As mentioned above, organizations and people are the two main sources a company will interact with in order to gain access to certain IP. However, not all organizations are the same, neither are all people. This is especially the case when these sources are spread all over the globe. We therefore differentiate four main sources of knowledge for the MNE, which are: lead users, start-ups, universities and research centers, and knowledge brokers. Each group has different motives to share or not share knowledge. *Lead users* may be willing to share knowledge in order to satisfy their own needs, while *start-ups* may open up in order to gather funds and grow. *Universities and research centers* may be willing to share, when companies offer new knowledge and/or royalties in return for the right to use their IP. *Knowledge brokers* form a separate group as they connect the supply and demand side of IP, and offer their services at a fee. When collaborating with each of these sources, the MNE should pay attention to the establishment of *trust* between them and their partner, as it is an essential part of cooperative relationships (Chan, 1997; Batt & Purchase, 2004, Das & Teng, 1998; Doz, Santos, & Williamson, 2001). In what follows we will discuss these four sources more into detail.

5.3.3.1 Gain access to lead user knowledge

Lead users are defined as "those who combine two characteristics: (1) they expect attractive innovation-related profits from a solution to their needs and as a result are likely to innovate; (2) they experience needs ahead of the majority of a target market" (von Hippel 1996, Urban and von Hippel 1988, Morrison, Roberts & von Hippel, 2000). As lead users experience needs ahead of the majority of the market, they can provide useful insights and knowledge that may lead to new innovations that may appeal to other users as well. They thus have the potential to be an important source of knowledge that should be tapped into (Doz, Santos, & Williamson, 2001). Lead users can be situated all over the world, which could make them difficult to track down. However lead users often manage to find each other as they will turn to people who know even more about the matter than they do to help solve the problem they face. By continuously asking them who knows even more about the matter than they do, it is possible to find the most knowledgeable ones and those that face similar problems, but in more extreme situations.

The development of antilock braking systems for motorcycles and cars is an example of this in a B2B context. Although it is a very useful system for cars and motorcycles, it was invented in the aerospace sector where they had a very high incentive to get their expensive airplanes to stop as fast as possible before they ran out of runway (von Hippel, Thomke & Sonnack, 1999). Technologies that were developed for one particular application can thus be applied in other situations as well. As the MNE is active in different locations around the world, its customers may face different challenges related to the product. Consider for instance a production machine produced by an MNE and sold all over the world. Suppose one of its customers is located in Africa. When the people in Africa run the machine at a standard rate in their hot environment, there are no problems. If however, they want to increase their manufacturing speed, the machine will not be able to cool sufficiently and will breakdown. When they realize that these breakdowns are caused by heat, they may invest in a massive air-conditioning installation to cool down the whole factory, and in that way prevent the production machine to become overheated. Others may try to increase the efficiency of the machine and try to reduce friction to prevent heat dissipation. Especially those 'lead users' are an important source of knowledge to MNEs. The solution also has other benefits apart from heat reduction: the lower friction will result in a longer life time, and the increased efficiency a lower electricity bill which makes it interesting for all customers. This example illustrates how different local factors can stimulate product improvement and innovations that can be applied globally. Note that this is not the same as adapting products for a specific local region as we have described in the local-for-local model. In our case, the changes are initiated local, but can be applied global.

Rather than focusing on lead users that would innovate the product (car, motorcycle, or airplane) as a whole, companies should focus on finding those lead users that can help improve a certain part of the technology needed to develop the product (von Hippel, 1986). This fits the fact that products have an increased complexity and consist of several different technologies (Doz, Santos, & Williamson, 2001), like for example a smartphone. It also appears that companies should not only focus on lead users in one certain industry. The same problem can play in other applications and industries as well, with possibly even a higher incentive to solve the problem (von Hippel, 1986).

MNEs wishing to apply open innovation can make use of the wealth of knowledge that lead users have to offer. To tap into lead user knowledge however, different approaches may be needed. Some are willing to freely reveal their knowledge (von Hippel, 2005) and others will require some form of compensation. Some lead users will not dispose over the needed resources to solve their problem and may share their ideas in return for those resources. MNEs thus have to develop different strategies when dealing with different lead users in order to tap into the knowledge they possess.

5.3.3.2 Gain access to start-ups knowledge

Start-ups often do not dispose over all the resources required to successfully commercialize a technology. Given their lack of resources (Chesbrough, Vanhaverbeke, & West, 2006), they may be more willing to share IP in return for support. Start-ups will also typically find themselves in a position where they have to choose to either compete, or cooperate with established companies (Brandenburger & Nalebuff, 1996; Gans & Stern, 2003). This means that besides developing own commercialization capabilities, start-ups could earn their returns on a “market for ideas” instead of the product market. However, they will evidently only be willing to offer their technology on the market for ideas, when they can appropriate a decent share of the value that will be created through the commercialization of their IP, without running the risk to be expropriated of their IP (Gans & Stern, 2003). In some cases, start-ups will look to be acquired, which thus also provides a way to gain access to certain IP (Chesbrough, 2003). One of the requisites for MNEs to get access to the IP of start-ups is thus the ability to provide the resources a start-up is looking for.

Though, merely providing resources will not be enough to convince a start-up to provide access to their IP. Sharing IP can create significant benefits for both parties: it can provide the required resources for the start-up, and the sought after IP for the firm. But it may also induce self-interested behavior by one of the partners (Daellenbach & Davenport, 2004; Bamford, Gomes-Casseres & Robinson, 2003). It is however in the interest of both parties that the other will contribute to the relationship rather than serve their own purpose (Bamford, Gomes-Casseres, & Robinson, 2003). In order to reduce uncertainty about self-interested behavior in the relationship, firms need a certain level of confidence when working with partners (Das & Teng, 1998; Doz, Santos, & Williamson, 2001). This means that trust is an indispensable part of the cooperative relationship (Chan, 1997; Batt & Purchase, 2004, Das & Teng, 1998; Doz, Santos, & Williamson, 2001). When a company is known for not paying up, or not meeting the conditions that were stated in the agreement, this company will have a hard time to gain access to IP, and will only be able to do so at a higher price, as the other party will add a risk premium. However when looking at trust within the context of geographically dispersed teams, a greater distance results in a lower level of trust. This is partially due to cultural differences (Zolin, Hinds, Fruchter & Levitt, 2003). These cultural differences will add complexity to the relationship between two parties among which a great cultural distance exists. Given the earlier mentioned importance of trust in cooperation, this adds to the complexity of applying open innovation on a global scale. A requisite for MNEs when opening up their innovation processes is thus the ability to create a climate of trust and openness in an international context.

Das and Teng (1998) also argue that control mechanisms have an impact on the trust level between partners in an alliance. Control mechanisms that allow the partner to influence the predictability of a desired outcome, will have a positive effect on the level of trust between the partners (Das & Teng, 1998). When dealing with IP, the availability of IP protection measures can influence the level of controllability of the partner regarding the IP, and thus the level of confidence in partner cooperation. When formal IP rights such as patents are controlled by an innovator, the potential for expropriation will be lower, which makes a cooperation strategy more interesting for the innovator (Gans & Stern, 2003). Given the different legal frameworks, namely the availability of weak versus strong IP protection measures, in which a start-up (or potential partner) may find itself, a different approach may be required in order to secure access to IP. Because MNEs have a sensing network, with nodes located all over the world, they will be more likely to be exposed to different IP regulations. A requisite is thus the development of an understanding of the legal framework in which the potential IP supplier is situated and the influence of the IP protection measures on the behavior of the controller of the IP.

5.3.3.3 Working with universities & research centers

University research was often portrayed as a public good. Things have changed however, since the spread of intellectual property rights protection throughout university's R&D activities. Universities are now looking for contractual relationships based on value exchanged. Companies can gain access to university R&D through both formal linkages (e.g. official collaboration programs) and informal linkages (e.g. informal contact). Informal linkages have the benefit that they can facilitate other ways of contact, both formal and informal. Another benefit of informal linkages is that they allow companies to tap into university knowledge at relatively low cost (Rappert, Webster & Charles, 1999). In what follows we will discuss through which links firms can connect to universities. After this we will discuss the importance of trust, as well as the influence of IP rights on the university-firm relationship. We will close this part with a brief outline of the motives of individual researchers to participate in knowledge sharing.

5.3.3.3.1 Establishing links with universities

In their research on academic-industrial relations and intellectual property in the sectors of new materials, IT and scientific instruments with university spin-offs (and some SME's), Rappert et al. (1999) define three main channels through which university links were maintained and extended by firms. These channels are: contacts, literature, and recruitment. *Contacts* are defined as taking place during consulting, collaborations, conferences, past networks, or chance meetings. Contacts were rated as the most important channel, as *literature* (only) provides a mean to scan across universities for new developments. A successful contact allows the development of understanding and trust. Another reason why contacts are so important is because they allow tacit knowledge to be transferred (Rappert et al., 1999; Doz, Santos, & Williamson, 2001). We will come back to knowledge transfers in the next part. However, because MNEs have subsidiaries that are located all over the world, the geographical distance between parties is greater, making frequent contacts more difficult to establish. Also *recruitment* provides a way to gain access to university R&D; this seemed to happen especially in the IT sector (Rappert et al., 1999). However, as universities move more towards commercialization of university research (Powers, 2004), it may be more difficult to gain access through informal channels, and formal channels should be addressed.

5.3.3.3.2 Trust, geographical proximity & IP rights

Trust, proximity, and flexibility of university policies regarding intellectual property rights, patents, and licenses positively influence technology transfers (Santoro & Gopalakrishnan, 2001). As a multitude of companies can work together with a university or research lab, there is a chance that when a company shares information with the research lab, there will be a leak of information to other parties with whom the research lab is involved with. However, the researchers will need enough information to understand the problem in order to be able to provide solutions. For this reason it is important that a climate of trust is established where both parties can collaborate without the fear of losing their competitive edge through knowledge leaks (Santoro & Gopalakrishnan, 2001).

Universities from their side will look to advance research in a particular area; partners thus should contribute to the research. Without confidence that the other party will contribute to this goal, universities may prevent access in order to avoid free riders to benefit from work of others. When other companies are aware that some of their partners are free riding, it will discourage these companies to contribute. This means that to be able to tap into knowledge residing in a university or research lab, the company will have to share information and contribute. To encourage this behavior, both parties will need to be able to trust each other. Rappert et al. (1999) also found that informal trust can serve as an informal form of intellectual property rights. Many of the companies in their sample stated that they minimized their "paperwork" (effort spent on legal safeguarding), the reason for this being both a limited market for their goods and peer sanctions against those who break informal rules and expectations.

Geographical proximity stimulates idea sharing through both formal (licensing, alliances...) and informal networks (mobility of scientists and engineers, social meetings, conferences, etc...). An additional advantage of these exchanges is that also information regarding on-going research may become available rather than only the established projects. When dealing with universities, meetings with researchers may be especially fruitful as they have less incentives to keep their work secret compared to firms (Santoro & Gopalakrishnan, 2001). Geographical proximity thus has many benefits. For this reason a MNE may consider to set up a local research subsidiary near important knowledge sources in order to tap more effectively into universities or research labs.

Flexible ways of dealing with intellectual property rights is necessary if universities want to convince firms to advance new technologies (Santoro & Gopalakrishnan, 2001). Universities will typically want to publish findings as soon as possible. The firm on the other hand will want to delay publishing of findings to benefit from using the knowledge before anyone else is able to. Corporations need to understand the different goals that universities pursue compared to themselves and find a way in which both parties can agree on how to handle the IP. One way to tackle such a problem can for instance be the delay (not cancellation) of publication of research findings (Santoro & Gopalakrishnan, 2001). This meets the desire of the university to publish, and the wishes of companies to keep information secret and to themselves for a period of time, enough to gain an advantage. Research performed by Hall, Link and Scott (2001) indicated that trouble finding an agreement over IP issues between firms and universities, appear to be at least one of the barriers that prevent the establishment of a research partnership. Problems may arise when the research results are perceived as being less appropriable (and thus of more public nature). One of the requisites is thus the ability to strike an agreement over the IP generated when working with universities, given the different goals of both parties. Universities and researchers connected to universities will prefer publishing, while companies most likely prefer to keep the generated knowledge confined.

5.3.3.3.3 Motives of individual researchers

Lee (2000) has identified what academics seek from firms. This provides a useful insight in what a company can offer to an academic. After all, it is the researcher who performs the research, not the university (Lee, 2000). The findings are displayed in Table 5.5.

Looking at the first four items, it is clear that advancing one's own research is of greatest importance. The firm should therefore provide funds, offer collaboration that can lead to new insights for the researchers, and help them to field-test their theories. Academics attach less importance to firms that make contributions the universities' mission, that create student jobs, provide knowledge for teaching, and business opportunities. This last item forms an interesting opportunity for both the firm and the university, as firms will look to commercialize research performed by researchers, while the researchers themselves are to a much lesser extent interested in this which lowers the potential for conflicts of interest. However, more recent studies suggest universities are looking more and more to commercialize research (Powers, 2004). This means that although the researcher may be willing to share information, they may be prohibited to do so. Also government incentives (which may vary across countries) that stimulate collaboration with companies may influence the willingness of researchers to collaborate with companies.

Table 5.5 - Benefits academics seek from firms

Ranking	What academics seek from firms
1	Secure funds for graduate assistants and lab equipment
2	Gain insight into one's own research
3	Field-test application of one's own theory
4	Supplement funds for one's own research
5	Assist university's outreach mission
6	Create student jobs and internships
7	Gain knowledge useful for teaching
8	Look for business opportunity

Source: Lee, 2000.

5.3.3.4 Working with knowledge brokers

Sousa (2008) defines knowledge brokers as those companies "providing the links, knowledge sources and even technical knowledge so that firms can accelerate and increase the effectiveness of their innovation processes". Knowledge brokers facilitate the process of searching, accessing and transferring the knowledge into the organization (Sousa, 2008). Innocentive is such a knowledge broker. They connect people from all over the world. Through them, a first contact can be established with another party, which may lead to access to excellent knowledge. What differentiates knowledge brokers from knowledge service providers is the active role knowledge brokers play in providing the links and the development of relationships between two parties. To better understand how knowledge brokers may be of service to corporations we will look at what the core capabilities of knowledge brokers within the context of open innovation are. These capabilities are shown in Table 5.6 (Sousa, 2008).

Table 5.6 - Core capabilities of knowledge brokers

Core capabilities of knowledge brokers are the ability to:
▪ Understand innovation problems
▪ Translate innovation problems into a structured project
▪ Understand the necessary capabilities, skills and knowledge to solve the problem
▪ Identify who can better provide those same capabilities, skills and knowledge
▪ Establish the necessary relationships and collaborative teams at a global scale to solve the innovation problem.

Source: Sousa, 2008.

Knowledge brokers can thus assist MNEs in defining what is necessary to provide a solution to an innovation problem. First they will develop an understanding of the innovation problem. After this they will translate the innovation problem into a project, and determine what is necessary to actually solve the problem. And finally they will establish the necessary relationships to solve the problem. They can provide useful insights on who can provide assistance in the problem solving process. But most interestingly, as far as gaining access to IP is concerned for the MNE, they can help establishing relationships and collaborative teams on a global scale (Sousa, 2008). A knowledge broker can thus be a valuable partner in applying the open innovation principles to a MNE as they can increase the span of a company’s sensing network.

Companies may however, be able to perform the functions of a knowledge broker themselves. But for a company that does not possess all the necessary skills to complete transactions of IP (legal, licensing, networks to find and access knowledge suppliers, etc…), knowledge brokers may be more efficient (Benassi & Di Minin, 2009). A knowledge broker merely aims to connect both sides of supply and demand; they do not seek to commercialize a certain technology themselves. Therefore, the risks a company faces when they share knowledge with a knowledge broker, is lower compared to sharing knowledge with a company interested commercializing the technology. This may increase the willingness to share important information that could contribute to the solution of a problem. It is of course not in the interest of the broker to leak important information or act in favor of either of the parties as this would damage their reputation and their business.

5.3.3.5 Conclusion

In order to succeed in accessing IP from external sources, the MNE will have to tackle some challenges. They will have to develop a good understanding of the needs of the party that controls the IP, to understand what they seek, and what could motivate them to share the IP. With this knowledge they have to create a tailored strategy to gain access to the knowledge that this party possesses. They also have to be able to create a climate of trust and openness to facilitate access. Besides this, they also have to be an attractive employer, in order to be able to gain access to knowledge embedded in the minds of people, and to retain them. These requisites are summarized in Table 5.7.

Table 5.7 - Considerations to gain access to IP when applying open innovation

Considerations to gain access to IP when applying Open Innovation	
Requisite 1	Develop a good understanding of the needs of the party controlling the knowledge
Requisite 2	Recognize the differences between parties and develop strategies to gain access to knowledge accordingly
Requisite 3	Create climate of trust and openness
Requisite 4	Be an attractive partner/employer

However to satisfy these requisites, a local presence may be required in some cases. Being co-located will also facilitate the transfer of knowledge from the foreign location into the company. As mentioned in chapter 4, the absorptive capacity of a company is influenced by the balance between common knowledge and different knowledge. Common knowledge of the culture and language is something that can be regarded as enhancing, if not essential for, the ability to tap into locally embedded knowledge. This can be achieved by setting up a local R&D subsidiary. We will therefore continue by discussing knowledge transfers, both from outside the MNE to its R&D subsidiaries, as well as the knowledge transfers among the R&D subsidiaries within the MNE.

5.3.4 How to integrate knowledge effectively from different parts of the world in a MNE?

The previous three questions discussed the challenges concerning the locations where a MNE can look for knowledge, in how many locations the MNE should be active, and how MNEs can get access to the knowledge that resides in a certain location. Apart from these challenges, MNEs should also be able to absorb the knowledge that is available to them in the location of the subsidiary. This sequence is depicted in Figure 5.9, where we now arrive at the third step in which companies have to integrate the knowledge.

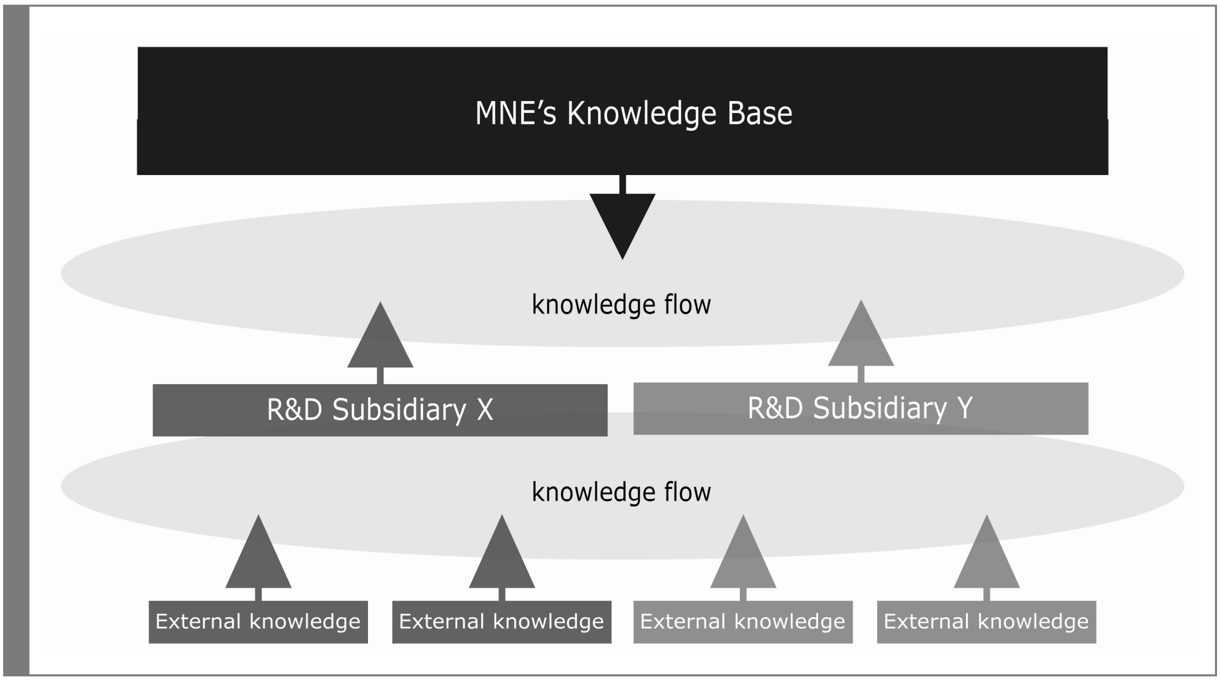
Figure 5.9 - Location, access and integration

As mentioned before in chapter 4, integrating knowledge depends on the *absorptive capacity* of MNEs. Absorption can only take place when the person who controls the knowledge is willing to share this knowledge. In other words, access to the knowledge is a prerequisite before knowledge absorption can take place. Cohen and Levinthal (1990) defined absorptive capacity as the ability to value new knowledge, assimilate, and commercialize it. To be able to value and assimilate new knowledge, the MNE (actually the employees) requires a *knowledge base*, relevant to the knowledge they are trying to absorb. This knowledge base enables people to identify new relevant external knowledge more easily (Cohen & Levinthal, 1990; Cohen & Dal Zotto, 2007). It also facilitates adding more information and to recall this information (Cohen & Levinthal, 1990). Having a relevant knowledge base thus facilitates the ability to learn more about a certain subject.

It is important to note that the absorptive capacity of a company is not just the sum of the absorptive capacities of all the individuals in the organization (Cohen & Levinthal, 1990). This is because the ability to exploit the knowledge is a part of the absorptive capacity. Exploiting knowledge requires transferring knowledge through different departments. During this transfer, knowledge losses are unavoidable. The ability to transfer knowledge thus affects absorptive capacity (Cohen & Levinthal, 1990).

The general concept of *knowledge transfer* in a MNE is depicted in Figure 5.10. The figure illustrates how the subsidiaries first will extract knowledge from their environment. This results in a flow of knowledge from the local environment to the subsidiaries. Afterwards, the knowledge has to be absorbed by the rest of the company in such a way that it contributes to the existing knowledge base of the MNE. The knowledge base is then available to other subsidiaries and the headquarters who can use it in their R&D projects.

Figure 5.10 - Knowledge flows in the MNE



We will now discuss the challenges MNEs will face, when trying to integrate knowledge that resides in locations abroad. This is an essential step in the execution of the open innovation strategy. We will start our discussion with the challenges for the subsidiary. Afterwards, the challenges to integrate the knowledge that resides in subsidiaries, with the knowledge of the company as a whole, will be discussed.

5.3.4.1 Absorbing knowledge from foreign locations

5.3.4.1.1 Culture

Cohen and Dal Zotto (2007) state that a smaller *cultural distance* between two parties improves the absorptive capacity. As a result, when a MNE wants to improve its absorptive capacity (which helps to tap into a foreign source of knowledge) it has two choices: it can adapt its culture to that of the local partner, or the local partner should adapt its culture to the MNE.

Adapting to someone's culture is however not an easy task. This is because a corporate culture is often unique, tacit and difficult to change (Tellis, Prabhu & Chandy, 2009). Even when the culture is fully understood, which is unlikely due to its tacit nature, it remains difficult to change. A companies' culture is determined by national factors, which apply to all companies in a particular nation (or region), and firm unique factors (Tellis, Prabhu & Chandy, 2009). *National factors* are for example legislation and government incentives, which cannot be controlled by firms. These factors will stimulate certain corporate behavior, which will have an influence on a company's culture. Also the dimensions determined by Hofstede (2003): power distance, uncertainty avoidance, individualism, masculinity and long-term orientation differ between nations and may thus affect a company's culture. *Firm unique factors* on the other hand, are under control of the firm. A factor that may influence the corporate culture is for instance the vision of the top management.

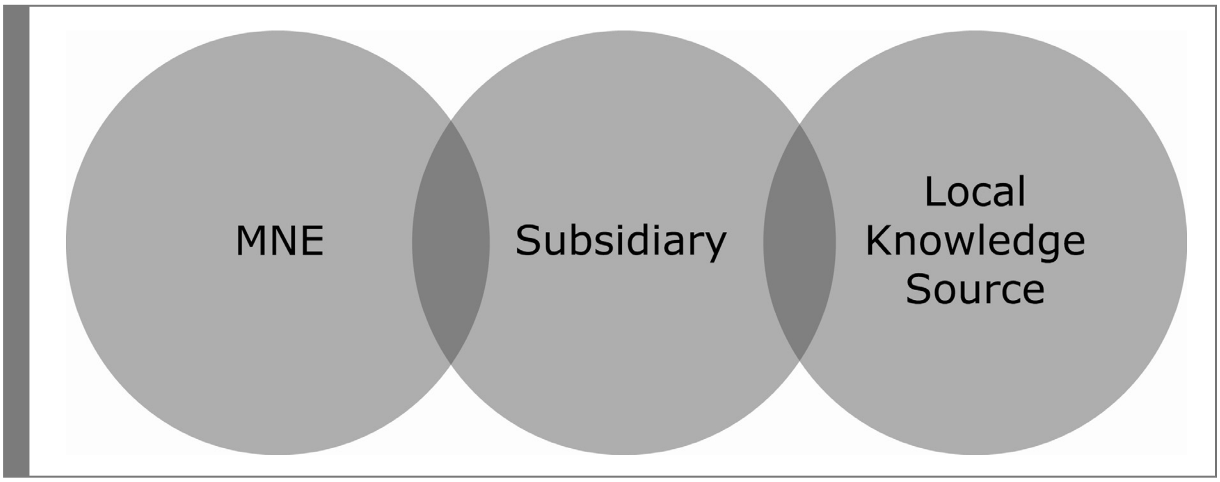
To reduce the chance of experiencing a cultural clash between the MNE and the local environment, MNEs should set up local subsidiaries. These subsidiaries are more likely to have a better cultural match with other companies in their location. MNEs should thus encourage their subsidiaries to adopt the local cultural values that stem from national factors. Doing so can enable a better cultural match between the MNE and the foreign location through the subsidiary. (Doz, Santos, & Williamson, 2001).The better cultural match could then lead to an improvement in knowledge transfer between the subsidiary and sources in the foreign location. However, the MNE should transfer the knowledge that is gained locally back throughout the whole MNE as well. The MNE should therefore also establish an internal cultural match. It should control the firm unique factors that determine the corporate culture, to achieve a global cultural match between its subsidiaries. This internal cultural match is necessary to facilitate the flow of knowledge gained locally in the subsidiaries, back throughout the MNE.

The principle of a cultural match can be aligned with the idea of familiarity of knowledge between partners of Cohen and Levinthal (1990) and cognitive distance as used by Nooteboom et al. (2007). Consider two extreme cases where the MNE wants to transfer knowledge from an external party. In the first case, two parties have much knowledge in common, which makes the cognitive distance between them small. Transfer of knowledge between them will therefore be easy. The absorptive capacity will be high in this case, but the knowledge is not really novel for both parties. If on the other hand, both parties have very dissimilar knowledge (high cognitive distance between them), the knowledge bases are too dissimilar, which will prevent both parties to reap the benefits of their complementary resources. As a result, the absorptive capacity will be low. The learning effects will however be the greatest somewhere between both extremes. At the optimum, the firm can profit from the novel knowledge of the other party, due to the partly similar knowledge base (Nooteboom et al., 2007). Nooteboom et al. (2007) notes that two parties "[…] need to share certain basic perceptions and values to sufficiently align their competencies and motives." This requires them to have a shared understanding, which can be achieved by "shared fundamental categories of perception, interpretation, and evaluation inculcated by organizational culture." (Nooteboom et al., 2007)

This previous analysis shows that MNEs should establish a corporate culture in the subsidiary that has on the one hand enough in common with the local culture in order to improve knowledge transfer, and on the other hand MNEs should of course develop the required technological knowledge in order to achieve a sufficient technological match with the local knowledge sources in which it wishes to tap as well.

The role of the subsidiary and the function of common knowledge are illustrated in Figure 5.11. The different circles represent the knowledge base of respectively, the MNE as a whole, the subsidiary, and the local knowledge sources. The overlapping areas indicate common knowledge, which facilitates knowledge transfer (Cohen & Levinthal, 1990; Cohen & Dal Zotto, 2007). The subsidiary allows the MNE to connect to the local knowledge sources. At the same time, other subsidiaries can be connected to the MNE as well. Diversification of the knowledge bases and task specialization among subsidiaries allows the MNE to increase its absorptive capacity as a whole.

Figure 5.11 - Frames of reference and common knowledge



A requisite for the MNE applying open innovation is thus the development of the required knowledge bases in its subsidiaries that enables it to effectively and efficiently transfer knowledge from its environment to its subsidiaries, as well as to the MNE as a whole. The achievement of a cultural match can be a reason to establish a local presence via a subsidiary in order to improve knowledge transfer. However, also the type of knowledge (tacit versus non-tacit) will determine if a local presence will be necessary or not.

5.3.4.1.2 Tacit knowledge

MNEs are interested in tapping into local pockets of specialist knowledge. Specialist knowledge is however most of the time tacit in nature. As mentioned before, tacit knowledge is difficult to transfer. This is because this knowledge resides in the minds of people and is difficult to make explicit. As we have concluded in previous paragraphs, MNEs should set up local subsidiaries, because they are better suited to tap into their local external environment than non local units. Subsidiaries are located closer to the foreign knowledge source and are thus able to have more face to face contact which facilitates the transfer of specialist, tacit knowledge (Doz, Santos & Williamson, 2001; Cohen & Dal Zotto, 2007). Personal contact is needed when one of the knowledge sources is tacit and cannot be codified and moved without personal contact.

If the culture of the subsidiary is also adapted to the local environment as we discussed in the previous paragraph, the cultural aspect of the tacit knowledge will be better understood and the transfer of knowledge will be improved. A requisite for the MNE is thus to arrange frequent face to face contact with knowledge sources by co-locating people in the foreign local environment. Nonaka and Takeuchi (1995) stated that after the knowledge that resides in the external environment was decontextualized by the subsidiary, it needs to be recontextualized afterwards, or codified to some extent when it has been integrated into the subsidiary. This partial codification is required in order to let other subsidiaries know which knowledge is available in another subsidiary. Face to face meetings can then still be arranged between people of both subsidiaries to facilitate the transfer of tacit knowledge (Doz, Santos, & Williamson, 2001).

5.3.4.2 Knowledge transfer from the subsidiary to the MNE.

When the knowledge has been absorbed by the subsidiary, it has to flow through the whole MNE. The transfer of knowledge among different people and units within the MNE is important as it allows people to build on their frame of reference. This frame of reference enables people to learn (Cohen & Dal Zotto, 2007), and combine different pieces of knowledge to create new innovations and new products. Also the speed at which this happens is of importance. Gupta, Govindarajan and Wang (2008) argue that the intellectual capital of a company is determined by the knowledge created or acquired by people or units, multiplied by the velocity at which it travels throughout the organization. If the velocity of the knowledge flow would be zero, synergies are non-existent, and knowledge would merely pile up in different subsidiaries. The faster knowledge travels, the more people can learn from knowledge gained elsewhere in the organization, and the faster they can expand their own frame of reference which increases their ability to absorb knowledge (Gupta, Govindarajan & Wang, 2008).

The effectiveness of knowledge transfer within the network of subsidiaries will again depend on the absorptive capacity of each subsidiary (Cohen & Dal Zotto, 2007). Two units with a high absorptive capacity will find it easier to transfer knowledge than when one of them has a lower absorptive capacity. Knowledge transfer is supported by systematic knowledge accumulation, and the development of the relevant knowledge concerning the technology that is being transferred (Mowery, Oxley & Silverman, 1996). The need to continuously accumulate new knowledge is evident. If the firm or subsidiary, will tap in its environment to acquire new knowledge, and will use this new knowledge to innovate, it will need to continuously improve its frame of reference. Once new knowledge is absorbed, the firm will develop new insights and needs to prepare itself to absorb even more new knowledge. Internal R&D plays an important role in this process, research on technology will help the company to better understand a technology, which makes it easier to gain new knowledge (Chesbrough, 2003; Cohen & Dal Zotto, 2007).

Also the velocity at which knowledge travels throughout the organization matters (Gupta, Govindarajan & Wang, 2008).

To build up absorptive capacity and knowledge transfer capabilities, permanent learning is also a necessary condition (Cohen & Dal Zotto, 2007). A requisite for the MNE applying open innovation is thus the ability to keep building on the frame of reference of the MNE and its employees, and create a continuously learning organization (Lievens, 2006). A second requisite is to monitor its network of subsidiaries and ensure a high level of absorptive capacity among all units.

However, possessing the required common knowledge to transfer knowledge between the subsidiary and the MNE does not guarantee knowledge transfer. People need to be *motivated* to transfer knowledge (Cohen & Dal Zotto, 2007). This means that the right incentives, and the right corporate culture needs to be in place. Apart from the cultural distance, there is also a geographical distance that complicates the transfer of knowledge. These issues lead to the identification of several pitfalls that a company should avoid. We will discuss these pitfalls in the following section.

5.3.4.3 Pitfalls regarding transfer of knowledge

Gupta, Govindarajan and Wang (2008) identified several pitfalls regarding the flow and transfer of knowledge which we summarized in Table 5.8.

Table 5.8 - Pitfalls of knowledge transfer

Pitfalls regarding knowledge transfer
1. The "halo" effect
2. "Garbage in, garbage out" syndrome
3. "How does it help me?" syndrome
4. "Knowledge is power" syndrome
5. Relative performance incentives
6. Mismatch between structure of knowledge and structure of transmission channels
7. Multiple links in the knowledge transfer line
8. "Not invented here" syndrome
9. Reluctance to recognize valuable knowledge in other units

Source: Gupta, Govindarajan & Wang, 2008.

We will briefly explain how these pitfalls affect knowledge transfer in corporations. Keep in mind that due to the geographical distances between different subsidiaries, these problems may be even more likely to occur when operating in an international setting than in a national or regional context. Trust is an important factor that can help lower the impact of some of these factors (Chan, 1997; Batt & Purchase, 2004, Das & Teng, 1998; Doz, Santos, & Williamson, 2001, Gupta, Govindarajan & Wang, 2008), and trust is more difficult to establish given a large physical and cultural distance (Zolin, Hinds, Fruchter & Levitt, 2003).

The "halo" effect

The halo effect means that units who show superior performance have a lot to teach to other units, and only little to learn from them (Gupta, Govindarajan & Wang, 2008). It may make people blind to potential synergies yet to be realized. Another assumption that can lead to this pitfall, is that all units dispose over the same resources, and that all of them are subjected to the same external forces. Nothing is less true, especially given the geographical spread of subsidiaries. Units in different fields may face different challenges and opportunities which can affect their performance. Going even one step further, a unit that performs less well may dispose over knowledge that is not relevant for the operation of their unit, but can increase performance of another unit in a different field. Units who perform less well than others can still realize synergies with other units.

"Garbage in, garbage out" syndrome

Garbage in, garbage out (GIGO) was a term that was mainly used to point out that when bad data is fed into an information system, it will also produce useless outputs (Phalgune et al., 2005). When an MNE, sets up an information system to share best practices among subsidiaries, but in fact subsidiaries are putting information in the system that are not real best practices, the system will be useless and filled with garbage (Gupta, Govindarajan & Wang, 2008). This means that when MNEs set up information systems to make the wealth of knowledge visible within the organization, they have to make sure that the information fed into the system is of good quality.

"How does it help me?" syndrome

Subsidiaries usually dispose over limited resources. A question they could ask themselves when they have to transfer knowledge to another unit, is "how does it help me?". Why would they invest time and other resources to help another unit if they do not receive benefits in return? They may be more motivated to invest more resources in the development of their own unit, rather than helping others(Gupta, Govindarajan & Wang, 2008).

"Knowledge is power" syndrome

When subsidiaries request additional resources for a certain project, they will almost always compete with other subsidiaries who request resources for their projects. This is because a company only disposes over a limited amount of resources. For this reason, subsidiaries may refuse to share knowledge as they would lose a part of their unique assets that provide them with a better bargaining position for additional resources when they share knowledge. Another problem arises from the fact that only a few managers at one level in the organization can get promoted to the next level. Managers on one level thus compete for promotion, and may want to keep knowledge to themselves as it improves their competitive position relative to each other (Gupta, Govindarajan & Wang, 2008).

Relative performance incentives

With a relative performance incentive scheme, rewards are allocated by comparing the performance of different units. This makes subsidiaries look at each other as competitors (Gupta, Govindarajan & Wang, 2008) and increase the probability of the occurrence of the previously mentioned "how does it help me" and "knowledge is power" syndrome. A second problem may be that due to the geographical dispersion of subsidiaries, they may dispose over less "natural" resources in their location which can affect their performance. A relative performance incentive scheme would then be very inappropriate and be very discouraging for the workforce in this subsidiary. A third problem with relative performance incentive schemes is the measurement of performance itself. What will be regarded as performance, how will it be measured?

Mismatch between structure of knowledge and structure of transmission channels

Companies should choose the correct transmission channels given the knowledge that has to be transferred. The choice of the channel is related to the complexity of knowledge. Simple knowledge can be transferred by means of an email, tacit knowledge on the other hand should be transferred by face to face meetings (Gupta, Govindarajan & Wang, 2008). However, due to the dispersion of subsidiaries, frequent face to face meetings may be difficult to establish, video conferencing may be able to assist in the transfer of tacit knowledge in this case.

Multiple links in the knowledge transfer line

When a subsidiary wishes to collaborate with customers of a certain region, but another department is responsible for those customers and the customers can only be contacted through this department, communication will be cumbersome (Gupta, Govindarajan &

Wang, 2008). The amount of intermediary links that have to be established between the source and the target will greatly influence the effectiveness and efficiency of communication.

"Not invented here" syndrome

This syndrome represents the unwillingness of managers (especially those with successful track records) to adopt ideas or inventions from units other than their own (Gupta, Govindarajan & Wang, 2008). They are convinced that they (can) do it better than external inventors.

Reluctance to recognize valuable knowledge in other units

Even when managers privately acknowledge the superiority of another unit, they may to refuse to recognize this due to power struggles. Managers may deny that other units have unique and/or valuable knowledge (Gupta, Govindarajan & Wang, 2008). Recognizing this means that they would acknowledge the other unit has something they don't have, and thus has some power in a certain area.

Given the geographically dispersed locations of subsidiaries and the different cultures, it may be required to tailor the different incentives to the individual subsidiaries to obtain the desired outcome. However, even if the MNE is able to avoid the pitfalls above, they will still have to ensure coordination of knowledge throughout the network of the MNE. A way to achieve this is making use of global business teams (Gupta, Govindarajan and Wang, 2008).

5.3.4.4 Global Business Teams

Kuemmerle (1997) states that only those managers who embrace their new role as global knowledge coordinators will be able to tap into the full potential of their R&D networks. Gupta, Govindarajan and Wang (2008) suggest that in order to do this, a global business team is required. They define a global business team as: "A cross-border team of individuals of different nationalities, working in different cultures, possibly in different businesses and across different functions, who come together to coordinate some aspects of the multinational operations on a global basis". Global business teams (GBT) are required to realize the potential value of the diversity of knowledge present in different subsidiaries. GBTs are able to leverage the value of a global presence and contribute to the transfer of knowledge (Gupta, Govindarajan & Wang, 2008). GBTs however often fail, they suffer from common problems that can occur in any form of team collaboration like: divergence of individual team member goals, missing skills in the team which prevent them to successfully complete their tasks, lack of clear objectives, … But besides those challenges, they face challenges due to the geographical distance that separates its members, differences in spoken languages, cultural diversity, and as mentioned before, problems with the establishment of trust among the members as well (Gupta, Govindarajan & Wang, 2008).

Trust

Gupta, Govindarajan and Wang (2008) state that some of the most important factors that determine the level of trust among people are: "individual characteristics, quality of communication, and the broader institutional context". When people are more similar to each other, have frequent communication, operate in an institutional and cultural context that is accepted by both, and punishes untrustworthy behavior, there will be a higher level of trust (Gupta, Govindarajan & Wang, 2008). However looking at these factors, it is clear that GBTs face even greater challenges in all of these areas. The distance between the members makes it harder to meet, the cultural differences make that people are less similar to each other, and they have to tackle the issues related to the different cultural contexts in which team members operate. It is however possible to punish untrustworthy behavior, but monitoring the behavior of team members that are so spread poses another challenge.

MNEs aware of these problems thus have to tackle the challenge of fostering trust in their GBTs, and overcome potential communication barriers.

In Table 5.9, the previously discussed requisites and challenges for the MNE that applies open innovation on a global scale are summarized.

Table 5.9 – Requisites and challenges for the MNE that applies OI on a global scale

Requisites and challenges for the MNE that applies OI on a global scale	
Requisite 1	Develop the required knowledge portfolio in subsidiaries that enables effective and efficient transfer of knowledge from the environment to the subsidiaries, as well as to the MNE as a whole
Requisite 2	Establish a match between the culture of the R&D subsidiary and the MNE as a whole in order to improve knowledge transfer between the subsidiary and the MNE
Requisite 3	Keep building on the frame of reference of the MNE and its employees, and create a continuously learning organization
Requisite 4	Keep the velocity of the knowledge flow at a sufficient level
Requisite 5	Monitor the network of subsidiaries and ensure a high level of absorptive capacity among all units
Requisite 6	Create the right incentives to avoid the pitfalls of knowledge sharing and transfer
Requisite 7	Arrange frequent face to face contact

5.4 Conclusion

This chapter showed how the traditional open innovation theory will face a many new challenges when it is applied in an international context. We note again that we are not trying to give an all-embracing overview of all the challenges a MNE will have to deal with when it applies open innovation to its international context. In describing each of the four main challenges we have determined some requisites that MNEs should take into account when applying open innovation. We have summarized these previously discussed requisites in Table 5.10.

Table 5.10 – Challenges and requisites for open innovation when applied in an international context

Important challenges for MNEs when applying open innovation.	
Challenge 1	**What are interesting R&D locations for a firm?**
Requisite 1	Availability of scientific labor.
Requisite 2	Quality of educational system.
Requisite 3	Proximity to academic centers of excellence.
Requisite 4	Robust IP protection system.
Requisite 5	Focus on traditional hotspots or not?
Requisite 6	Separation of research and development locations?
Challenge 2	**What is an effective number of R&D locations?**
Requisite 1	Perform a value-benefit analysis before adding an extra location.
Requisite 2	Database of the knowledge that exists within the MNE.
Requisite 3	Having insight in the nature of the knowledge will help to decide if adding an extra location is needed.
Requisite 4	Type of innovation (radical versus incremental).
Requisite 5	Company’s strategy.
Requisite 6	The external knowledge needs to complement the ideas which are generated internally.
Challenge 3	**How to tap effectively into local R&D-communities around the globe?**
Requisite 1	Develop a good understanding of the needs of the party controlling the knowledge
Requisite 2	Recognize the differences between parties and develop strategies to gain access to knowledge accordingly
Requisite 3	Create climate of trust and openness
Requisite 4	Be an attractive partner/employer

Table 5.10 – Challenges and requisites for open innovation when applied in an international context (continued)

Challenge 4	**How to integrate effectively knowledge from different parts of the world in a MNE?**
Requisite 1	Develop the required knowledge portfolio in subsidiaries that enables effective and efficient transfer of knowledge from the environment to the subsidiaries, as well as to the MNE as a whole
Requisite 2	Establish a match between the culture of the R&D subsidiary and the MNE as a whole in order to improve knowledge transfer between the subsidiary and the MNE
Requisite 3	Keep building on the frame of reference of the MNE and its employees, and create a continuously learning organization
Requisite 4	Keep the velocity of the knowledge flow at a sufficient level
Requisite 5	Monitor the network of subsidiaries and ensure a high level of absorptive capacity among all units
Requisite 6	Create the right incentives to avoid the pitfalls of knowledge sharing and transfer
Requisite 7	Arrange frequent face to face contact

In sum, there are many new questions to be solved when we apply open innovation to MNEs in an international context. In the last, concluding chapter, we will provide an answer to our central research question which we described in our first chapter, i.e. "How does the open innovation theory change, when it is applied to and integrated in the R&D globalization strategy of MNEs?"

Chapter 6: Conclusions

6.1 Conclusion

Combining the globalization of R&D theory with the open innovation theory results in a more realistic picture of the innovation process of MNEs. Applying open innovation to the multinational environment in which MNEs operate, and from where they can source external knowledge, results in a series of new managerial and organizational challenges. These challenges will have to be faced and overcome in order to win in the global knowledge economy where knowledge has become an increasingly geographically dispersed resource. This is why our master thesis was centered around the central research question: *"How does the open innovation theory change when it is applied to the R&D globalization strategy of MNEs?"*

First, we came to the conclusion that the metanational structure is the best suited to make use of these dispersed knowledge sources. This has several implications on how MNEs should manage their R&D activities. Previously, closed innovation strategies were found to be no longer efficient in the new knowledge economy. MNEs should change their strategy towards a more open way of innovation, because this strategy allows companies to make maximal use of external sources. The open innovation theory however was never applied to MNEs that operate in an international context. Therefore, the new challenges MNEs face are the result of the additional complexity introduced when they apply open innovation practices with partners located in different geographical and cultural contexts. The MNE now has to address, according to us, four new critical questions. Each of these questions introduces specific management challenges. These four questions are:

1. What are interesting R&D locations?
2. What is an effective number of R&D locations?
3. How to tap effectively into local R&D-communities around the globe?
4. How to integrate effectively knowledge from different parts of the world in a MNE?

The management challenges MNEs face when determining the location for a new R&D subsidiary are related to the comparison and weighting of several factors. Because MNEs are looking for topnotch knowledge, the availability of scientific labor, the quality of the educational system, and the proximity to academic centers of excellence are of importance. Also an adequate IP protection system is crucial. The management will also have to decide whether it will locate in a traditional hotspot or not, and if they should separate their research centers from their development centers. Should the latter be co-located with production sites or not?

Closely related to the question of which location is interesting, is the question in how many locations should the MNE be present? To answer this question, the MNE will have to balance the additional cost of an additional location, versus the benefits of an additional location. Costs will rise due to the increased complexity of the network, while benefits could come from the knowledge being sourced itself, and potential synergy effects with knowledge that is already available internally in the MNE. Also the kind of knowledge the MNE deals with will influence this decision. If the MNE deals with primarily simple knowledge it will not require many nodes in its network, the knowledge can be transferred without many problems. When the knowledge is mainly tacit however, it may be desirable to be present in more locations in order to transfer this tacit knowledge into the company.

Knowing where knowledge resides, or being locally present, does not guarantee the ability to actually use certain IP. MNEs need to gain access to knowledge sources like lead users, start-ups, universities and research centers. Gaining access to these different sources however will require a tailored strategy. The MNE should thus develop a clear insight in what is important to the other party and avoid generalizing. Critical in the process of gaining access is that a climate of openness and trust will be established as it provides the basis for a successful collaborative relationship. The knowledge of (potential) employees is another source that companies should gain access to. MNEs should attract knowledgeable people, but also retain them.

The fourth question deals with the integration of knowledge into the MNE. In the MNE, knowledge integration will happen on a global scale, although subsidiaries may be separated by large geographical and cultural distances. Subsidiaries have the role of connecting the local environment to the rest of the MNE. They are in a better position to adapt to the local culture, and connect to the corporate culture. To ensure knowledge transfer, the subsidiary should possess the knowledge portfolio that allows it to transfer knowledge from the local environment into the subsidiary and from the subsidiary to the rest of the MNE. However to ensure a high absorptive capacity in the future, the MNE has to continuously build on the frame of reference of the MNE, and as a result its individual employees as well. All the nodes in the network should dispose over a high absorptive capacity, knowledge should flow quickly throughout the network, and face to face contacts will be required to transfer tacit knowledge. However, to avoid the many pitfalls concerning knowledge transfer, the MNE will have to develop the right incentive scheme to share knowledge among its different R&D centers.

The complexity of answering these four questions confirms our proposition that open innovation will be challenged when applied to a MNE. In this master thesis we only revealed a tip of the iceberg of questions and problems MNEs will face when introducing an open innovation strategy. We gave some recommendations that could facilitate the implementation of open innovation for a MNE. But we like to emphasize that further research on each of these topics is vital to the applicability of open innovation in an international context. More and more MNEs are acknowledging that open innovation is the only way forward. We can therefore expect that open innovation will become an essential part of the innovation strategy of MNEs, but in order to apply this strategy, the new challenges need to be addressed.

6.2 Limitations and recommendations for further research

The aim of this research was to identify the challenges MNEs will face when applying an open innovation strategy. We identified some factors that have an impact, but it is beyond the scope of this thesis to produce an exhaustive list as this would require more empirical research to be performed. Some theories (e.g. the optimal amount of R&D locations and the optimal absorptive capacity) still need empirical testing and are unproven at the moment. Furthermore we looked at open innovation from the perspective of the MNE. As a result, our findings cannot be generalized to smaller globalized companies and global borns. To develop a deeper understanding of the challenges a MNE faces and how they can be tackled we propose some topics for further research.

In chapter 5 we have presented some of the issues MNEs will face when they apply the open innovation theory in an international setting. Although literature gives some suggestions and ideas on how to tackle the many challenges, we propose some topics that need further research to guide a MNE in its open innovation adventure. We will group the research questions according to the four main challenges which we defined in chapter 5. These challenges are: the choice of location, the amount of R&D subsidiaries, gaining access to IP, and integrating IP. These questions however should always be looked at from the perspective of a certain industry. As Chesbrough (2003) already noted, some industries are more ready to apply open innovation than others. This will lead to different outcomes for the different research questions we propose.

6.2.1 The choice of location

We already determined that some of the factors that are likely to have an influence on the choice of location: the availability of scientific labor, the quality of the local education system, proximity to academic centers of excellence, and the IP protection system. Also the local culture can have its influence on innovation (Shane, 1992, 1993) and should be considered in the equation as well. Further research should determine how these factors impact the innovative performance of an MNE, and which other factors also might have an influence. The outcome of this research could provide MNEs with a tool that enables them to make a better choice of location.

Another important research question concerns the benefits of locating in a traditional hotspot versus non-traditional locations. In traditional hotspots other companies may already be present, this results in trailing rather than leading the competition in terms of tapping into external research. There is thus a trade-off to be made between being located in a location where the competition is already established and much knowledge is available and locating in a less known location, where competition is not present at the moment, and where less but maybe high quality information is available. Research should thus identify the different ways traditional and untraditional locations can add to the innovation performance of the MNE. In the future however, the locations that are not well known may become a new hotspot. Hence, the development of a model based on empirical research that forecasts the emergence of hotspots is another interesting research topic.

6.2.2 The number of R&D subsidiaries

Research already indicated that too large R&D networks negatively impact financial performance (Jaruzelski & Dehoff, 2008). The more subsidiaries are present in the network, the more work there is to be done to coordinate the network and evidently, more knowledge transfers will have to take place. On the other hand different subsidiaries will offer different knowledge which results in an increase of the available knowledge. Higher diversity in the network thus both adds value and increases costs. We therefore propose research to be performed that can help companies to determine the shape of their value and costs curves in relation to the amount of R&D nodes in their network. Factors that may influence the value curve are the same ones as we discussed under the choice of location. After all, these factors determine the value of choosing a certain location over another. The costs related to an additional location will be related to accessing knowledge in the foreign location, and the costs to integrate this knowledge into the MNE network.

6.2.3 Considerations to gain access to IP when applying Open Innovation

As we illustrated in the previous chapter, when dealing with different partners, different strategies will be required to gain access to IP. A question for further research is thus how companies should approach lead users, universities, research centers, and start-ups? And to what extent knowledge brokers can help companies to gain access to IP? We already determined that the establishment of a climate of trust and openness is of great importance. When dealing with different parties, an action may increase the level of trust with some, while it decreases the level of trust with others. For this reason it is important to develop a deeper insight in actions that strengthen the collaborative relationship and encourage knowledge sharing with different partners.

6.2.4 Transferring and integrating knowledge throughout the MNEs network

The integration of knowledge is influenced by the knowledge that is already present within the company. However to stay competitive, the company will have to keep building on its knowledge base. In the case of the MNE however, this learning needs to happen in an international environment and knowledge has to be transferred over larger distances. We therefore suggest further research to be performed on systematic processes that streamline organization wide learning on a global scale. Gupta, Govindarajan and Wang (2008) have already described the actions companies should undertake (internally) to avoid the pitfalls described in chapter 5. However we suggest broadening the view and looking beyond the internal organization and include the knowledge transfer from the local environment to the subsidiary as well which is a crucial part of the open innovation strategy. We discussed the importance of a cultural match, and therefore suggest research to be performed that uncovers the cultural aspects that play an important role in local knowledge transfer.

Another point of interest is the mix of common and different knowledge in the organization. We already discussed the influence of this mix on the absorptive capacity and knowledge transfer. We suggest there will be an optimal point somewhere between both extremes; this however still needs to be tested. Two factors of which we think that influence the optimal mix are the amount of different technologies incorporated in the products that the MNE develops, and the speed of technological advancement in the respective technological fields.

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