Reverse Innovation
Insights from Western Medical Equipment Manufacturers in China

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Abstract

Recently, emerging market firms have gained market shares both in emerging and developed markets through pursuing reverse innovation – i.e., good-enough, frugal products developed in emerging markets that are taken to the markets of developed countries. Their success endangers the global market share of Western multinational corporations (MNC) as they have traditionally focused only on advanced products for the affluent few at the top of the economic pyramid.

The phenomenon of reverse innovation has attracted much academic and managerial attention. Nevertheless, extant literature so far has been limited to the description of anecdotal examples, ignoring the question of how Western MNCs successfully facilitate reverse innovation in order to stay competitive.

Current literature on MNC and innovation management is limited to provide insights. Despite this, reverse innovation challenges existing theoretical assumptions of the product life cycle. Traditionally, innovations are based on new technologies that diffuse from developed to emerging markets.

This thesis investigates the raised question by conducting multiple case studies in four Western medical equipment manufacturers. Based on empirical data, the thesis provides a conceptualization of reverse innovation. It reveals detailed insights on decision-making and implementation structures that facilitate reverse innovation.

I find that reverse innovation comprises two independent processes, the development of frugal innovation for resource-constrained customers and its subsequent global diffusion. Frugal innovations are developed by the emerging market subsidiary that possesses unique capabilities pertaining to the development of frugal products. Its development involves technological and market knowledge. Both knowledge types are managed differently within the MNC. Western MNCs implement dual R&D structures to pursue successfully both high-end and frugal innovation types.

Based on the empirical results, I expand product life cycle theory. Innovations are based on a new value proposition that is grounded in new market knowledge and/or technological knowledge. Innovation can diffuse from emerging to developed markets.

Zusammenfassung

In den letzten Jahren konnten Firmen aus Schwellenländern ihre Marktanteile sowohl in Industrie- als auch in Schwellenländern durch Reverse Innovation vergrössern. Reverse Innovation bezeichnet dabei schlichte, frugale Produkte, die in Schwellenländern entwickelt und auch in Industrieländern vermarktet werden. Ihr Erfolg gefährdet den weltweiten Marktanteil westlicher multinationaler Unternehmen (MNC), da sich diese traditionell nur auf fortschrittliche Produkte für die wenigen, wohlhabenden Kunden an der Spitze der ökonomischen Pyramide konzentriert haben.

Das Phänomen Reverse Innovation wird aktuell in Wissenschaft und Praxis stark diskutiert. Bisherige Erkenntnisse beschränken sich jedoch auf die Beschreibung anekdotischer Beispiele. Die Frage, wie westliche MNCs erfolgreich Reverse Innovation fördern, um wettbewerbsfähig zu bleiben, ist unbeantwortet.

Bestehende wissenschaftliche Literatur kann bislang nur beschränkt Erkenntnisse liefern. Darüber hinaus stellt Reverse Innovation bisherige theoretische Annahmen des Produktlebenszyklus in Frage. Traditionell basieren Innovationen auf neuen Technologien. Diese diffundieren von Industrie- hin zu Schwellenländern.

Basierend auf den empirischen Daten von vier Fallstudien westlicher Medizintechnikunternehmen bietet die vorliegende Arbeit eine Konzeptualisierung von Reverse Innovation. Sie gibt detaillierte Einblicke in Entscheidungs- und Umsetzungsstrukturen, welche Reverse Innovation fördern.

Die Ergebnisse zeigen, dass Reverse Innovation auf zwei voneinander unabhängigen Prozessen basiert: der Entwicklung von frugalen Innovationen für Kunden mit begrenzten Ressourcen und der anschließenden globalen Vermarktung. Frugale Innovationen werden durch die Niederlassung im Schwellenland entwickelt, die einzigartige Fähigkeiten für deren Entwicklung besitzt. Die Entwicklung beinhaltet technologisches und marktbasiertes Wissen. Beide Wissensarten werden unterschiedlich innerhalb des MNCs gemanagt. Westliche MNCs implementieren duale F&E Strukturen, um erfolgreich sowohl high-end als auch frugale Innovationen entwickeln zu können.

Basierend auf den empirischen Ergebnissen wird die Theorie des Produktlebenszyklus erweitert. Innovationen basieren auf einer neuen Value Proposition, die auf neuem Marktwissen und/oder technologischem Wissen basiert. Innovationen können von Schwellenländern hin zu Industrieländern diffundieren.

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Abbreviations

B2B	Business to Business
B2C	Business to Consumer
BRIC	Brazil, Russia, India, China
CEO	Chief Executive Officer
CIS	Common Wealth of Independent States
CT	Computed Tomography
CTO	Chief Technology Officer
DE	Deutschland (Germany)
ECG	Electrocardiogram
e.g.	for example, for instance (Latin: *exempli gratia*)
EMEA	Europe, Middle East, Africa
et al.	and others (Latin: *et alii/alia*)
F&E	Forschung und Entwicklung
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GE	General Electric
HQ	Headquarters
i.a.	among other things (Latin: *inter alia*)
ICFC	In-Country-For-Country
i.e.	that is to say, in other words (Latin: *id est*)
IT	Information Technology
M&A	Merger and Acquisition
MNC	Multinational Corporation
MR	Magnetic Resonance
n/a	not available
NPD	New Product Development
OEM	Original Equipment Manufacturer
p.	page
PMB	Portfolio Management Board
R&D	Research and Development
SMART	Simple, Maintenance-friendly, Affordable, Reliable, Timely
SSME	Siemens Shanghai Medical Equipment Limited
U.K.	United Kingdom

UNCTAD	United Nations Conference on Trade and Development
U.S.	United States of America
USD	United States Dollar
VP	Vice President

1. Introduction

The burgeoning phenomenon of reverse innovation – i.e., low priced, good-enough products, which are taken to the markets of developed countries – has recently attracted much academic and managerial attention. Despite this, extant literature so far has been limited to the description of anecdotal examples lacking theoretical insights. The present research addresses this limitation and provides empirical insights on how Western multinational corporations (MNC) organize reverse innovation.[1]

Overview: Chapter 1.1 outlines the practical and theoretical motivation of the present research. *First,* this includes a description of the practical phenomenon. *Second,* deficits in current research and limitation of existing theory are being uncovered. Chapter 1.2 presents the research objective and the research questions. Chapter 1.3 defines the focus and terms for the present study. Chapter 1.4 gives an overview of the structure of the thesis.

1.1. Motivation

The tremendous rise of emerging countries in the last decade has challenged companies and managers worldwide. Recently, the emerging world has become a center for innovation that had originally been solely a privilege of the developed and technologically sophisticated countries.

For many years, Western MNCs have developed innovations – predominantly on technological advancement – for their home market in the West and exported these innovations to other developed as well as emerging markets. In the same way, numerous Eastern MNCs have started to create innovation for their local market and

[1] This thesis represents the results of my research at the Institute of Technology Management at the University of St. Gallen and the Judge Business School at the University of Cambridge. Partly, the results of my research have been published or are currently considered for publication in the following articles: Widenmayer, Zeschky, & Gassmann, 2012; Zeschky, Widenmayer, & Gassmann, 2011a, 2011b, 2011c, 2012.The following PhD thesis includes findings, extracts, and lines of argumentation that have been previously applied in the publications outlined above. However, changes were made due to the progress of my research.

exported these products to foreign markets. Nevertheless, the characteristics of both innovations strongly differ. While Western innovations provide often highly sophisticated and expensive solutions based on new technologies, many Eastern innovations are a new combination of existing technologies and are characterized as being low-cost. Recently, Western MNCs have also started to engage in low-cost emerging market innovation to address the huge local market potential while still fostering high-end innovations in their home markets. Consequently, within one product category some Western MNCs follow different innovation concepts depending on the target market.

Despite its original focus, the emerging market innovations are not exclusively commercialized in emerging markets but diffuse to developed markets in the West. This back flow of emerging market innovation creates new markets in the West and may lead to substitution effects. The implementation of two innovation concepts and the bilateral flow of innovation may cause organizational challenges within MNC. Current examples in practice indicate that both innovation concepts have different characteristics. High-end innovations, on the one side, are based on the latest technologies and target affluent customers while emerging market innovations are characterized as low-cost and simple appealing to the majority of the people in emerging markets. It seems that different structures are required for high-end and emerging market innovation. As firms are constrained by limited resources, this raises questions on resource allocation. Furthermore, different capabilities may be needed to enable both innovations concepts.

The recent phenomenon has strong theoretical and managerial implications. The following chapters reflect the points stated previously. Chapter 1.1.1 will outline in detail the practical relevance of the research and provide current managerial challenges. Chapter 1.1.2 will show several limitations of current theory. It provides insight on the product life cycle and the management of innovation within MNC.

1.1.1. Relevance of research subject

Many emerging countries – especially India and China – have experienced significant economic growth due to the liberalization of trade and markets particularly in the last decades. Thus, ever more people in emerging markets experience an increase of income that puts them for the first time in their lives in a position to turn from non-consumers

to consumers (Gadiesh, Leung, & Vestring, 2007; Hart & Christensen, 2002; Williamson & Zeng, 2009). Especially the 'emerging middle class' in China and India presents a rapidly growing segment of the population (Hart & Christensen, 2002). However, despite this, members of the emerging middle class still have little disposable income compared to Western standards and will need to take care to achieve value for their money. This group lives on 2 USD to 13 USD per day at 2005 purchasing power parity prices (Prahalad, 2010). This middle class is a rapidly growing segment of the population. Projections indicate that the number of Chinese households whose income exceed their basic needs will quadruple from around 55 million in 2008 to 212 million in 2013, with an average income of about 5,000 USD per annum. In India, 5 % of the households are predicted to earn around 4,000 USD per annum by 2020 (Williamson & Zeng, 2009). Worldwide, this emerging middle class includes some 2.6 billion people, of which Asia alone is estimated to have 60 % (Prahalad, 2010). It therefore represents a huge business opportunity that Western and emerging country MNCs increasingly aim to address.

Thus, emerging countries are no longer only recipients of innovation but they increasingly represent a source for innovation. Products that have been associated with local innovation in emerging markets are often characterized as 'good-enough' products (Christensen, 1997), 'cost innovation' products (Williamson, 2010), or 'frugal innovation' products (Economist, 2010; Zeschky, Widenmayer, & Gassmann, 2011a). These innovations are characterized by meeting the basic needs of resource-constrained people at very low cost. They often look inferior to existing solutions because they provide limited functionality and are often made of simpler, cheaper materials.

The quality and number of innovations developed by multinational companies from emerging countries is increasing dramatically. For example, the Chinese home appliances firm Haier developed a washing machine for small loads suitable for everyday use for the Chinese mass market that was later successfully commercialized in America and Europe (Hang, Chen, & Subramian, 2010). Similarly, the Chinese microwave manufacturer Galanz developed a microwave that fits in the kitchens of typical small Chinese households that was subsequently commercialized worldwide (Hang et al., 2010). The development of such products has largely been the domain of local corporations in emerging countries. Recently, Western MNCs have also started to engage in low-cost innovation as well. For example, GE's healthcare division in India has developed a simple, low-cost handheld electrocardiogram that is today

commercialized in the markets of developed countries (Immelt, Govindarajan, & Trimble, 2009).

As the examples illustrate, some innovations in emerging countries are subsequently taken to developed countries – a phenomenon that has been referred to as 'reverse innovation' (Immelt et al., 2009) or 'innovation blowback' (Brown & Hagel, 2005). The term 'reverse' indicates that product innovations no longer solely flow from 'West-to-East' (from developed to emerging countries), as was the dominant case until now, but increasingly from 'East-to-West' (from emerging to developed countries).

The increasing amount of emerging country innovations and their reverse diffusion has significant implications for the business models of MNCs in developed countries. From a strategic perspective, their business models are traditionally designed to meet the needs of the customer with an average Western living standard and purchasing power, both in the developed and emerging countries (Christensen, Hang, Chai, & Subramaniam, 2010; Matthyssens, Vandenbempt, & Berghman, 2006; Williamson, 2010). This approach entails that the majority of the customers in emerging countries are the few at the top of the economic pyramid who are able to afford Western products and technologies (London & Hart, 2004). However, while this business model has worked well in the past, it is increasingly jeopardized for two reasons. *First*, there is a trend that incomes of people in emerging countries like China and India are expanding (Gadiesh et al., 2007; Williamson & Zeng, 2009). Although still lacking excess income, people in emerging markets are increasingly demanding low-cost products that cater to their basic needs. Thus, they now become consumers as opposed to non-consumers (Hart & Christensen, 2002), representing a huge market and business opportunity. *Second*, low-cost innovations are increasingly coming to the markets of developed countries and find customers who are not willing to pay a premium for functions they do not need, especially in the wake of the recent worldwide economic crisis that has made people more price-sensitive (Lee, Rabanal, & Sandri, 2010). Taken together, these two reasons call the established business models of Western MNCs into question as they are not designed to compete with the aggressive price-performance characteristics of emerging market innovations (Hang et al., 2010).

Like the business models that shape them, the existing organizational structure of Western MNCs is often optimized for the development of advanced products and technologies targeted at high-end consumers. Often still, the role of local research and

development (R&D) units in the international R&D network is to adapt centrally developed products to local needs, thereby exploiting existing competences and avoiding the costs of new product development (Gassmann & von Zedtwitz, 1998; Kuemmerle, 1999; Pearce, 1999). As a result, Western MNCs have missed to build low-cost innovation competences to meet the requirements of the price sensitive customer. Building such competences changes the firm's R&D strategy and requires that existing R&D structures are adapted to allow for the development of low-cost innovation in the periphery of the MNCs' R&D network. Furthermore, the adaptation of the R&D structure also modifies the interaction between the R&D headquarters and the local R&D units as more competences are shifted to the local units in the emerging country (von Zedtwitz, Gassmann, & Boutellier, 2004). In addition, the management of international R&D projects imposes severe challenges due to the physical distance between the R&D subsidiary and the headquarters (von Zedtwitz & Gassmann, 2002).

The innovation flow from developed to emerging markets has long been the dominant strategy of Western MNCs to further exploit products that have passed the zenith of their life cycle in developed markets (Vernon, 1966). Western MNCs and their management are challenged by emerging market innovation. They are required to reorganize their structures to allow for the development of low-cost innovation.

1.1.2. Limitations in current theory and research

While emerging market innovation and its reverse diffusion has strong implications for managerial practice, this new phenomenon challenges current theory and scientific literature. The present study relates to four highly interdependent literature streams (see figure 1). All literature streams entail innovation and its management as an underlying theme. Each stream focuses on a specific facet of the management of innovation and is thus important to understand the phenomenon of reverse innovation.

Within the literature stream of *firm internationalization* special focus is given to theories of innovation diffusion and product life cycle. The central question is how does reverse innovation correlate with existing theory of innovation diffusion and product life cycle.

The literature stream of the *management of the MNC* is related to the strategic and structural pre-conditions of innovation and the management of knowledge and

capabilities inside the firm to foster innovation. Here, the leading question is how the present scientific insights on MNC management relate to management of reverse innovation. This comprises aspects on where reverse innovation is development within the MNC, what knowledge and capabilities are required, and how the required knowledge and capabilities are generated. These questions refer to issues of subsidiary innovation, subsidiary autonomy, initiative taking, and decision making

The phenomenon of emerging market innovation and its reverse diffusion has strong implication on scientific literature on *R&D management* and *new product development* (NPD). Both literature streams provide concepts on the effective and efficient management of corporate innovation. Thus, the question arises how current concepts interact with the present firm practices.

In general, each analyzed literature field considers the question how innovation can be spurred within the firm. Therefore, the present research discusses the intersections of these literature streams with respect to innovation in emerging markets and its potential reverse diffusion to illustrate limitations of the existing research. The following paragraphs outline limitations in theory and scientific literature.

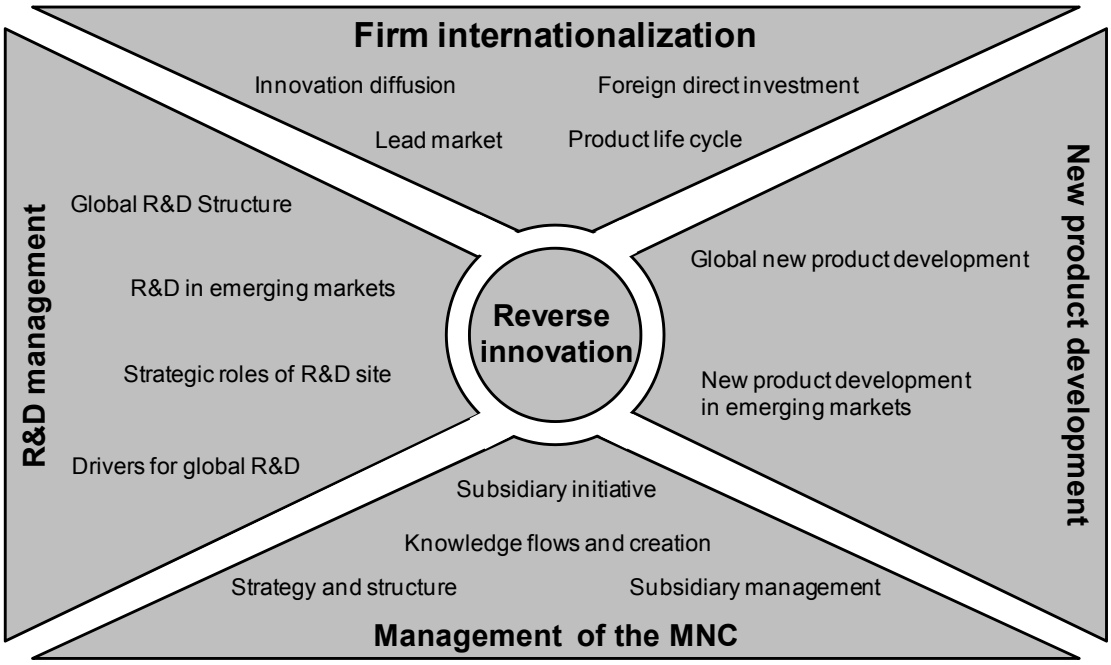


Figure 1: Related literature streams

Theories of firm internationalization

Internationalization is seen as a process of increasing involvement in international operations (Welch & Luostarinen, 1988). According to Adam Smith's theory of absolute cost advantage, countries specialize in the production of goods in which they can achieve lower production costs than its trading partner and export these goods. This theory was further advanced by numerous economic theorists trying to predict patterns of internationalization (Case & Fair, 1998; Ohlin, 1933; Ricardo, 1817).

The increased internationalization of firms based on technological advancement in the 1950s and 1960s raised the demand for new theoretical perspectives in internationalization. Based on Roger's (1962) theory of innovation diffusion, Vernon's (1966) theory on the international product life cycle explained internationalization as a function of the maturity stage of a product innovation. He argues that product innovations enable firms to create temporary monopolies that they exploit first in their home markets and then in foreign markets. Product innovations are based on new technologies that disrupt existing markets and substitute present products. As the product matures, the firm faces growing competition and is required to find new markets as well as cheaper production locations. Along the product life cycle, firms start to internationalize following a consistent pattern. The product life cycle starts with the innovation in the home country, located in a developed world.

At the core, Vernon's theory is based on the assumption that innovation flow from developed to emerging markets. This assumption is based on two factors. *First,* the existence of innovation and technological advantages leads to technology gaps between developed countries – the U.S. and Western Europe – and emerging countries (Posner, 1961). *Second,* the higher per capita income and purchasing power in developed countries induces firms to develop innovations for developed countries and later distribute them to emerging countries (Dima, 2010; Vernon, 1971, 1979). Vernon's theory has influenced scientific literature and theory for many decades.

The post war era has seen a tremendous growth in foreign direct investments (FDI) especially by manufacturing firms from the U.S. and U.K. (Ietto-Gillies, 2003). These FDIs were rooted in the search for imperfect markets (Hymer, 1976). In imperfect markets – which are based on exclusive and permanent control of property rights on technology, access to resources, economies of scale, distribution system, and product differentiation – companies are able to generate higher profit. Notably, the majority of

FDIs after World War II were directed to other developed countries scarce on raw materials. In his eclectic theory – also known as the OLI (Ownership, Location, and Internationalization) model – Dunning (1981) explains why firms pursue FDIs and how these are interrelated to resource allocation and firm structure. The theory connects country perspective – advantages of countries – and firm perspective. Thus, it is able to predict why specific firms invest in certain countries (Dunning, 1993). Based on the transfer of firm-specific advantages – like technology, brand, and capabilities – the firm is able to generate profits in foreign markets and may achieve lower production costs. Once present at an international level, additional costs emerge due to coordination and communication, lack of market knowledge, and differences in country regulations. These costs are outweighed by temporary monopolies that are created based on intellectual property, access to scarce resources, superior financial resources, economies of scale, or technology. Especially innovations are a core driver for internationalization. Through product innovation firm-specific advantages can be easily transferred to foreign markets.

In his 1999 study, Kuemmerle investigated the drivers of FDI into R&D and offers a dichotomous set of motives. *First,* through home-base-exploiting companies leverage their firm's specific advantages towards foreign markets. FDI in R&D are motivated to adapt innovations to local preferences and needs. *Second,* through home-base-augmenting, firms try to strengthen their technological base in their home country to enable innovation. FDI in R&D are targeted to benefit from spillovers from existing local R&D institutions. Such institutions include universities and other innovative firms.

Research by Beise (2004) showed that the sole analysis of technology gaps is insufficient in explaining the diffusion of innovation. Building on economic theory of consumer behavior (Deaton & Muellbauer, 1980) and country advantages (Porter, 1990), lead market theory provides more detailed reasoning for innovation flows between countries. Lead market theory proposes that several country specific attributes explain why an innovation is first adopted by a local market and then becomes globally dominant and squeezes out other locally preferred designs (Beise, 2001, 2004). Lead markets are defined as geographical markets that first induce global innovations by local demand preferences and local environmental conditions (Bartlett & Ghoshal, 1990; Beise, 2004; Kalish, Mahajan, & Muller, 1995). As an eclectic theory, lead

market theory is also based on the assumption that innovation diffuses from developed to emerging markets.

The internationalization theories provide detailed explanation on the transformation of domestic, developed market firms into MNCs in the post war era (Andersen, 1993). The theories assume that most MNCs follow a strongly centralized and hierarchical structure and that internationalization is driven by the goal to transfer firm specific advantages generated at the home market to foreign markets. Thus, the theories underlie a dual taxonomy that differentiates the economic world in developed countries prevailingly located in the West and emerging countries prevailingly located in the East (Beise, 2004; Dunning, 1977; Vernon, 1966). The Western countries, especially the U.S., are taking a leading role in internationalizing value chain activities that comprised sales, manufacturing, sourcing, and R&D (Vernon, 1966). While the source of competitive advantage is located at the headquarters in the West, it becomes leveraged to a globally dispersed network of subsidiaries. This assumes that firm specific advantages can be easily transferred from one country to the other without regarding any transfer problems (Vernon, 1966).

The West-to-East taxonomy is based on two factors. *First,* theories on international trade, international investments, and innovation diffusion generally assume that innovations are based on new technologies (Dunning, 1981; Vernon, 1966). Thus, internationalization is based on the technology gap between developed and emerging countries (Ronstadt, 1978; Trepsta, 1977). *Second,* internationalization is based on the per capita income and demand structure gap between developed and emerging countries (Rugman & Collinson, 2006). Consumers in developed countries are highly advanced and have a high per capita income, which makes it more attractive for Western companies to develop their products to Western market needs (Beise, 2004; Hicks, 1939). These factors ignore the recent development in emerging countries. The phenomenon of reverse innovation and the economic power of a new emerging middle class are not considered in current theory.

The West-to-East paradigm also influenced the scientific perception of internationalization of innovation. Whereas scholars identified patterns of international innovation flows of Western MNCs, these patterns were based on the assumption of a West-to-East flow of knowledge and innovation (Ronstadt, 1978; Trepsta, 1977).

MNCs use FDIs either to explore new technologies or to exploit existing competences on a global scale (Kuemmerle, 1999).

Most theories of internationalization overemphasize cost optimization and the protection of the competitive advantages when MNCs move to emerging markets (von Zedtwitz & Gassmann, 2002; von Zedtwitz et al., 2004). This underestimates the fact that the internationalization towards emerging markets can also contribute to capability creation.

Management of the MNC

Predominantly, the multinational corporation is seen as a knowledge creating entity that leverages its proprietary advantages within its network of dispersed subsidiaries to foreign markets (Dunning, 1998; Kogut & Zander, 1993; Nobel & Birkinshaw, 1998). The MNC has become an established research field in international and strategic management that can be categorized in four literature streams. *First,* starting in the post war era, numerous studies analyzed the strategy and structure of the MNC (e.g., Bartlett & Ghoshal, 1989; Birkinshaw & Hood, 1998; Hedlund, 1994). *Second,* another literature stream analyzed the role and the management of the subsidiary within the MNC (e.g., Avridsson, 1999; Holm & Johanson, 1995; Jarillo & Martínez, 1990; Kim & Mauborgne, 1993a). *Third,* subsidiary initiatives and subsidiary evolution were subject to many studies (e.g., Birkinshaw, 1996; Birkinshaw & Fry, 2003; Delany, 2000). *Fourth,* many studies analyzed the knowledge flows and knowledge creation within MNCs (e.g., Gupta & Govindarajan, 1991, 1994, 2000; Monteiro, Arvidsson, & Birkinshaw, 2008).

Despite the large number of studies on the MNC, existing literature underlies several limitations pertaining to the rise of the emerging world as a source of innovation. Six basic highly interrelated limitations of current literature are derived with respect to reverse innovation: (i) biased database: focus on the triad countries; (ii) evolution of the MNC: blurring boundaries between subsidiaries; (iii) MNC structure: emerging inter-organizational challenges; (iv) MNC knowledge and capability transfer: too broad concepts; (v) knowledge bias: focus on technological knowledge; (vi) ‘knowledge flow is always good’ bias. These limitations are outlined in greater detail each in turn:

(i) Biased database: focus on the triad countries. Research on MNC strategy and structure is driven by data conducted in the triads (namely the U.S., Western Europe,

and Japan), predominantly in the U.S. and Europe (Bartlett & Ghoshal, 1989; Birkinshaw, 1996; Jarillo & Martínez, 1990). In their seminal works, Ghoshal and Bartlett (1988a; 1988b; 1998) revealed archetypes of organizational structures and of global innovation processes based on an analysis of developed country datasets. The research on global innovation processes displayed practices of remote subsidiaries that develop products for the local and/or global markets based on their competences and resources. In the 'local-for-local' setting, the cases showed merely a slight adaption of existing Western technologies and products, whereas in a 'local-for-global' setting all respective subsidiaries were located in a developed country, e.g., the U.K. or the U.S.

Current studies on subsidiary initiatives and entrepreneurship (Almeida, Phene, & Grant, 2003; Birkinshaw, 1999; Birkinshaw, Hood, & Jonsson, 1998; Cantwell & Mudambi, 2005) as well as on knowledge transfer (Birkinshaw & Morrison, 1995; Frost, Birkinshaw, & Ensign, 2002) are also based on empirical data conducted in the triads. For examples, the studies of Frost (2001) and Mu and colleagues (Mu, Gnyawali, & Hatfield, 2007) only analyzed subsidiaries of Western MNCs based in the U.S. Gupta and Govindarajan (2000) only looked at knowledge flows between subsidiaries located in developed countries. Insights on emerging market subsidiaries are absent.

Reflecting the triad data bias of current research on MNC management on theories of internationalization (see chapter 4.1); the West-to-East paradigm is still prevalent. Despite the fact that foreign subsidiaries are recognized to contribute to the firm's corporate advantages, models such as the heterarchy (Hedlund, 1986) and the transnational corporation (Bartlett & Ghoshal, 1998) underlay the assumption that innovation is based on new technologies developed in the West. To address emerging markets, Western products are stripped down to local needs. Thus, the internationalization of firms in terms of knowledge and innovation creation has been solely analyzed in developed countries. According to cultural similarities, comparable economic status, and similar technological advancement of the Western countries, the MNCs' subsidiaries face similar demand structures in their host and foreign countries, which eases coordination and reduces tensions within the MNC network (Dima, 2010; Hicks, 1939). The organizational impact of reverse innovations that are based on an entirely different demand structure due to large cultural and structural differences on Western MNCs is under-researched. The question of whether the recent expansion towards emerging countries will have scientific implications on MNC strategy and

structure remains unanswered. The transferability of the results to an emerging market context is questionable.

(ii) Evolution of the MNC: blurring boundaries between subsidiaries. Existing literature on MNC assumes that MNCs are increasingly internationalizing following an evolutionary path (Johanson & Vahlne, 1977, 2009; Rao & Naidu, 1992). This path is also reflected in the evolution of research on the MNC. The scientific perception of the MNC has changed over the last 50 years. Up to the 1980s, the headquarters-subsidiary relationship was the subject of many research studies. It was assumed that the subsidiary represents a local affiliate that controls the entire local value chain. Over time, the peripheral subsidiary were given more autonomy and reached a status of self-determination. Today, scholars adopt a more integrated perspective. The subsidiary is seen as a distinct remote unit that controls parts of the local value chain and incorporates one or more specific capabilities (Birkinshaw & Pedersen, 2009).

In the last years, increasingly more large MNCs achieved a steady state of internationalization. Thus, the MNC network does not evolve in a straight line towards more internationalization but rather follows a cycle of more centralization and decentralization within the network. It appears that the geographic dispersion becomes less important. The mapping of subsidiaries to geographic sites and specific value chain activities becomes ever more difficult as many companies have established project organization. Projects are executed by virtual teams – enabled by better ICT infrastructures and a high mobility of managers – whose members reside in several dispersed subsidiaries. The virtual team represents value chain functions and is the entity that holds specific capabilities. The perception of a subsidiary as a country entity that controls specific parts of the local value chain and hold specific capabilities seems outdated (Frost et al., 2002; Moore & Birkinshaw, 1998). The allocation of capabilities and knowledge to local subsidiaries becomes progressively blurred.

As we have seen in the previous sections, reverse innovation is a new phenomenon to the management of Western MNCs. The question arises in what MNC context reverse innovation is developed. Does the spatial allocation and concentration of value chain activities in a single subsidiary foster reverse innovation, or is it rather developed in a setting of globally dispersed activities within the MNC network?

(iii) MNC structure: emerging organizational challenges. Relating to the previous argument, the boundaries between subsidiaries and its allocated resources and developed capabilities become increasingly more blurred. This increases the exchange within the MNC network. Some value chain activities located at one subsidiary might be shared with other subsidiaries within the MNC network. Thus, more than one subsidiary accesses resources of remote value chain activities within one business. Based on the description of the reverse innovation phenomenon it seems that it follows a different – even contradictory – rationale than the existent innovation concepts in Western MNCs. This might result in organizational challenges on resource allocation between reverse innovation and existent Western innovation. Current literature falls short of providing insight on how such challenges are addressed from an organization and coordination perspective. This is due to two aspects where further research can provide more insight.

The *first limitation* in current literature is based on the unit of analysis of existing studies. The unit of analysis varies between the corporation-, the subsidiary-, or the MNC network-level. Most datasets comprise large corporation that maintain numerous independent business fields that represent standalone units controlling the entire value chain. In these cases, the subsidiary is responsible for an entire business field beyond a specific regional focus (Fratochii & Holm, 1998; Holm & Pedersen, 2000; Reger, 2004; Surlemont, 1998). Studies that analyze the interaction process within one business field whose value chain activities are globally dispersed and interdependent are rare. Thus, the analysis of current studies stays on a broad level. Internal conflicts and challenges that result from geographic dispersal and shared activities – along the value chain functions, e.g., sales operations, marketing, R&D – are not addressed from an organizational perspective. Moving the unit of analysis to business unit/field level may allow analyzing in more depth existing organizational challenges and how they are resolved.

Connected to the previous argument, the *second limitation* in current literature is related to the concepts on how organizational structure is described. The notion of mandates, responsibilities, and roles seem to be too broad to provide insights on how interaction and coordination within the MNC network take place. As clear boundaries between subsidiaries disappear, the analysis of formal structures that overlay geographic structure becomes more important. The analysis of decision-making structures on a project level may provide more detailed insight on how MNC are structured and how

network challenges are resolved (Foss & Pedersen, 2004). The decision-making structures may serve as a proxy for the formal structure of the MNC.

(iv) MNC knowledge and capability transfer: too broad concepts. As reverse innovation may differ from Western innovation it is unclear if it may be based on a new knowledge set and may require a new kind of capabilities. Numerous scientific studies analyze the knowledge transfer and capability leverage within the MNC (e.g., Doz & Santos, 1997; Gupta & Govindarajan, 1994, 2000; Monteiro et al., 2008; Phene & Almeida, 2008). Relating to the previous argument, the question is what does it mean to transfer knowledge or leverage capabilities within the MNC network? It seems obvious that 'capabilities' and 'knowledge' are too aggregated concepts to provide answers to the previous question (Foss & Pedersen, 2004). More detailed and differentiated views are required to provide deeper insights into how MNCs work. Current literature hardly addresses the complexity of knowledge. What kind of knowledge is transferred? This question may lead to a differentiation between implicit and explicit or market and technological knowledge. Even in studies that stress the knowledge based view of the MNC the heterogeneous character of knowledge and the way it is structured and stratified is not considered (Foss & Pedersen, 2004; Kogut & Zander, 1993). How are capabilities leveraged within the MNC network? The answers to these questions are not trivial and require more detailed view on project execution, virtual teams, and interpersonal exchange. They represent an uncharted territory in existing theory with high managerial implications (Foss & Pedersen, 2004).

In addition, the linkages of organizational structure to knowledge transfer and capability leverage on a micro level are unclear. How does structure and control enable or perhaps constrain knowledge transfer within a project where several subsidiaries are involved? In more detail, it might be interesting to look at how decision-making structures – where decision-making authorities are allocated within the MNC network – on a micro level influence knowledge transfer (Foss & Pedersen, 2004).

(v) Knowledge bias: focus on technological knowledge. Theories on internationalization assume that innovation is based on new technology rather than on market knowledge and new value propositions (Dunning, 1981; Kuemmerle, 1999; Vernon, 1966). This view is adopted by research on knowledge creation and transfer in MNCs. Predominantly, the flow of technology related knowledge was analyzed. A large number of studies on subsidiary innovation are based on patent citation data (Almeida

& Phene, 2004; Frost, 2001; Phene & Almeida, 2008). For example, Phene and Almeida (2008) find that the innovativeness of a subsidiary depends more on patents from firms in the home and host country than internal sources (headquarters and other subsidiaries). Analyzing patent citation data, Frost (2001) finds that the technological specialization in subsidiaries is supported by ideas that originate in the subsidiary's local environment. Other studies focus explicitly on technological knowledge flows (Kogut & Zander, 1992) or technological development within MNC (Cantwell, 1992, 1993). Despite that, much research has been done on the forward, lateral, and reverse knowledge transfer within MNCs, scientific insights on the role market knowledge in the MNC are fragmented. For example, in some studies market knowledge was only used as a proxy for the innovativeness of the subsidiary. Thus, current scientific literature in knowledge creation and knowledge flow in MNC is biased on technological knowledge.

The previous analysis of the practical phenomenon of reverse innovation indicates that market knowledge may be decisive for reverse innovation. The detailed studies on the flow of market knowledge within MNC are still missing.

(vi) 'Knowledge flow is always good' bias. In present studies, free knowledge flow between all horizontal and hierarchical levels within an MNC network is always regarded as being beneficial (Hedlund, 1994). This also includes the leverage of local capabilities throughout the MNC (e.g., Avridsson, 1999; Birkinshaw & Hood, 1998; Nohria & Ghoshal, 1997; Yang, Mudambi, & Meyer, 2008). This view neglects that certain capabilities or certain knowledge can be beneficial for one product line or business while it may negatively affect other product lines or business models within one MNC. This might be true in the case of reverse innovation as it seems to contradict a prevalent rationale in Western innovation management, the most ingenious technological solution will win the market. Thus, a more differentiated perspective on knowledge transfer is required.

In summary, it seems that reverse innovation requires structures that enable a high global efficiency to meet cost targets and requires a high local effectiveness to offer products that meet local requirements in emerging markets. The transnational model of the MNC offers a solution to the competing relationship between global efficiency and local effectiveness (Bartlett & Ghoshal, 1998). This is achieved through intense knowledge transfer and leverage of locally bonded capabilities. Nevertheless, existing

theory falls short to explain in detail how this transnational model can be achieved. Several challenges have to be overcome. *First*, as subsidiaries become more autonomous over time they define their own agendas. This may lead to conflicting goals between different entities in the MNC network. Consequently, conflicts on shared value chain activities and limited resources within the MNCs emerge. *Second*, knowledge and capabilities that are beneficial for achieving one subsidiary's goal may not be beneficial for other subsidiaries. Some capabilities may jeopardize capabilities that are crucial to another subsidiary. These internal challenges have recently become more important as companies increasingly implement more than one business model that is partly rooted in the growing heterogeneity of local and global markets. This has even intensified organizational challenges. In short, current literature romanticizes collaborative exchanges within MNC and neglects conflicting goals between subsidiaries and resulting organizational challenges. *Third*, the transnational model has so far neglected hierarchical/decision-making structures that may increase or resolve these challenges. More scientific insights are required on how these challenges and conflicts are resolved. Further, questions regarding how knowledge creation and transfer is organized remain unanswered.

Relating to the previous arguments, the level of analysis of the current research does not allow direct implication on the management of local based innovation. Company specific endogenous conditions, which may reveal insights on decision-making and on the process on how knowledge is transferred, are described merely fragmentary. Detailed insight on how knowledge is transferred, combined, and deployed is missing (Foss & Pedersen, 2004). The same holds true for a detailed picture on how decisions are made and how authorities are delegated (Foss & Pedersen, 2004). How organizational structures affect knowledge transfer represents an uncharted territory in current literature. Theory on the MNC and management practice strongly benefits from more insight. Nevertheless, the existing literature on multinational company subsidiaries forms a guiding frame for the underlying investigation, but falls short to explain how reverse innovation is pursued.

Global R&D

Within the last 30 years, the management of R&D and R&D internationalization has emerged towards a separate stream of literature. Numerous studies analyzed the drivers for global R&D (e.g., Belderbos, Lykogianni, & Veugelers, 2008; Chiesa, 1996a; Farrell, 2005; Hegde & Hicks, 2008; Ito & Wakasugi, 2007; Patel & Vega, 1999; von

Zedtwitz & Gassmann, 2002). Other studies examined the strategic roles of R&D sites (Dunning & Narula, 1995; Iwata, Kurokawa, & Fujisue, 2006; Kurokawa, Iwata, & Roberts, 2007; Le Bas & Sierra, 2002). Additionally, a strand of literature provides models of global R&D structure (Gassmann & von Zedtwitz, 1998, 1999; Gerybadze & Reger, 1999; von Zedtwitz & Gassmann, 2002).

Despite the fact that scientific literature has paid increasing attention to R&D internationalization in the last few decades (e.g., Archibugi & Iammarino, 1999), it fails to fully account for emerging market innovation. R&D internationalization has been dominantly interpreted as the attempt of Western technology-intensive companies to leverage and exploit home-generated knowledge to foreign markets and/or gain access to technological know-how (e.g., Gassmann & von Zedtwitz, 1998; Kuemmerle, 1997; Sun, 2003; Sun, Du, & Huang, 2006; Sun, von Zedtwitz, & Simon, 2007; Von Zedtwitz, 2005). Within the last decade, the need to anticipate local market information and adapt products accordingly has become a significant driver of global R&D. Thus, firms have started to establish local engineering units allowing a customization of global product platforms. Nevertheless, existing literature on market adaptation as a driver for R&D internationalization is still based on the conjecture that innovations are centrally driven from a Western mindset and then locally adapted to specific needs (e.g., Chiesa, 1996a; Niosi, 1999; Patel & Vega, 1999; von Zedtwitz & Gassmann, 2002).

As current cases in practice show, innovation in emerging markets marks a challenge for the R&D in Western MNCs (Maisch, Zeschky, Widenmayer, & Sauter, 2011). An adaptation of Western products is not sufficient when it is about to provide innovative solutions for emerging markets (e.g., Immelt et al., 2009; Williamson, 2010). New product lines are necessary to meet local requirements and to achieve a high customer value in emerging markets based on an entirely different knowledge base: product propositions are characterized as being low-cost and providing basic functionality and high quality (Christensen, 1997; Gadiesh et al., 2007; Hart & Christensen, 2002; Matthyssens et al., 2006; Williamson, 2010; Zeng & Williamson, 2007).

Present studies on R&D structure provide a guiding frame for how R&D can be organized (Gassmann & von Zedtwitz, 1998, 1999; Gerybadze & Reger, 1999; von Zedtwitz & Gassmann, 2002). Nevertheless, these models underlie the West-to-East paradigm and provide only fragmented and incomplete guides of how to achieve

innovations in and for emerging markets. While scholars have highlighted local market adaptation as one crucial exogenous driver of global R&D, there is little insight about its distinct manifestation with respect to emerging market innovation. Under the empirical phenomenon of reverse innovation, the underlying determinants of the evolution of international R&D, its organizational configurations and structures have not been scrutinized and elaborated by existing research. Additional research is required to evaluate to what degree innovation in emerging markets and their potential backflow to the home country affect current models. In particular, no empirical studies have examined local R&D capabilities of Western MNC subsidiaries in emerging markets. While the normative character of the present studies on R&D structure allows a categorization of R&D, they fall short to provide insight on how global R&D is coordinated on a micro level. Insights on project organization, decision-making structures and inter-unit exchange are missing. Present studies on R&D structure in emerging markets do not reveal sufficient scientific insight on how R&D is organized to innovate successfully in emerging countries (Mudambi, 2011; Schanz, Huesig, Dowling, & Gerybadze, 2011).

New product development

Predominantly, studies on NPD have concentrated on coordination aspects and routines including information flows and people allocation (Cooper, 1999; Cooper, Edgett, & Kleinschmidt, 2003). Extensive research on NPD has also been conducted on customer integration (Glazer, 1991; Li & Calantone, 1998; Tidd, Bessant, & Pavitt, 2005; von Hippel, 1986). Few studies analyzed the global NPD process (Boutellier, Gassmann, Macho, & Roux, 1998; Chryssochoidis & Wong, 1998; de Brentani, Kleinschmidt, & Salomo, 2010; Kleinschmidt, de Brentani, & Salomo, 2007). They have revealed insights on how global routines may leverage NPD resources for a global product development. Thus, NPD is understood as a dynamic capability that is leveraged across the entire MNC.

Despite that NPD is a well-addressed research field, the majority of studies focuses on a developed market setting. Only a few recent studies focused on NPD in emerging markets (Al-Shalabi & Rundquist, 2010; Atuahene-Gima & Murray, 2007; Grigoriou, 2010). While these managerial studies indicate that NPD processes of companies in emerging markets differ from those in Western companies, an analysis of NPD processes in Western MNC subsidiaries in emerging markets is missing.

1.2. Research objective and research questions

Despite burgeoning scientific literature, reverse innovation still represents a complex and unevenly developed field. Present research on the management of the MNC has so far principally considered data from the triads whereas insights from emerging countries are missing. Reverse innovation comprises numerous variables within the MNC that influence it. As we have seen in the previous chapter these variables comprise i.a. organizational structure, knowledge and capability generation and transfer, decision-making, R&D structure, NPD processes and routines. So far, it appears unclear, which variables and its values enable reverse innovation. Currently, it seems not all variables are identified and their interdependence appears to be unclear still. Therefore, this research takes an explorative approach to identify the variables that influence it and provide insights in cause and effect between the variables. Based on current literature, an initial reference framework is developed that includes variables derived from theory that potentially influence reverse innovation. According to new empirical insights, the initial reference framework will be adapted. A revised framework will potentially illuminate new variables and interdependencies.

Thus, the objective of this research is to explore the phenomena of emerging market innovation and its reverse diffusion for Western MNCs. In particular, the thesis aims to provide detailed insights on how organizational challenges are addressed. To provide a comprehensive understanding, this study also analyses strategic, structural, and process-related patterns as well as capabilities that mark prerequisites for facilitating reverse innovation. This integrative research approach requires overarching research questions. This research aims at answering the following main research question:

> *Main research question: How do Western MNCs facilitate reverse innovation?*

As previously stated, current literature falls short in providing detailed insight into how organizational challenges are addressed. This is for two reasons. *First*, the view of the MNC as a network of subsidiaries with clear geographic boundaries and assigned mandates is blurring. Increasingly more MNCs have established project organizations where virtual teams – its members belonging to various subsidiaries – are responsible for innovation. A clear geographic allocation of tasks is hardly possible anymore. Thus, structures need to be analyzed not on the interaction between geographic units but on decision-making and innovation implementation on a project basis overlaying the

geographic component. *Second,* studies on MNCs have predominantly analyzed large corporation that comprised several business areas. More insights are required on how interaction effects occur within one business field. In this respect, the present study focuses on a single business field of Western MNCs as the level of analysis. As a vignette for revealing decision-marking structures, a reverse innovation project represents the unit of analysis. From this follows the sub-question:

> *Sub-question 1: Which organizational and decision-making structures of a single Western MNC's business field enable (a) emerging market innovation and (b) its reverse diffusion?*

Additionally, current literature falls short of providing detailed insights on how knowledge is shared and which capabilities are required within the MNC to foster reverse innovation. This is because current concepts in scientific literature are too broad to provide insight. As previously outlined, managerial literature indicates that emerging market innovation may follow a different logic to innovations for developed markets. To stay competitive in emerging markets, Western MNCs are required to build up specialized capabilities. Nevertheless, the characteristics of these capabilities seem unclear. The present research intends to shed light in this field. This research responds to these limitations by adopting a more differentiated view on knowledge flows and capability creation/leverage for enabling reverse innovation. Hence, the following two research questions derive:

> *Sub-question 2: How is knowledge sharing characterized to enable reverse innovation?*

> *Sub-question 3: Which capabilities promote reverse innovation?*

Within the process of reverse innovation, R&D plays a vital role, as it is mainly responsible for driving corporate innovation. The R&D capabilities and knowledge stock represent a major source of competitive advantages. Thus, a special focus of the present research lies on the R&D management, the allocation of R&D resources, and the development of local R&D capabilities that may advance reverse innovation.

In summary, this research contributes to existing theory and literature on innovation diffusion, MNC management, and R&D and NPD management by developing a

conceptual framework for reverse innovation. This serves as the basis for the development of propositions advancing theory. Furthermore, this research aims at translating theoretical insights from the conceptual framework into managerially relevant practices by providing managerial implications as to what strategies and organizational structures are used. Managerial recommendations will be derived regarding how emerging market innovation and its reverse diffusion can be managed contingent on specific environmental circumstances.

1.3. Focus and definitions

The following section outlines the focus of the present study. A clear frame is set on the subject of research. Preliminary definitions of core terms are provided. The literature review in chapters 3 and 4 will give more detailed insights.

1.3.1. China as a research setting

Within the last 20 years, the BRIC (Brazil, Russia, India, and China) countries have experienced rapid economic growth. Nevertheless, the emerging market economies are heterogeneous and market structures are not comparable among the BRICs. Within the BRICs, China takes an exceptional position.

With a GDP of 7.0 trillion USD, China currently represents the second largest economy in the world after the U.S. (GDP of 15.0 trillion USD) and before Japan (GDP of 5.9 trillion USD) (CIA, 2012). China is by far the single largest emerging market economy followed by India with a GDP of 1.8 trillion USD (CIA, 2012). Based on an annual GDP growth rate of approximately 10 %, China is estimated to become the world's largest economy by 2020 (Shamim, 2010). Additionally, China holds an incomparable potential of a new emerging middle class. By 2030, China will account for approximately 1.4 billion middle class consumers compared to 365 million in the U.S. and 414 million in Western Europe (Rapoza, 2011). According to James Wolfensohn, former World Bank president, an estimated two thirds of the world's middle class will live in China by 2030.[2] This development underpins the importance for companies to provide new products for the Chinese middle class.

China's large market has attracted foreign investors for more than one hundred years. Many Western MNCs have a long tradition of doing business in China. For instance, Siemens, GE, and Philips opened their first Chinese offices at the turn of the 20th century. Within the last twenty years, foreign investment increased even more. In 2010, foreign institutions invested 580 billion USD in China (UNCTAD, 2012). Thereby, China represents the largest recipient of foreign investments within the BRIC nations. The long history of many Western companies in China and the recent development increases the availability of business data to form a solid basis for data collection.

[2] Interview with John Wolfensohn, former World Bank president; retrieved May 18, 2012, from http://www.gsb.stanford.edu/news/headlines/vftt_wolfensohn.html

Thus, China is selected as a research setting for two reasons. *First,* China's large market offers the highest potential of innovation driven by local markets. *Second,* Western MNCs have a very long business history in China that increases the availability of data.

1.3.2. Emerging market innovation

In times of intense and globalized competition, innovations sustain the competitive advantage of the firm and are a crucial precondition for its long-term success and survival (Baden-Fuller & Stopford, 1994; Christensen, 1997; Leifer, O'Connor, & Rice, 2001; Levinthal & March, 1993). Despite vast research on innovation, there is no general definition of the term. According to Joseph Schumpeter, innovation is the new combination of existing resources that can result in new products, new methods of production, new sources of supply, the exploitation of new markets, and new organization structures (Fagerberg, 2005; Schumpeter, 1934; Tidd et al., 2005). In a business context, innovation can be defined as the specification, configuration, or application of new ideas to products, processes, or any other aspect of the firm's activity (Rogers, 1998; Utterback, 1996).

Emerging market innovation has recently been subject to many managerial studies (e.g., Gadiesh et al., 2007; Hang et al., 2010; Matthyssens et al., 2006). The underlying characteristics of these innovations have been described as being good-enough, low-cost, and value oriented that target a new emerging middle class. Nevertheless, the innovation landscape in emerging markets is heterogeneous and practice shows that innovations in emerging markets do not exclusively focus on low-cost innovations. For example, several science parks in China – close to large cities like Beijing and Shanghai – have become centers for high-end innovation (Gassmann & Han, 2004). The Swiss high-tech company ABB offers an illustration. In 2005, the company established its 'Global Robotics Research Center' in Shanghai. Since 2006, the global robotic business including high-end developments is managed in Shanghai.[3] ABB's Shanghai subsidiary meets demand from discerning Western customers.

The present research focuses exclusively on innovations that are targeted for an emerging middle class and are thus characterized as being low-cost. This kind of innovation follows a different logic than the hitherto existing innovations from Western

[3] ABB; retrieved May 18, 2012, from http://www.abb.de/cawp/seitp202/2a165cfb936be18d4825764d00261cff.aspx

MNC. Emerging market innovations are based on a different demand structure than MNCs face at their home markets. Henceforth, the following preliminary definition of emerging market innovation is deduced:

> *Emerging market innovations meet the requirements of resource-constrained customers in emerging markets.*

This phenomenon generates challenges within the firm – as outlined in the previous section – that are highly relevant for theory and scientific literature.

1.3.3. Reverse innovation

The review on theories of firm internationalization revealed (chapter 1.1.2) a dominant pattern of innovation diffusion in the last century. Western MNC – predominantly located in the U.S. and Western Europe – developed innovations based on sophisticated technologies for their domestic markets. Over time, Western MNCs moved to foreign markets to exploit their innovations. In the course of internationalization, Western MNC also started to commercialize their innovations in emerging countries predominantly located in the East (Kuemmerle, 1999; Vernon, 1966, 1971). This formed the pattern of West-to-East flow of innovation.

As outlined in chapter 1.1.1, recently many Eastern MNCs and a couple of Western MNC have begun to develop innovations in and for emerging countries. These innovations particularly address an emerging middle class in these countries and are often characterized as low-cost or good-enough (Christensen, 1997; Gadiesh et al., 2007; Zeng & Williamson, 2007). Some of these innovations have received great interest also in developed markets and are commercialized in Western countries following an East-to-West flow of innovation (Brown & Hagel, 2005; Immelt et al., 2009). Thus, some emerging country innovations 'reversed' the traditional flow of innovation from West-to-East to an East-to-West direction (Frost et al., 2002). The following constitutes a preliminary definition of reverse innovation:

> *Reverse innovation is an emerging market innovation that diffuses from emerging to developed markets.*

1.3.4. Western multinational corporation

Multinational corporations can be seen as corporations that have their headquarters in one country and have other units in other countries and do business across borders (Rugman & Collinson, 2006). Based on previous definitions (Bartlett & Ghoshal, 1998; Foss & Pedersen, 2004; Gupta & Govindarajan, 1991; Hedlund, 1994; Nohria & Ghoshal, 1997), Ambos and Ambos (2009, p. 2) conceptualize the multinational corporation *"as consisting of semi-autonomous entities, in which units in dispersed locations take on various missions and control heterogeneous stocks of knowledge."* Based on the *OECD Guidelines for Multinational Enterprises* (2008), MNCs comprise entities – parent companies and/or local entities – established in more than one country. They are linked in a manner that they may co-ordinate their operations in various ways. While one or more of these entities may be able to exercise a significant influence over the activities of others, their degree of autonomy within the corporation may vary widely from one MNC to another. According to the actual distribution of responsibilities among them, the different entities are expected to co-operate and to assist one another.

Due to their physical dispersal, MNCs operate in various different economic, social, and cultural environments (Ghoshal & Bartlett, 1991). They entail complex structures that enable them to respond to environmental and organizational differences in its diverse businesses, functions, and geographic locations (Ghoshal & Bartlett, 1991; Prahalad & Doz, 1987). MNC deploy different coordination mechanisms and feature multilevel internal linkages that characterize inter-unit exchange (Ghoshal & Nohria, 1989).

Western MNCs are multinational corporations that are headquartered in the U.S. or Western Europe. In the last decades of research on R&D internationalization, scholars have predominantly focused on developed-country MNCs (e.g., Asakawa, 2001; Gerybadze & Reger, 1999; Granstrand, 1999; Kuemmerle, 1999; Pearce, 1999; Reger, 2004). Although the majority of studies focused on MNCs domiciled in the triads, (von Zedtwitz & Gassmann, 2002; von Zedtwitz et al., 2004), studies have shown that there are differences in how Western European, U.S., and Japanese companies approach the internationalization of R&D (Perrino & Tipping, 1991; von Zedtwitz & Gassmann, 2002). While Western Europe and U.S. based companies take a rather active role in establishing or acquiring foreign R&D sites to gain access to local markets, many Japanese companies rely more on home development and listening posts to tap new

technologies (von Zedtwitz & Gassmann, 2002). Despite the 'traditional' evolution of foreign subsidiaries, numerous Japanese MNCs installed research sites in Europe or the U.S. before establishing manufacturing in these regions.

In defiance of the singular focus of research on MNCs located in the triads, scholars have started to examine patterns of R&D internationalization of emerging country MNCs in recent years (Liu, Wang, & Zheng, 2010). Current research shows that emerging country MNCs behave significantly different with respect to R&D internationalization – regarding aspects of strategic intent (von Zedtwitz, 2005), organizational structure (Liu et al., 2010), technological competences and strategic resources (Deng, 2007; Rui & Yip, 2008) – than developed country MNCs.

The focus of the present research is on MNCs that have their home country in the U.S. and/or Western Europe. This selection is reasoned by two aspects: (i) due to the different perception of the internationalization between Western European/U.S. based MNCs and Japanese based MNCs, practices on reverse innovation may not be comparable under the lens of scientific research; (ii) with reference to underlying definition of reverse innovation, emerging country based MNCs do not face the same challenges as Western European/U.S. based MNCs. For the present research, the unit of analysis will be Western MNCs, which are defined as follows:

> *Western MNCs are corporations that comprise entities in more than one country and have their home country in Western Europe and/or the U.S.*

1.4. Thesis structure

Figure 2 provides an overview of the thesis structure.

Chapter 1 demonstrates the theoretical and practical motivation of the present research by discussing the novelty of the empirical phenomenon of reverse innovation. Based on the empirical phenomenon and existing literature, the research gap is derived and the research questions are developed. Further, this chapter outlines the focus of the present investigation and relevant definitions. These include the constituting concepts of reverse innovation and Western MNCs.

Chapter 2 outlines in detail the research design, the exerted methodological approach, and data sampling. The chapter provides reasoning on method and sample selection. Additionally, it describes how data is acquired and analyzed.

Chapter 3 illustrates the practical relevance of reverse innovation for Western MNCs. This includes overview of the Chinese market structure, the current understanding of reverse innovation, and current challenges for Western MNCs.

Chapter 4 provides a literature review centered on the investigated empirical phenomenon. This comprises the literature streams of firm internationalization, MNC management, R&D management, and new product development. The literature review reveals several limitations. Based on the theoretical insights an initial reference framework is developed. It guides the subsequent investigation of how Western MNCs facilitate reverse innovation.

Chapter 5 illustrates the in-depth case studies pertaining to reverse innovation in four selected firms. These include GE Healthcare, Philips Healthcare, Siemens Healthcare, and Draeger Medical. Furthermore, the chapter provides a brief overview of the medical equipment industry.

Chapter 6 analyzes insights gained from the case studies. Based on the new insights, I revise the initial reference framework. Subsequently, the cases are discussed in a cross-case comparison according to the revised reference framework. The cross-case analysis reveals common characteristics as well as differences across the cases. The results form the basis for the conceptualization of reverse innovation. The conceptualization provides answers to how Western MNCs facilitate reverse innovation.

Chapter 7 reflects the gained insights on existing literature. Based on the results, propositions are derived to extend existing literature and theory pertaining to innovation diffusion, MNC management, R&D management, and new product development.

Chapter 8 derives implications for management practice regarding how to facilitate reverse innovation. A threefold innovation provides guidance on how to adapt the current structure for emerging market innovation and its reverse diffusion. Additionally, the chapter provides detailed insight for the management of R&D.

Chapter 9 summarizes the theoretical and managerial implications. Furthermore, it outlines the limitations of the present research and provides thoughts for future research.

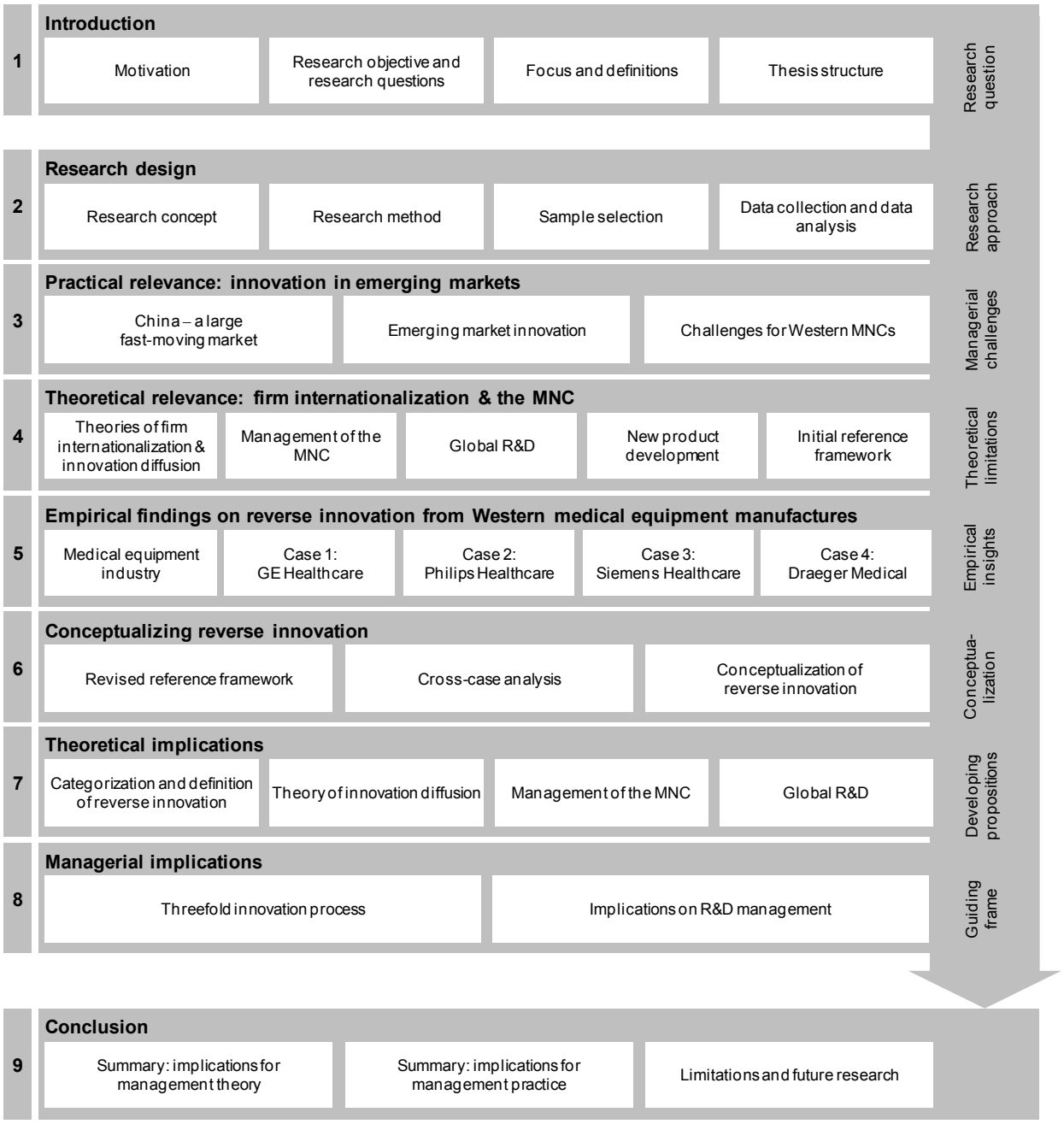


Figure 2: Structure of the thesis

2. Research design

Since reverse innovation is an under-researched and novel phenomenon, an explorative approach is applied. The focus is on the exploration of interesting situations, correlations, and contexts in Western MNCs. According to the understanding of management research as an applied social science, this research intends to generate solutions for both practical problems and theoretical implications. Field data is collected and analyzed iteratively based on reflection of scientific literature. This results in alternations between inductive and deductive procedures.

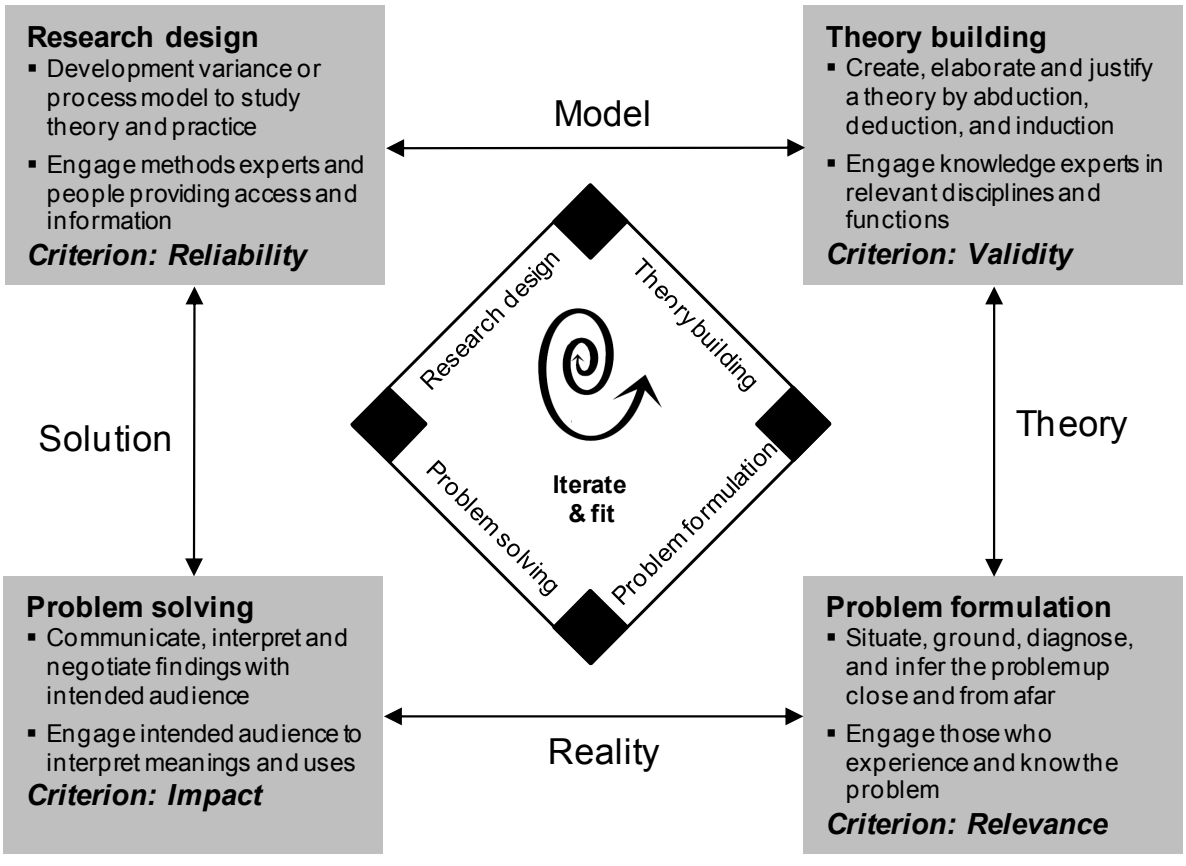
Overview: Chapter 2.1 outlines the general nature of present study, the goal, the generic research concept, and its underlying assumption. Chapter 2.2 provides detailed information on the applied case study method for explorative research. Chapter 2.3 gives in-depth reasoning to the selected sample. Chapter 2.4 shows how empirical data is acquired and subsequently analyzed.

2.1. Research concept

The present research is targeted to establish a better empirical understanding of emerging market innovation and its global diffusion. Despite the high importance for management and scientific literature, the phenomenon of reverse innovation has not been sufficiently addressed by empirical research to date. As current studies lack scientific insights, the description of the phenomenon is limited to anecdotal narrations scarce on empirical data. This thesis sheds light into the phenomenon adopting three scientific perspectives. *First,* the global diffusion of innovation that has its origin in an emerging market is analyzed on a macro level and reflected on theories of firm internationalization. The goal is to gain a better empirical understanding of how the phenomenon interacts with existing theory on product life cycle and innovation diffusion. *Second,* the goal of the study is to expand existing theory on the multinational corporation. *Third,* adopting an R&D management perspective, the present study aims to reveal structures for the management of R&D in Western MNCs.

This research is based on field research aiming at contributing to existing literature and theory. Following Kubicek (1977), Tomczak (1992), and Gassmann (1999), research is seen as an iterative learning process. Instead of validating hypotheses solely derived from theory, newly created knowledge comprises questions about reality that are based on practice and theory (Kubicek, 1977). Based on data analysis, observable elements and their interrelations are revealed. The reflection of the empirical data on theory and an initial references framework creates new pictures of reality. Measures of differentiation, abstraction, and changes in perspective enhance alternations and theory building (Skorna & Widenmayer, 2010).

The research process follows Van de Ven's (2007) diamond model of 'Engaged Scholarship'. The model provides guidance throughout the research project to ensure completeness and coherence. The model further secured the quality of the research with respect to validity and reliability (see figure 3).



adapted from Van de Ven (2007)

Figure 3: Diamond model of 'Engaged Scholarship'

The study creates new questions and propositions relevant to explaining the phenomenon of reverse innovation (Eisenhardt, 1989; Kromrey, 1995). Throughout the whole research process empirical data is connecting and disconnecting with existing literature that result in theory expansion (Mintzberg, 2005). As a result of the research process, propositions are developed that extend existing theory on firm internationalization and the management of the MNC. Thus, the results differ strongly from confirmative approaches that test preliminarily formulated hypotheses, which can be accepted or rejected on a broad scale to generalize the findings (Eisenhardt, 1989).

2.2. Research method

The objective of the research is to shed light on the phenomenon of reverse innovation and its effects on the management of Western MNCs. Due to the multifaceted and novel character of the phenomenon and the absence of scientific literature, an exploratory qualitative research methodology is applied. The present research targets expanding theory from case study through an in-depth analysis of the novel phenomenon from a holistic perspective guided by Eisenhardt (1989). The research follows a multiple-case design (Yin, 2003).

Industry and company selection is based on theoretical sampling as a means to maximize theoretical insight. The research focuses on 'extreme' cases that exhibit strong peculiarities with respect to phenomenon under research due to its industry and company setting (Voss, Tsikriktsis, & Frohlich, 2002; Yin, 2003). The present research follows Eisenhardt and Graebner's (2007) sampling approach, in which extreme cases (e.g., innovation characteristics, degree of emerging market involvement) are selected in order to more easily observe patterns. The goal is to reveal very clear patterns of the central constructs, variables, their relationships, and logic of reverse innovation (Eisenhardt & Graebner, 2007).

Depending on the research questions outlined in chapter 1.2, the study differentiates between unit and level of analysis. The unit of analysis is a single reverse innovation project of a Western MNC. The study investigates particular innovation characteristics and pattern of diffusion. The level of analysis is the company and the respective business field. Thus, the particular reverse innovation project represents a vignette to illustrate strategic and organizational structures that enable emerging country innovation on a business field level. The goal is to reveal management practices enabling reverse innovation.

Since academic research on the question of how Western MNCs facilitate reverse innovation is lacking insights, in-depth data on four case studies is collected. The main criteria in qualitative empirical research are validity and reliability of results. The following generic measures were undertaken by a research team to increase construct validity, internal validity, external validity, and reliability. Using multiple sources of evidence, establishing a clear chain of evidence between the questions asked, data collected and conclusion drawn, and having key informants review the draft case study report and agree upon increase the construct validity (Yin, 2009). Internal validity of

causal relationships requires a reliable process of analyzing data and comparing emerging concepts and theories with previous literature for generalization and theory building from cases. Pattern matching, explanation building, and time-series analyses can enhance it. Additionally, the concept of triangulation is central to achieving internal validity (Yin, 2003). This includes semi-structured data based on thoroughly conducted desk research, internal documentation, and interviews. The interpretations of the conducted data are subsequently confirmed in follow-up interviews. External validity confirms that the findings can be generalized within the frame of the conducted research. Lastly, reliability ensures that another researcher could conduct the same research successfully using the same procedure at later times (Eisenhardt, 1989). Therefore, it is critical that data collection and data analysis are described in detail, which increases transparency. The following sections illustrate in detail how the quality criteria are addressed and how rigorousness of research is assured.

2.3. Sample selection

As outlined in the previous chapter, the goal is to identify and select extreme cases that offer a high learning potential for theory and practice. The empirical research and sample selection is carried out between 2009 and 2012 and consists of two phases. In the first phase, general insight on Western MNCs, their management of global R&D, and the related challenges were derived. This led to 30 case studies based on 152 interviews from Western MNCs comprising data on R&D strategy, organization and processes. All of the companies (see table 1) either participated in contracted research projects at the Institute of Technology Management at the University of St. Gallen or were subject to bachelor or master theses. Each company aimed at increasing innovation efficiency and effectiveness by adopting new approaches in the field of open innovation and/or management of global R&D. All companies are major global players in their respective markets and are headquartered in France, Germany, the Netherlands, the U.S., or Switzerland. Within the sample, various different industries (see table 1) are represented that differ according to technology intensity and technology life-cycle from high-tech, medium-high-tech, medium-low-tech, and low-tech industries (OECD, 2005). The entire sample holds a heterogeneous picture on global R&D management practices.

In the second phase, an in-depth analysis of Western MNCs with experience in innovation in emerging markets is carried out. On the basis of the conducted case studies in phase one, an industry setting and appendant companies were selected that have the highest learning potential for new insights with respect to the phenomenon.

2.3.1. Industry selection

The case study data of phase one revealed large differences between the represented industries according to emerging market innovation strategy and practices. Especially, the technology and know-how intensive industries in the sample – i.e., electronic, medical, and machinery – that face strong competition from local emerging market firms show distinct emerging market innovation strategies. These firms offer examples of emerging market innovation and, partially, their global diffusion. In accordance with the research concept, they provide the highest learning potential for the subject of investigation.

Table 1: Case studies and interviews of research phase one

Company	*Industry*	*Location of headquarters*	*Number of interviews*
Airbus	Aviation	Toulouse (France)	5
Bayer MaterialScience	Chemical	Leverkusen (Germany)	3
BASF	Chemical	Ludwigshafen (Germany)	2
Beiersdorf	Consumer goods	Hamburg (Germany)	2
Buhler	Machinery	Uzwil (Switzerland)	3
Draeger Medical	Medical	Luebeck (Germany)	5
Dr. August Oetker	Food	Bielefeld (Germany)	7
General Electric	Electronic, Machinery	Fairfield (U.S.)	2
GF AgieCharmilles	Machinery	Meyrin (Switzerland)	1
Giesecke & Devrient	Machinery	Munich (Germany)	8
Henkel	Consumer goods	Dusseldorf (Germany)	5
Hilti	Construction	Schaan (Lichtenstein)	2
IBM	Electronic	New York (U.S.)	2
Liebherr	Machinery	Bulle (Switzerland)	12
Logitech	Electronic	Morges (Switzerland)	3
MAN Turbo & Diesel	Machinery	Munich (Germany)	14
Mettler Toledo	Electronic	Greifensee (Switzerland) Columbus (U.S.)	4
Microsoft	Software	Redmond (U.S.)	1
MTU Friedrichshafen	Machinery	Friedrichshafen (Germany)	9
Nestlé	Food	Vevey (Switzerland)	5
OSRAM	Lighting	Munich (Germany)	7
Philip Morris International	Tobacco	New York (U.S.)	8
Philips	Electronic	Amsterdam (Netherlands)	2
Reichle & DeMassari	Electronic	Wetzikon (Switzerland)	5
Riether	Machinery	Winterthur (Switzerland)	2
Roche Diagnostics	Medical	Risch (Switzerland)	1
QIAGEN	Medical	Venlo (Netherlands)	2
Siemens	Electronic, Machinery	Munich (Germany)	14
SMS Siemag	Machinery/ Construction	Hilchenbach (Germany)	7
Varian Medical	Medical	Palo Alto (U.S.)	9

Total number of conducted case studies	*Total number of conducted interviews*
Σ 30	*Σ 152*

For the present study, the medical equipment industry was selected as a research setting. This is based on the following four reasons:

- *First*, the field of medical equipment represents a knowledge-intensive industry. In particular, the processes of knowledge exchange and capability leverage are crucial aspects in the management of medical equipment manufacturers. With respect to the outlined research questions, this setting offers high learning potential for the subject under research.

- *Second*, the medical equipment industry especially in Asia – China in particular – underlies severe competition. A high number of smaller medical equipment providers and a few large MNCs from both developed and emerging countries with subsidiaries located around the world populate the industry. In China, Western manufacturers face strong competition from large, partially state owned medical and small equipment manufacturers (China Market Research Group, 2009). The strong local and global competition compels Western medical equipment manufacturers to provide highly adapted products for local conditions and thus increases the need for emerging market innovation.

- *Third*, Western medical equipment manufacturers have a long history in China and emerging markets. In the 1980s and 1990s, Western medical equipment manufacturers expanded in emerging countries largely by joint ventures and acquisitions with the intent to access new markets. Subsequently, with the demand for more locally adapted products, the value chain has increasingly internationalized to include R&D activities. Thus, Western medical equipment manufacturers offer a rich database for empirical research.

- *Fourth*, the markets for medical equipment in emerging countries are highly diverse and impose several challenges on the development of medical equipment products (Prahalad, 2010). Apart from tier three hospitals, which resemble the most advanced hospitals in China, tier two and tier one hospitals lack the resources to buy, for example, advanced diagnosis machines that in addition would have to be laid out for rugged conditions such as dirt and electrical power outages. The medical equipment manufacturers are challenged to develop high-end innovations and innovations for recourse-constrained customers that cater to the needs of the majority of the market.

2.3.2. Company selection

The in-depth case study sample includes GE Healthcare, Philips Healthcare, Siemens Healthcare, and Draeger Medical. All of the companies are based in Western Europe or the U.S., which facilitates our analysis since differences in terms of culture and business environment are minimized. In terms of size and revenues, all selected firms are highly comparable with the exception of Draeger Medical. Nevertheless, Draeger Medical is also challenged by reverse innovation and follows a distinct approach for management. As Draeger Medical provides additional insights, it is also selected for data analysis. The following criteria were applied for case selection:

- *Western headquartered*. All companies are headquartered in developed, Western countries (Western Europe/U.S.).

- *R&D unit in China*. All selected companies have more than five years' experience with a remote R&D unit in China. This criterion is important as the experience in R&D in emerging markets is expected to have a large influence on the strategic decision on where innovation for emerging markets takes place. This criterion constrains case variation.

- *Comparability in strategy*. All companies strive to technological leadership and address the Western markets with high-end products. Traditionally, the companies employ a pioneer strategy by introducing new technologies and innovations first in the market.

- *Established structures*. All companies have more than a century of history, with a long experience in global management. The selected firms have established processes and structures enabling global development.

- *Focus on innovation for a new low and middle class in emerging countries*. Each local R&D unit is involved in the development of innovation for resource-constrained customers for the global and/or local mid- and/or low-end market.

- *Comparability with respect to industry:* All selected companies operate in the medical equipment industry. Thus, they are highly comparable with respect to technology intensity and technology life cycle.

Thus, the cases were chosen according to theoretical rather than random sampling (Eisenhardt, 1989). This procedure is in line with the overall goal of the present research, to advance or develop existing or new theory instead of theory testing on a broad scale (Eisenhardt, 1989; Yin, 2003). Despite the fact that there are no explicit scientific recommendations in the number of case studies in qualitative research, between three and ten are regarded as sufficient for theory development. Thus, the research was based on four in-depth case studies revealing a distinct approach to reverse innovation (see table 2).

Table 2: Case studies and interviews of research phase two

Company	*Industry*	*HQ*	*Foundation*	*Revenues*[a]	*Employees*	*R&D intensity*[b]	*Distribution of revenues*	*Number of conducted interviews*
General Electric Healthcare	Medical equipment	Little Chalfont (U.K.)	1892	16.9 bn USD	51,000	6.5%	52% Americas 27% EMEA, CIS 21% Asia	4
Philips Healthcare	Medical equipment	Andover (U.S.)	1881	11.5 bn USD	35,000	8.1%	45% North America 24% Western Europe 20% Emerging markets 11% Other mature markets	2
Siemens Healthcare	Medical equipment	Erlangen (Germany)	1877	16.6 bn USD	49,000	9.0%	42% Americas 38% EMEA, CIS 20% Asia, Australia	6
Draeger Medical	Medical equipment	Luebeck (Germany)	1889	1.97 bn USD	6,000	6.9%	22% Americas 57% Europe 14% Asia Pacific 7% Other	6
Total number of conducted case studies *Σ 4*								*Total number of conducted interviews* *Σ 18*

[a] The reference year for all data is 2010.
[b] R&D intensity is calculated according to each firm's financial statements, corresponding to the firm's R&D expenditures as a percentage of revenues.

2.4. Data collection and data analysis

2.4.1. Data collection

According to data selection, data collection was also carried out in two phases. In phase one, multiple sources of data were used to gain a general overview of the companies' global R&D setup (see table 1). Following a semi-structured interview guideline (see appendix 1), CTOs, R&D directors, and R&D unit managers were asked to describe the global R&D strategy and organization, current challenges in the management of global R&D, as well as global R&D processes. In particular, the interviewees were asked to name the company's R&D units in emerging countries and characterize their local R&D activities. In group meetings and workshops at the companies on site, the conducted data of each company was revised and validated during discussion sessions. Furthermore, additional sources of information including company reports, company's internal and external documents (presentations, memos, and project reports), published case descriptions, and press releases were used.

Based on the empirical data of phase one and scientific literature, an initial reference framework is constructed in phase two (Kubicek, 1977; Miles & Huberman, 1994). This reference framework displays the objects, their dimensions, and interdependencies underlying the phenomenon to be investigated (Voss et al., 2002). The framework is derived from theory and current scientific literature relevant for innovation in emerging markets. It guides the development of the semi-structured interview guideline applied for data collection. This procedure allows the acquisition of required data in alignment with scientific literature and theory for analyzing the reverse innovation phenomenon as a means to gain theoretical insight.

The data of phase two was collected by personal face-to-face or telephone interviews, which lasted between 60 and 120 minutes on average (see table 2). For each interviewee, the semi-structured interview guideline (see appendix 2) was applied that also allowed the interviewee to talk freely about specific subjects at the end of the interview. The semi-structured interview guideline was improved and adapted to gain better insight whenever needed. Whenever possible, this interview guide was sent to the interviewee in advance. The interviewees were asked to refer to the most prominent example of reverse innovation where they had the most insights. Based on the example, strategic decisions, structures, development, and sales processes were illustrated. The interviewees were further asked in what way the presented example differs from the

company's first innovation in the emerging market case and to other cases they are aware of. After each interview, the interviewee was asked to name further colleagues who were also involved in the development or decision-making on innovation activities in emerging markets (snowball sampling). Special attention was paid to ensure that relevant hierarchical levels were represented by the interviews. Thereby, it was possible to collect and validate the data from different angles. Some of the interviewees were interviewed more than once for follow up questions and validation. Further material such as firm presentations, annual reports, and internal presentations and documents that were disclosed from the interview partners were analyzed. Data collection ended when theoretical saturation was achieved. This was the case when the marginal improvement of insight based on additional data became small (Eisenhardt, 1989).

In phase two, at least two managers were interviewed per company. All answers were cross-checked. In case of ambiguity or uncertainty, the answers were resubmitted for clarification. This procedure reduced the risk of biased information from personal views. The triangulation of various types of data by different methods in both phases of data collection enhanced construct validity by overcoming the limitations of using only one method (Jick, 1979).

2.4.2. Data analysis

With an exception of three, all semi-structured interviews of phase two were tape recorded and transcribed by one researcher using standard spelling and excluding non-verbal statements. Each transcript was analyzed in single statements. Two researchers paraphrased, coded, and categorized the single statements independently according to the recommended procedure of Creswell (2009). Afterwards, every paraphrased statement in each category was cross-checked. In case of disagreement or insufficient information, follow up questions were addressed towards the respective interviewee. The data gained from the interviews were compared with the information received from non-personal sources. If discrepancies emerged, these were clarified with representatives of the specific company.

With the exception of Draeger Medical, all companies agreed to directly refer to their reverse innovation project and reveal the product. In the case of Draeger Medical the reverse innovation project and underlying product is anonymized.

3. Practical relevance: innovation in emerging markets

The last two decades have seen the tremendous rise of new economic powers in the emerging world. Especially, growing domestic markets in China and India have urged local companies to innovate products for a new emerging middle class. Based on their local success, emerging market MNCs started to commercialize their products in the Western world. As we have seen in chapter 1.1.1, this challenges Western MNCs not only in the emerging but also in their home markets. The following chapter demonstrates the high practical relevance of the research subject in more detail. Therefore, it reiterates current challenges of Western MNCs. Based on the research frame special focus is on China.

Overview: Chapter 3.1 illustrates the determining factors in the Chinese market and shows current market dynamics and structures. Chapter 3.2 provides an overview of existing concepts of reverse innovation. Chapter 3.3 examines resulting challenges for Western MNCs. Chapter 3.4 gives a summary on the existing managerial shortcomings.

3.1. China – a large fast-moving market

In 1999, China became the second largest economy in the world after the U.S. (CIA, 2012). According to market size, market structure, and economic evolution, China is taking a leading role within the emerging countries. It offers a huge business potential for local and foreign firms due to its economic power and growth.

3.1.1. Market liberalization and market growth

The liberalization of trade and markets, a more stable political system, and large state investments have enabled a significant economic growth in China especially in the last decades. The country achieved nearly double-digit growth rates of GDP over the last ten years (CIA, 2012). With a GDP of almost 7.0 trillion USD in 2011, China emerged towards the second largest economy in the world after the U.S. (GDP of 15.0 trillion USD). China is the single largest emerging market economy followed by India with a

GDP of 1.8 trillion USD (CIA, 2012). It is expected that China will become the world's largest economy by 2020 (Shamim, 2010).

Currently, China offers a workforce of 800 million to local and foreign companies. Along with the economic development, the level of education has increased. The country holds a high number of skilled and qualified workers. From 2000 to 2008, the number of students in the 3,000 higher education institutions increased from 10.7 to 26.7 million (Destatis, 2010; Gassmann & Han, 2004; Zhou, 2006). From 2000 to 2005, the number of graduate student increased by over 20 % to 360,000. Every year, China produces about 6.3 million graduates (Jin, 2009). In 2010, 117,000 PhDs were awarded in China, ranking first ahead of the U.S. with approximately 48,000 (Fiegener, 2011; Liu & Geng, 2011).

Encouraged by the recent economic and demographic development, China has attracted a large number of foreign investors. In 2010, China received 580 billion USD of foreign direct investments (UNCTAD, 2012). In comparison, inward FDI in India only amounted to 200 billion USD the same year. Thus, China represents the largest recipient of foreign investments within the BRIC nations. At the same time, Chinese companies also expanded their business activities and increasingly started to engage in cross-border activities themselves. China's institutions spent 68 billion USD on foreign direct investments in 2010, representing 5 % of the worldwide foreign direct investments (UNCTAD, 2009).

In summary, the economic, demographic, and educational developments demonstrates China's tremendous rise. As a consequence, an increasing number of people in China experience an increase of income that puts them for the first time in their lives in a position to turn from non-consumers to consumers (Gadiesh et al., 2007; Hart & Christensen, 2002; Williamson & Zeng, 2009).

3.1.2. China's dual market structure

The enormous economic growth in China has led to rising incomes that unfold a huge market potential (Gadiesh et al., 2007; Hart & Christensen, 2002; Zeng & Williamson, 2007). Nevertheless, this has created a severance of the domestic market, as consumer groups are highly diverse. In general, the Chinese market can be divided in two segments: (i) a premium or high-end segment at the top of the economic pyramid; (ii) a

low-end or good-enough segment consisting of a new emerging middle class. This segment also includes people at the bottom of the economic pyramid who can hardly afford any products mostly located in rural areas (Gadiesh et al., 2007; London & Hart, 2004). The premium segment in China accounts for approximately 10 % of the entire market. Yet, it represents the largest single market for premium products for many Western MNCs. For example, Siemens Healthcare has sold more premium fluoroscopy products to China than to any other country.[4] The low-end segment is the fastest growing segment and accounts for about 90 % of the entire Chinese market. In the case of Siemens Healthcare, China also represents the company's largest market for basic, low-technology x-ray products. While Western MNCs still succeed in serving the premium segment, they struggle in competing in the low-end segment (London & Hart, 2004). Local competitors have gained tremendous market share by offering well-adapted products to local conditions.

3.1.3. A new emerging middle class in China

Especially the emerging middle class in China presents a rapidly growing segment of the population that has turned for the first time in their lives from non-consumers to consumers (Hart & Christensen, 2002). However, despite this, members of the emerging middle class still have little excess income compared to Western standards and will need to take care to ensure value for their money. This group lives on 2 USD to 13 USD per day at 2005 purchasing power parity prices (Prahalad, 2010). Projections indicate that the number of Chinese households whose income exceeds their basic needs will quadruple from around 55 million in 2008 to 212 million in 2013, with an average income of about 5,000 USD per annum. In India, 5 % of the households are predicted to earn around 4,000 USD per annum by 2020 (Williamson & Zeng, 2009). Currently, this emerging middle class includes some 2.6 billion people worldwide, of which Asia makes up for about 60 % (Prahalad, 2010). By the end of the decade, estimations claim that emerging market consumers will account for over 20 trillion USD of market value (Court & Narasimhan, 2010). By 2030, it is estimated that the Chinese middle class will reach 1.4 billion consumers (Rapoza, 2011). By that time, the U.S. and Western Europe will only account for 780 million members of the middle class. Thus, roughly two thirds of the world's middle class will live in China.

[4] Interview with Dr. Joachim Reiss, Head of Engineering Fluoroscopy, Siemens Healthcare, conducted on January 25, 2011.

3.1.4. New market needs for a new middle class

As outlined, the new emerging middle class in China represents an enormous business potential for local and Western MNCs. Notwithstanding, the middle class in China features several peculiarities in demand and product needs. Consumers in China encounter severe infrastructural challenges. Most people have to cope with regular power shortages. Urban areas are extremely crowded and residents have only limited space available (Hang et al., 2010). This drives the need for space-saving solutions. Furthermore, Chinese consumers have to deal with contaminated water and food (Economist, 2010). Additionally, the prices for fuel and electricity are disproportionately high. Thus, consumers look for energy saving products.

The Chinese demographic structure strongly differs to Western countries and many emerging countries. On average the Chinese household size includes only 3.1 members (CIA, 2012). This rather low number is due to the single child policy and the high number of single households in urban areas.

The majority of the emerging middle class are first time buyers that are leap-frogging technological developments. For example, marketing research by Logitech found that a significant percentage of Chinese households have never owned a television or stereo set. Instead, the personal computer is used in several ways. It is used as a workstation, a stereo, and a television for home entertainment.[5] Another illustration is the decreasing acceptance of conventional telephone networks. Many users move directly to voice over internet protocol or cell phone networks.

Despite the recent increase, the budgets of the Chinese middle class are still limited. The new consumer households will still have little excess income and will need to take care to gain value for their money. The amount they spend on health, energy, or transportation is dramatically lower compared to Western standards. Thus, members of the middle class are not willing to pay for product features they do not need. Instead, they call for tailor-made products that meet their basis needs at a very low price.

[5] Interview with Delphine Donne, Logitech Shanghai, conducted on March 21, 2011.

3.2. Emerging market innovation

Recently, emerging countries like China have become centers for the development of innovations (Ray & Ray, 2010; Williams & van Triest, 2009; Williamson, 2010). The appearance of emerging market innovation is facilitated by the rising incomes of people in emerging countries who can increasingly afford products of basic quality (Gadiesh et al., 2007; Hart & Christensen, 2002; Zeng & Williamson, 2007).

Current literature has provided numerous examples of emerging market innovations that meet demand of China's emerging middle class. The underlying products are stripped down to their essentials offering the resource-constrained customer basic functionalities at affordable costs.

3.2.1. Characteristics of emerging market innovation

The rationale of emerging market innovations is to cut costs in every perceivable way to make it affordable for resource-constrained customers and achieve high quality to meet the harsh local user environment. Several studies addressed the characteristics of product innovations in emerging markets targeted at the base of the pyramid. Table 3 gives an overview of terms and characteristics.

In sum, all concepts are examples of 'good-enough' products that meet basic needs at a low cost and thus provide high value to resource-constrained customers at the mid- and low-end market in emerging countries. Products like these are at the center of Christensen's concept of low-end disruptive innovation (1997); they have also been termed 'resource-constrained innovations' (Ray & Ray, 2010), 'cost innovations' (Williams & van Triest, 2009; Williamson, 2010), and 'frugal innovation' (Zeschky, Widenmayer, & Gassmann, 2011a). They are described as low-cost, reliable, and providing basic functionality at a sufficient quality level. Most underlying products are easy to use and space-saving. They are energy efficient and work independently, which is especially important in rural areas (Brown & Hagel, 2005; Immelt et al., 2009). These products often look inferior to existing solutions because they provide limited features and are often made of simpler, cheaper materials.

Table 3: Terms and characteristics of emerging market innovation

Term	*Descriptions*	*Key characteristics*	*Empirical data*	*Reference*	*Journal*
Cost innovation	*"Emerging country MNC deploy their cost advantage to deliver high technology, variety and customization at minimal price premiums, and to redirect niche offerings towards volume segments."*	▪ high technology ▪ variety at low cost ▪ move niche products to mass market	Case studies from Western and Eastern MNCs	Williamson, 2009	Long Range Planning
Disruptive product	Disruptive products are characterized by an aggressive price/ performance ratio and are targeted at resource-constrained consumers.	▪ less expensive materials ▪ less features ▪ low-cost ▪ simplicity of use ▪ smaller size	Four case studies from Eastern MNCs	Hang et al., 2010	Research Technology Management
Frugal innovation	*"Frugal innovation [is] defined as responding to severe resource constraints with products having extreme cost advantages compared to existing solutions."*	▪ look inferior ▪ limited functionality ▪ simples materials	Four case studies from Western MNCs	Zeschky et al., 2011a	Research Technology Management
Ghandian innovation	Ghandian innovations are affordable for everyone and sustainable. They can be based new or existing technologies.	▪ affordable ▪ sustainable	Anecdotal stories from Western and Eastern MNCs	Prahalad & Mashelkar, 2010	Harvard Business Review
Good-enough product	*"It's the 'good-enough' market segment, home of reliable-enough products at low-enough prices to attract the cream of China's fast-growing cohort of midlevel consumers."*	▪ low-cost ▪ reasonable quality ▪ basic features	Anecdotal stories from Western and Eastern MNCs	Gadiesh et al., 2007	Harvard Business Review
Innovation blowback	*"Far from being easy targets for exploitation, emerging markets are generating a wave of disruptive product and process innovations that are helping established companies and a new generation of entrepreneurs to achieve new price performance levels for a range of globally traded goods and services."*	▪ disruptive ▪ no adaptation ▪ targeted low-end segment	Anecdotal stories from Western and Eastern MNCs	Brown & Hagel, 2005	The McKinsey Quarterly
Low-end disruptive innovation	Low-end disruptive innovation result initially in good-enough products / services / business models that *"offer less of what customers in established markets want."*	▪ good-enough ▪ lower performance ▪ relative low cost	Anecdotal stories from Western and Eastern MNCs	Christensen, 1997, Christensen & Raynor2003	Book
Value innovation	Value innovations are innovations which break through dominant industry recipe	▪ competitive advantage ▪ superior customer value ▪ new market space	Case studies from Western MNCs	Matthyssens et al. 2006	Industrial Marketing Management

Some scholars argue that emerging market innovation is mainly based on the effective combination of existing technologies – in some cases even high-end technologies (Zeng & Williamson, 2007) – to develop a product that drastically changes the way of human life or business (Matthyssens et al., 2006). For example, when Chinese Galanz started its business in 1992 it licensed an existing microwave technology from Toshiba to develop an energy-efficient and small microwave for the typical space constrained Chinese kitchens.

The presented concepts assume that emerging market innovation is induced through the creation of new markets rather than new technologies and is targeted at the resource-constrained customer in emerging and developed countries. This is exemplified by the Chinese home appliances firm Haier. In 1996, the company developed a washing machine called Mini Magical Child for the local market. Designed for small daily loads it addressed the needs of emerging market's single households in urban areas caused by the limited budget, space, and infrastructure. Shortly after its introduction, the product became a huge success.

While the majority of these innovations are developed by firms from emerging countries, Western MNCs also started to engage in low-cost innovations in emerging markets (Immelt et al., 2009; Zeschky, Widenmayer, & Gassmann, 2011a). For example, GE's Indian subsidiary has developed a portable, basic featured, handheld electrocardiogram targeted for emerging markets that is significantly cheaper than its Western equivalent – around 1,000 USD. Especially in rural areas the product was a success.

3.2.2. Reverse diffusion of emerging market innovation

Increasingly, emerging market innovations are subsequently also commercialized in developed countries – a phenomenon that has been referred to as 'reverse innovation' (Immelt et al., 2009) or 'innovation blowback' (Brown & Hagel, 2005). This starkly contrasts the conventional assumption that innovation is generated in developed countries and subsequently transferred to emerging countries. The term 'reverse' indicates the flow direction of the innovation at question, that is, where the innovation is developed and where it is ultimately commercialized (Brown & Hagel, 2005; Immelt et al., 2009). The 'reverse' reflects that the flow of innovation is reversed from the traditional West-to-East to an East-to-West direction (Frost et al., 2002). The West-to-

East flow of innovation has long been the dominant strategy of Western MNCs to further exploit products that have passed the zenith of their life cycle in developed markets (Vernon, 1966). Today, however, emerging countries are no longer only recipients of innovation but they are increasingly able to develop innovations on their own.

Consumers in Western markets are also becoming more value oriented, especially in the wake of the recent economic crisis. During the recession, the U.S. suffered from stagnating incomes and personal consumption expenditure dropped by more than 3 % during the recession (Lee et al., 2010); Western consumers have begun to look for simpler offerings that offer the greatest value (Flatters & Willmott, 2009). Based on empirical data between 1994 and 2005, Broda and Romalis (2008) found that low-income consumers in the U.S. are able to purchase a wider range of goods than economically predicted as they increasingly rely on low-cost products from China. Thus, emerging market innovation also appeals to price-sensitive customers in developed markets who are attracted by the lower costs compared to established products and who only need the product's basic functionalities (Brown & Hagel, 2005; Williamson, 2010). For example, after Haier's success of the Mini Magic Child in China, a similar product based on the same technology has now been marketed to developed countries and Western consumers value the low price point of the product (Hang, Chen, & Subramian, 2010). An Indian example includes Tata's Nano, a car that comes without conveniences and safety features such as power steering, air conditioning, antilock braking, airbags, or a passenger-side mirror. With the Nano selling for just 2,200 USD approximately, Tata is unable to meet the demand for it in India. The Nano is scheduled for sale in Europe in 2012 when Tata has conformed to the minimum safety requirements stipulated by law.

From a market perspective, reverse innovation is associated with emerging market innovations that are taken global over time. Some authors have highlighted the disruptiveness of reverse innovation and its effects on future business models especially in Western markets (e.g., Brown & Hagel, 2005; Immelt et al., 2009). For example, GE's low-cost, portable electrocardiogram was also successfully commercialized in the U.S. For the first time the product offered small resource-constrained clinics and rural doctors the opportunity to buy an electrocardiogram. Thereby, it targeted a latent market that was not previously served.

Based on these notions, reverse innovation is conceptualized as an emerging market innovation that is developed in an emerging country and taken to the markets of developed countries. This concept emphasizes the physical dimension of reverse innovation, notwithstanding the broader implications that reverse innovation may have on future competition between MNCs from developed and emerging countries and the design of future business models.

3.3. Challenges for Western MNCs

As outlined, emerging market innovations follow a different rationale than the prevailing Western concept of innovation. Emerging market innovations focus on the different demands of customers based in emerging markets compared to the demands of customers in developed markets (Hart & Christensen, 2002; Williamson, 2010). While products for developed markets typically entail state-of-the-art technology and features, emerging market innovation can be mostly characterized by a simple design, the incorporation of only basic functionalities, and the use of established technologies (Economist, 2010). Due to this, and to be able to address the resource-constrained needs of the emerging middle class, emerging market products come at a fraction of the cost of advanced products for developed countries.

The increasing global commercialization of emerging market innovation from Eastern MNCs challenges Western MNCs not only in emerging markets but also in their home markets. This has significant implications for the business models of Western MNCs.

3.3.1. Chinese MNCs on the raise

Research by Baghai, Smit, and Viguerie (2008) found that MNCs headquartered in emerging markets grew approximately twice as fast as those domiciled in developed countries. In emerging countries where none of the companies is headquartered, emerging market MNCs grew up to two and a half times as fast as their Western counterparts did. This effect was observed across industries (Dora, Smit, & Viguerie, 2011)

In contrast to many Western MNCs that rely on brand recognition and high margins, emerging market MNCs target the needs of the fast-growing emerging middle class (Atsmon, Kloss, & Smit, 2012). Some emerging market MNCs aligned their entire business model to provide low-cost products to new emerging resource-constrained consumers. This alignment of the business model also includes R&D that exclusively focuses on low-cost innovations. Part of this strategy is that emerging market companies concentrate more on exploiting existing technologies than investing in costly research for new technologies. This can be observed by patent filing data. The number of patents filed by emerging market MNCs is generally significantly lower than developed market MNCs (Atsmon et al., 2012).

Emerging market MNCs strongly profit from low-cost structures in their home market. This includes low labor costs and the possibility to directly source from other local companies. Thus, emerging MNCs are able to offer products that are 10 % to 60 % cheaper than the Western equivalents (Atsmon et al., 2012).

Despite the cost advantage, innovative ideas and products are increasingly being developed by local companies in emerging countries and marketed worldwide. Especially, Chinese corporations have flourished by developing emerging market innovations. In the case of Galanz's low-cost, energy-efficient microwave, the Chinese company has managed to develop what had been a minor market – initially only 2 % of households could afford a microwave – into a mass market, more than 60 % of which it now controls, making the company one of the largest microwave manufacturers in the world today (Ge & Ding, 2008; Hart & Christensen, 2002).

The previous examples of Haier, Galanz, and Tata illustrate the typical course of innovations from emerging market companies, which are often initially developed to meet the needs of resource-constrained consumers in emerging markets. These products are increasingly finding their way to markets in developed countries. Many of the emerging market companies established growth oriented business models that target the middle class and benefit from economies of scale.

Using these scale effects some emerging market MNCs have even recently started to not only engage in emerging market innovation but also aspire for innovation leadership in high-end applications for affluent customers in developed and emerging countries. The Chinese network and telecommunication supplier Huawei is among the world's top five companies in terms of international patents filed from 2008 to 2010. The company's R&D personnel amount to approximately 51,000 R&D in 2010 that represents 46 % of its total headcount. The R&D employees reside in 20 research sites located in Germany, India, Russia, Sweden, and the U.S. (Atsmon et al., 2012).

3.3.2. Western business models neglect resource-constrained customers

The business models of Western MNCs are typically designed based on two of the generic strategies for competing in a given industry, i.e., differentiation and focus (Porter, 1985). In the case of differentiation, innovative firms usually pursue the introduction of the latest high-end technology targeted at the most demanding users and

early adopters (Williamson, 2010). The target customer is typically able to pay a price premium. Consequently, the firm focuses on this specific high-end segment and it only gradually transfers the underlying technologies to mainstream products. This approach exploits the maximum value throughout the product's life cycle, thereby enhancing the return on R&D investment (Vernon, 1966). Similarly, differentiation is based on increased variety that allows the firm to charge a price premium for the time lost in the development process to develop the variants. In the case of focus, the firm is able to charge a premium for focusing on a niche market with specialized products, which per definition do not yield large economies of scale.

Thus, the business models of Western MNCs are typically designed for the average Western customer who has a much higher average purchasing power than customers in emerging countries (Hang et al., 2010; Matthyssens et al., 2006; Williamson, 2010). To address emerging markets, Western MNCs transferred their existing business. This approach entails that the majority of the customers in emerging countries are the few at the top of the economic pyramid with an average Western living standard who are able to afford Western products and technologies (London & Hart, 2004). However, while the transfer of the Western business model has worked well in the past, it is increasingly jeopardized for two reasons.

First, Western MNCs neglect the purchasing power and needs of resource-constrained customers in China's new emerging middle class whose incomes are increasing (Gadiesh et al., 2007; Hang et al., 2010; Williamson & Zeng, 2009). Although still lacking excess income, they are demanding low-cost products that cater to their basic needs. Thus, people in emerging countries now become consumers as opposed to non-consumers (Hart & Christensen, 2002), representing a huge market and business opportunity. As the business model of many Western MNCs target the higher-margin segments, which are relatively smaller, they do not profit from the large overall growth rates in the middle and low-end segment.

Second, emerging market innovations are increasingly coming to the markets of developed countries. This trend is driven by emerging country MNCs that addressed the needs of their home market and started to export their products. These innovations increasingly find customers in developed markets. Consumers in Western markets are becoming more value oriented. They are not willing to pay a premium for functions they do not need. Especially in the wake of the recent economic crisis, Western

consumers started to look for simpler offerings with the greatest value (Flatters & Willmott, 2009).

Taken together, these two reasons call the established business models of Western MNCs into question as they are not designed to compete with the aggressive price-performance characteristics of emerging market innovations (Hang et al., 2010). Western MNCs are therefore challenged to adapt existing business models to compete with the low-cost competition coming from emerging countries as high-priced products are increasingly being jeopardized.

The fundamental differences of emerging market compared to high-end innovation have a bearing on the organization and product development of emerging market innovations. A core challenge for Western MNCs is to adapt their existing business models from merely focusing on high-end innovations to low-end innovations for emerging markets (London & Hart, 2004; Prahalad, 2010).

3.3.3. Rigid R&D structures of Western MNCs

Like the business models that shape them, the existing R&D organization of Western MNCs is often optimized for the development of advanced products and technologies targeted at high-end consumers. Because of the focus on affluent customers and the weak institutional structures to protect intellectual property in emerging markets (Ray & Ray, 2010), Western MNCs' efforts to build local innovation capabilities have been reluctant. From an organizational perspective, research and development of Western MNCs is predominantly organized in a global-for-local structure where advanced products and technologies developed in the Western headquarters are adapted by local development units to meet local market requirements (Ghoshal & Bartlett, 1988a). Often still, the role of emerging market R&D units in the international R&D network is to adapt centrally developed products to local needs, thereby exploiting existing competences and avoiding the costs of new product development (Gassmann & von Zedtwitz, 1998; Pearce, 1999).

To enable the development of emerging markets innovations implies changes in the Western MNCs' R&D strategy and requires that existing R&D structures are adapted. Furthermore, the adaptation of the R&D structure also modifies the interaction between the R&D headquarters and the local R&D unit as more competences are shifted to the

local unit in the emerging country (von Zedtwitz & Gassmann, 2002; von Zedtwitz et al., 2004). In addition, the management of international R&D projects is not trivial and imposes severe challenges due to the physical distance between the R&D subsidiary and the headquarters (von Zedtwitz & Gassmann, 2002).

However, extant management literature merely provides prescriptive recommendations about the structures that Western MNCs should implement to enable reverse innovation and to compete successfully with emerging market MNCs. There is a lack of empirical evidence for an effective organization.

3.4. Summary and managerial shortcomings

Typically, the business models of Western companies operating in emerging countries have not considered the resource-constrained consumer, but rather have focused on the affluent few at the top of the population pyramid who possess the buying power to afford Western products (Arnold & Quelch, 1998; Prahalad & Lieberthal, 1998). However, this strategy of earning high margins on a few affluent consumers is increasingly in question for two reasons. *On the one hand,* emerging market innovations will also attract, over time, affluent consumers who may decide to go for less expensive products that still meet their needs. *On the other hand,* the growing middle class especially in emerging counties is a large and still expanding market that offers great business potential. If Western MNCs continue to ignore the growing middle class in emerging markets, they run the risk of losing market share to the rising competition, both in the emerging markets and in their home markets. These trends will force Western MNCs to adapt, which might fundamentally alter the way products are developed and markets addressed.

Overall, current literature merely provides anecdotal cases that described challenges related to emerging country innovation and its reverse diffusion. Managerial concepts that offer guidance in the management of reverse innovation are fragmented. Clear definitions that characterize reverse innovation are missing in the same way that managerial guidelines are lacking insights of how reverse innovation can be achieved. In particular, organizational challenge caused by the reverse diffusion of innovation marks an uncharted territory in current managerial literature. These challenges refer to R&D structure in particular but also to the corporate structure in general.

The literature on emerging market and reverse innovation is missing linkages to current theory and is thus described as a practical phenomenon.

4. Theoretical relevance: firm internationalization and the MNC

Reverse innovation represents a new practical phenomenon that challenges the business models of Western MNCs. Due to the strong local competition in emerging countries; Western MNCs are required to engage in emerging market innovation, as it is a vital precondition for the firms' long-term competitiveness. However, the phenomenon of reverse innovation questions current dominating theories on innovation diffusion. Reverse innovation breaks with the underlying assumption that innovations are generated in developed countries – predominantly located in the West – and diffuse to emerging countries – predominantly located in the East. This assumption has influenced the theory of the multinational corporation and its subsequent management principles. Especially in the field of R&D management, current practices and management approaches seem to fall short of addressing reverse innovation. The question arises how current theory and literature has to be expanded.

The present chapter directly refers to the limitations of current theory and research outlined in chapter 1.1.2. It provides a rigorous demonstration of the presented limitations. Therefore, current literature is revisited in order to give detailed reasoning of how current limitations and underlying theoretical assumptions are deviated. The summary section after each chapter reiterates the limitations.

Overview: Adopting an economic perspective, chapter 4.1 provides an overview of the most influencing theories of innovation diffusion. Special focus is on the theories of product life cycle, FDI, and lead markets. These theories are illustrated in detail. All named theories have their origins in the theories of firm internationalization and international trade. Thus, also an overview of the last named is given. Based on the theory review, underlying theoretical assumptions are derived. Adopting a company perspective, chapter 4.2 illustrates the theory of the multinational corporation and its implications on innovation management. Chapter 4.3 and 4.4 reviews the literature on R&D management and new product development. In chapter 4.5 an initial reference framework is developed.

4.1. Theories of firm internationalization and innovation diffusion

In economics, internationalization is seen as a process of increasing involvement in international operations (Welch & Luostarinen, 1988). Early 'classic' theories of internationalization focus on country specific differences in factor endowments and their effects on international trade. In his seminal work *Wealth of Nations*, Adam Smith established in 1776 the theory of absolute cost advantage (Smith, 1977). He argues that a country specializes in the production and export of goods in which it could achieve lower production costs than its trading partner. At the same time, it imports goods in which it has an absolute cost disadvantage. In this way, specialization in the production of goods with lower costs and the export of the production surplus is beneficial for both countries. In 1817, David Ricardo extended Smith's theory in the way that specialization is still beneficial if one country does not possess an absolute but rather a comparative cost advantage. In the middle of the 20th century, Eli Heckscher and Bertil Ohlin developed Ricardo's theory further by predicting patterns of commerce and production on the basis of the production factors of a country (Case & Fair, 1998; Ohlin, 1933). The Heckscher-Ohlin theorem proposes that countries will export products that make use of their abundant and cheap factors of production and import products that will require the countries' scarce factors. The increased internationalization based on technological advancement in the 1950s and 1960s increased the demand for new theoretical perspectives in internationalization. Vernon's theory on the international product life cycle explains internationalization as function of the maturity stage of a product innovation. International trade is based on a technology gap between countries. Technologically advanced countries export products to less advanced countries. Research by Beise (2004) shows that the sole analysis of technology gaps is insufficient in explaining the diffusion of innovation. Building on economic theory of consumer behavior (Deaton & Muellbauer, 1980), lead market theory provides more detailed reasoning for innovation flows between countries. Five country specific factors determine the diffusion of innovation from lead markets to lag markets: demand-, price-, export-, transfer-, and market structure-advantages.

The previous classic theories of internationalization are based on the positive impact of free trade. In his new theory of international trade, Krugman (1979, 1991) criticized the existing theories. He argued that it could be beneficial for countries to use protectionist measures to sustain local infantile industries for a given period until they are able to claim an international leadership position. A good exemplification is the case of Samsung where the South Korean state sustained the company to penetrate international

markets enabling later global leadership (Dima, 2010). In his seminal book *The Competitive Advantage of Nations*, Porter (1990) describes, based on his diamond model, why specific competitive structures arise in certain industries and countries. The diamond model consists of four plus two factors that determine an industry structure: factor conditions, demand conditions, related and supporting industries, firm strategy, structure and rivalry, governmental regulations, and chance. All six factors are interdependent. Differences in the competitive advantage of nations are thus responsible for international trade.

While many theories of international trade are able to explain why companies go abroad, they are lacking detailed insight on why specific locations are chosen and why some firms prefer foreign production instead of licensing or exporting. The theories of foreign direct investments (FDI) target this deficit. According to Hymer (1970, 1976), the search for imperfect markets determines the internationalization of firms. In imperfect markets – which are rooted in exclusive and permanent control of property rights on technology, access to resources, economies of scale, distribution system and product differentiation – companies are able to generate higher profit. As competition increases, profit decreases. Moving abroad enables a company to execute its advantages over competitors in foreign markets. Many theories of international production argue that not only differences in factors endowments between the home and the foreign country but also governmental regulations determine the initial investment decision. Location theory is based on the assumption that a firm chooses the location that maximizes its profits and that consumers choose the location that maximizes their utility. Thus, numerous factors – like salary levels, market potential, employment regulations, taxation, environmental regulations, local infrastructural facilities and human resources – explain why and how companies move to foreign locations (Dima, 2010; Weber, 1929). Demand structure theory argues that companies are more likely to invest in countries with similar demand structures to the home country than in countries with entirely different demand structures (Hicks, 1939). This theory offers explanation to the extensive FDIs after World War II, especially of U.S. firms in other developed markets in Europe. Published by Coase in 1937 – and further developed by McManus (1972), Buckley and Casson (1976), Brown (1976), and Hennart (1977) – transaction cost theory argues that firms seek for an optimum between market sourcing and in-house production to minimize transaction costs. Coase differentiates between internal and external transaction costs. Despite external transaction cost – exchange with other market actors – that cannot be controlled by the firm, internal transaction cost can be

influenced and optimized. The internationalization of companies leads to MNCs that can minimize transaction cost within the internal network. Thus, they are able to generate profits, as they are more efficient than the market. Dunning's eclectic theory developed in the 1980s presents an extensive approach to internationalization and FDI (Dunning, 1977, 1981). Motivations and direction of FDIs are explained by the structure of the company, the location advantage (access to raw materials, wages, country regulations), the ownership advantage (trademark, production capabilities, managerial capabilities), and international environment (advantages through partnership and alliances). Resource allocation and company structure are interdependent and influence each other.

Despite its high explanatory power on a macro level, FDI theories fall short in explaining different path of internationalization and international performance of firms. New theories were required that include firm specific characteristics and evolutionary approaches towards internationalization. Firm internationalization theories focus on the process of internationalization and firm specific behavior based on its characteristics. Developed by a group of Swedish researchers, the Uppsala model proposes that based on the degree of a firm's knowledge on a specific country an appropriate way of internationalization is chosen (Johanson & Vahlne, 1977, 2009). As the knowledge base increases, initial investment costs are compensated and the involvement in the country increases accordingly. Thus, firms start to internationalize in countries that are similar to the home country as the firm has more knowledge than of culturally distant countries. As firms encounter high uncertainty when moving to a foreign country, they choose a form of internationalization that involves low initial investment costs. Starting from exports conducted by contractors, the firm subsequently opens up its own production site as the knowledge of the country improves. Thus, Johanson and Vahlne argue that internationalization of firms follows a sequential process. Nevertheless, there are three exceptions to sequential internationalization. *First,* large firms can make initial investments due to strategic decisions. *Second,* firms can gain knowledge of countries other than through firsthand experience, e.g. through acquisition of a local firm. *Third,* firms can extrapolate knowledge from one country to another that changes the subsequent pattern of internationalization. The Uppsala model set the basis for numerous stage models of internationalization (Bilkey & Tesar, 1977; Cavusgil, 1980; Czinkota, 1982; Rao & Naidu, 1992). All of these models describe the internationalization of firms as a sequential evolution through certain stages. These models were subject to strong criticism (Andersen, 1993). For example, Kogut and

Zander, (1993) argue that the internationalization of firms does not necessarily follow a sequential evolution but depends on the characteristics of the transferred knowledge and the transfer and combinative capabilities of the firm.

The economic perspectives on the internationalizations of countries and regions formed the basis for many theories of firm internationalization in the 20th century. Scholars analyzed and predicted the internationalization of companies based on technology gaps and product innovation, market imperfections, transaction costs, location advantages, and market knowledge. Table 4 gives an overview of the discussed theories. Due to the high relevance and close connection to the phenomenon under research, three theoretical approaches are reviewed in more detail: international product life cycle and innovations diffusion, foreign direct investment, and lead market. These theories share that they look at technology and innovation diffusion as the main source of internationalization. In the next section, extant literature on these theories is reviewed. Based on the review, implicit assumptions that underlie existing theories are derived.

Table 4: Theories on international trade, investment and innovation diffusion

Theory	*Overview*	*Source*
International trade theories – economic theories		
Absolute advantage theory	Countries specialize in the production of goods for which they hold an absolute cost advantage.	Smith, 1977
Comparative advantage theory	Countries specialize in the production of goods for which they hold a comparative cost advantage.	Ricardo, 1817
Factor proportion theory (Heckscher–Ohlin theorem)	Countries specialize in the production of goods that intensively use the most abundant production factors.	Ohlin, 1933
International product life cycle theory	According to the maturity stage of a product innovation, the firm internationalizes its value chain activities, from export to production.	Vernon, 1966, 1979
New theory of international trade	Instead of free trade, countries utilize protectionist measures to develop a specific industry in order to make it more competitive on a global scale.	Krugman, 1979, 1991
Competitive advantage theory	The degree of competitive advantage of a country with respect to different industries depend on six factors: factor conditions, demand conditions, related and supporting industries, firm strategy, structure and rivalry, governmental regulations, and chance.	Porter, 1990
Lead market theory	Countries that first adopt an internally successful innovation can be described as lead markets. Five country-specific factors determine a lead market: demand-, price-, export-, transfer- and market structure-advantages.	Beise, 2004
Foreign direct investment theories & international production theories		
Market imperfections theory	Market imperfections are structural and come from the deviations from the perfect competition. They have their roots in exclusivist and permanent control on intellectual property, access to resources, scale economies, distribution system, and product differentiation.	Hymer, 1970, 1976
Demand structure theory	Investments direction shows a higher attraction to the countries with a similar demand structure to that in the country of origin.	Hicks, 1939
Location theory	Firms choose the location that maximizes their profits and consumers choose the location that maximizes their utility.	Weber, 1929
Transaction costs theory	The development of transnational companies allows the manipulation of the transactions within the firm to minimize cost.	Coase, 1937; McManus, 1972; Brown, 1976; Buckley & Casson, 1976; Hennart, 1977
Eclectic theory	FDIs and the location decision of firms are a function of firm's structure, location advantages, ownership advantages, and international environment advantages.	Dunning, 1977,1981
Internationalization theories of the firm – behavior theories		
Uppsala model	Firms move to foreign markets in a gradual way, in accordance to the level of knowledge and information they accumulate about the destination market.	Johanson & Vahlne, 1977, 2009
Internationalization theories of the firm – stage models	The internationalization process follows specific stages. Firms utilize innovation to respond to stagnation and challenges by the international environment.	Bilkey & Tesar, 1977; Cavusgil, 198; Czinkota, 1982; Rao & Naidu, 1992

adapted from Dima (2010) and Morgan & Katsikeas (1997)

4.1.1. International product life cycle

In 1962, Rogers introduced the theory of innovation diffusion that describes how, why, and at what speed new ideas and technologies spread among institutions and individuals. Rogers argued that five characteristics influence the adoption of innovation: (i) the relative advantage of the innovation over old solutions; (ii) the degree of compatibility to existing infrastructures; (iii) the degree of complexity; (iv) the triability of an innovation; and (v) observability and likelihood of communication. The market penetration and maturity of innovation follows an S-curve over time that is divided in five phases. Distinct characterized adopters portray each phase: innovators, early adopters, early majority, late majority, and laggards.

Building on the theory of innovation diffusion, Vernon (1966) argues in his theory of international product life cycle that product innovations enable firms to create temporary monopolies that they exploit first in their home markets and then in foreign markets. Product innovations are based on new technologies that disrupt existing markets and substitute present products. As the product matures, the firm faces increasing competition and is required to find new markets as well as cheaper production locations. Along the product life cycle, firms start to internationalize following a consistent pattern. The product life cycle starts with the innovation in the home market, located at technological advanced countries in the developed world. As the maturity increases, the product innovation is exported. Later, firms make foreign direct investments to establish sales subsidiaries abroad. Increasing competition from other firms requires reducing production cost. Thus, manufacturing follows the sales subsidiaries in emerging countries to benefit from lower wages and production costs. At the end of the life cycle, the home country imports the product innovations from low-wage countries. Due to its dynamic character, the theory is able to explain changes in company strategy according to changes of the company's surrounding conditions.

At the core, Vernon's theory is based on the assumption that innovation flows from developed to emerging markets. This assumption is based on two factors. *First,* the existence of innovation and technological advantages leads to technology gaps between developed countries – the U.S. and Western Europe – and emerging countries (Posner, 1961). *Second,* the gap in per capita income between developed and emerging countries induces that innovations are first advanced in developed countries due to the higher purchasing power (Vernon, 1971). These gaps lead to international trade and investments. Vernon's theory has influenced scientific literature and theory for many

decades. Despite that the technology gap between developed countries and emerging countries was decreasing in the late 1970s, the theory of international product life cycle proved to be still applicable (Vernon, 1979).

4.1.2. Foreign direct investments and eclectic theory

The era after World War II has seen a tremendous growth in foreign direct investments (FDI) especially by manufacturing firms from the U.S. and U.K. (Ietto-Gillies, 2003). The increase in FDI could no longer be explained by the need to gain access to raw materials that were unavailable in the home country. Indeed, the majority of FDIs were directed to other developed countries scarce on raw materials. In his early studies, Dunning (1958) analyzed investments of U.S. companies in the U.K. and compared the performance of the foreign and indigenous firms and the impact of FDIs on the host country. In the 1980s, he proposed the eclectic theory and the related OLI model (ownership, location, and internationalization). The theory gives reason to why firms pursue FDIs and how these are interrelated to resource allocation and firm structure. The theory connects country perspective – advantages of countries – and firm perspective. Thus, it is able to predict why specific firms invest in certain countries (Dunning, 1993). Based on the transfer of firm-specific advantages – like technology, brand, and capabilities – the firm is able to generate profits in foreign markets and may achieve lower production costs. Once present at an international level, additional costs emerge due to coordination and communication, lack of market knowledge, and differences in country regulations. These costs are outweighed by temporary monopolies, which are created based on intellectual property, access to scarce resources, superior financial resources, economies of scale, or technology. Especially innovations are a core driver for internationalization. Through product innovation, firm-specific advantages can be easily transferred to foreign markets.

In his 1999 study, Kuemmerle investigates the drivers of FDI into R&D and offers a dichotomous set of motives. *First,* through home-base-exploiting companies leverage their firm specific advantages towards foreign markets. FDI in R&D are motivated to adapt innovations to local preferences and needs. *Second,* through home-base-augmenting firms try to strengthen their technological base in their home country to enable innovation. FDI in R&D are targeted to benefit from spillovers from existing local R&D institutions. Such institutions include universities and other innovative firms. Based on an emerging market research setting, Isobe, Makino, and Montgomery,

(2000) analyzed FDI strategies of Japanese international joint venture in China. They find that a high commitment to technology transfer and an early entry have a positive impact on the performance of the joint ventures.

4.1.3. Lead market theory

The theories of innovation diffusion and international product life cycle argue that country differences based on a technological and per capita income gap determine why innovations flow from one country to another. The pure focus on these factors proved to fall short in explaining the diffusion of many technological innovations at the end of the 20th century. Lead markets theory proposes that several country specific attributes explain why an innovation is first adopted by a local market and becomes globally dominant and squeezes out other locally preferred designs (Beise, 2001, 2004). Lead markets are defined as geographical markets that first induce a global innovations by local demand preferences and local environmental conditions (Bartlett & Ghoshal, 1990; Beise, 2004; Kalish et al., 1995). Typically, lead markets contain technologically leading companies and highly innovative customers who are open to new products, willing to take risk, and adopt early (Albach, 1993). Consumers in lead markets anticipate opportunities of innovation faster than consumers in lag markets and therefore lead a trend (Tiwari & Herstatt, 2011; von Hippel, 1986). Five country specific factors can explain why certain markets act as lead markets (Beise, 2004): (i) cost advantage. A lower price of a product innovation in the lead market makes it more attractive for users in the lag market to adopt the innovation. This can be due to two reasons. *First,* the product innovation was initially cheaper than the preferred product innovation in the lag market. *Second,* the cost for the product innovation decreased more compared to the design preferred in the lag market. A relative price decrease can be based on economies of scale or lower input costs; (ii) demand advantage. A higher per capita income marks a country-specific advantage, as consumers are able to adopt innovations earlier and lead a trend (Vernon, 1971). Additionally, the *a priori* existence of complementary products can be a catalyst for the adoption of an innovation; (iii) transfer advantage. A relatively high perceived reputation and sophistication of users in one country can influence preferences in other countries (Kalish et al., 1995). This transfer effect is supported by groups that travel from one country to the other (e.g., businessmen, tourists). Additionally, the adoption of innovations, which proved successful in one country, reduces uncertainty and risk for the following country (‘demonstration effect’). Especially for high-technology products, network externalities

mark a strong benefit, which will make users in a lag market adopt the innovation (Varian, 2001); (v) export advantage. Lead markets may have an export advantage, as local market conditions may be similar to those in foreign markets, as domestic demand may be sensitive to needs of foreign markets, and as local stakeholders may influence companies to develop exportable products.

As an eclectic theory, lead market theory builds on and includes several other theories, such as Porter's diamond model, Vernon's international product life cycle, or economic theory of consumer behavior. Thus, lead market theory is able to offer a more detailed explanation for international innovation diffusion. Nevertheless, lead market theory adopted several implicit assumptions and limitations of the existing theories. Lead market theory is also based on the assumption that innovations diffuse from developed to emerging markets.

4.1.4. Summary: underlying theoretical assumptions and limitations

The internalization theories provide detailed explanation on the transformation of domestic, developed market firms into MNCs in the post war era. The theories assume that most MNCs follow a strongly centralized and hierarchical structure. The headquarters in the home country makes decisions on internationalization that are driven by the goal to transfer firm specific advantages generated in the home country to foreign markets. According to Rugman and Verbeke (2001), these theories suffer from five limitations. *First,* they assume that firm specific advantages can be easily transferred from one country to the other without regarding any transfer problems. *Second,* the theories lack a dynamic component, which sees the firm as a learning organization. *Third,* it is neglected that local subsidiary initiatives may contribute to the firm's specific advantages. *Fourth,* the role and importance of individuals in forming initiatives and creating firm specific advantages is not considered. *Fifth,* most theories overemphasize cost optimization and the protection of the competitive advantages and neglect capability creation in the course of internationalization.

On a macroeconomic level, research on international trade, international investments, and innovation diffusion in the 20th century is underlying a dual taxonomy that differentiated the economic world in developed countries prevailingly located in the West and emerging countries (Vernon, 1966). The Western countries, especially the

U.S., are taking a leading role in internationalizing value chain activities that comprised sales, manufacturing, sourcing, and R&D.

The West-to-East taxonomy is based on two factors: (i) the technology gap and (ii) the per capita income gap between developed and emerging countries. Western countries are technologically more advanced than emerging countries. Additionally, consumers in developed countries have a higher per capita income, which makes it more attractive for Western firms to sell their products to local markets. Beise's (2001, 2004) lead market theory provides a more refined explanation why innovations are first adopted by one country and later diffuse towards other countries. Nevertheless, lead market theory provides only limited explanation for the global diffusion of emerging market innovations. In all of the analyzed cases, only Western countries were identified as lead markets.

The theoretical perspective adopted affirms a paradigm that innovations in MNC are driven by the parent organization located in the West and later distributed to emerging countries following the international product life cycle (Vernon, 1966). While the source of competitive advantage is located at the headquarters in the West, it becomes leveraged to a globally dispersed network of subsidiaries through technology transfer (Dunning, 1981; Vernon, 1966). MNCs use FDIs either to explore new technologies or to exploit existing competences on a global scale (Kuemmerle, 1999). Research on FDI in emerging markets highlights the importance of technology transfer from developed countries to emerging countries (Isobe et al., 2000)

The theories on international trade, international investments, and innovation diffusion generally assume that innovations are based on new technologies. This assumption neglects the fact that even disruptive innovation are not necessarily based on new technology but new demand patterns and value propositions.

In addition, existing theories are based on the assumption of insular markets. Firms are able to introduce an innovation only in one local market without making it available for global consumers. Increasing globalization and free trade puts this assumption into question. Local innovations become globally available beyond the control of the firm.

4.2. Management of the MNC

Following the post war trend of internationalization, Western companies started in the 1950s and 1960s to build up local sales offices worldwide to distribute products that were produced and innovated in their home market. To maximize efficiency, Western companies began to source globally and to move parts of the value chain to low-cost countries (Farrell, 2005). Manufacturing and back office activities were soon off shored and entire national subsidiaries were built up (Reddy, 1997). Formerly national companies expanded their business operation beyond national borders and transformed towards multinational corporations. The evolution from national to multinational corporations became the subject of research for many scholars.

Many theories of internationalization – like Vernon's (1966) product life cycle – argue that firm internationalization is primarily driven by the firm's motivation to leverage its proprietary home country advantages to foreign markets. This view was enhanced by many scholars analyzing the multinational corporation as a knowledge creating network of dispersed entities (Bartlett & Ghoshal, 1989; Dunning, 1998; Kogut & Zander, 1993; Nobel & Birkinshaw, 1998). Nevertheless, they outline that subsidiaries can also be a source of competitive advantages of an MNC by accessing locally available knowledge and resources and transferring it within the MNCs. As Doz and Santos (1997, p. 4) state, *"leveraging internationally the know-how advantages derived from a home country competence cluster is no longer sufficient to underpin competitive advantage unless the home base remains the only crucible of new technologies, competencies and leading customers."* In his seminal work on the 'geocentric firm' Perlmutter (1969) highlights the importance of knowledge transfer.

Since the early 1980s, the management of MNC has become an established research field in international management and strategic management. The following literature review identifies four research streams relevant to the analyzed phenomenon of MNC innovation in emerging markets: (i) strategy and structure of the MNC; (ii) MNC subsidiary management; (iii) subsidiary initiatives and evolution within the MNC; and (iv) knowledge flows and knowledge creation within the MNC.

Despite that, all research streams are highly interdependent; each research stream is analyzed separately. The summary chapter (4.2.5) provides an integrated picture and reveals prevalent assumptions in current literature.

4.2.1. MNC strategy and structure

The strategy and structure of MNC has become an important research field in strategic management and has attracted the interest of numerous scholars (Birkinshaw & Hood, 1998). The structure of an MNC can be characterized as the formal system that defines tasks and managerial authority and that guides its members on how they collaborate and use resources with the aim to achieve the corporate goals (Barnard, 1938; Jones & Bouncken, 2008). Generally, two generic organizational structures can be differentiated within MNCs (Rugman & Collinson, 2006): (i) one dimensional; (ii) two or more dimensional structures. Within the one-dimensional structure, MNCs are typically organized according to function, geographic region, or product. A global product structure embraces all worldwide activities for one product or product segment under one organization unit. A geographical region structure combines all value chain activities for all products according to one region. A global function structure concentrates all activities for one value chain function under one unit. Each one-dimensional structure can be managed through cost-, profit-, or investment- centers. The latter accounts also for investments in addition to its profit structure. The two- or more dimensional structures represent a matrix that may consist of value chain functions, geographic regions, and product categories.

Hierarchy vs. heterarchy

Up to the middle of the 20th century, organizational theorists assumed a hierarchical model of the firm (Hedlund, 1993; Simon, 1962). The headquarters is responsible for strategic decisions and monitors the different divisions (Chandler, 1962). Based on the works of Chandler (1962) and Williamson (1975), Birkinshaw and Morrison (1995, p. 736) derived three assumption on hierarchical firms: *"(i) coordination costs are economized by grouping tasks according to the geographic or product markets on which they are focused; (ii) critical resources (including management expertise) are held at the centre to ensure the most efficient use of scarce resources; and (iii) the development of an appropriate system to monitor and control divisional managers ensures that the likelihood of opportunistic behaviour on their part is minimized"*.

In the 1980s it became obvious that the hierarchical model of the firm could not adequately explain the complexity of the MNC (Hedlund, 1986, 1993). This was mainly rooted in the fact that top management located at the headquarters was not able to fully understand the complexity of the subsidiary with its internal and external network and execute adequate control measures (Doz & Prahalad, 1981). A new model of the firm

was proposed, the heterarchy (Hedlund, 1986, 1993). It differs from the hierarchical model in three distinct ways (Birkinshaw & Morrison, 1995): (i) core resource and capabilities and top management is dispersed throughout the MNC. Control is executed in a more normative rather than numeric manner; (ii) there is a horizontal exchange between subsidiaries (in contrast, in the hierarchical model this is avoided to increase efficiency); (iii) activities are coordinated in more than one dimension, e.g. across products, functions, and geographic regions. In the hierarchical model, this is also avoided to increase efficiency.

The transnational corporation

Based on the principle of the heterarchical model – informal exchange, lateral knowledge flow and decision-making, normative integration – Bartlett and Ghoshal (1989) offered in their seminal book *Managing Across Borders: The Transnational Solution* a new categorization of globally acting companies. Based on inductive case study research, four types of corporations were identified that differed according to structure and strategic competences: (i) 'multinational corporation'[6]. The corporation consists of loosely connected national subsidiaries that take responsibility for local operations and sales. Thus, the multinational corporation can achieve high responsiveness to local needs. (ii) 'global corporation'. The corporation is strongly centralized. Subsidiaries take care of the global distribution of the centrally developed products. The global corporation is focused on increasing efficiency; (iii) 'the international corporation'. Depending on business strategy, some business areas are strongly centralized while others are decentralized. The international corporation focuses on knowledge transfer between local entities; and (iv) 'transnational corporation'. This model represents the ideal-type. As a means to cope with global competition, the transnational corporation achieves a high local responsiveness while being efficient and facilitating knowledge transfer.

The transnational structure of MNCs combines elements of the functional, geographical, and product related structures into one network of globally dispersed subunits. By applying the transnational structures, the MNC is able to exploit economies of scale while being highly responsive to local customer needs. The MNC network consists of dispersed subunits that specialize in one or more activities, like

[6] In this context, the term 'multinational corporation' directly relates to the definition of Bartlett and Ghoshal (1989) and not to the definition outlined in chapter 1.3.4. Unless otherwise stated, the term 'multinational corporation' relates to the definition in 1.3.4.

cheap production, research, marketing, provision of technological or market knowledge, and develop distinct competences. The linkages and exchange between the subunits is characterized by an interdependent relationship. Information and technology, as well as the decision-making process, are shared across all subunits. Thus, a clear organizational classification in a matrix or a divisional structure is no longer possible. All units are connected via their specialized competences. The advantage of the transnational structure is that subunits move from being a subordinated entity to a node in the network, which is linked to internal and external actors and enjoys a greater degree of freedom (Birkinshaw & Pedersen, 2009). The headquarters is essentially another subunit that coordinates the network and its peripheral units (Rugman & Collinson, 2006). The transnational corporation is seen as a knowledge creating entity whose competitive advantage does not solely reside at its headquarters but is based on the ability to create and absorb knowledge on a global basis. Based on the works of Bartlett and Ghoshal other classification and organizational models of MNCs emerged (e.g., Hedlund's (1994) 'N-form corporation').

4.2.2. MNC subsidiary management

The evolution towards a progressively globally dispersed value chain has had major implications on the management of MNC subsidiaries. In the 1960s and 1970s, subsidiaries were characterized as subordinated national companies that controlled the entire local value chain. The headquarters-subsidiaries relationship was extensively analyzed by Kim and Mauborgne (1991, 1993a, 1993b) on the basis of strategic planning processes. Whereas a number of studies looked at the perception gap between headquarters and subsidiary managers and its consequences (Avridsson, 1999; Birkinshaw, Holm, Thilenius, & Arvidsson, 2000; Holm & Johanson, 1995). These studies assume a dyadic headquarters-subsidiary relationship.

As a result of the increasing diversification of international activities in recent years, large national subsidiaries of MNCs with clear assigned tasks controlling major parts of the value chain no longer exist. Instead, there is a series of global dispersed value-adding activities (Birkinshaw & Pedersen, 2009) each of which holds specialized roles in a global network (Bartlett & Ghoshal, 1986; Birkinshaw & Morrison, 1995; Jarillo & Martínez, 1990; Taggart, 1997). Kutscher and Schmid (2006) define foreign subsidiaries as a heterogeneous group of units, which are in charge of different tasks that can differ considerably in terms of value adding activities. Thus, some subsidiaries

are pure sales offices that are responsible for the local distribution of locally or globally developed products. Other subsidiaries include production, product development, marketing and sales that allow them to be highly responsive to local market needs.

Strategic roles and mandates of MNC subsidiaries

As the importance of foreign markets and foreign subsidiaries increased, scholars tried to characterize and define roles and tasks of MNC subsidiaries (Nobel & Birkinshaw, 1998). This led to a large number of typologies and classifications of MNC subsidiaries. One of the most prominent categorization is offered by Bartlett and Ghoshal (1986). The roles of subsidiaries are classified according to a matrix with the axes 'strategic importance of local environment' and 'competence of subsidiary'. The first axis refers to the strategic importance of the local market for the entire company. The second axis describes the level of competence along the value chain activities (development, operations, sales) residing at the subsidiary. Four types of subsidiaries are defined: (i) 'strategic leader'. The subsidiary operates in a future growth market with high strategic importance for the company. It plays a crucial role for the long-term profit of the MNC and thus receives high attention from top management. To address the local market, the subsidiary has developed unique competences. It takes a leading role for certain products and technologies within the company network; (ii) 'black hole'. The subsidiary is responsible for a market, which is of high strategic importance, but it lacks necessary competences to address market needs. The black hole marks a challenge for the MNC as new competences need to be developed to transform the subsidiary into a strategic leader (Delany, 1998, 2000); (iii) 'contributor'. The subsidiary has achieved considerable competences on market and technological know-how. Nevertheless, it operates in a stagnating market that is not strategically important to the MNC. Thus, the subsidiary exploits its competences by exporting its products to markets of high strategic importance; (iv) 'implementer'. The subsidiary does not possess important competence and is active in a market with low importance to the MNC. The subsidiary relies on products and knowledge from the headquarters or other subsidiaries.

Subsequently, a number of studies emerged in scientific literature that explored subsidiary roles, charters, and mandates (Birkinshaw & Morrison, 1995; Jarillo & Martínez, 1990). Ghoshal and Nohria (1989) argue that the headquarters-subsidiary relationship depends on the assigned role of the subsidiary – depending on local resources and local environmental conditions – and can be characterized by centralization of authority, formality of rules and systems, and normative integration.

The subsidiary is still seen as an appendix of the headquarters. Building on Bartlett and Ghoshal's (1986) work, Gupta and Govindarajan (1991) introduced a model that differentiates various subsidiaries' roles according to inflows and outflows of knowledge inside the MNC network. Birkinshaw and Morrison (1995) analyzed the degree of lateral and hierarchical autonomy according to different subsidiary roles. They found that a subsidiary holding a 'global mandate' encounters a high strategic as well as horizontal autonomy.

Centers of excellence within MNCs

Within the research in subsidiary roles and mandates, the phenomenon of centers of excellence within an MNC has attracted researchers since the 1990s (Fratocchi & Holm, 1998; Frost et al., 2002; Holm & Pedersen, 2000; Surlemont, 1998). Despite the vast research interest, an agreed definition does not exist. There are at least two distinct strands of thought in scientific literature (Frost et al., 2002). *First,* some researchers describe centers of excellence as a whole subsidiary that holds a mandate for certain product lines and whose responsibility exceeds the local geographic market (Fratocchi & Holm, 1998; Holm & Pedersen, 2000; Jarillo & Martínez, 1990; Surlemont, 1998). This view has its roots in the research of subsidiary evolution and headquarters-subsidiary control and coordination (Bartlett & Ghoshal, 1986; Jarillo & Martínez, 1990). *Second,* other studies regard centers of excellences as a group of individuals that represent specific capabilities inside the firm. Thus, a center of excellent does not require a fixed physical location (Moore & Birkinshaw, 1998). The most prominent definition is offered by Frost, Birkinshaw, and Ensign (2002, p. 997) who define a center of excellence *"as an organizational unit that embodies a set of capabilities that have been explicitly recognized by the firm as an important source of value creation, with the intention that these capabilities be leveraged by and/or disseminated to other parts of the firm"*. Despite having a physical presence, a center of excellence does not necessarily represent an entire subsidiary. It holds one or more core capabilities that may be connected to one or more value chain activities. For a subsidiary to become a center of excellence, parent firm investment, linkages to the external network in the host country, and corporation within the internal network mark important factors (Frost et al., 2002).

4.2.3. Subsidiary initiatives and evolution within MNCs

In scientific literature subsidiary initiative is closely related to the field of entrepreneurship within MNC (Birkinshaw, 1997). Birkinshaw and Fry (2003, p. 745) define a subsidiary initiative as *"the proactive and deliberate pursuit of a new business opportunity by a subsidiary company, undertaken with a view to expand the subsidiary's scope of responsibility in a manner consistent with the strategic goal of the MNC."* By taking risk and pursuing a business opportunity, subsidiaries are seen as a source of innovation and as a contributor to the MNC's competitive advantage (Birkinshaw et al., 1998; Rugman & Verbeke, 2001). In recent years, intensive research was done on the determinants for successful initiative taking (Birkinshaw, 1999; Birkinshaw et al., 1998). A study by Birkinshaw (1999) revealed that entrepreneurship within MNC is positively related to a high level of distinct subsidiary capabilities and constrained by a high level of centralized decision-making, a low level of subsidiary credibility, and a low level of headquarters-subsidiary communication. Birkinshaw and Fry (2003) found that a high level of subsidiary autonomy and the exclusion of the headquarters in the initial phases are crucial for the success of the initiative. The personal involvement of the initiator and the subsidiary's general management and the late integration of the headquarters – after positive market tests – mark additional success factors.

Further research was undertaken on the evolution of subsidiary roles over time and its drivers (Birkinshaw & Hood, 1997, 1998; Chang & Rosenzweig, 1998; Delany, 1998; Peters, 1999). Many studies differentiate that the evolution of subsidiary roles can be driven from the inside (Birkinshaw, 1997), e.g. through subsidiary initiatives, and from the outside (Chang, 1995; Malnight, 1996), e.g. through headquarters' investments. Based on the three contextual factors – relating to parent company, subsidiary, and host country – Birkinshaw and Hood (1998) defined five generic subsidiary evolution processes. To take initiatives, subsidiaries need to be given a certain level of autonomy to be able to expand their own charter and develop required capabilities. Malnight (1995, 1996) exhibited how subsidiary roles evolve with the level of maturity of the MNC.

4.2.4. Knowledge flows and knowledge creation in MNCs

The access and leverage of internal and external knowledge represents a core source of competitive advantage for MNCs (Nohria & Ghoshal, 1997; Yang et al., 2008).

Superior capabilities in internal transfer and external knowledge acquisitions – rather than the internationalization of markets – are regarded as one of the most important drivers for the internationalization of firms (Kogut & Zander, 1993). Avridsson (1999) has done research on the capabilities of MNC subsidiaries and the information flow between them. Extensive research was conducted on how knowledge is created within MNCs (Almeida & Phene, 2004; Cantwell & Mudambi, 2005) and how technology and knowledge is transferred within the MNC network (Birkinshaw & Pedersen, 2009). Studies have explored the role of knowledge transfer as a source of firm-specific advantage and superior performance within the MNC (Gupta & Govindarajan, 2000). Effective knowledge management in MNCs relies more on heterarchical structures allowing horizontal and vertical flows of knowledge rather than hierarchical structures (Hedlund, 1994).

Knowledge flows in MNCs

In general, a subsidiary within an MNC can assimilate knowledge from or diffuse knowledge to nine sources (see figure 4). Within the MNCs network, there are three sources: (i) the subsidiary itself. The subsidiary can utilize own knowledge based on its resources; (ii) the MNC headquarters. Knowledge can flow hierarchically (vertically) from the MNC headquarters based in the home country to the subsidiary. In the other direction, there can be reverse knowledge flow from the subsidiary to the MNC headquarters; (iii) other MNC subsidiaries. Knowledge can flow on a lateral (horizontal) level between the subsidiary and other subsidiaries located in other countries. There are six sources located outside the MNC: (iv) other firms and institutions in the host country; (v) customers in the host country; (vi) firms and institutions in the home country; (vii) customers in the home country; (viii) firms and institutions of other countries; (ix) customers in other countries.

Knowledge flows within the MNCs have attracted many researchers since the Second World War. In the early literature, subsidiaries were considered as an appendage to the headquarters (Phene & Almeida, 2008). Thus, research on knowledge flows within MNCs focused on forward, vertical knowledge transfer from the headquarters to the subsidiary for many years (Doz & Santos, 1997; Vernon, 1966). In the 1990s, scholars increasingly analyzed lateral knowledge flows between peer subsidiaries with different strategic roles and between the headquarters and the subsidiaries (Gupta & Govindarajan, 1991, 1994, 2000). Gupta and Govindarajan (2000) found that the value of the subsidiary's knowledge stock and the richness of the transmission channel are

positively related to knowledge transfer. While the motivation to absorb knowledge has a positive impact on knowledge transfer, the motivation to transfer knowledge has no impact. In general, knowledge flows from more advanced to less advanced subsidiaries. A recent study by Monteiro, Arvidsson, and Birkinshaw (2008) analyzed the role of perception and self-perception of units with an MNC network as an important determinant for technology transfers. The study indicates that knowledge flows mainly from subsidiaries within the MNC network that are perceived as highly capable to units that perceive themselves as highly capable. Ciabuschi and Martìn (2010) found that the transfer of knowledge from the headquarters to the subsidiary is influenced by the impact of the intended innovation on the subsidiary and by the previous involvement of the headquarters in the innovation development process. Yang, Mudambi, and Meyer (2008) claim that the knowledge flows from the headquarters to the subsidiary and from the subsidiary to the headquarters follow different logics. Subsidiaries that are acquired with competence-creating objectives receive significantly larger inflows. Subsidiaries whose knowledge is of high relevance to the headquarters achieve significantly larger outflows.

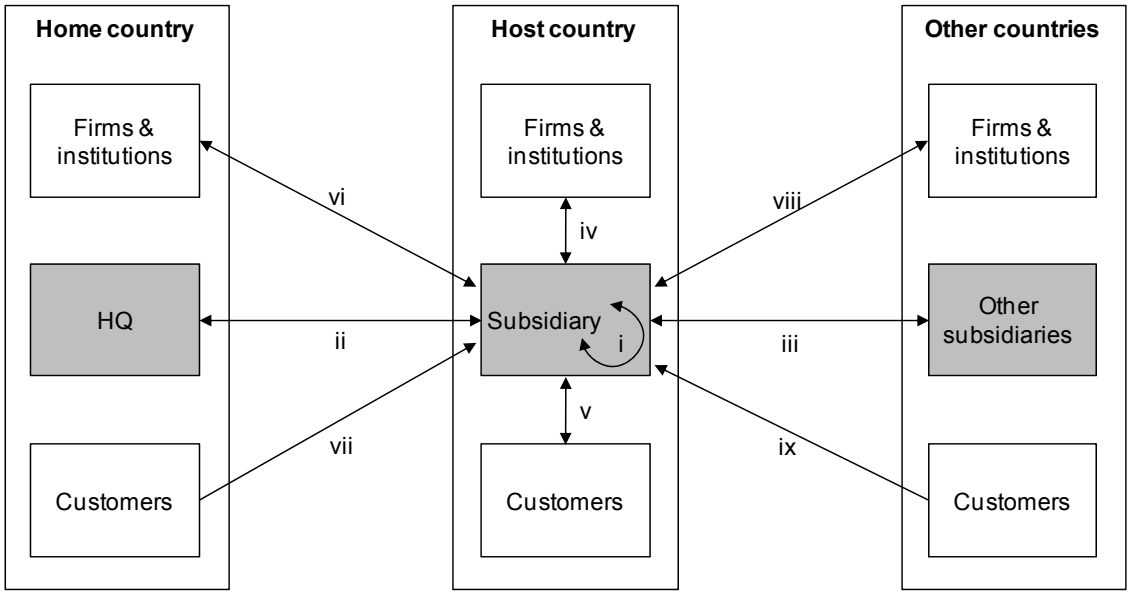


Figure 4: Sources of knowledge flow in MNCs

A literature stream analyzed in particular the reverse knowledge transfer – knowledge flow from the subsidiary to the headquarters – within MNCs (Frost, 1998; Frost & Zhou, 2005; Håkanson & Nobel, 2001; Yang et al., 2008). Håkanson & Nobel (2001) found that the degree of integration of the subsidiary in the MNC is positively related to

reverse knowledge transfer. Further, they found that the local embeddedness positively influences the innovativeness of the subsidiary. Concentrating on the external network studies investigated how and to what degree subsidiaries are embedded in their local environment (Enright, 2000; Grabher, 1993). The more subsidiaries collaborate with the headquarters the more willing they are to transfer knowledge (Frost & Zhou, 2005). The findings of Björkman, Barner-Rasmussen, and Li (2004) indicate that MNCs can influence knowledge transfer by specifying the objectives of the subsidiary and by establishing corporate socialization mechanisms. However, no evidence was found that management compensation systems and the use of expatriate managers had a positive impact on reverse knowledge transfers. A study by Ambos and colleagues outlines that the successful reverse transfer of knowledge depends on the importance of the host market for the MNC and the role and absorptive capacity of the headquarters (Ambos et al., 2006). Interestingly, the cultural and geographic distance did not affect reverse knowledge transfer. Mu, Gnyawali, and Hatfield (1997) identified that the innovativeness of a subsidiary drives reverse technology transfer.

Other studies stress the importance of the social network and internal embeddedness for knowledge transfer. In the context of new product development, Hansen, Mors, and Løvås (2005) analyzed different phases of knowledge sharing – deciding to seek knowledge, searching knowledge, and transferring knowledge – with respect to the social network. Interpersonal relationships that developed through lateral networking mechanisms such as virtual teams and personal meetings positively impact the frequency of subsidiary-headquarters and lateral subsidiary communication (Ghoshal, Korine, & Szulanski, 1994). The degree of subsidiary autonomy seems to have no influence on inter unit communication.

Knowledge creation in MNCs

Further studies analyzed the role of the subsidiary's local environment on knowledge creation and innovation. Frost (2001) found that technological innovation in subsidiaries depends on the exploration of host country knowledge and the exploitation of home country knowledge. The subsidiary innovativeness is influenced by its local embeddedness, the subsidiary's top management heterogeneity, and the corporate entrepreneurial culture. Nevertheless, a high degree of local embeddedness of the subsidiary can constrain reverse technology transfer, as problems with technology compatibility can arise and local customer needs may strongly differ from those in the home countries (Mu et al., 2007). The larger the subsidiary the more it depends on host

country knowledge exploitation. Based on an analysis of the Hong Kong financial service cluster, Enright (2000) found that the local development of the regional cluster and foreign MNC investment strategies are highly interdependent variables. Foreign MNC investment in the foreign cluster can be motivated by 'asset seeking' and or 'asset augment'. Being present in a local cluster allows MNCs to access a local market and gain access to a local information network.

4.2.5. Summary: underlying theoretical assumptions and limitations

Based on the previous literature review six basic highly interrelated limitations of the current literature are derived with respect to the subject of research. The six limitations are outlined in greater detail in the following paragraphs. Notably, no analyzed study on MNC management addressed subsidiary innovation in emerging markets as a peculiarity in current theory on MNC management.

Biased database: focus on the triad countries

Research on MNC strategy and structure is driven by data conducted in the triads – predominantly in the U.S. and Europe (Bartlett & Ghoshal, 1989; Jarillo & Martínez, 1990). In their seminal works, Ghoshal and Bartlett (1988a; 1988b; 1998) revealed archetypes of organizational structures and of global innovation processes based on analysis of developed country datasets. The research on global innovation processes displayed practices of remote subsidiaries that develop products for the local and/or global markets based on their competences and resources. In the 'local-for-local' setting, the cases showed merely a slight adaption of existing Western technologies and products, whereas in a 'local-for-global' setting all respective subsidiaries were located in a developed country, e.g., the U.K. or U.S.

Current studies on subsidiary initiatives and entrepreneurship (e.g., Almeida, Phene, & Grant, 2003; Birkinshaw, 1999; Birkinshaw et al., 1998; Cantwell & Mudambi, 2005) as well as on knowledge transfer (Bartlett & Ghoshal, 1989; Birkinshaw & Morrison, 1995; Frost et al., 2002) are also based on empirical data conducted in the triads. For examples, the studies of Frost (2001) and Mu and colleagues (2007) only analyzed subsidiaries of Western MNCs based in the U.S. Gupta and Govindarajan (2000) only looked at knowledge flows between subsidiaries located in developed countries. Insights on emerging market subsidiaries are missing.

Reflecting the triad data bias of current research on MNC management on theories of internationalization (see chapter 4.1); the West-to-East paradigm is still prevalent. Despite the fact that foreign subsidiaries are recognized to contribute to the firm's corporate advantages, models such as the heterarchy (Hedlund, 1986) and the transnational corporation (Bartlett & Ghoshal, 1998) underlay the assumption that innovation is based on new technologies developed in the West. To address emerging markets, Western products are stripped down to local needs. Thus, the internationalization of firms in terms of knowledge and innovation creation was solely analyzed in developed countries. According to cultural similarities, comparable economic status, and similar technological advancement of the Western countries, the MNCs' subsidiaries face similar demand structures in their host and foreign countries, which eased coordination and reduced tensions within the MNC network. The organizational impact on innovation for emerging markets that are based on an entirely different demand structure due to large cultural and structural differences is under-researched. The question of whether the recent expansion towards emerging countries will have scientific implications on MNC strategy and structure remains unanswered. The transferability of the results to an emerging market context is questionable.

Evolution of the MNC: blurring boundaries

Existing literature on MNC assumes that MNCs are increasingly internationalizing following an evolutionary path. This path is also reflected in the evolution of research on the MNC. The scientific perception of the MNC has changed over the last 50 years. Up to the 1980s, the headquarters-subsidiary relationship was subject of many research studies. It was assumed that the subsidiary represents a local affiliate that controls the entire local value chain. Over time, the peripheral subsidiary was given more autonomy and reached a status of self-determination. Today, a more integrated perspective is adopted. The subsidiary is seen as a distinct remote unit that controls parts of the local value chain and incorporates one or more specific capabilities. In the last years, increasingly more large MNCs achieved a steady state of internationalization. Thus, the MNC network does not evolve in a straight line towards more internationalization but rather follows a cycle of more centralization and decentralization within the network. It appears that the geographic dispersion becomes less important. The mapping of subsidiaries to geographic sites and specific value chain activities becomes increasingly difficult, as many companies have established project organization. Projects are executed by virtual teams – enabled by better ICT infrastructures and a high mobility of managers – whose members reside in several dispersed subsidiaries. The virtual team

represents value chain functions and is the entity that holds specific capabilities. The perception of a subsidiary as a country entity that controls specific parts of the local value chain and hold specific capabilities seems outdated (Birkinshaw & Pedersen, 2009; Moore & Birkinshaw, 1998). The allocation of capabilities to a local subsidiary becomes progressively blurred.

MNC structure: emerging organizational challenges

The boundaries between subsidiaries and its allocated resources and developed capabilities become ever more blurred. This increases the exchange within the MNC network. Some value chain activities located at one subsidiary might be shared with other subsidiaries within the MNC network. Thus, more than one subsidiary can access resources of remote value chain activities within one business. This results in organizational challenges on resource allocation, which have to be resolved. Current literature falls short of providing insight on how such challenges are addressed from an organization and coordination perspective. This is due to two aspects where further research can provide more insight.

The *first* limitation in current literature is based on the unit of analysis of existing studies. The unit of analysis varies between the corporation-, the subsidiary-, or the MNC network-level. Most datasets comprise large corporations that maintain numerous independent business fields that represent standalone units controlling the entire value chain. Studies that analyze the interaction process within one business field whose value chain activities are globally dispersed and highly interdependent are rare. Thus, the analysis of current studies stays on a broad level. Internal conflicts and challenges that result from geographic dispersal and shared activities – along the value chain functions, e.g., sales operations, marketing, R&D – are not addressed from an organizational point of view. Moving the unit of analysis to business unit/field level may allow analyzing in more depth existing organizational challenges and how they are resolved.

Related to the previous argument, the *second* limitation in current literature is related to the concepts of how organizational structures are described. The notion of mandates, responsibilities and roles seem to be too broad to provide insights on how interaction and coordination within the MNC network take place. As clear boundaries between subsidiaries disappear, the analysis of formal structures that overlay geographic structure becomes more important. The analysis of decision-making structures on a

project level may provide more detailed insight on how MNCs are structured and how network challenges are resolved. The decision-making structures may serve as a proxy for the formal structure of the MNC.

MNC knowledge and capability transfer: towards microstructure analysis

Numerous scientific studies analyze the knowledge transfer and capability leverage within the MNC. Relating to the previous argument, the question is what does it really mean to transfer knowledge or leverage capabilities within the MNC network. It seems obvious that 'capabilities' and 'knowledge' are too aggregated concepts to provide answers to the previous question (Foss & Pedersen, 2004). More detailed and differentiated views are required to provide deeper insights into how MNCs work. Current literature barely addresses the complexity of knowledge. What kind of knowledge is transferred? This question may lead to a differentiation between implicit and explicit or market and technological knowledge. Even in studies that stress the knowledge based view of the MNC the heterogeneous character of knowledge and the way it is structured and stratified is not considered (Foss & Pedersen, 2004; Kogut & Zander, 1993). How are capabilities leveraged within the MNC network? This question may lead to a closer investigation of job or subsidiary rotation. The answer to these questions are not trivial and require more detailed views on project execution, virtual teams, and inter personal exchange. They represent an uncharted territory in existing theory with high managerial implications (Foss & Pedersen, 2004).

In addition, the linkages of organizational structure to knowledge transfer and capability leverage on a micro level are unclear. How does structure and control enable or perhaps constrain knowledge transfer within a project where several subsidiaries are involved? In more detail, it might be interesting to examine how decision-making structures – where decision-making authorities are allocated within the MNC network – on a micro level influence knowledge transfer (Foss & Pedersen, 2004).

Knowledge bias: focus on technological knowledge

Theories on internationalization assume that innovation is based on new technology rather than on market knowledge and new value propositions (see chapter 4.1.4). This view is adopted by research on knowledge creation and transfer in MNCs. Predominantly, the flow of technology related knowledge was analyzed. A large number of studies on subsidiary innovation are based on patent citation data (e.g., Frost, 2001; Phene & Almeida, 2008). For example, Phene and Almeida (2008) found that the

innovativeness of a subsidiary depends more on patents from firms in the home and host country than internal sources (headquarters and other subsidiaries). Analyzing patent citation data, Frost (2001) finds that the technological specialization in subsidiaries is supported by ideas that originate in the subsidiary's local environment. Other studies focus explicitly on technological knowledge flows (Kogut & Zander, 1993) or technological development within MNC (Cantwell, 1992, 1993). Despite the fact that much research has been done on the forward, lateral, and reverse knowledge transfer within MNCs, scientific insight on the role market knowledge in the MNC is fragmented. For example, market knowledge was only used as a proxy for the innovativeness of the subsidiary. Thus, current scientific literature in knowledge creation and knowledge flow in MNC is biased on technological knowledge. The detailed studies on the flow of market knowledge within MNC are still missing.

'Knowledge flow is always good' bias

In present studies, free knowledge flow between all horizontal and hierarchical levels within an MNC network is always regarded as being beneficial (Hedlund, 1994). This also includes the leverage of local capabilities throughout the MNC (Birkinshaw & Hood, 1998). This view neglects that certain capabilities or certain knowledge can be beneficial for one product line or business while it may harness other product lines or business model within one MNC.

Summary

Based on our current limited understanding, reverse innovation requires structures that enable a high global efficiency to meet cost targets and requires a high local effectiveness to translate market needs into new products. The transnational model of the MNC offers a solution to the competing relationship between global efficiency and local effectiveness. This is achieved through intense knowledge transfer and leverage of locally bonded capabilities. Nevertheless, as we have seen, existing literature falls short to explain how the transnational model can be achieved. Several challenges have to be overcome.

First, as subsidiaries become more autonomous over time they define their own agendas. This may lead to conflicting goals between different entities in the MNC network. Consequently, conflicts on shared value chain activities and limited resources within the MNCs emerge.

Second, knowledge and capabilities that are beneficial for achieving the one subsidiary's goal may not be beneficial for other subsidiaries. Some capabilities may jeopardize capabilities that are crucial to another subsidiary. These internal challenges have recently become more important as companies increasingly implement more than one business model, which is partly rooted in the growing heterogeneity of local and global markets. In short, current literature romanticizes collaborative exchanges within MNC and neglects conflicting goals and challenges within the MNC network.

Third, the transnational model has so far neglected hierarchical/decision-making structures that may increase or resolve these internal challenges. More scientific insights are required on how these challenges and conflicts are resolved. Further, questions regarding how knowledge creation and transfer is organized remain unanswered.

Relating to the previous arguments, the level of analysis of the current research does not allow direct implication on the management of local based innovation. Company specific endogenous conditions that may reveal insights on decision-making and on the process of how knowledge is transferred are described only fragmentary. Detailed insight on how knowledge is transferred, combined, and deployed is missing (Foss & Pedersen, 2004). The same holds true for a detailed picture of how decisions are made and how authorities are delegated (Foss & Pedersen, 2004). The way organizational structures affect knowledge transfer represents an uncharted territory in current literature. Theory on the MNC and management practice would strongly benefit from more insight. Nevertheless, the existing literature on MNC subsidiaries forms a guiding frame for the underlying investigation, but falls short to explain how reverse innovation is pursued.

4.3. Global R&D

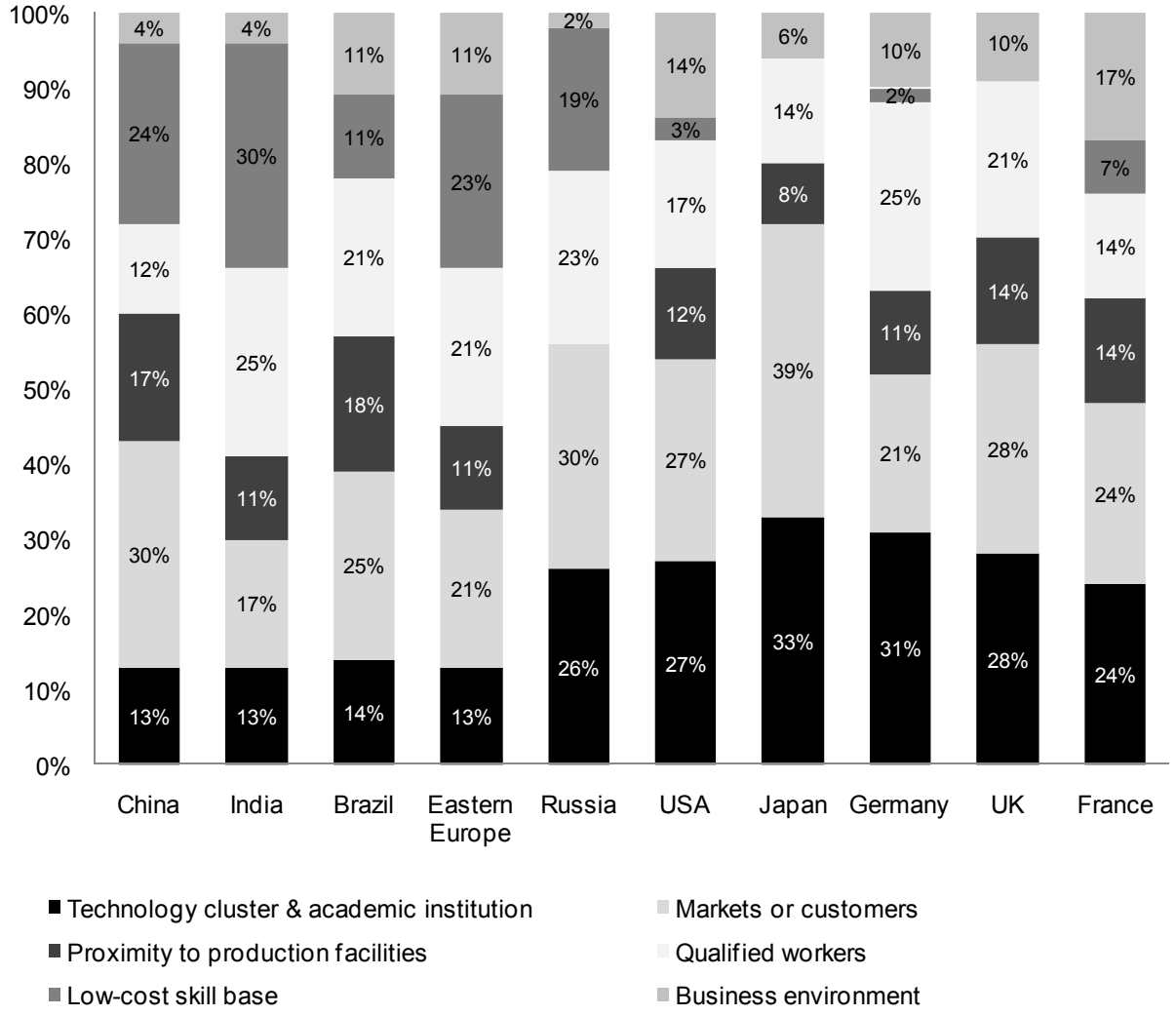
Traditionally R&D was the most shielded activity within the corporate value chain (Boutellier, Gassmann, & Von Zedtwitz, 2008). For many years, the R&D activities were strongly centralized. Companies feared to lose their core competence due to knowledge drain or decreased efficiency due to double invention (Ambos & Ambos, 2009). Whereas value chain functions like sales and manufacturing were off shored much earlier, R&D was regarded as a national treasure. A study of Western MNCs by Pausenberger (1982) showed that at the end of the 1970s less than 15 % of R&D expenditures were spent abroad in other developed countries. Western MNCs started to internationalize their R&D only 15 years ago. Today, the 1,000 largest R&D spenders invest 91 % of their R&D budget outside their home country (Jaruzelski & Dehoff, 2008). In the last years the internationalization of R&D and the number of cross-border innovation activities increased dramatically (Dunning & Lundan, 2009; UNCTAD, 2006)

As domestic markets were still growing in the 1970s, products were developed and produced for the Western world. In the last decades, Western companies commenced to globalize R&D as being 'last' within the value chain (Ernst, 2006; Manning, Massini, & Lewin, 2008). On a worldwide basis, global product platforms are developed that allow a local adaptation to specific regional needs.

4.3.1. Drivers of global R&D

The motives for MNCs to internationalize R&D described in literature are manifold. A study of 186 Western MNCs by Booz Allen Hamilton and INSEAD (Doz, Wilson, Veldhoen, Goldbrunner, & Altman, 2006) revealed that the drivers strongly differ according to geographic region. Figure 5 shows the importance of drivers of global R&D according to geographic region based on the number of cited reasons.

In general, six drivers for the internationalization can be distinguished: (i) cost reduction; (ii) access to skilled science and engineering personnel; (iii) increasing R&D productivity; (iv) proximity to manufacturing; (v) access to local market knowledge; and (vi) access to technological knowledge.



adapted from Doz et al. (2006)

Figure 5: Drivers of global R&D according to geographic region

(i) Cost reduction. Following a general trend of cost reduction Western MNCs have started in the 1990s to off shore R&D activities to low-cost countries. For a long time, cost has been a major driver for the internationalization of R&D (Gupta & Wilemon, 1996; Reddy & Sigurdson, 1997). The installation of R&D sites in low-cost countries allows Western MNCs to benefit from labor arbitrage (Lewin & Peeters, 2006). Figure 5 shows that especially in developing regions – China, India, Russia, and Eastern Europe – access to a low-cost skill base represents a major driver for R&D internationalization of Western MNCs. Furthermore, the cheap R&D personnel enable Western MNCs to introduce cost-optimal round-the-clock shifts. Thereby, Kuemmerle (1998) estimates that companies could save 30 % to 44 % of operating costs for their R&D. Nevertheless as wages of skilled R&D personnel are increasing rapidly in

emerging countries, labor arbitrage as a driver for international R&D will become less important in the future (von Zedtwitz, 2005).

(ii) Access to skilled science and engineering personnel. The shortage of science and engineering personnel in their home countries forces Western MNCs to skim the large growing talent pool of high skilled science and engineering personnel in foreign countries like India or China (Hegde & Hicks, 2008; Ito & Wakasugi, 2007). To attract local researchers and engineers MNCs are compelled to offer local R&D facilities (Lewin & Peeters, 2006). Due to cultural ties and local labor law regulations, the transfer of workers to the home country is often impracticable. Figure 5 shows that access to qualified workers is a driver relevant to all geographic regions. Nevertheless, it seems especially important to India, Russia, Eastern Europe, and Brazil.

(iii) Increasing R&D productivity. Dispersed R&D sites in different time zones enable MNCs to shorten development times by introducing a 'follow-the-sun' approach. Research and development work is handed over from one location to another in a different time zone. Thus, innovation projects can be conducted 24/7 without causing overtime. The increase of speed and productivity marks an important driver for the internationalization of R&D (Lewin et al., 2009).

(iv) Proximity to manufacturing. In the course of the vast globalization, manufacturing and marketing activities became ever more dispersed. To provide technical support and enable learning processes, globalized manufacturing and marketing pulled for co-located R&D at off shored manufacturing plants (Dunning & Lundan, 2009; Ernst, 2006; Medcof, 2001). Furthermore, close interaction between R&D and manufacturing increases innovation success (Dunning & Lundan, 2009; Ernst, 2006; Medcof, 2001). The local concentration of R&D and manufacturing decreases transfer cost and subsequently time to market as well as overall cost. Thus, MNCs started to internationalize R&D to exploit benefits of the co-location of R&D and manufacturing (Ito & Wakasugi, 2007; Patel & Vega, 1999). Most notably, proximity to manufacturing plays an important role in China and Brazil (see figure 5).

(v) Access to local market knowledge. The localization of R&D allows MNCs to adapt products, processes, and supply chains to the needs and requirements of foreign markets as a means to gain market share (Belderbos et al., 2008). Therefore, location-specific knowledge about markets and customers is acquired. This implies that MNCs leverage

their technological base built within their home country towards development and engineering sites in foreign countries (Chiesa, 1996a; Niosi, 1999; Patel & Vega, 1999; von Zedtwitz & Gassmann, 2002). In a study analyzing 1,012 R&D units of 81 MNCs, von Zedtwitz and Gassmann (2002) found that the 'market-driven paradigm' is the most prevalent within the sample. According to Hegde and Hicks (2008), the market size of the foreign country marks an important factor for the decision on the installation of a remote R&D site for local product adaptation. Thus, the large, growing domestic markets in China and India are major targets of direct R&D investments (Howells, 2008). Nevertheless, due to the high purchasing power of customer in developed countries access to local market knowledge is also important to MNCs (see figure 5).

(vi) Access to technological knowledge. More recent studies focus on the establishment of overseas R&D sites as a means for MNCs to observe new scientific and technological advancements at centers of excellence and to gain access to leading-edge technological knowledge (Le Bas & Sierra, 2002; Patel & Vega, 1999; von Zedtwitz & Gassmann, 2002). These centers are distinguished by a high rate of technology output – facilitated by leading public and private research intuitions, company owned R&D sites, and advanced users – and provide a high spillover potential (Gerybadze & Reger, 1999). Traditionally, they have been based in the triads, e.g. Silicon Valley. In recent years, several centers of excellence mainly in China and India have emerged (Dunning & Lundan, 2009). With the establishment of R&D sites in close proximity to innovation clusters, companies expect to benefit from spillover effects and take the risk of losing proprietary knowledge to external institutions (Belderbos et al., 2008; Ito & Wakasugi, 2007). Local technology development capacity fosters and accelerates the process of learning and knowledge absorption from centers of excellence (Kuemmerle, 1997). For example, Kuemmerle (1999) observed that 38 % of 156 foreign R&D sites established by 32 Western MNCs followed the goal to extant the existing knowledge base.

4.3.2. Strategic roles of R&D sites

Numerous studies ascertain two strategic roles of foreign R&D units: home-base-augmenting, and home-base-exploiting (Chiesa, 1996a; Dunning & Narula, 1995; Iwata et al., 2006; Kuemmerle, 1997, 1999, 2002; Kurokawa et al., 2007; Pearce & Papanastassiou, 1996). Home-base-augmenting R&D units aim to complement and advance MNCs' capabilities by absorbing technological know-how from local institutions – i.e. universities, research institutes, governments, suppliers and

competitors (Iwata et al., 2006). Those R&D sites tend to evolve towards a center of excellence within the corporate R&D network as they concentrate on basic research, applied research, and advanced development, making the R&D unit a center of technical knowledge flows (Iwata et al., 2006; Kurokawa et al., 2007). MNCs with a relative advantage in their home country in a technology field tend to establish home-base-augmenting R&D units in countries that are relatively high in this specific technological field (Le Bas & Sierra, 2002; Patel & Vega, 1999). Home-base-exploiting R&D units attempt to adapt products to local needs of foreign markets and to support remote manufacturing facilities (Kurokawa et al., 2007). Those prevalent foreign R&D units focus on product development according to local market needs, accenting market-related knowledge flows (Iwata et al., 2006; Kurokawa et al., 2007).

4.3.3. Organizational structures of global R&D

In existing literature, there are numerous organizational and structural manifestations of international R&D. Gerybadze and Reger (1999) distinguish between four types of transnational innovation based on two clusters of dynamic innovation processes: science and research based innovation (large R&D base in home country; small R&D base in home country); coupling of lead marketing, R&D, and innovation (important lead market in home country; lead market outside home country). Based on the research of Perlmutter (1969) and Bartlett and Ghoshal (1989), Gassmann and von Zedtwitz, (1999) introduced an evolutionary model of international R&D organization in MNCs. Based on the dispersion of R&D activities and the degree of cooperation between individual R&D sites, five types of R&D organizations in MNCs are classified; each of which differ according to organizational structure and behavioral orientation (see figure 6).

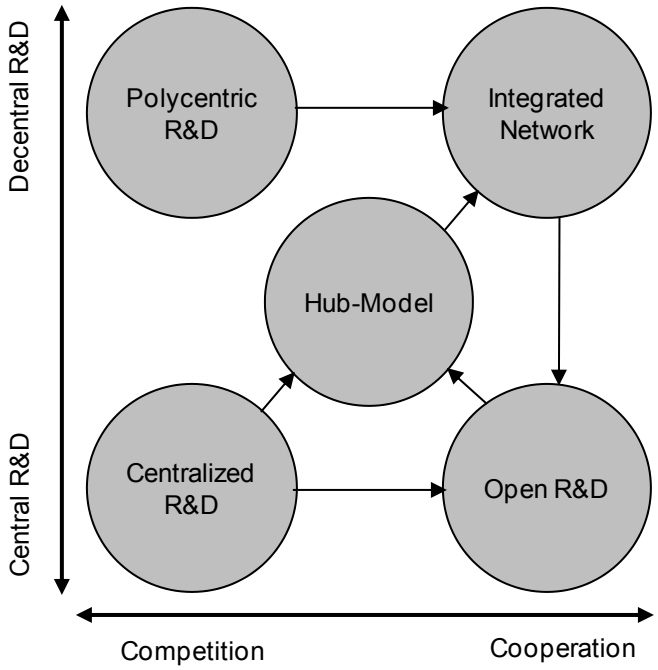
- *Ethnocentric centralized R&D* is characterized by a dominant R&D center serving global markets. R&D is seen as a national treasure. This structure enables high efficiency due to specialization and scale effects that result in lower R&D costs and shorter development lifecycles. Nevertheless, the ethnocentric centralized R&D is rigid in sensing local market needs and transferring these needs in new product offering.

- *Geocentric centralized R&D* (Open R&D) constitutes a central R&D that is globally engaged in exchange with customers, suppliers, and research institutes. This leads to a higher sensitivity for local markets and technological trends while still being cost efficient. This structure is still endangered to neglecting systematic internationalization and local market needs.

- *Polycentric decentralized R&D* consists of multiple R&D sites with little global alignment and coordination. In a majority of cases, this setup results from mergers and acquisitions of entire companies or external R&D sites. Information flows between the highly independent sites are limited. While this structure enables optimal local market sensing and exploitation of local resources, it can lead to problems with the critical mass of a single local market, inefficient parallel development, and a loss of technical focus.

- Within the *R&D hub model*, the R&D center takes care of global coordination between various dispersed R&D sites and marks the decision-making platform for all global R&D activities. The central control reduces the risk of suboptimal resource allocation and parallel development. The R&D center constitutes the main laboratory for all research and development activities, retaining a worldwide lead in relevant technological fields. The dispersed R&D sites are responsible for identifying new technologies, anticipating local demands, and enabling global R&D activities. This structure requires high coordination efforts. Thus, it is critical to find an optimal balance in the number and size of the remote R&D sites (Kuemmerle, 1998). Many small sites require enormous coordination efforts, while few large sites may lead to redundant development efforts and lower local market sensitivity.

- *Integrated R&D network* combines several equal R&D sites. There is no R&D headquarters that is responsible for coordination. Information is shared on a network basis and decision-making is organized in a decentralized manner (von Zedtwitz, 2005). Each R&D site represents a competence center specialized on a particular product, component, or technology area. Thus, the site takes a leading role in its particular field. This structure offers the highest learning potential for the organization. As each site is responsible for coordination, many interaction and decision interfaces lead to high coordination effort. Thus, the integrated R&D network requires mature internal structures.

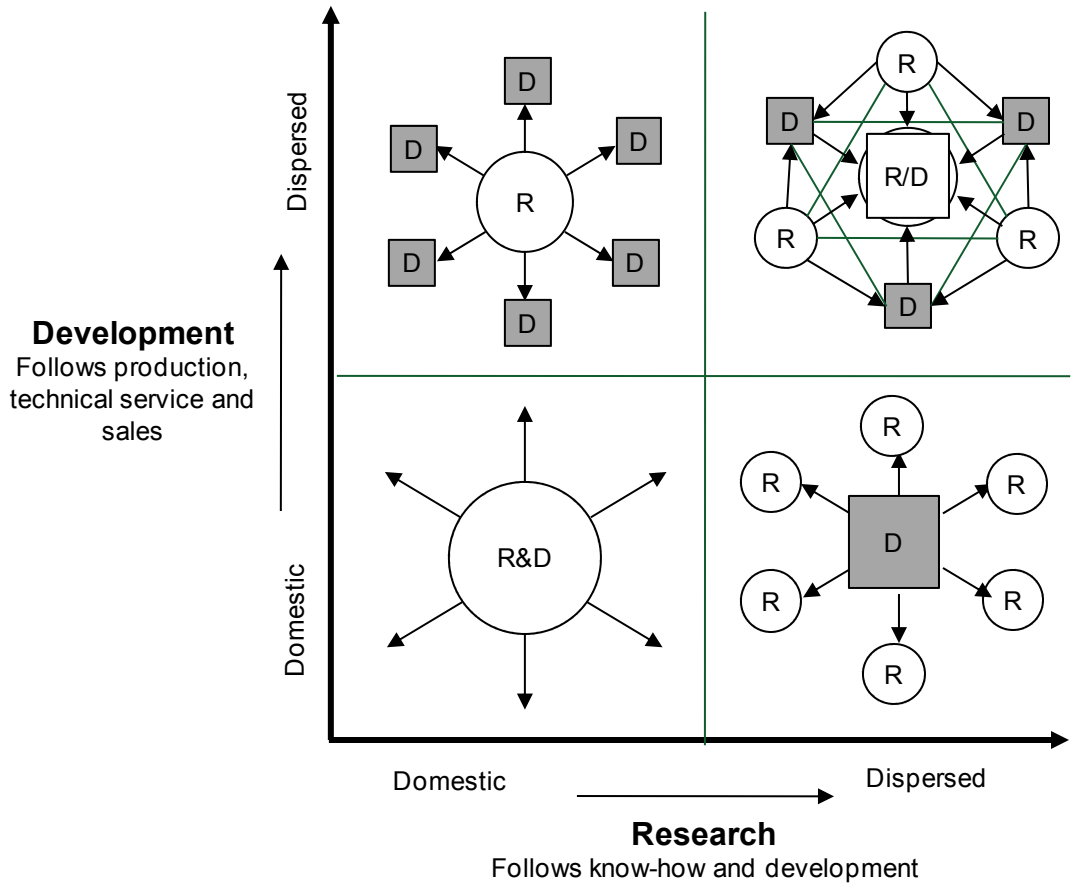


according to Gassmann & von Zedtwitz (1999)

Figure 6: Concepts of global R&D

In their empirical study of 33 firms, Gassmann and von Zedtwitz (1999) identified patterns in the evolution of the five organization structures of global R&D (represented by the arrows in figure 6). There is a general trend towards an *integrated R&D network* in the organizational configuration of international R&D, which is rooted in the need for decentralization to acquire local market and technological knowledge. As competencies emerge, R&D subsidiaries head towards more empowerment and autonomy.

A study by von Zedtwitz and Gassmann (2002) further distinguishes between the internationalization of research and development. They differentiate four organizational manifestations of research and development (see also figure 7): (i) national treasure R&D (domestic research and domestic development); (ii) technology-driven R&D (dispersed research and domestic development); (iii) market-driven R&D (domestic research and dispersed development); and (iv) global R&D (dispersed research and dispersed development).



according to von Zedtwitz & Gassmann (2002)

Figure 7: Internationalization of research and development

4.3.4. Moving R&D to emerging markets

Internationalization in the 20th century has focused predominantly on locating R&D activities in the triads. A study of German MNCs in the high-tech industry by Wortmann (1990) revealed that the internationalization of R&D was only targeted at the U.S. and Japan. The goal was to acquire new technological knowledge or to adapt own technologies to foreign markets. Only in the last decade, the R&D internationalization towards emerging countries like China and India has increased dramatically (Dunning & Lundan, 2009; Reger, 2004). According to a study of the United Nations, *"of the more than 1000 FDI projects in R&D worldwide for which information has been collected for the period August 2002–July 2004 the majority (739) were located in emerging economies or economies in transition"* (UNCTAD, 2006, p 6). This trend is enhanced by the tremendous growth of large emerging economies like China or India and the increasing availability of well-educated local workforce (WIR, 2005). Thus,

Western MNCs started to establish local R&D units as a means to adapt existing technological capabilities to emerging markets.

In the case of China, the majority of Western MNCs establish R&D units in the course of joint ventures in the economic metropolises of Beijing or Shanghai (Gassmann & Han, 2004). Most sites were market driven and development oriented. Gassmann and Hang (2004) identified nine drives categorized in three core motives for MNCs to establish R&D units in China (see table 5). As China offers a huge pool of qualified personnel, MNCs try to skim this pool by local proximity. The establishment of local R&D units allows Western MNCs to gain access to informal networks and information sources at, for example, universities or local scientific communities. To obtain local technological know-how, Western MNCs established R&D units nearby newly set-up science parks and high-tech clusters. Local R&D units enable MNCs to better adapt their products to local customers, to speed up the R&D cycle time by better exchange with local manufacturing, and to save costs. Local governmental policy massively fosters domestic innovation. Thus, China is attracting foreign R&D investments to position itself as a global innovation hub (Sun et al., 2007). Consequently, not only local product or service adaptations but also the research activities are located on the ground (Reddy, 1997). Furthermore, constant economic growth rates of a huge local market and the fear to lose competitive advantage towards MNCs already present in China drives the localization of R&D.

Table 5: Motivations for MNCs' R&D establishment in China

Input-oriented motivations	*Performance-oriented motivations*
▪ Availability of high qualified personnel	▪ Customer and market-specific development
▪ Tapping informal networks and knowledge source	▪ Adaptation to local production processes
▪ Local pocket-of-innovation	▪ Cost advantages
Business-ecological motivations	
▪ Governmental policy	
▪ Continuing economic growth and unique market size	
▪ Peer pressure	

according to Gassmann & Han (2004)

Recently, researchers have provided anecdotal insights on R&D structures for Western MNC in emerging markets. Based on two case studies in one MNC, Schanz and colleagues introduced two structural models on how R&D can be organized in

emerging countries (Schanz et al., 2011). Depending on IP strategy and local innovation experience, it might be beneficial to follow either an integrated or a separate structure approach. In an integrated structure, the R&D unit in the emerging market is tightly controlled by the headquarters securing IP. In a separate structure, the R&D unit is dislodged from the headquarters enjoying high autonomy. Mudambi (2011) highlights the importance of establishing separate R&D structures in emerging countries for successful local innovation.

4.3.5. Underlying assumptions of R&D management

The West-to-East flow paradigm prevalent in internationalization (see chapter 4.1) and MNC management literature (see chapter 4.2) was adopted by the literature stream on R&D management. The R&D internationalization of MNCs has been dominantly interpreted as the attempt of Western technology-intensive companies to leverage and exploit home-generated knowledge to foreign markets and/or gain access to technological know-how (e.g., Gassmann & von Zedtwitz, 1998, 1999; Kuemmerle, 1997, 2002; Wortmann, 1990). Accordingly, firms started to build up local engineering and development units allowing for a customization of global product platforms (von Zedtwitz & Gassmann, 2002). Within the last decade, the need to understand local market requirements and adapt products accordingly has become a significant driver of global R&D (Belderbos et al., 2008). Nevertheless, existing literature on market adaptation as a strategic driver for R&D internationalization (e.g., Chiesa, 1996; Niosi, 1999; Patel & Vega, 1999), its structural (Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; von Zedtwitz & Gassmann, 2002) and its process related manifestation (Boutellier et al., 1998; de Brentani et al., 2010; Kleinschmidt et al., 2007) is still based on the conjecture that innovations are centrally driven by a Western mindset and then locally adapted to specific needs.

Present studies on R&D structure provide a guidance framing for how R&D can be organized (Gassmann & von Zedtwitz, 1998, 1999; Gerybadze & Reger, 1999; von Zedtwitz & Gassmann, 2002). Nevertheless, these models underlie the West-to-East paradigm. Additional research is required to evaluate to what degree innovation in emerging markets and their potential backflow to the home country influences current models. Studies on R&D structure in emerging markets do not reveal sufficient scientific insight on how R&D is organized to innovate successfully in emerging countries (Mudambi, 2011; Schanz et al., 2011).

Additionally, while the normative character of the present studies on R&D structure allows a categorization of R&D, they fall short of providing insights on how global R&D is coordinated at a micro level. Insights on project organization, decision-making structures, and inter unit exchange are missing.

4.4. New product development

NPD processes can be characterized as a series of discrete activities, tasks, and gates (Cooper & Kleinschmidt, 1995, 2000; Kleinschmidt & Cooper, 1991). Many studies have concentrated on the coordination aspects of NPD routines including information flows and people allocation (Cooper, 1999; Cooper et al., 2003).

Extensive research on NPD has been conducted on customer integration. It is widely agreed that an early anticipation of customer needs marks the foundation of a successful NPD. Therefore, Tidd and colleagues have recommended an organization wide customer orientation including the support of senior management (Tidd et al., 2005). The capability to anticipate customer needs and to integrate them in development processes presents a core capability of the firm (Glazer, 1991; Li & Calantone, 1998). Within the literature of customer integration, von Hippel's (1986, 2005) studies on lead user are highly relevant as the insights gained from lead user are a source of radical innovation. In literature, many studies have described customer integration processes and structures (e.g., Jeppesen & Molin, 2004; Tidd et al., 2005).

4.4.1. Global new product development

Despite the emphasis of past research on domestic markets regarding NPD processes, several recent studies take a global perspective into account (e.g., Boutellier et al., 1998; Chryssochoidis & Wong, 1998; de Brentani et al., 2010; Kleinschmidt et al., 2007). They revealed insights on how global routines may leverage NPD resources for a global product development. According to global NPD literature, there are three core process activities that are crucial for an effective international NPD (Kleinschmidt et al., 2007): (i) activities to access, coordinate, and integrate information, knowledge, and resources concerning global market opportunities (Graber, 1996; Ogbuehi & Bellas, 1992); (ii) executing NPD homework tasks (Henard & Szymanski, 2001); and (iii) preparing for international new product launch (Chryssochoidis & Wong, 1998). Adopting a resource based view, Kleinschmidt et al. (2007) found that resource commitment, NPD process formality, strong global innovation culture, and top management involvement positively influenced NPD performance. Based on data of 432 corporate global new product programs, de Brentani et al. (2010) revealed two global NPD strategies: (i) global presence strategy – expanding the firm's marketing efforts across boundaries allows to offer market adapted products and to decrease time

to market; (ii) global product harmonization strategy – effective integration of the company's worldwide product-, market-, and skill-based knowledge to focus on being global.

4.4.2. New product development in emerging markets

Despite that NPD is a well-addressed research field, the majority of studies focuses on a developed market setting. Only a few recent studies focused on NPD in emerging markets. A study by Atuahene-Gima and Murray (2007) analyzed the impact of exploitative and explorative learning on new product performance of new technology ventures in China. The study outlines that social capital plays a crucial role in enhancing new product performance. A study in Malaysia on outsourcing and organizing NPD in emerging markets shows that NPD practices of local firms focused more on production cost and manufacturing than on acquiring external knowledge (Al-Shalabi & Rundquist, 2010). The study further revealed that the NPD processes strongly differed between local companies and Western MNC subsidiaries.

One main challenge for Western MNCs entering emerging markets is the question of how they are required to adapt their NPD process in order to be successful. This depends on their emerging markets strategy: localizing Western products or developing new products for emerging markets (Grigoriou, 2010). The strategy of localization includes adapting marketing to local conditions. It further requires to localize production and sourcing and allow a local product adaptation (Dawar & Chattopadhyay, 2002; Khanna, Palepu, & Sinha, 2005). This can be part of a 'product mapping' strategy (Wheelwright & Sasser, 1989) in which a global core product is adapted to local needs (Grigoriou, 2010). The development of a new product for an emerging market requires emphasizing the front-end of the product development process and customers' needs have to be integrated early in the development process (Grigoriou, 2010). A way to realize this is the adoption of a 'holistic' product development process (Khurana & Rosenthal, 1997, 1998).

Iyer, LaPlaca, and Sharma (2006) outlined that the decision whether to foster incremental or radical product development strategies for emerging markets depends on market characteristics, institutional development, and customer behavior. Based on their research, they outline the importance for MNCs to focus on platforms rather than on singular products and to concentrate on after-sales service in order to generate profit.

Additionally, it is crucial for MNCs to build up distribution capabilities and establish strategic alliances with local partners.

4.4.3. Underlying assumptions of international NPD

While NPD is a well-researched scientific field, only a limited number of studies take an international perspective (Boutellier et al., 1998; de Brentani et al., 2010; Kleinschmidt et al., 2007). Literature on global NPD focuses on routines that enable one global innovation process. Thus, NPD is understood as a dynamic capability that is leveraged across the entire MNC. While managerial studies indicate that NPD processes of companies in emerging markets differ from those in Western companies, an analysis of NPD processes in Western MNC subsidiaries in emerging markets is missing. The possibility of specific local NPD capabilities in emerging markets has not been considered in NPD literature so far.

Recently, first studies analyzed the NPD processes of emerging country companies. Nevertheless, these studies provide only limited and anecdotal insights that do not allow comparing Western NPD routines with those from emerging country companies.

4.5. Initial reference framework

The goal of this thesis is to expand theory of innovation diffusion and to contribute to literature on the multinational corporation and R&D management using case study research. Therefore, an initial reference framework is developed based on the previously gained insights of the literature review. The initial reference framework allows the reflection of existing theory and literature on the phenomenon under investigation. It includes the categories, their dimensions, and relationships relevant for addressing the presented research questions. Additionally, the initial reference framework integrates current underlying assumptions in literature that may dissent from the phenomenon of reverse innovation. The initial reference framework guides data collection and data analysis. Along the research process, the initial reference framework is reflected upon empirical insights and adapted, when necessary. The research will result in a conceptualization of reverse innovation. This conceptualization will address the proposed research questions. Subsequently, the empirical insights will be reflected on existing theory. This leads to propositions that expand current literature.

The following section describes the initial reference framework and its derivation including present underlying theoretical assumptions from the literature:

The review on firm internationalization literature revealed that innovation diffusion along the product life cycle is based on two fundamental assumptions. *First*, innovations are based on new technologies. *Second,* these innovations flow from developed markets to emerging markets as consumers in developed markets have advanced needs that later become persistent in emerging markets. Consequently, Western MNC internationalize as means to exploit further existing home-based competences.

Literature on MNC management provides further insights on the management of innovation. The MNC network is characterized by the headquarters-subsidiary relationship and the relationship between the subsidiaries. Within the MNC network, the headquarters can assign a specific mandate to one subsidiary or a network of subsidiaries. These mandates can refer to processes, which are described as local-for-local, local-for-global, global-for-local, or global-for-global. According to the theoretical assumptions of a West-to-East flow of innovation, an emerging market subsidiary can either be part of a global-for-local innovation process or be responsible for local-for-local innovation.

Based on the mandate and given freedom, the subsidiary is able to form its own initiatives and uses its internally available resources within the boundary of the mandate. These can comprise i.a. financial, infrastructural, or technical resources. With respect to innovation, technical resources play a vital role. The subsidiary benefits from free, multi-directional technological knowledge flows within the MNC network. Additionally, the subsidiary profits from a globally implemented NPD process. This process represents a dynamic capability within the MNC network.

Additional, the subsidiary can access external resources from its local environment (e.g., access to customers or access to local institutions). Based on the subsidiary's mandate, its available internal resources, and external local environmental resources, the subsidiary can create local initiatives that facilitate emerging market innovation.

The emerging market innovation is based on an existing Western solution, which is adapted for local conditions. Thus, the innovation is still based on a Western mindset. As emerging market consumers are less advanced than their Western counterparts and have less purchasing power, the emerging market innovation shows a limited fit to emerging markets.

Based on the previous literature review a preliminary initial reference framework is developed, which is displayed in figure 8. It shows the categories that influence the emerging market activity and emerging market innovation. The headquarters defines the strategy and assigns mandates to the subsidiaries. Within the MNC network, there is a free flow of technological knowledge and each unit can create initiatives on their own (within the boundaries of the mandate). The availability of corporate internal and external resources influences the emerging market innovation activity. The emerging market innovation activity is characterized by the exploitation of existing technologies available in the corporate network. The innovation activity determines the development of emerging market innovation.

As outlined, current literature on the management of the MNC and R&D management is based on the assumption of product life cycle theory that innovations flow from developed to emerging markets. Thus, the 'reverse' diffusion is new to theory and its effects on the described categories are unclear. Hence, the aspect of reverse diffusion is not yet an element in the reference framework.

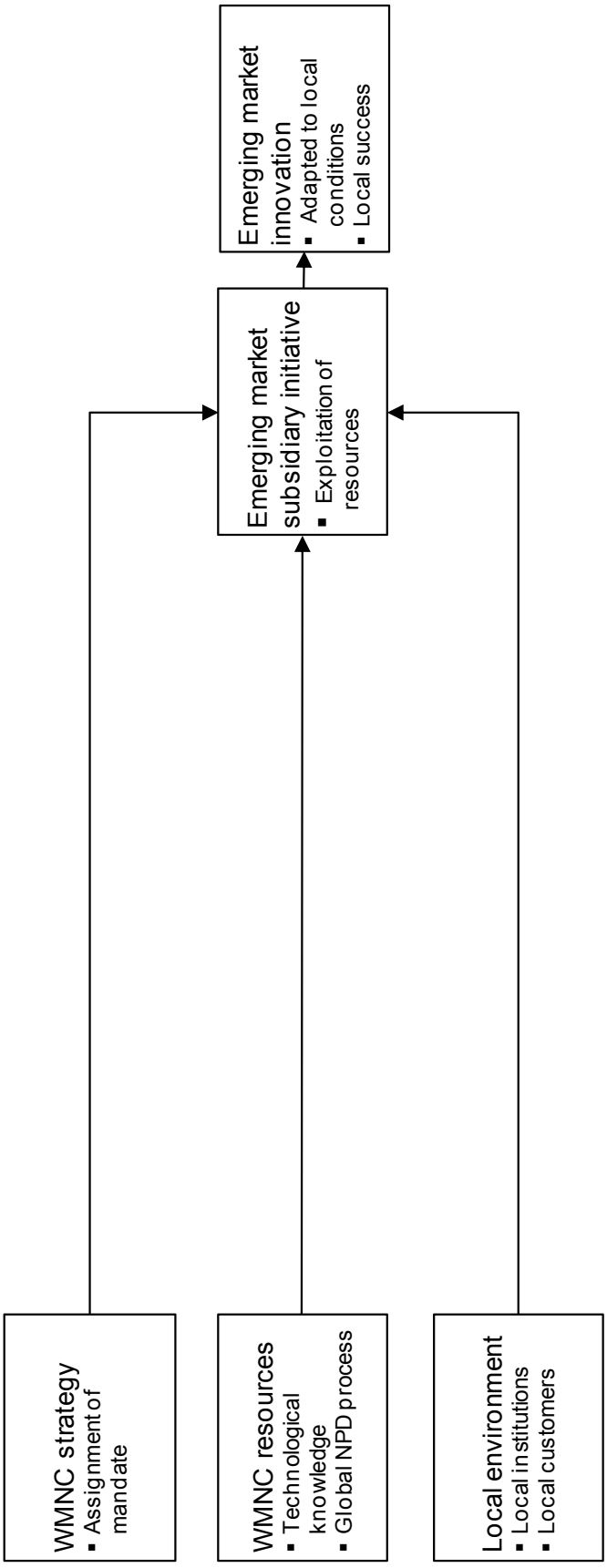


Figure 8: 'Preliminary' initial reference framework

The review in this chapter further revealed that literature on the MNC management is based on broad concepts of mandate, structure and knowledge. The preliminary reference framework is based on these concepts. However, they seem to be inappropriate to reveal detailed insights on the complex theme of reverse innovation. They fall short of showing how Western MNCs resolve challenges that are rooted in conflicting innovation concepts (high-end vs. emerging market innovation) and how reverse innovation may be implemented.

Thus, the preliminary reference framework needs to be adapted and refined to show how reverse innovation is organized and facilitated. The enhancements focus on two aspects.

On the one hand, the concepts of mandate and structure need to be itemized to provide insights on how interaction and coordination within the MNC network take place. As outlined, the analysis of decision-making structures on a project level may provide more detailed insights on how MNCs are structured and how organizational challenges caused by emerging market innovation are resolved.

On the other hand, current studies on innovation in MNCs do not reveal detailed insights on how innovations are implemented. There is no differentiation between various knowledge types and it is not revealed how knowledge is combined. Consequently, current studies fall short in accommodating the full complexity of knowledge flows and innovation implementation and thus can reveal only limited insights into how reverse innovations are developed and implemented.

Thus, the preliminary initial reference framework (see figure 8) is further advanced to provide deeper insights. The focus is on decision-making and the implementation of emerging market innovation. The adapted framework includes the dimensions ‘Structure of decision-making’ and ‘Structure of implementation’, which characterize the constitutional organizational dimensions in which emerging market innovation is developed. While the structure of decision-making reflects the question of where decisions about a new emerging market product are made (hierarchical and spatial), the structure of implementation refers to where and how the emerging market innovation is actually developed. The latter includes a differentiation between required market and technological knowledge and how knowledge exchange across sites is characterized. In the following, both dimensions are described in greater detail.

In large organizations, the decision-making process on innovation can be somewhat complex depending on how many hierarchical levels and people from different functions are involved. Mostly, people involved in strategic and operational new product development decisions come from different functions such as R&D, marketing, controlling, and production (Cooper, 1999). In MNCs, an additional level of complexity is added through the geographic dispersion of people, resulting in a multi-level, multi-locus decision-making process. In the context of an MNC, the structure of decision-making can be determined by the degree to which the decision-making authority is divided between 'headquarters and its various operational units' (Garnier, 1982). In general, the decision-making power on new product innovation projects can be located centrally at the MNC's headquarters, shared between headquarters and the subsidiary, or locally at the subsidiary (Gates & Egelhoff, 1986). The decision-making power can be defined by the degree to which the unit at question has power over the product portfolio strategy and the product market strategy. 'Product portfolio power' refers to the authority over a product line that is distinct from other product lines, within the MNC. For example, firms may maintain two distinct product lines for advanced, high-end products and for low-end, emerging market products. 'Product management power' refers to the unit's authority over a specific product including the authority to decide upon the product's design, features, price point, target markets and time of entry relative to competitors (Zott & Amit, 2008). For example, while the product portfolio power may be located at the headquarters, the product market power may be located at the subsidiary. Thus, the structure of decision-making can be described by the following three basic, organizational approaches:

(i) Central decision. This approach refers to the situation where headquarters solely decides about new emerging market innovation. In this case, both product portfolio and product market power are concentrated at the headquarters. This approach can be viable for Western MNCs where emerging market innovation is of high strategic importance and where the product market strategy is aligned with the firm's worldwide product portfolio. Although all decisions are made centrally, the physical development of the products may occur in a local subsidiary.

(ii) Shared decision. In shared decisions, the headquarters and the subsidiary jointly decide about the emerging market innovation's product market strategy. Although the product portfolio strategy power may be located at the headquarters, the local market organizations of large MNCs have more profound market insights about their local

markets than is present at the headquarters. Therefore, headquarters consult intensively with the subsidiary before making decisions about the product market strategy. Often, the headquarters have the final say in the decision process.

(iii) Local decision. In this approach, the subsidiary enjoys a high degree of autonomy from headquarters regarding the product market strategy and sometimes even the product portfolio strategy. This approach can be feasible for large MNCs where growth in structurally different markets (such as emerging countries) is of higher strategic relevance than control and organizational efficiency. As the local market organizations often have profound customer knowledge, the decision-making is passed from the headquarters to the subsidiary.

Similar to the structure of decision-making, new product development can be carried out in different locations in MNCs with a globally dispersed R&D organization. Depending on the type of R&D activity, which can range from simple product adaptations over product engineering to fully-fledged technology development (Kuemmerle, 1997), R&D activities can be conducted at the local subsidiary in a specific country, at the firm's R&D headquarters, or in collaboration between the different R&D locations in the firm's global R&D network. The decision about the locus of the physical product development can be analyzed adopting a resource-based view (Grant, 1991; Wernerfelt, 1984). Subsidiaries that have a profound 'technological knowledge' and product development competence may be better suited for developing new emerging market innovation if they have additional competitive advantages such as lower wage levels or supply chain costs. Similarly, profound local 'market knowledge' and insight understanding of local customer needs facilitates the translation of those needs in physical products.

Based on this understanding, the structure of implementation can be distinguished in three basic approaches:

(i) Central implementation. This approach is feasible if both technological and market knowledge about a new emerging market product development is concentrated at the headquarters. This approach may be feasible for Western MNCs whose international R&D network is not yet fully developed in terms of local technological and market competencies.

(ii) Shared implementation. This approach refers to the constellation where both the headquarters and subsidiary each have distinct competencies that are mutually complementary and both contribute development resource to generate innovation. For example, while the headquarters have the technological knowledge, the local subsidiary may be better able to exploit and adapt the existing technological knowledge to develop locally adapted products based on its customer proximity. Typical activities may involve simple product adaptations of existing products to local market requirements, such as design changes, adaptations of interfaces (e.g., power plugs), and adaptations in the product's basic performance (Johanson & Vahlne, 1977). Mostly, the specifications for adaptation are clearly defined by the headquarters.

(iii) Local implementation. In this approach, the technological and market knowledge are both concentrated at the local subsidiary. The subsidiary is able to develop new products based on its R&D competencies and draws on its extensive local market know-how to design customer-tailored products. This approach can be feasible for MNCs that have developed the technological and product development competence in its local subsidiary over time and where the subsidiary has competitive advantage relative to the headquarters.

Figure 9 shows the initial reference framework that is an advancement of the preliminary reference framework. It will guide data collection and the empirical analysis. Overall, the initial reference framework allows a more granular view of the implementation of subsidiary innovation in general and reverse innovation in particular.

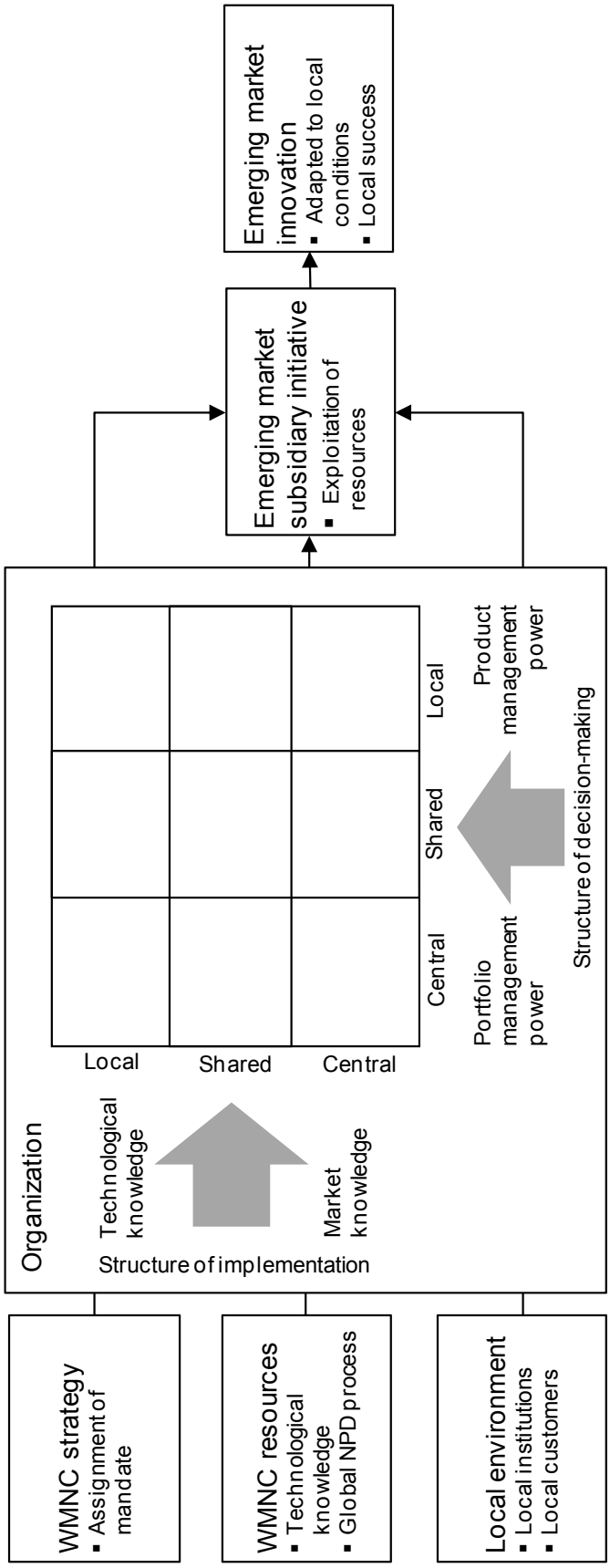


Figure 9: Initial reference framework

5. Empirical findings on reverse innovation from Western medical equipment manufacturers

In this chapter, four case studies are presented that pertain to innovation activities of Western MNCs in emerging countries. The case studies are the results of the empirical, in-depth investigation of this research. The initial reference framework developed in the previous chapter sets the groundwork for the presentation of the case studies. It provides the empirical basis for the subsequent cross-case analysis and theory expansion. The new insights lead to managerial recommendations on the management of reverse innovation.

Overview: Chapter 5.1 provides a brief overview of the characteristics of the medical equipment industry. Special focus is put on China. Chapter 5.2 presents the in-depth case studies.

5.1. Medical equipment industry

The following paragraphs provide a short overview of the medical equipment industry. Special focus is on the medical equipment industry in China.

Global healthcare challenges

On a global scale the medical equipment industry faces several acute challenges. While healthcare costs are increasing, the tax base of many public budgets is decreasing. Both societies in developed and emerging countries are confronted with aging populations that require more medical care. Especially, in emerging countries there are a large number of people who do not have access to medical care. But also in rural areas of the U.S. people have limited access to healthcare. 60 million U.S. citizen lack health insurance and 60 million lack regular bank accounts (Economist, 2012).

Industry characteristics

In general, the industry is characterized by high investments cost. These are based on three major aspects. *First,* in most countries approval requires a high number of clinical trials and high quality standards. The approval regulations vary strongly from one

country to another, which drives cost for adaptation. *Second,* the industry is driven by high-end technologies. To stay competitive, companies have to constantly develop new technologies, which necessitate costly basic research. *Third,* product failure could lead to acute health issues or even death. Thus, major effort is put into maintaining high quality standards. Additionally, the companies are burdened by high insurance costs against infringements.

Chinese medical equipment industry

Currently, China is the world's third largest medical device market followed by the U.S. and Japan. In 2009, sales revenue of medical equipment in China surpassed 14 billion USD (APCO, 2010). The Chinese medical equipment sector has continually experienced double digit growth rates and was forecast to reach 16 billion USD by the end of 2010. It is estimated that in five to seven years China will surpass Japan and become the second largest market in the world (APCO, 2010).This massive growth is partly due to state subsidies. In total, the Chinese government plans to spend 123 billion USD on its healthcare system within a timeframe of five years starting in 2009 (China Market Research Group, 2009). In the last years, the Chinese Ministry of Health invested over 1.3 billion USD in devices for tier one hospitals in rural areas (China Market Research Group, 2009). Subsidies are given to favor products made in China.

The Chinese medical equipment industry is highly competitive. A high number of smaller medical equipment providers and a few large MNCs from both developed and emerging countries populate it. There are over 3,000 Chinese medical equipment manufacturers including large Chinese multinational corporations like Weigoa, Mindray, and China Medical Technologies (China Market Research Group, 2009).

Demand for medical equipment in China is diverse. Besides tier three hospitals, which resemble the most advanced hospitals in China, tier two and tier one hospitals lack the resources to buy advanced diagnosis machines. Thus, the medical equipment manufacturers are challenged to develop high-end innovations and innovations for recourse-constrained customers that cater to the needs of the majority of the market. For example, for Siemens Healthcare China represents at the same time the largest single market for high-end and low-end products. Predominantly, high-end products are delivered to tier three hospitals – mostly military hospitals in metropolitan areas like Shanghai. The rural areas of China are the single largest low-end market.[7]

[7] Interview with Dr. Joachim Reiss, Head of Engineering Fluoroscopy, Siemens Healthcare, conducted on January 25, 2011.

5.2. In-depth case studies

As a means to increase consistency, comparability, and to avoid repetition, the presentation of the case studies follows a guiding structure. Nevertheless, firm specific characteristics and language are accommodated in the case presentations that follow the following structure:

- *Company profile*. A brief introduction to the firm's historical background is given. Key figures, products, and general strategy provide background information. Additionally, the organizational structure is described, which includes an outline of the product and market organization.
- *Emerging market strategy*. This section summarizes emerging markets strategy and illustrates current initiatives related to emerging market innovation.
- *China operations*. This paragraph provides a summary of the business activities and structural set-up in China. This includes an overview of the China strategy.
- *Reverse Innovation example*. To illustrate the innovation structure a reverse innovation project is presented.
- *Summary and generalizability*: This last section summarizes the findings by briefly illustrating the most distinct factors and evaluates the generalizability – to the degree data was available – of the illustrated innovation example.

5.2.1. Case 1: General Electric Healthcare

Company profile

GE Healthcare is a premium provider of medical solutions and services in the fields of imaging and information technologies, medical diagnostics, patient monitoring systems, drug discovery, and biopharmaceutical manufacturing technologies. GE Healthcare is part of GE Technology Infrastructure, which is one division of General Electric. The history of the healthcare sector of GE dates back to 1896. During its more than one hundred years' existence, GE Healthcare grew predominantly through merger and acquisition. In 2010, the company employed more than 51,000 people worldwide and is headquartered in Little Chalfont, Buckinghamshire, U.K. It generated revenues of 16.9 billion USD the same year.

GE Healthcare drives global leadership in every product category by developing new technologies, by creating high customer value, and by investing in emerging markets. In

2010, GE Healthcare invested 1.1 billion USD in research and development representing an R&D quota of 6.5 %. The focus of GE Healthcare is to tap into technologies that address today's healthcare challenges. GE Healthcare maintains a broad product portfolio and aims for global leadership in all of its segments. The portfolio provides hospital, clinical, and home solutions.

GE Healthcare is organized in a matrix structure that is set-up between the product organization and the market organization. GE Healthcare has five globally operating product organizations that are led by a CEO and Vice President (VP) of the respective business field. Each product organization represents a profit and loss center. Every CEO is a member of the executive board. The five product organizations are listed below:

- *GE Healthcare Surgery* offers intra-operative and interventional imaging products to help guide minimally invasive surgical procedures.
- *GE Healthcare Systems* provides a wide range of technologies and services including x-ray, digital mammography, computed tomography (CT), magnetic resonance (MR) and molecular imaging technologies, ultrasound, electrocardiogram (ECG), bone densitometry, patient monitoring, interventional imaging, incubators and infant warmers, respiratory care, and anesthesia management.
- *GE Healthcare Life Sciences* business offers products in drug discovery, biopharmaceutical manufacturing, and in cellular technologies.
- *GE Healthcare Medical Diagnostics* provides innovative imaging agents used during medical scanning procedures to highlight organs, tissue, and functions inside the human body.
- *GE Healthcare IT* provides comprehensive clinical & financial IT solutions including enterprise and departmental information technology products, radiology information systems (RIS), picture archiving and communication systems (PACS), and cardiovascular information (CVIS) systems, revenue cycle management and practice applications, to help customers streamline healthcare costs and improve the quality of care.

The market organization of GE Healthcare is split into five regional profit and loss centers that are led by a CEO and VP of the respective region. Each CEO is a member of the executive board. The regions are *Americas, Asia-Pacific (Japan), China, EMEA, and India.*

Emerging market strategy

To become a leader in emerging markets especially in China and India, GE Healthcare invests in its local as well as global footprint. Being local means investing in local capabilities. Therefore, GE Healthcare fosters ICFC (in-country-for-country) products. Products are designed by the engineers in that country for that country. The rationale is that the closer the engineers are to the customers the higher the local success will be. Having a great global technology base is core to enabling ICFC products as local engineers have the opportunity to select from a global technology base and execute these technologies locally. In 2008, GE Healthcare started a strategic initiative named 'healthymagination'. Its mission is to "*bring better health for more people at lower cost*"[8]. During a period of six years, GE Healthcare's corporate R&D directly finances ICFC development projects. Total funds account for 6 billion USD. The goal is to provide healthcare access to more people in the world, especially in the emerging markets by developing affordable products that meet local requirements. To foster ICFC products, development teams of every product division within GE Healthcare can apply for direct additional funding.

GE Healthcare China operations

GE Healthcare started its activities in China based on joint ventures in the early 1990s. Since then, it has taken full control of its local operations and has constantly expanded its business. In 2010, GE Healthcare generated revenues of 1.1 billion USD in China. The company maintains six manufacturing sites in China with a total staff of 5,200 employees, of which about 1,000 account for R&D and design engineering. GE Healthcare's goal is to leverage its global strength, capabilities, technologies, processes, and capital to the Chinese market by localizing supply chain, manufacturing, distribution, and product development. Hardware is manufactured locally and is supported with state-of-the-art software solutions. For rural customers a direct distribution system is established. Customized solutions and services expand the product portfolio for the dedicated market in China.

GE Healthcare serves two markets in China. *First,* the urban market – approximately 3,600 hospitals – is addressed with Western premium products. In this market, GE Healthcare faces competition from major global players. *Second,* the rural market – approximately 80,000 hospitals – is addressed dominantly by local players.

[8] GE (2010) Healthymagination Annual Report 2010.

GE Healthcare's low-cost ultrasound machines

GE's ultrasound products are organized as a self-standing division within GE Healthcare. The product portfolio of GE Healthcare's ultrasound business comprises systems in the field of diagnostics, gynecology, and cardiology. The ultrasound business is organized in four separated segments, each of which covers different products according to the market segment and use cases. The four segments are led by a global steering board that consists of the four segment heads and the head of the ultrasound division. The steering board assigns the R&D budgets for all segments over which each segment leader can dispose. The segments can apply for additional funding from 'healthymagination'.

One of the four segments is exclusively responsible for low-cost and emerging market products and has a global mandate including R&D, manufacturing, sourcing, product strategy, portfolio management, service for all of its products, and holds a global profit and loss responsibility. Additionally, the low-cost segment operates its own marketing that is aligned with the strategic marketing of the entire ultrasound division. The segment was established based on an initiative from the ultrasound business headquarters to compete in the low-end market of emerging countries. The segment is entirely located and managed in China.

An engineering team based in Wuxi, China executes the development for the low-cost ultrasound machines. Two experienced native managers lead the team, which consists of Chinese engineers only. During the development phase, the team makes use of GE's global technology base and is supported on demand by GE engineers from around the world. The core team furthermore regularly visits Chinese hospitals and small medical practices to gain a deep understanding of the local needs, as its credo is to develop solutions that exactly fit the local market. After the local product roll-out, possibilities of a global commercialization are evaluated and discussed with the steering board and the head of the ultrasound division. If a global commercialization seems promising, a small six to twelve month project is added to calculate the business cases and outline necessary adaptations of the existing local solutions to the requirements of other markets in the emerging and developed world.

> *"To realize in-country-for-country products and to commercialize them in the rest of the world, you need both, the required engineering and product management capabilities on-site." (GE Healthcare, Head of China Technology Center)*

Generally, the ultrasound products of all segments are distributed worldwide by the local market organizations. Regional teams who belong to the market organization do the operational dealership. In China, a 'go blue' sales team is formed that is responsible for the low-cost segment and focuses on specific sales channels that are different from the channels of the premium products. Sales supports the segments with market information from around the world.

As early as 2002, GE Healthcare launched its first compact low-cost portable ultrasound machine that was developed and commercialized in China. GE Healthcare's motivation was to offer basic image quality at the lowest possible cost for the local customers. For inexperienced users, the low-cost portable ultrasound machine is easy to use, compatible with local language, and portable for use in rural areas. It is based on a new, software centric platform to reduce the overall volume of the product and to meet the strict cost requirements. GE Healthcare achieved a cost reduction to 30,000 USD. In 2007, GE Healthcare could even further reduce cost to 15,000 USD that represents 15 % of the cost of GE Healthcare's high-end ultrasound machines (Immelt et al., 2009). The ultrasound machine operates with a standard notebook and can easily be adjusted because of its flexible product architecture.

Despite being initially developed in and for China, the low-cost portable ultrasound machine is globally commercialized also in Western hospitals where easy handling and portability are required. Additionally, the device can be used in emergency cases that cannot be handled at the hospital. Between 2002 and 2008, worldwide sales of portable ultrasound machines increased from USD 4 million to approximately 278 million USD of which 70 % accounts for emerging and 30 % for developed markets. The average price for an ultrasound machine sold in the U.S. dropped by 45 % in the last ten years. At the same time, GE Healthcare managed to increase contribution margins. Today, GE Healthcare is the largest provider of ultrasound machines in China.

Summary and generalizability

The initial decision to develop a low-cost ultrasound machine was made by the ultrasound business steering board at the headquarters. The central drivers were to compete against low-cost competitors on a local and global basis and to address a new market potential at the low-end segment. A development team was formed and located at GE Healthcare's Chinese ultrasound manufacturing site. The goal was to develop a device to address Chinese market needs. To achieve the goal, the local team was given a high freedom to operate that included access to corporate technology and autonomy to create their own product management and marketing. The low-cost ultrasound machine comes at a fraction of the costs of the existing Western product. Due to its portability and ease of use, it provides a high fit to Chinese market conditions. Today, the product is a global success also in developed countries.

The development of low-cost ultrasound machine represents one of the first complete product developments of GE Healthcare in and for an emerging market. Based on the experiences, similar projects followed in the field of imaging systems, including CT, MR, and x-ray. The projects share the high focus on local emerging markets. The outlined concept was adopted widely within the company. The potential global commercialization is based on business cases that are generated subsequently to the local development. In this way, the potential for global commercialization is institutionalized. Today, several other business fields share similar organizational structures as the ultrasound business, amongst others the CT business and the x-ray business. In total, GE Healthcare has managed to introduce 43 products and services that meet special requirements of emerging countries.[9]

[9] GE (2010). Healthymagination Annual Report 2010.

5.2.2. Case 2: Philips Healthcare

Company profile

Philips Healthcare is one of the worldwide leading providers of healthcare solutions. It is part of Royal Philips Electronics of Netherlands (Philips). Its product range includes screening, diagnosis, monitoring, and treatment machines. In 2010, Philips Healthcare generated revenues of 11.5 billion USD with 35,000 employees.

In all of its operational business areas, Philips Healthcare heads towards innovation leadership. In 2010, Philips Healthcare invested 935 million USD in research and development representing an R&D quota of 8.1 %. 48,000 registered patents show the innovative nature of the company. Philips currently holds around 35,000 registered trademarks, 56,000 design rights, and 3,100 domain names.

Philip Healthcare is organized in a matrix structure of three dimensions. In the business dimension, four business fields represent the product organization:

- *Imaging Systems*: interventional x-ray, diagnostic x-ray, computed tomography, magnetic resonance, nuclear medicine and ultrasound imaging equipment, as well as women's health.
- *Patient Care & Clinical Informatics*: cardiology informatics including diagnostic electrocardiography (ECG); enterprise imaging informatics, including radiology information systems (RIS) and picture archiving and communication systems (PACS); patient monitoring and clinical informatics; perinatal care including fetal monitoring and Philips Children's Medical Ventures; therapeutic care including cardiac resuscitation, emergency care solutions, therapeutic temperature management, hospital respiratory systems, and ventilation.
- *Home Healthcare Solutions*: sleep management and respiratory care, medical alert service, remote cardiac services, and remote patient management.
- *Customer Service*: consultancy, site planning and project management, clinical services, ambient experience, education, equipment financing, asset management, and equipment maintenance and repair.

The second dimension, the market organization, is divided into three sales regions: *North America, International, and Emerging markets.* The third dimension contains central functions including *Operations*.

Emerging market strategy

Philips Healthcare recognizes a clear demand for both state-of-the-art and value products in emerging markets. Therefore, Philips strategy is to become a leader in the premium segment and penetrate further in the fast growing mid- and low-end market. The company's goal is to continue a double-digit growth in emerging markets. Therefore, Philips Healthcare expands its emerging market footprint by small local-for-local and local-for-global acquisition to achieve product portfolio and channel improvements. Since 2000, Philips Healthcare has spent about 12 billion USD acquiring medical companies from which a significant share was invested in emerging markets. One example is the Shenzhen Goldway; a Chinese medical company specialized in patient monitoring systems. To facilitate value-priced products and services, Philips Healthcare is leveraging its supply chain capabilities in China, India, and Brazil. Due to a huge growing, competitive market and an emerging strong supplier base – with respect to components and technologies – a strategic focus of Philips Healthcare is on Asia.

Philips Healthcare's China operations

The company established its first joint venture in China in 1985. Today, it maintains two wholly owned entities for research and development and four manufacturing sites in China with about 3,400 employees. In 2010, the company generated sales of approximately 600 million USD in China.

Two separate regional management boards, the China Management Team and the India Management Team, lead India and China. Each management team is led by a CEO of the respective country and consists of a regional CFO as well as head of HR, the CTO Asia, and the local sector heads – representing Healthcare, Consumer Lifestyle, and Lighting. The local sector heads have a matrix like reporting structure. *On the one hand,* they interact directly with the global business sectors responsible for the global product portfolio. *On the other hand,* they are part of the regional management team.

Philips Healthcare's emerging market bedside patient monitors

In 2002, Philips Healthcare established a new organizational unit within its Patient Care and Clinical Informatics (PCCI) division, which is responsible for emerging markets products. Primarily, this unit focuses on patient monitoring systems in emerging markets for responding to the resource constraints of rural health institutions. The unit consists of four business segments, each of which came into existence through formerly

acquired companies, e.g., Shenzhen Goldway. Each of these segments develops products in and for emerging markets. Of these four, only one business segment uses the Philips brand and markets its mid- and low-end products not only in emerging but also in developed countries. Besides the 'emerging market product' unit, another unit within PCCI takes care of Philips Healthcare premium patient monitoring solutions.

A small management team based in Andover, USA, which is responsible for global strategy and solution architecture development, coordinates the entire emerging market patient monitoring business. It furthermore fosters the exchange of market and technological know-how across all segments. Despite being headquartered in the USA, the management team has allocated each segment's R&D, engineering, manufacturing, and quality management in the local markets in order to understand better local needs, to develop low-cost products in a favorable environment, and to benefit from the significantly lower cost structures compared to more developed countries. The local Chinese entity is exclusively focused on the development of value products. This setup ensures the goal to build local expertise while still having a global oversight over all activities.

> *"We put the bulk of the resource in the local markets […]. Less than 10 % of our resources are in the US, the rest are out in local markets. We try very hard to build local expertise in these markets. We still keep some global coordination and make sure we have this oversight. " (Philips Healthcare, General Manager Specialty & Emerging Markets Patient Care and Clinical Informatics)*

In the case of the segment that operates under the Philip brand, 45 Chinese employees are responsible for R&D, engineering, manufacturing, and quality management in Shanghai. The team makes decisions on local sourcing and execution of the development strategy, as they best understand local medical environment and are able to outline use cases based on close exchange with local health institutions. The Chinese developers are led by a local management team that is supported with global emerging market information by the management team in the USA. When needed, the U.S. management team subsidizes the local team with resources from the Philips design group on product design tasks. Initial assessments on product architecture are made in the U.S. Decisions on new products and their global commercialization are discussed in

collaboration between the local and global management team. The final strategic decisions are made in the U.S.

Triggered by the local use conditions that may include lack of air conditioning or humidity control, rough handling, less trained personnel, power surges, and immanent resource constraints of many hospitals, the Chinese R&D unit developed a basic and more robust bedside patient monitor for the emerging markets. While this robust monitor offers basic functionality, it comes at low cost and high quality and incorporates established and reliable technologies. Compared to its high-end line, Philips Healthcare managed to reduce costs by one third.

Although the robust low-cost bedside patient monitor was initially targeted for all emerging countries, special focus was put on China as the single largest market for this product. Today, India and China account for approximately 50 % of global sales of all low-cost patient monitoring systems while about 10 % of the low-cost patient monitoring systems are sold to price sensitive market segments in the developed countries such as the U.S. and Western Europe.

Summary and generalizability

To develop emerging market products focus is crucial. Therefore, within one business field, Philips Healthcare established a dedicated unit that is exclusively responsible for emerging market products and separated from the premium products. This unit comprises several acquisitions that are commercialized under a third brand and products that are marketed under the Philips brand. A management team located in the U.S. leads the unit. It makes final strategic decisions on product development, fosters global information exchanges, and has global oversight. There were two major drivers to locate the development and operations resources in the respective emerging markets. The lower cost structure allows a cost efficient development and production. The local personnel are better able to anticipate and translate market needs into new product offerings. The developed bedside patient monitor provides a ruggedized design. It offers basic functionality at a high quality and low price. Originally developed for emerging markets, the product is also sold in price sensitive markets in Western countries.

Other product categories followed the example of the patient monitoring business and developed in China for the local and global mid- and low-end market. Examples include a 16-slice CT scanner (MX16), ultrasound machines, and general x-ray system.

5.2.3. Case 3: Siemens Healthcare

Company profile

As a premium manufacturer, Siemens Healthcare develops advanced healthcare solutions in the fields of medical imaging, laboratory diagnostics, and medical information technology. Siemens Healthcare represents one out of four business sectors of the Siemens AG. Headquartered in Erlangen, Germany, the history of Siemens Healthcare dates back to 1877 when at the end of the 19th century the first x-ray machines were produced. In 2010, Siemens Healthcare generated revenues of 16.6 billion USD with 49,000 employees.

Siemens Healthcare has positioned itself as an innovation leader following a clear innovation strategy that includes technology strategy, resource optimization in R&D, improving the innovation process, as well as patent and standardization strategy. The company wants to become a pioneer in affordable and personalized healthcare. To stay competitive in the end, Siemens Healthcare realized that it must go beyond simply advancing towards new technologies. Thus, the company focuses on addressing local customers' needs and on improving the alignment of the global value chain towards a quick and cost efficient market response especially in emerging markets. In 2010, Siemens Healthcare spent 1.5 billion USD in research and development that represents an R&D quota of 9.0 %.

Siemens Healthcare has four divisions. Each division represents its own profit and loss center led by a CEO. Every CEO is a member of the Siemens Healthcare executive board. The four divisions are listed below:

- *Imaging & Therapy Systems* includes computed tomography (CT), magnetic resonance imaging (MRI), fluoroscopy and angiography (AX), molecular imaging, IT archiving, IT healthcare, ultrasound, and refurbished systems.
- *Customer Solutions* is responsible for the entire sales and service organization of Siemens Healthcare. It also includes the audiology solutions business.
- *Diagnostics* provides solutions for in vitro diagnostics, treatment, and monitoring. It offers more than 900 tests across multiple diseases.
- *Clinical Products* provide x-ray and ultrasound solutions to practices and hospitals. Additionally, it develops components and subsystems for medical devices and further developed core technologies.

Each division is subdivided into business units. Each business unit represents a profit and loss center that maintains its own customer relationship, engineering, product management, marketing, supply chain management, and manufacturing. The business unit *Customer Solutions* is responsible for the global sales and service. Sales is divided into the following regions: *Americas, Germany, EMEA and CIS (excluding Germany), Asia and Australia.*

Emerging market strategy

At the corporate level, Siemens realized that new kinds of products are required to address price-sensitive markets in emerging countries. Thus, Siemens Corporate Technology launched the SMART initiative. The goal is to develop '(s)imple, (m)aintenance-friendly, (a)ffordable, and (r)eliable products' for emerging markets – especially China, India, and Russia – and to bring these products '(t)imely to market' in all of Siemens business sectors. In the last ten years, Corporate Technology significantly increased its resources in India and China. Currently, it maintains three research centers in Beijing, Shanghai, and Bangalore to push SMART product innovation. In addition, it established a technology-to-business center in Shanghai, which fosters new business ideas in cooperation with internal and external partner. The goal is to use local resources and knowledge effectively to develop new solutions rather than simply downsizing Western high-end products. Corporate Technology functions as a service provider for the Siemens business units. As customers, the business unit can contract Siemens Corporate Technology for development project. In 2009, Siemens Corporate Technology's budget amounted to about 380 million USD, which was composed of contracted projects of the business units (about 60 %), corporate financing (31 %), and external funding (9 %).

Siemens Healthcare's China operations

To address the Chinese market, Siemens Corporate Technology China released the 80-20 solution: Western premium products or down-seized Western products cover 80 % of China's market needs; 20 % will be addressed with entirely new product offerings specifically developed for local needs (Achatz et al., 2009). For this purpose, SMART innovations play a vital role. These innovations are based on new ideas and value propositions and are enabled through new technologies or the combination of old technologies.

Siemens Healthcare has been represented in China for several decades. Currently, it maintains six operating companies that produce computed tomography, magnetic resonance, x-ray, ultrasound, and hearing instruments. With over 3,000 employees in China, the company generated in-country sales of about 1.2 billion USD in 2010. Siemens Healthcare maintains four R&D centers in China: Shanghai (computed tomography and x-ray devices); Wuxi (x-tubes); Shenzhen (magnetic resonance); and Suzhou (hearing products). All four R&D and manufacturing centers implement the concept of 'local development with a global perspective' providing high quality and affordable products for the worldwide markets. Siemens Shanghai Medical Equipment Ltd. (henceforth SSME) presents the largest site with over 800 employees of which 350 are researchers and developers. It was established in 1992 based on a joint venture with a local company. In 2005, Siemens Healthcare acquired 100 % share of SSME through buy-out. The SSME represents an R&D hub for Siemens Healthcare in China hosting subsidiaries of the computed tomography and x-ray business unit.

In July 2011, Siemens Healthcare launched the initiative 'healthy China' to improve the local healthcare system by providing innovative solutions. The company donated equipment worth 300,000 USD to 19 rural hospitals.

Siemens Healthcare's low-cost computed tomography scanner

The Computed Tomography division (henceforth CT) is a standalone unit within Siemens Healthcare whose product portfolio comprises a wide range of dual slice and multi-slice computed tomography scanners. In total, CT maintains two R&D and manufacturing centers: while the R&D center at the headquarters in Erlangen, Germany, concentrates on research and development of high-end technology products, the R&D unit in Shanghai focuses on the development of products for the mid- and low-end markets. Both entities work on two separated product platforms. The portfolio management, life cycle management, and roadmap planning for all products are located in Germany.

The overall product strategy is managed by the CT strategy board, which is composed of the CT head, CTO, operations head, head of product & design, and CT head China. The strategy board makes final decisions on product development and on where the products are sold. The entire R&D budget is consolidated at the CT headquarters in Germany and the R&D unit in Shanghai applies for budgets on a project basis.

For the initial product definition and to decide which projects are executed in China, Erlangen and Shanghai are in close cooperation. While the R&D in Erlangen makes final decisions, the local staff in Shanghai are responsible for further specifying product definition and to execute the development project. The local development is led by a Chinese team leader and executed by 150 Asian engineers (also including one product manager) and two Western delegates who are called in based on demand. Their tasks include system design, system engineering, hard and software development, test, validation, and sourcing (90 % of all parts are sourced locally in China). According to Western managers, especially sourcing represents a local skill set that Western engineers are lacking.

The Chinese project leader as well as the local engineers closely collaborate with their German counterparts and access their technological know-how for the development of the low-end products. On their own responsibility, the local team may add new features, based on their market insight and use experience in local hospitals and practices. However, to maintain the technological core know-how in Erlangen and to avoid a redundant development of competences, key parts concerning acquisition and imagery are located in Forchheim. Preassembled modules are supplied to Shanghai. On a quarterly basis, the R&D in Erlangen monitors the current R&D projects in Shanghai and provides advice.

Nevertheless, SSME is also involved in the development of the high-end products, especially regarding software development, as low-end and high-end systems use the same software platform. Half of the software development team in Shanghai is working on the high-end systems.

The R&D in Shanghai is also in close interaction with local sales and marketing that belong to the local market organization, also located in Shanghai. At regular intervals, the local development team visits local practices and hospitals to gain market insights. Additionally, the product managers in Shanghai are in close exchange with the global head of CT product management and design in Erlangen, which provides Shanghai with global product requirements and ensures that input from other markets goes into the development of the low-end products.

> *"The most important thing was communication – with local customers, within the team, and with the Siemens Medical Solution headquarters in Erlangen – and the experience of the local engineers and their know-how to develop products for the emerging market." (Siemens Healthcare, Project Leader low-cost CT scanner)*

In September 2000, the CT Shanghai introduced its first locally developed low-cost computed tomography system. It was designed to meet the needs of small radiological practices and hospitals in emerging markets. Based on the usage experiences, the CT team in Shanghai developed a new low-cost dual-slice computed tomography system with 3D radiography imaging only one year later. This product is characterized by long and reliable operating hours, fast workflow, compact design, and a low price compared to Siemens' computed tomography premium products. Despite the low price, the product meets the same quality requirements as the equivalent Western premium. Due to the limited previous experience of medical staff in emerging countries with advanced computed tomography scanners, it was designed for high ease-of-use. In some parts, it provides even more features than the premium products: Chinese engineers equipped it with internet access allowing online maintenance of the product; a feature that later became standard in the premium products as well.

During the first year after its introduction, over 400 units were sold making up one fifth of the annual sales of CT, and three out of four orders came from outside of China. It has been exported to over 20 countries including the U.S., Europe, and Latin America and sells most units to Japan in second place after China. In Japan, space is a critical issue and the CT scanner fit in practices where previous products were too large. Today, sales in developed markets make up about one quarter of total sales.

Summary and generalizability

Siemens Healthcare follows the goal to address the huge potential of China's middle- and low-end market. At the Siemens Healthcare site in Shanghai, the CT business maintains two development teams. One is assigned for supporting the development of high-end products in Germany. The other is exclusively responsible for the development of cost-efficient products for the Chinese and other emerging markets. The unit is led by a Chinese manager and consists predominantly of Chinese engineers. The

local personnel have a better understanding of the local market needs and are thus more eligible to develop products for the local market. The Chinese development team has the freedom to make its own decision on product features. Nevertheless, the headquarters in Germany defines the product architecture and makes the final decisions. The developed CT scanner is characterized by a basic design and functionality. Originally developed for emerging markets, the product is also sold in price sensitive market segments in developed countries, like Japan or the U.S.

At the CT business, several succeeding reverse innovation projects were conducted. Each project followed a similar development path.

5.2.4. Case 4: Draeger Medical GmbH

Company profile

Headquartered in Luebeck, Germany, Draeger Medical is a market leading company providing solutions in the field of critical care, perioperative area, intensive care, and obstetrics. The portfolio includes products for respiratory, anesthesia, continuous monitoring of vital signs and the respective accessories. In recent years, Draeger Medical's market position as a systems provider expanded considerably. Draeger Medical is one of two business sectors within Draegerwerk AG & Co. KGaA that was founded in 1889. In 2010, Draeger Medical generated sales of 1.5 billion USD and employed more than 6,000 employees, of which 11 % account for R&D. The company maintains five globally dispersed manufacturing facilities: Luebeck (Germany), Policka (the Czech Republic), Andover and Telford (the U.S.), and Shanghai (China).

Draeger Medical heads towards market leadership in all of its product segments through superior technology. System integration represents a core competitive advantage. According to clinical workflow, Draeger Medical not only sells individual products, but all the solutions necessary including hardware and software. This requires a coherent development of all single products, complementary services, and accessories. The latter make up one third of annual sales. In 2010, Draeger Medical invested 135 million USD in research and development representing an R&D quota of 6.9 %.

In the course of a major reorganization some years ago, Draeger Medical moved from a divisional structure along the product lines to a functional structure. Today, the company is organized along the value chain functions R&D, Marketing, Operations, and Sales. In the medical sector, marketing hosts six strategic business fields, each of which holds the global responsibility for the product portfolio in its respective field:

- *Anesthesiology* provides a whole range of anesthesia devices and vaporizers. In this field Draeger Medical is the number one in the European and number two in the U.S. market.
- *Respiratory* serves ventilators, being the market leader in Europe and number three in the U.S.
- *Neonatal Care & Thermoregulation* provides products in the field of incubators and phototherapy, being the number two worldwide.

- *Monitoring, Systems & IT* is the third largest global supplier of monitoring systems. The business unit further offers products in the area of infinity acute care systems, IT network solutions, telemetry, and IT solutions.
- *Infrastructure Projects* offers integrated workplace solutions, project business, gas management, architectural systems, and medical lights.
- *Lifecycle Solutions* provides training and service and is responsible for consumables and accessories as well as for multivendor services.

The strategic business fields do not maintain their own R&D resources. All R&D is concentrated in one organizational unit. This focus of the R&D resources is done to enable better development projects across product categories and to increase synergies. The central development organization is responsible for the R&D portfolio and global project management

Emerging market strategy

As a global company, Draeger Medical has been present in China and other emerging markets with its sales organization for many years. Nevertheless, Europe and the U.S. have represented the most important markets for a long time. The company realized that its existing products addressed the needs in emerging markets only to some extent. The current product portfolio had gaps that needed to be closed. The strategy was to strengthen a development hub in an emerging market to address better the requirements of emerging markets. Despite the emerging markets focus, all developed products were required to have a global market potential also in developed markets.

Draeger Medical's China operations

Draeger Medical has been present in China since the mid-1990s. The company entered the Chinese market based on a joint venture with a local investor, which still exists. The company localized the supply chain by bringing manufacturing capabilities and capacities to China. Today, the local activities of the company include development, purchasing, operations, and sales. This enables the local manufacturing of products. In 2008, Draeger Medical established a new manufacturing facility in China. The production site in Shanghai accommodates over 380 employees and replaced its leased premises. One business unit before the reorganization drove the investment in China when each business unit had full control over its value chain functions. The site in Shanghai represents Draeger Medical's only development and manufacturing site in an emerging country.

In China, products in all types of market segments are sold. With its current portfolio, Draeger Medical is able to serve most Chinese market segments. *First,* the high-end market is addressed with Western premium products. Here, Draeger Medical faces competition mainly from major global players. *Second,* the medium to low-end market of many hospitals is addressed with mid- and low-end products, facing competition from global and local players.

Draeger Medical's emerging market therapy device

In 2012, the Draeger Medical introduced its first therapy device enhancement for emerging markets that was developed under the leadership of the Shanghai site. The strategic business field that is responsible for the emerging market therapy device holds the global mandate for product management and marketing for the associated product category. The emerging market therapy device represents a life critical system predominantly used in hospitals. One of Draeger Medical's strategic business fields manages it. The strategic business field's products are developed and manufactured at two sites. In Luebeck, Germany, the majority of manufacturing and R&D resources are allocated. Luebeck is responsible for the development of products in all market segments. Shanghai recently introduced a product for the mid- and low-end market.

The product strategy is managed by the strategic business field that is located in Luebeck. It is further responsible for the portfolio management, product management, and roadmap planning. The strategic business field's devices are split into three major product segments – high, middle, and low. All segments are managed in one global portfolio.

The strategic business fields can propose a new development project to the portfolio management board (henceforth PMB) based on a business case. The business case includes feasibility, project duration, development costs, product costs, product specification, and market potential, including a proposition of where the product should be sold. Two main functions are involved in the generation of the business case. Marketing leads in providing market data and product requirements. R&D provides data on feasibility, development time, and development costs. The PMB meets annually and is composed of the executive board of the Draegerwerk AG & Co. KGaA, the function heads, and the heads of all strategic business fields. Based on the proposed business case a decision on the development project is made. The PMB directly releases the development budget for the project. Some members of the PMB are also represented

in the gate review board that is responsible for project steering. These members represent a bridge between the PMB and the development team. The gate review board is composed of a cross-functional team, which ensures adherence to the project plan and the implementation of the defined product requirements. The gate review board also establishes a cross-functional development team comprising the following domains: project management, product management, R&D, purchasing, operations, quality, and service. On certain milestones, the gate review board monitors the project team, provides advice, and may authorize additional financial resources when needed. In addition to the gate review board, the project management office requires monthly reports on project progress.

In 2008, Draeger Medical introduced its first therapy device that was partly developed in Shanghai. The product represents a cost-efficient device in the respective product portfolio of Draeger Medical. The product was based on a Western platform. After some years, it became obvious that a succeeding product model was required. The Chinese development team developed a mockup to drive the decision on the project. The team intended to signal that they had the required skills to develop the new product. Under the lead of the strategic business field and the support of R&D a business case was developed. In the course of the creation of the business case, the features and functional specification of the device were defined in collaboration with the Chinese engineers. In 2010, the business case was presented to the PMB. The decision to conduct the project under the lead of the development team in China was based on four reasons. *First,* the development of the new product did not include core technological competences and know-how that is only located in Luebeck. *Second,* the development team in China was expected to have reached a sufficient level of maturity and to have built up the required skills to conduct the project. *Third,* the proximity to the local market and sales would increase market fit. *Fourth,* the cultural background of the Chinese developers made the team more likely to develop a product that fits emerging markets.

Aligned with the specification presented to the PMB, the local development staff in Shanghai were responsible to execute the development project that included the technical conversion and further specification of product characteristics. Nevertheless, the gate review board whose team members were predominantly from Luebeck made final decisions. A Chinese project manager led the global cross-functional development team. Most of the team members were from Shanghai including engineering,

operations, and purchasing (some support function – e.g. master data management – reside in Luebeck). Their tasks included system design, hardware development, test, validation, and sourcing. The Chinese project manager as well as the local engineers closely collaborated with the product management that is located in Luebeck. In the course of many visits to China and other emerging markets, the product management team gained market knowledge and sensed market needs. They regularly met with customers and checked product specification before and during the development process to assure customer fit. On a technical level, the Chinese development team closely worked together with the technical documentation team, which is also located in Luebeck. In the initial project definition of the PMB it was assessed that an existing software code should be used for the emerging market therapy device to save development cost and to reduce project risk. Thus, the Chinese development team was required to develop the device accordingly. On their own responsibility, the cross-functional team was able to add new features.

In 2012, Draeger Medical introduced its first therapy device enhancement for emerging markets that was developed under the leadership of the Shanghai site. It was designed to meet the needs of several hospitals in emerging markets. The product is characterized by an adapted design, a larger screen that makes it easier to navigate and read as well as a competitive price compared to Draeger Medical's high-end products – reduced by roughly one third to the original Western equivalent. The product relies on a well-proven and rugged core system, which was taken over from a former Western product platform.

The emerging market therapy device is sold through the global sales organization that is organized according to seven regions and subdivided into country entities. Based on market structure and country regulations, each sales entity is free to decide which product to sell. All three product segments of the strategic business field are sold by the same country-specific sales teams, which are motivated through profit contribution. The emerging market therapy device was well accepted by the global sales teams. *On the one hand,* the device supported the premium products' price points. The price difference was easy to argue on the price-performance ratio. *On the other hand,* the device enabled the sales teams to sell a Draeger product to resource-constrained institutions that have not been Draeger customers before.

For Draeger Medical the emerging market therapy device was a success. Units and margin are better than expected. With respect to global sales numbers, the emerging market therapy device represents a significant portion of all sold Draeger devices in the associated product category. The majority of all sold products are distributed to emerging markets – China representing the single largest market; a low percentage is also distributed to developed markets.

Summary and generalizability

The decision to develop an emerging market therapy device was made by the Draeger Medical headquarters in Germany and was based on two major aspects. *First,* Draeger Medical planned to face competition from low-cost manufacturers on a global scale. *Second,* the emerging market subsidiary was willing and had the capabilities for a product enhancement. Right from the beginning, the emerging market therapy device was designed to have a global market potential. A dispersed cross-functional team was responsible for the development of the device. The major part of the team was located in China at Draeger Medical's manufacturing site. The emerging market therapy device is characterized by a low price point compared to Draeger Medical's existing products and relies on proven and tested Western technologies. The decision where the emerging market therapy device is sold depends on the local sales organizations. Today, the product is sold worldwide. The local emerging market and global success for Draeger Medical surpassed expectation.

The emerging market therapy device represents the first completed product enhancement project of Draeger Medical in and for an emerging market. Thus, it is not possible to generalize the presented project for Draeger Medical. According to management, the development projects marked a pilot that paved the way for further reverse innovation projects that will follow a similar path.

6. Conceptualizing reverse innovation

During the data collection, new insights emerged, which were not covered by the initial reference framework developed in chapter 4.5. Thus, I revised the initial reference framework based on the empirical results. This sets the basis for the cross-case comparison and the later conceptualization of reverse innovation. In the following, I outline the undertaken changes to the initial reference framework. These include new categories, new dimensions, and new causal relationships between the categories. The empirical data and the new insights are combined in a conceptualization of reverse innovation.

Overview: Chapter 6.1 provides a focused summary of the revised reference framework. In particular, the changes from the initial reference framework to the revised reference framework are outlined. Chapter 6.2 contains the cross-case analysis. The analyzed cases are reflected based on the revised reference framework. Thus, the cross-case analysis offers an illustration of the new categories, dimension, and causal relationships, which derived from the empirical data. Furthermore, the chapter discusses the results of the cross-case analysis. In chapter 6.3, I develop a conceptualization of reverse innovation based on the results.

6.1. Revised reference framework

The initial reference framework developed in chapter 4.5 is based on existing literature. It served as a reference for data acquisition and data analysis. The results from the data analysis entail new insights not yet covered by scientific literature. Therefore, the empirical data provides new perspective towards the initial reference framework. Thus, the initial reference framework is expanded and adapted according to new empirical insights. This procedure is in alignment with case study research proposed by Eisenhardt (1989) and Eisenhardt and Graebner (2007). Applying multiple perspectives on the data allows a valid extension of existing theory and scientific literature. Consequently, the tentative categories, their dimensions, and relationships represented in the revised reference framework serve as a basis for the analysis during the cross-

case comparison. *First,* I present a brief overview of the commonalities between the initial and the revised reference framework. *Second,* I outline the changes in detail.

The empirical data shows no severe conflicts to the initial reference frame. Thus, the fundamentals of the initial framework are maintained for the most part. The causal relationship between the 'Western MNC strategy', 'Western MNC resources', the 'Local environment' and the 'Emerging market innovation initiative' – the category name is changed to 'Emerging market innovation activity' as the initiative was driven by the headquarters – remained the same. The emerging market innovation 'organization' matrix proved to be fully applicable and was not subject to revision.

The empirical insights on how reverse innovations are developed and globally commercialized require further development of the initial reference framework. It appears that the development of emerging market innovation and its reverse diffusion represent two separate processes. While the reverse innovation directly relies on the emerging market innovation, the process of global commercialization is in three of the four cases dislodged from the actual development. Thus, the initial reference framework requires revision. Next, the changes to the initial reference framework are proposed. These include an adaptation of categories, new dimension, and new causal relationships between categories that emerged during data collection and analysis. Detailed empirical illustrations and a discussion of the revised reference framework will be provided in the cross-case comparison of the following chapter 6.2.

Figure 10 shows the revised reference framework. The new categories and the categories that contain changes to the initial reference framework are shaded in grey. Within the categories, each change is marked with a Roman letter. In the following paragraphs, each change is described in detail referring to the Roman letter.

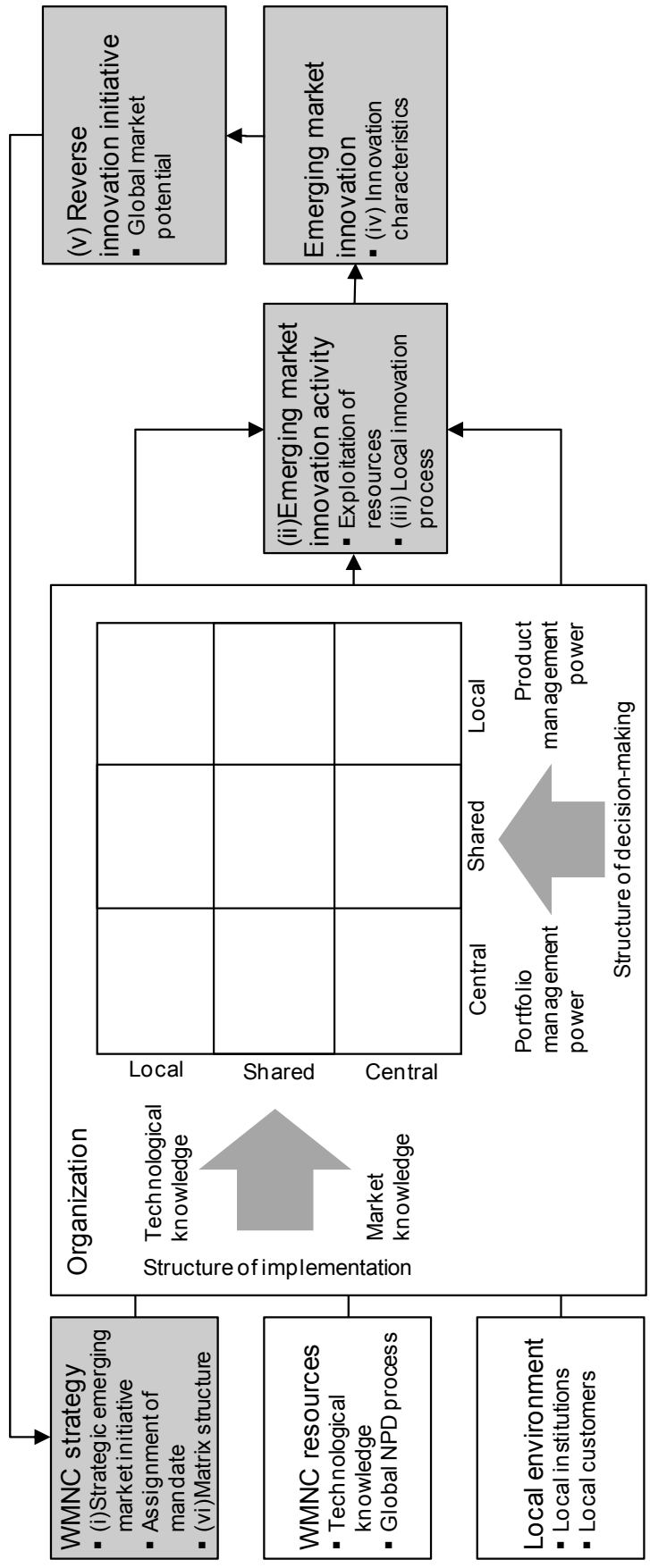


Figure 10: Revised reference framework

(i) Strategic emerging market initiative. In the initial reference framework, the Western headquarters assigns the mandate to the subsidiary. Within given freedom, the subsidiary can launch its own initiative for emerging market innovation. The data shows that in all cases the first initiative for an emerging market innovation activity came directly from the Western MNCs headquarters. The strategic decision was made after the emerging market subsidiary had been involved in the manufacturing and local sourcing for several years. The subsidiaries were perceived as being experienced enough to understand technologically the product. Under the overview of the headquarters, a development team was formed to conduct the emerging market innovation task.

(ii) Emerging market innovation activity. In all cases, the majority of developers that were responsible for emerging market innovation were based at the subsidiary in China. The emerging market innovation teams were complemented and supported by developers from the headquarters and/or other subsidiaries. These developers either were directly members of the emerging market innovation team or assigned to collaboration. Thus, the empirical data reveals that not a single MNC subsidiary is entirely responsible for the emerging market innovation activity. However, a dispersed development team characterizes the executing entities with the majority of resources at the emerging market subsidiary.

(iii) Local innovation process. Based on scientific literature it was expected that the emerging market innovation activities followed existing development routines of the MNCs. The data indicates that the emerging market development teams established its own routines that better fit the development task and the involved developers. These routines were apparent at the emerging market subsidiary.

(iv) Innovation characteristics. Based on the theory of innovation diffusion, the emerging market innovation was expected to be an adapted version of existing Western solutions. The examples show that the analyzed emerging market innovations differ in parts strongly from the Western equivalents. In one case, the emerging market innovation is based on a new combination of existing Western technologies. The cost reductions range from 30 % to 80 % compared to the Western equivalents. All emerging market innovations were targeted for special use cases that included adapted design and new features. The combination of drastic cost reduction and new application

fields created a new value proposition that had not been addressed by the existing Western products before.

(v) Reverse innovation initiative. According to literature on mandates and strategy development within MNC, the headquarters was assumed to define clear mandates for the developed product categories. The locus of the reverse innovation initiative varies in the sample. At one company, the initiative came from the local development team. The local developer aspired to a global mandate for their innovation. At two companies, it was a joint decision between the headquarters and the local team in China. At the fourth company, the initiative for reverse diffusion was based at the headquarters.

In three cases, the global market potential (including also developed markets) was first fully realized after the development of the emerging market innovation. It became apparent that the specific innovation characteristics could also meet latent needs in developed markets. The initiatives for the reverse diffusion had in all cases influence on the Western MNC strategy. Especially, it had an impact on the existing matrix structure of the Western MNCs.

(vi) Matrix structure. The reverse diffusion of emerging market innovation challenged the structure and strategy of the Western MNC. All analyzed companies had implemented a matrix structure between a product and a market organization. At the product organization, the firms offered two product types in one product category that follow a different value proposition. The potentially competing relationship between both innovation concepts (high-end vs. emerging market) had a possible impact on the market organization as the same sales teams distribute different innovation concepts. With respect to sales and marketing, this raises questions on sales channels and country specific sales restriction.

Overall, the revised reference framework remains in the same tradition as the initial reference framework. Nevertheless, the refinements provide a more complete picture of reverse innovation. Thus, the refined framework provides a richer and more nuanced account of the categories, their dimensions, and relationships understanding reverse innovation. Some new insights are merely interesting while others are more revealing and salient. The decision to become involved in emerging market innovation seems to be more strategically driven by the headquarters. Interestingly, the initiative for the global distribution was not located in all cases at the headquarters.

6.2. Cross-case analysis

The empirical insights reveal that emerging market innovation and its reverse diffusion represent a strategic and organizational challenge. However, within the analyzed Western MNCs approaches emerged that successfully facilitate reverse innovation. The analyzed MNCs implemented mechanisms that foster emerging market innovation and its global diffusion. The revised reference framework (see figure 10) sets the basis for the following cross-case analysis. Next, each category and its dimensions are discussed in detail.

6.2.1. Western MNC strategy

The analysis of the case studies reveals that in the majority of cases reverse innovation evolved as an emerging strategy that was triggered by external drivers. Interestingly, the decision to compete in emerging market innovation was in three of the four cases dislodged from the decision to commercialize the emerging market products also in developed markets. In one case, the initiative for global commercialization was entirely driven by the emerging market subsidiary. Thus, the initiative for emerging market innovation and initiative for commercialization in developed markets are analyzed separately. In all cases, the strategic intention to develop emerging market innovation was fostered by the headquarters.

Initiative for emerging market innovation

Urged by increasing pressure from local low-cost competition, the analyzed firms made the strategic decision to engage in emerging country innovation. GE Healthcare headquarters decided to face its competitors head-on by developing a new low-cost ultrasound machine targeted at emerging markets. This decision was made despite the concerns that such a product could jeopardize the company's more expensive, existing Western products.

> *"And in the discussion we quickly came to the point, if we do not do it [emerging market innovation], then someone else will. So, you will rather be cannibalized by your own brother than by someone outside the family. So, you are rather taking the lead or you get run over by somebody else." (GE Healthcare; General Manager, GE China Technology Center)*

Similarly, Philips Healthcare headquarters initiated the development activities of its bedside patient monitoring system as a means to compete against local competitors. Likewise, Draeger Medical's first emerging market innovation activities were driven by the headquarters to face local competition in 2008. Likewise, the Siemens Healthcare headquarters wanted to offer a local product that could be a real alternative to existing local solutions.

Assignment of mandate

In all four cases, the firm's headquarters made the initial decision to locate the majority of the innovation activities for the emerging market product in China and give the local subsidiary a mandate for the development. At all firms this location decision was based on three main factors: (i) due to the long manufacturing experience of Western based products in China, the local engineering teams were considered to have a sufficient technological understanding of the product and were thus capable to fulfil innovation tasks; (ii) the lower labor costs enabled a more cost efficient development; and (iii) Chinese engineers were more eligible to develop innovation for local and emerging markets than their Western counterparts as they better understand the market.

> *"We felt that the team had a particular skill set in China in terms of, first, understanding the local market, second, designing for low-cost, and third, maintaining a cost structure of R&D that was significantly lower than in the U.S. When we wanted to design products for the Chinese market all three characteristics fit quite well with the strategy." (Philips, General Manager Specialty & Emerging Markets Patient Care and Clinical Informatics)*

Additionally, managers at Siemens Healthcare and Philips Healthcare mentioned that Western engineers could not be motivated to work on low-end products.

Consequently, the Western headquarters assigned local development mandates to its Chinese subsidiaries. For example, the executive board of GE Healthcare's ultrasound business decided to develop a product that addresses the needs of rural hospitals and practices. Consequently, they formed a development team that was located at GE Healthcare's production site in Wuxi, China, with the task to develop a new emerging market ultrasound machine. This mandate included the freedom to develop local sales and marketing activities.

The reverse diffusion of the emerging market innovation had a strategic impact including mandate assignment. Since the global commercialization, GE Healthcare has adapted its strategies in the U.S. and other developed countries to include new low-cost offerings. The entire product portfolio of the low-end segment of GE Healthcare's ultrasound business is managed in and from the Chinese subsidiary. GE Healthcare's China ultrasound business has a profit and loss responsibility and holds a global mandate to design its own products. For example, the business in China develops and designs the product. Together with the business segments, they decide in which markets their products are sold. The head of the ultrasound division only interferes if the subsidiary's strategy severely threatens the success of other businesses.

Philips Healthcare and Siemens Healthcare chose to make a more gradual change in their strategy. In both cases, the definition of the product and sales strategies was a rather central decision. For example, Siemens Healthcare headquarters in Germany has the lead in defining the global product strategy with respect to the product type, the development location, and the target markets. One global product portfolio includes all CT products of the firm. This portfolio is managed centrally at the headquarters and includes the high-end devices as well as the emerging market products. However, the headquarters closely interacts with the management of the subsidiary in Shanghai, which actively participates in the strategy design process. In the case of Philips Healthcare, high-end and low-end patient monitoring businesses are managed separately. Both segments have their own strategy and maintain their own product portfolio. Additionally, both are managed at the headquarters in the U.S. The emerging market patient monitoring business is part of the low-end segment portfolio, which is also managed from the headquarters in the U.S. The U.S. headquarters holds the global mandate for its products.

At Draeger Medical, strategy and all product mandates reside at the headquarters in Luebeck. Thus, the headquarters uses the dislodged resources of its Chinese subsidiary for product development.

Matrix structure

All of the four analyzed firms implemented a matrix structure at least between the product organization and the market organization. The market organizations shows a high level of independence in the decision of which products they sell and how they sell the products. At GE Healthcare, the different regions can decide which products they

sell in the respective markets. Similarly, the sales regions of Draeger Medical can decide independently which products they sell. Siemens Healthcare takes a more gradual approach. The decision of which products are sold in which region is made in collaboration between the product portfolio management and the sales organization. Nevertheless, the product organization can decide not to sell a specific product in one market.

In two cases, reverse innovation had also an impact on the sales organization. After GE Healthcare had sold high-end and low-end products with the same sales teams, the company realized the large differences in market structure and product characteristics. Thus, the market organization decided to split both segments. Separate sales team for high- and low-end products were formed. This structure replicates the structure of the product organization. Now, there is a dedicated and focused team for low-end products, which competes in some areas with the 'high-end team'. Likewise, Philips Healthcare maintains dedicated sale teams for its low-end products.

6.2.2. Western MNC resources

In the course of the emerging market innovation development two resources were available for the emerging market innovation activity within the Western MNC network: technological knowledge and a global NPD process for innovation development.

Technological knowledge

In all cases, corporate technologies were made available to the development teams in China. In every analyzed project, the development teams relied strongly on the given resources. Draeger Medical's emerging market therapy device is based on an existing Western product platform. Siemens Healthcare's low-cost CT scanner is based on a well-established technological platform developed in Germany. Philips Healthcare's bedside patient monitor uses parts that are similar to the product components of its current Western products. GE Healthcare's low-cost ultrasound machine is based on technologies that were available within the corporate network.

Global NPD process

All firms established a global new product development process that defines milestones and development gates. Project management tools that are globally standardized and

available for the project managers support this new product development process. Nevertheless, it seems that the global NPD process played a minor role in the development of the emerging market innovation. Only in the case of Draeger Medical, the managers referred to the global NPD process as a supporting resource for the local development.

6.2.3. Local environment

The local environment of the development teams played a crucial role in acquiring market competences. Interestingly, local research institutions, universities, or other companies however were not named as a source for developing technological competences.

Local institutions

All analyzed cases stress the importance of supplier relationships. Before innovating for the local market, all firms localized their products, which involved the sourcing of components from Chinese suppliers. Thus, the companies had experience with local suppliers as the subsidiaries had a long history of local production and sourcing. At Siemens Healthcare, the CTO of CT termed the sourcing capabilities a special skill set that the German engineers do not have.

> *"One thing that is unique in China: the Chinese developers have a better understanding how to work with Chinese suppliers. [...] This is a skill that we cannot provide out of Germany. This is not only due to the language barrier, but this is mainly due to the fact that the handover is at a different level. The colleagues in Shanghai still have the ability to describe, draw, and design in great detail to provide the Chinese supplier with a detailed construction plan." (Siemens Healthcare, CTO CT)*

Interestingly, none of the analyzed firms referred to exchanges with research institutions or universities with respect to emerging market innovation.

Local customers

All interviewed managers pointed to the high importance of interactions with local customers to anticipate customer needs. All development teams interacted with local

physicians and hospital personnel to sense product requirements based on use cases. According to the interviews these exchanges had a direct impact on the ability of the local developers to innovate for the Chinese market.

6.2.4. Organization of emerging market innovation activities

The 'Organization' category offers a detailed picture of 'Western MNC strategy', 'Western MNC resources', and 'Local environment' leading to 'Emerging market innovation activities'. The analysis of innovation project data allowed generating insights into how reverse innovation is organized. Along the two dimensions 'Structure of decision-making' and 'Structure of implementation', the firms' organizational implementations of reverse innovation were analyzed. Table 6 provides an overview of the results.

The empirical data shows that the firms implemented similar organizational structures. In all cases, the Chinese activities formally belong to a corporate division whose headquarters are located in the West. However, the degree to which headquarters control is exerted and tasks are divided between the headquarters and the subsidiary differs between the firms.

Structure of decision-making

The analysis reveals that most of the firms employ a rather centralistic decision-making procedure. This is most apparent at Draeger Medical in which the decisions about the firm's global portfolio strategy as well as decisions about the emerging country product offerings are determined by the headquarters. These decisions entail how different product lines are distinct from each other (e.g. features and performance) and on which technological platforms they are built. At Draeger Medical, the headquarters finances development activities on a project basis directly by the executive board.

The analysis indicates that Philip Healthcare pursues also a more central approach. At Philips Healthcare, the headquarters consists of only a few senior managers who collect market relevant data from their units around the world to determine the global product portfolio and emerging market product offerings for specific markets. All R&D projects are approved by the headquarters. Local product market strategy is formed in collaboration with the local unit. Nevertheless, the headquarters has the final say.

Table 6: Organization of emerging market innovation activities

Firm	*Structure of decision-making*		*Structure of implementation*	
	Product portfolio power	*Product market power*	*Technological knowledge*	*Market knowledge*
GE Healthcare	**Local** GE Healthcare's four segments are led by a global steering board. The emerging market segment is entirely located in China. Each segment head can freely dispose of the assigned R&D budget.	**Local** Emerging market segment has a global mandate including R&D, manufacturing, sourcing, product strategy, portfolio management, and service. Segment also holds a global profit and loss responsibility.	**Shared** During the development phase, emerging market segment makes use of company's global technology base. On-demand support by engineers from entire firm network.	**Local** Emerging market segment has own marketing which is aligned with the strategic marketing of the entire business.
	Local ▪ Decisions on new products are made at subsidiary. ▪ The subsidiary can apply for additional resources at the headquarters.		**Local** ▪ The product development is initiated and executed by an engineering team based at the subsidiary in China.	
Philips Healthcare	**Central** The product portfolios (high-end & low-end) are managed by HQ. Local R&D projects must be approved by the HQ.	**Shared** Global market research and sales is coordinated by a small management team at HQ. HQ consults with local subsidiaries to define product market strategy including product prices, design features, and target markets.	**Local** HQ has no technological competence but fosters exchange of technological know-how across all segments. HQ supports local teams in product design if required. Initial assessments on product architecture are made by HQ.	**Local** HQ marketing team fosters exchange of market know-how across all segments. International market information is analyzed at HQ.
	Central ▪ Decisions on new products are made centrally by HQ for all product segments. ▪ In the course of the decision making the local subsidiaries are consulted.		**Local** ▪ Product development takes place at the subsidiary in China	

Firm	*Structure of decision-making*		*Structure of implementation*	
	Product portfolio power	*Product market power*	*Technological knowledge*	*Market knowledge*
Siemens Healthcare	**Central** Executive board allocates R&D budget and defines product portfolio at HQ.	**Shared** Products for emerging markets are designed in close collaboration between HQ and subsidiary. Subsidiary head is involved in product management decisions.	**Central** Key technologies for product portfolio are developed at HQ. Subsidiary has engineering competence for frugal products.	**Shared** Global marketing team collects market information. Subsidiary development team exchange with local customers
	Shared ▪ Final decisions on product development, price points, design features, target markets, entry times are made by executive board at the HQ. ▪ Head of CT China is member of the board ▪ Local subsidiary is consulted for specific market questions / can make proposition on product development.		**Shared** ▪ Adaptation and engineering activities are performed by local engineers in the subsidiary ▪ Subsidiary initiatives incorporate new product components and features ▪ Core components are delivered by HQ	
Draeger Medical	**Central** Product portfolio is determined at HQ. Finance of local R&D projects by the central executive board.	**Central** Product prices, product architecture, functional specifications, target markets, and entry times are defined at HQ.	**Central** All product technologies are developed and maintained at the HQ.	**Shared** Worldwide product management is based at HQ. Regular meetings with local customers to assure customer fit.
	Central ▪ Decision on new products are made centrally in the HQ by the executive board ▪ On certain milestones, a gate review board -located at the HQ monitors the development team at the subsidiary and may authorize additional financial resources when needed		**Shared** ▪ The local development staff in China is responsible for execution of the development project that includes the technical conversion and further specification of product characteristics ▪ The tasks of the local development team include system design, hardware development, test, validation, and sourcing	

Siemens Healthcare follows a more shared approach regarding product market power and the decision-making of new emerging market product innovations. Here, the authority for the firm's entire product portfolio resides at the headquarters. However, the subsidiary may initiate a new innovation project, which then needs to be approved by the headquarters. This constellation implies an increased autonomy of the local R&D unit, which seems to be able to develop emerging market products. Although the product market power resides at the headquarters as well, they closely consult with their local R&D unit to ensure that all market information is up to date and incorporated in headquarters decisions. The head of CT Shanghai is member of the executive board of CT and thus can influence strategic decisions. Headquarters closely consults with their local R&D unit in China when it comes to the development of emerging market products. Due to the extensive local market know-how, the head of the Chinese engineering team is involved in decisions on product features and design and he plays an important role in the predevelopment phase of the emerging market product.

GE Healthcare represents the only firm in the sample that completely employs a local approach. The worldwide product portfolio for emerging market products is located at the Chinese unit. Although GE Healthcare has a central steering board, which oversees all innovation projects of their four segments, the decisions about emerging market innovations are made at the local subsidiary in China. The Chinese subsidiary is fully responsible for their entire product portfolio and even holds a profit and loss responsibility for its operations. The emerging market segment can dispose freely of its budget, which is passed on an annual basis from the headquarters.

> *"So, it is production and product engineering on one side, on the other side it is product management and marketing. Those are the two capabilities you need to build. Building up the engineering capability is relatively easy, but we are still learning in building up the marketing and product management capability. This takes a lot more time and it is a more challenging task than the technical." (GE Healthcare, General Manager, China)*

With respect to the question of which products are offered in which target markets, the analyzed firms take different approaches. In the case of Siemens Healthcare and Philips Healthcare, the headquarters determines target markets and price points. The headquarters closely interacts with sales. At Draeger Medical, the sales organization has

a high autonomy. The regions can decide which products they sell. At GE Healthcare, the Chinese subsidiary manages its own local sales channels. On a global scale, GE Healthcare maintains two separate sales teams – one for high-end and one for low-end products. The Chinese subsidiary is in close interaction with the global sales for the low-end segment.

The decision-making structures also reflect the approach of control mechanisms. The subsidiary of GE Healthcare enjoys a rather high degree of autonomy from headquarters in the development of low-cost products. The executive board of the ultrasound business only intervenes if the activities of one of the four segments are in conflict with the overall strategy. The development activities in the Chinese subsidiaries of Philips Healthcare, Siemens Healthcare, and Draeger Medical are more tightly controlled by central headquarters. On a regular basis, the local subsidiary is monitored, controlled, and coached.

Structure of implementation

The data reveals that the technological competence for emerging market innovation in half of the firms resides at the headquarters. This is true for Siemens Healthcare and Draeger Medical. The headquarters develop and maintain the technological core competencies for the firms' entire product portfolio. In these cases, the local R&D units use centrally existing technologies to develop emerging market products within the strategic boundaries given by the product portfolio and product market strategies. According to management, transferring core technological knowledge and thus intellectual property is a risk due to knowledge drain and the weak legal enforcement regime present in China. Therefore, the central R&D headquarters has a tight control over the technological knowledge. Components that contain core technologies are transferred as a 'black box' to the local subsidiary for final development and product assembly.

At GE Healthcare and Philips Healthcare, the technological competence in terms of designing and developing the emerging market innovation is located at the subsidiary in China. Particularly in the case of GE Healthcare, the entire process from idea generation to product concept, material sourcing, and full scale development takes place at the subsidiary. Nevertheless, no technologies are developed at the Chinese subsidiary. All technologies in use come from the corporate technology base.

At GE Healthcare, the subsidiary's market competence entails that it possesses an emerging market innovation competence that is not present at the headquarters. The entire development team consists of Chinese engineers and the subsidiary is managed by a native-born Chinese. It is the firm's strategy to empower local people in their local markets due to their extensive local market know-how. This is also true for Philips Healthcare. The market knowledge resides at the subsidiary. The headquarters only fosters exchange on market know-how between the various subsidiaries in emerging countries. In the case of Siemens Healthcare and Draeger Medical, the market knowledge is shared between the subsidiary and the headquarters. The subsidiary development team is in close exchange with local customers and collects in-depth market knowledge. The global marketing team at the headquarters collects all market information from the various subsidiaries and closely discusses with the development team the local market fit of the products.

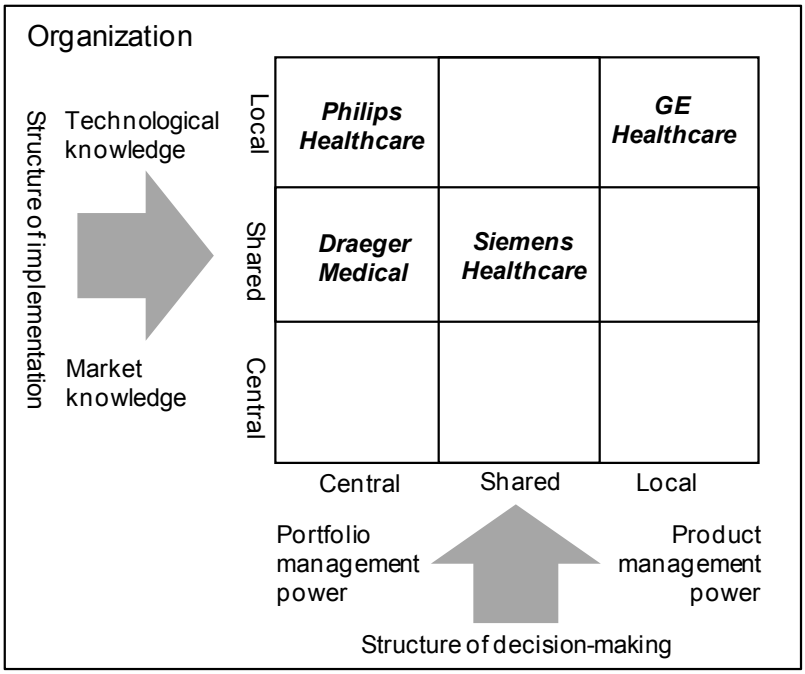


Figure 11: Organization of emerging market innovation activities

Thus, in contrast to the structure of decision-making, the structure of implementation regarding development activities of the emerging market product tends to be more shared between headquarters and subsidiary. Figure 11 provides an overview of the results.

6.2.5. Emerging market innovation activities

A common trait across all cases is that the majority of the innovation activities for the emerging market products were performed in China. All development activities were led by the Chinese subsidiary. Yet, the degree to which the Chinese development activities were supported by the headquarters or other subsidiary differed. At Draeger Medical and GE Healthcare, some activities during the project were performed outside the subsidiary, while Siemens Healthcare's and Philips Healthcare's approaches were more spatially concentrated. At Draeger Medical, the development team included several members from the headquarters. Thus, a global team conducted the project execution. At GE Healthcare, the development team was directly supported by other subsidiaries. Engineers at other sites were dedicated full time to support the Chinese team. The development team of Philips Healthcare was only supported on a contract basis by corporate design and R&D. Siemens Healthcare's innovation activities took place entirely in Shanghai.

Exploitation of resources

In all analyzed cases no new technologies were developed. Existing technologies available in the corporate network were exploited and in some cases recombined for emerging market innovation. In the case of Siemens Healthcare, Philips Healthcare, and Draeger Medical the knowledge base was secured by transferring an existing, well-established product platform to the emerging market subsidiary. Based on manufacturing, the R&D personnel learned about the technological features of the product and gained a better understanding of it. In the course of the further development of the product, the teams did not search for additional technologies available in the corporate network. In the case of GE Healthcare, a new team was formed to develop a new product. The team was located closely to the manufacturing of the existing ultrasound machines in Wuxi. Nevertheless, this team actively searched the corporate network for new technologies and was additionally supported by developers, not only from the local manufacturing site.

Emerging market innovation process

According to the gained empirical insights, the emerging market innovation seems to differ from the established innovation process. Two aspects indicate this. *Firstly,* the development activities relied in all cases on local personnel. The development teams were deliberately composed of Asian or Chinese engineers in particular. Their cultural background was expected to enable them to better develop products for the local

market. *Secondly,* in the majority of cases the development of emerging market products was separated from the established development processes to avoid mutual dilution.

In all cases, the head of the product development team and the core development team were natives from China or other Asian countries. Managers from all analyzed MNCs pointed out that understanding the local environment and user behavior was vital to product success. Having a team consisting almost exclusively of local engineers guaranteed that they could effectively translate local requirements into products. This was based on two major assumptions:

Firstly, local engineers are able to interact with local suppliers. In particular, managers from Siemens Healthcare headquarters stressed that the Chinese colleagues have a skill set to interact and negotiate with Chinese suppliers that their Western counterpart do not have. *Secondly,* Chinese developers better understand and anticipate local customer needs. They are also better at translating these needs into product solutions. For example, Philips Healthcare sought to understand how their products were actually used under local conditions. By observing local doctors at work, they discovered that their bedside patient monitors were used not only as a display device but also as a writing pad that was carried around and even taken into operating rooms where it was exposed to sweat and blood, a scenario unimaginable in Western hospitals. The Chinese engineers translated the requirement into a new product offering that met the restricted budgets of Chinese customers. Several interview partners stated that a local development team is necessary to develop low-cost innovations, as Western engineers are likely to have problems understanding and translating true local customer problems.

> *"In the US, engineers always want the best. Local competitors for example in China are more willing to make trade-offs: Chinese customers cannot afford the best technology. So, they give them the best they can buy for their money. That is a mindset that traditionally has been difficult for people in the U.S. and Germany to get their heads around." (Philips Healthcare, General Manager Specialty & Emerging Markets Patient Care and Clinical Informatics)*

Siemens Healthcare explicitly separated high-end development activities from low-end activities. At the Siemens Healthcare Shanghai subsidiary, a team of programmers develops software for the high-end products manufactured in Germany. In parallel, another team develops emerging market products. The development also includes separate software programming for the emerging market products. Nevertheless, there is no exchange between both development teams as different capabilities are required for both development tasks. A mutual dilution should be prevented. Similarly, Philips Healthcare strictly separates the innovation process of the low-end segment from high-end segment by establishing a dedicated organization unit for emerging market products. GE Healthcare's emerging market ultrasound represents a separate segment within the overall ultrasound business. It has its own marketing and portfolio management. Draeger Medical marks an exception to the previously discussed structures. The emerging market products are developed in the same structure as the high-end products.

6.2.6. Emerging market innovation – characteristics

The displayed cases reveal commonalities and differences in emerging market innovation characteristics. The following paragraphs outline a cross-case comparison in the emerging market innovation, which include product characteristics, relative price point; technology base; market knowledge base, and stage of product life cycle. Table 7 gives an overview of the discussed categories.

Product innovation characteristics

All analyzed emerging market innovation offer only basic functionality in comparison to the Western equivalent. They include adapted features and cost considerably less. All firms assessed the educational level of medical staff in the emerging market as being lower than in the West. Thus, parallel to offering only basic functionality with limited features the products were designed specifically for ease of use. In the case of GE Healthcare, the ultrasound machine works with an off-the-shelf laptop and is highly compatible with the Chinese language. This made it easy to use for Chinese doctors. The ultrasound machine was also targeted to doctors in rural areas of China. Thus, portability became an important requirement. In most cases, patients in rural areas are not able to visit practices due to the absence of reliable public transportation. Consequently, doctors treat their patients at their home.

Especially products that are targeted for the middle- and low-end segment face infrastructural challenges – like power surges, dirt, high humidity, constrained space, rough handling. Consequently, GE Healthcare and Philips Healthcare invested in improving the reliability and the ruggedness of their offerings. In addition to infrastructural challenges, Siemens Healthcare adapted its CT scanner to longer working hours and higher patient rates. Without influencing basic quality and reliability, Draeger Medical used cost-effective materials and adapted designs to reduce further the price point.

> *"For China you have to make the product rugged and bullet proof, because conditions are rough and difficult – no air-conditioning, things are handed roughly, power surges. This often is why Western products fail. But, those products [developed in China] also work in the West." (Philips Healthcare, General Manager Specialty & Emerging Markets Patient Care and Clinical Informatics)*

Technology base

In all analyzed cases, the emerging market innovations were based on existing technologies that were available by the corporate technology base. Draeger Medical, Philips Healthcare, and Siemens Healthcare used an existing technology platform for their emerging market innovations. At the core, these platforms were unmodified. GE Healthcare used a new combination of existing technologies. Some of them have never been used for an ultrasound machine before. Thus, the development of the product necessitated the development of a new product platform based on existing technologies. The GE Healthcare case shows the highest degree of technological novelty.

Market knowledge base

In the case of GE Healthcare and Siemens Healthcare, the local development teams were in direct contact with local hospitals and physicians. The goal was to gain in-depth market insights to enable innovations that meet market needs. In both cases, the initial product innovation was exclusively targeted for the local market. In a following step, the product was adapted to legal requirements and local peculiarities of other markets. For Philips Healthcare, the global marketing team collected market needs and preferences globally and forwarded them to the Chinese subsidiary. Product design and product features were aligned with the global preferences by the Chinese development

team. In the case of Draeger Medical, the product features and its design were defined with the senior management board at the beginning of the development project. Thus, local adaptations based on market knowledge were limited.

Stage in product life cycle

In all cases, the underlying products have been in Western markets for more than 25 years. All of the products are considered 'medical standard equipment' in Western hospitals. In addition, all have reached a high degree of market maturation in developed countries. In all cases, the devices' basic working principle has not changed since market introduction. CT scanners have been in the market since the early 1980s. The first dual slice scanner was introduced in 1992 and it later became a standard device. For most medical applications, the dual slice CT scanners offer sufficient quality. More sophisticated 16, 64, or even 640 slice scanners can provide improvements that are only required in specific use cases. Ultrasound devices and patient monitoring systems have been in the market since the 1960s. The basic active principal has not changed since. The product category and the workings principle of the emerging market therapy device of Draeger Medical has not changed for decades.

Relative price point to Western equivalent

The comparison of the relative cost reduction of the emerging market innovation with the Western equivalent shows a dichotomy. GE Healthcare and Siemens Healthcare were able to achieve a cost target that is more than 80 % lower than the Western offering. This tremendous price difference offered the possibility for many institutions to afford a device for the first time. By contrast, Philips Healthcare and Draeger Medical only achieved cost reduction of about 30 %.

Emerging market innovation performance

Based on manager feedback, all projects exceeded expectations both in emerging markets and on a global scale. At GE Healthcare and Siemens Healthcare developed markets account for more than 25 % of the globally sold products. Considering the much larger market size of emerging countries compared to developed countries, this marked a huge success. At Philips Healthcare, the developed market share is 10 %. This is more than expected as the product was initially only targeted at emerging markets. For Draeger Medical no distribution of market share was provided. According to management, the emerging market therapy device exceeded expectation and is regarded as a product success.

Table 7: Emerging market innovation characteristics

	GE Healthcare *Low-cost ultrasound machine*	*Philips Healthcare* *Bedside patient monitor*	*Siemens Healthcare* *Low-cost CT scanner*	*Draeger Medical* *Emerging market therapy device*
Positioning	Low-end segment	Middle- / low-end segment	Low-end segment	Middle- / low-end segment
Estimated cost reduction compared to Western equivalent	80 %	30 %	80 %	30 %
Product characteristics	▪ Basic functionality ▪ Standard laptop as data processing and imaging unit ▪ Support of local language ▪ Portable ▪ High ease of use	▪ Basic functionality ▪ Robust design ▪ High reliability ▪ High ease of use	▪ Basic functionality ▪ Designed for intensive use and fast workflow ▪ High reliability ▪ High ease of use	▪ Basic functionality ▪ Simple materials ▪ Adapted design ▪ High reliability
Technology base	New combination of existing technologies	Existing Western product platform	Existing Western product platform	Existing Western product platform
Market knowledge base	China market insights	Emerging market insight	China market insights	Emerging market insight
Approximate sales by region	70 % emerging countries 30 % developed countries	90 % emerging countries 10 % developed countries	75 % emerging countries 25 % developed countries	n/a
Innovation success	Above expectation	Above expectation	Above expectation	Above expectation
First introduction of product category	1960s	1960s	1980s	n/a

6.2.7. Reverse innovation initiative

With the exception of Draeger Medical, all of the analyzed MNCs initially focused on the development of low-end products for China or other emerging countries and only later marketed these products in developed countries. In the case of Draeger Medical, from the outset the emerging market therapy device was intended to have market potential in developed markets too.

At GE Healthcare, the Chinese subsidiary proposed a global business case to the management board of the ultrasound business. When the company recognized that low-cost competitors from emerging countries might take over the low-end market segment also in developed markets, GE Healthcare headquarters approved the proposal and the company started to sell its emerging market product also in developed countries.

At Philips Healthcare and Siemens Healthcare, headquarters and subsidiary collaboratively discussed developed market potential. In both cases, the final decision was made by the Western headquarters.

> *"If we cannot compete in China and bring the products to the West, then our competitors are going to do it. So, it is better that we cannibalize our high-end portfolio ourselves." (Philips, CTO China)*

At GE Healthcare, Philips Healthcare, and Siemens Healthcare, the Chinese subsidiaries are incentivized on internal transfer prices received for every sold unit. There was no resistance to enlarge the market reach.

6.2.8. Control variables

The present thesis intends to provide empirical insight into how Western MNCs facilitate reverse innovation. The goal is to unfold cause and effect between the identified categories including their dimension and reverse innovation. To minimize alternative explanation approach core control variable and their possible effect on the innovation outcome are analyzed.

In summary, the analyzed Western medical equipment manufacturers represent a highly comparable sample that limits the probability of alternative explanation approaches based on differences in the control variable. Table 8 represents an overview of the considered control variable. Compared to the other three Western MNCs, Draeger Medical reveals some differences, which may influence its emerging market innovation activity.

Table 8: Control variables

	GE Healthcare	*Philips Healthcare*	*Siemens Healthcare*	*Draeger Medical*
General company data				
Year of corporate foundation	1896	1895	1877	1889
Location of headquarters	U.K.	U.S.	Germany	Germany
Employees	51,000	35,000	49,000	6,000
Sales	16.9 billion USD	11.5 billion USD	16.6 billion USD	1.97 billion USD
R&D expenditure	1.1 billion USD	935 million USD	1.5 billion USD	135 million USD
R&D quota	6.5 %	8.1 %	9.0 %	6.9 %
China operations				
Year of entry	early 1990s	1985	1990s	1980s
Entry mode	Joint venture	Joint venture	Joint venture	Joint venture
Degree of control	Wholly owned entity	Wholly owned entity	Wholly owned entity	Partly owned entity
Sales in China	1.1 billion USD	600 million USD	1.2 million USD	n/a
Employees in China	5,200	3,500	3,000	380

The reference year for all data is 2010.

All firms follow a growth strategy in China and are committed to make investments to foster emerging market innovation. All four firms entered the Chinese market based on a joint venture. All MNCs, except Draeger Medical, took over the shares and now own the Chinese units. GE Healthcare, Philips Healthcare, and Siemens Healthcare are part of a corporate group that maintains a corporate research and development unit that serves all business sectors. Nevertheless, in the analyzed reverse innovation cases, no project was directly supported by corporate funds and emerging market programs. In the case of the ultrasound machine, no funding was directly applied from the healthymagination program. Likewise, the development of the low-cost CT from Siemens Healthcare did not involve funding from the SMART program.

6.2.9. Summary and discussion of cross-case analysis results

The analyzed emerging market innovation cases show a high variance in terms of price point, degree of local adaptation, and degree of innovation novelty. With its ultrasound machine, GE Healthcare achieved a tremendous cost reduction. It is based on a new combination of technologies that have partially never been used in an ultrasound machine before. Compared to the other analyzed case, the ultrasound machine has the highest degree of innovation novelty. Due to its portability, the ultrasound machine offered new use cases that were not addressed by the conventional products before. Like GE Healthcare, Siemens Healthcare could achieve an enormous cost reduction with its CT scanner. The product is based on an established platform but offers new features to its customers. Due to its compact design, the CT scanner could be placed in more medical practices where conventional scanners do not fit. Philips Healthcare's patient monitoring is sold at a price that is 30 % lower than the premium products. It is based on an established platform and offers adapted, basic functionality at a high quality. The product is ruggedized to meet harsh local conditions. Draeger Medical's therapy device meets a similar cost target. The product is also ruggedized for Chinese use cases. It offers similar functionality as the Western equivalent. Compared to the three other cases, Draeger Medical's therapy device has the lowest degree of innovation novelty.

The following section summarizes the central findings of the cross-cases analysis, discusses the variances within the analyzed cases, and tries to provide explanations.

Reverse innovation as a nascent strategy

With the exception of Draeger Medical, reverse innovation emerged as a nascent strategy in all cases. The projects of GE Healthcare, Philips Healthcare, and Siemens Healthcare first aimed to provide solutions to China in particular or emerging countries in general and were only later considered for commercialization in developed countries. This proceeding minimized potential compromises in early development phases.

After the emerging market innovation was successful in China and other emerging markets, initiatives were formed for global commercialization. A profit share motivated the local teams for every unit sold. The decision of global commercialization had also strategic impact on the firm's global market organizations. For example in the case of GE Healthcare, the market organization structure was adapted according to the structure of the product organization. A double structure was implemented. This way, the first

reverse innovation projects opened the possibility for further project and institutionalized reverse innovation. For example, after the development of the low-cost CT several succeeding reverse innovation projects were executed by Siemens Healthcare.

Different business strategies

The business strategy varied in the analyzed cases. In the case of GE Healthcare and Siemens Healthcare, business strategy focuses on providing healthcare to a new emerging middle class in developing countries. Thereby, both companies focus on China as the largest single emerging market. They rely on recognition of their strong brands in Asia. Both companies offer their most price efficient products in its respective category under their original brand.

In addition to the original Philips branded product segment, Philips Healthcare maintains several non-Philips brands in emerging economies, which target the low-end market and compete against local cost leaders. For example, Shenzhen Goldway, a Philips Healthcare acquisition in patient monitoring, competes against Chinese low-cost medical equipment manufacturers like Mindray. The price level of Shenzhen Goldway is lower than the products commercialized under the Philips brand. The emerging market segment under the Philips is positioned above Shenzhen Goldway. It is targeted at customers that have a restricted budget but still want to rely on high Philips quality and longevity standards.

Draeger Medical decided not to compete with local products based on absolute cost advantage. Rather the company positioned its emerging market products at a higher price level, but still affordable for resource-constrained institutions. Thus, Draeger Medical's products offer an alternative to local customers that still want to rely on Western quality. Thus, Draeger Medical's strategy significantly differs from the strategy of the other three companies. One explanation approach could be the size of the company and the limited dedicated resources for emerging country innovation. As a medium-sized medical equipment manufacturer, Draeger Medical positioned itself as premium provider. Offering low-end products would interfere with this strategy. Compared to the other large companies, Draeger Medical might lack sufficient resources to implement an entire low-cost segment that could be differentiated from the high-end products.

Degree of centralized decision-making

The analysis of the structure of decision-making reveals that most firms employ a rather central approach regarding product portfolio and product market decisions. Considering the strategic importance and the size of emerging market innovation, the data suggests that decisions of strategic importance are centrally made at higher hierarchical levels rather than being delegated to the local subsidiary, as is the case with GE Healthcare. The rather central approach to strategic decision-making also reflects the importance of emerging market innovation: emerging market innovation and its reverse diffusion is not merely a product innovation but involves fundamental changes in existing business models and organizational structures. This may explain why such far-reaching decisions as on emerging market innovations are made at the senior management level as this ensures a proper alignment across the entire product portfolio while achieving maximum synergies. However, in the cases where headquarters intensively consult with their local subsidiary or where decision-making is completely delegated to the subsidiary, it seems that local market and customer know-how are a precursor for local or shared product market power and therefore a shared overall decision-making process between headquarters and subsidiary.

In the case of GE Healthcare, the Chinese branch is organized as a self-standing business. The headquarters allows a large degree of freedom and only exerts a management and controlling function in cases where the subsidiary strategy would interfere with the divisional strategy. Their operational tasks are limited to support the Chinese business with strategic marketing. It seems that this structure allows more creative freedom and serves as an incentive for increased innovation within the subsidiaries. Thus, the emerging market development team of GE Healthcare enjoyed the highest freedom in product innovation. The team was not required to use an existing product platform but could use technologies that were available within the corporate network. As the ultrasound machine offers the highest innovation novelty, the data indicates the local freedom has a positive impact on innovation novelty.

The management and controlling function of the headquarters at Philips Healthcare, Siemens Healthcare, and Draeger Medical are more extensive than at GE Healthcare. In particular, the headquarters determine the budgets on a project basis and sales strategy of their Chinese activities and control them accordingly. In these cases, the subsidiaries propose their own strategies that, however, must be approved by the headquarters. In these cases, the emerging market innovation was based on an existing platform.

Localization of implementation

The analysis shows that the structure of implementation, where value-adding development competences reside, has been shifted to the local unit. While strategic decisions are mostly made at the Western headquarters, the empowerment of the local subsidiaries in China seems to lead to local innovation.

This is especially true for emerging market innovations, where a deep understanding of the resource-constrained environment seems to be vital for appropriate emerging market innovation development. The data indicates that developers with an Asian origin are better able to develop products for the local markets. They share the same cultural background and are thus able to better anticipate market needs.

According to the interviews, a reason for the local implementation in terms of the physical development and manufacturing of products are still the comparatively low labor costs. Although most firms in this study consult with their local subsidiaries prior to product innovation decisions and use their local market knowledge, it seems that some have an extended workbench approach where local subsidiaries are merely used for final touches and engineering tasks. This seems to be true for the Draeger Medical case. Another explanation can be found in the degree of freedom (decentralized decision-making structures) of the local development team.

6.3. Concept of reverse innovation

Based on the revised reference framework, the insights from the cross-case analysis, and the subsequent discussion, this chapter offers a concept of reverse innovation. This concept provides answers to the research questions of chapter 1.2. It describes a steady state of strategy and structure that facilitates reverse innovation. In other words, reverse innovation is already implemented as business strategy within the MNC.

The cases show that reverse innovation had acute impact on the management of the MNC. This study indicates that reverse innovation benefits from establishing a double structure that separates high-end (Western) and low-end (emerging market) innovation concepts. This structural separation is based on three factors: (i) market knowledge is spatially bound to the specific innovation task and confined from diffusion; (ii) the empirical results suggest a dual organizational structure. The segments for high-end and low-end innovation maintain their own portfolio management and define their own product market strategy; and (iii) in matrix structure of product and market organization this dual structure is also replicated on the market organization. The high-end and low-end segments have separately assigned sales teams.

The empirical data gives proof to the implicit assumption that emerging market innovation development and its global diffusion marks to separate processes within reverse innovation. It even seems that the separation marks a prerequisite for successful reverse innovation. Considering a global roll-out in an early phase of the innovation process seems to constrain its ‘emerging market characteristic’.

Alignment of Western MNC strategy to reverse innovation

The empirical data shows that the ‘early’ successful reverse innovation cases had an impact on Western MNC strategy. As a result, the MNC strategy was adapted. The formation of a global low-end mandate by the headquarters allowed institutionalizing reverse innovation. The cases show that this had a positive impact on succeeding projects. Additionally, the Western MNC strategy was adapted in allowing a dual market structure. One regional market is divided into high-end and low-end, as both segments follow different logics. The regional markets enjoy a high freedom to operate and decide which products to sell in their market.

Reliance on Western MNC resources

The development of reverse innovation relies on existing resources of the MNC. These are technological knowledge and established NPD processes. In this regard, the conceptualization remained unchanged with respect to the initial and revised reference framework.

Importance of local environment

The exchange with local customers and users plays a vital role in the development of reverse innovation. The development team closely interacts with local customers and anticipates local needs. Additionally, the development team sources from local suppliers to achieve cost targets. Interestingly, the exchange with the local technical network seems to be of minor importance to the reverse innovation development.

Emerging market innovation organization

(i) Decentralization of implementation structures. The data shows that in all cases the emerging market innovation represented an answer to the needs of customers in a resource-constrained environment. In each case, this market knowledge was unique within the corporate network and resided at the emerging market subsidiary. The translation of the market requirement in new product offerings marked the new value proposition of the emerging market innovation. The technological knowledge represented the means by which the requirements are translated into a product. According to these insights, emerging market innovation and its degree of novelty is facilitated by a decentralization of implementation at the subsidiary level.

(ii) Decentralization of decision-making structures. The empirical data suggests that a decentralization of decision-making with respect to portfolio management and product market strategy facilitates reverse innovation. The right to manage a separate emerging market portfolio and generate a separate product markets strategy appears to facilitate the degree of novelty of the emerging market innovation. The entity can decide on their own business case and develop the product that best fits the local market without being constrained by the headquarters. It can foster reverse diffusion initiatives if there is a business potential also in developed markets.

The outlined decision-makings structure and autonomy leads to a segmentation of different product categories between high-end Western products and emerging market

products. These segments are self-managed and contain large parts of the value chain, especially R&D, marketing, and sourcing.

Emerging market subsidiary – local knowledge and capabilities

The analysis shows that technological and market knowledge mark two vital parts for the creation of emerging market innovation. Nevertheless, both are managed in a different way. Technological knowledge is made freely available throughout the corporate network. The emerging market innovation shows that the technological understanding represented a prerequisite for the developing product in the emerging market. Thus, it marks a catalyst for local innovation. In all cases, local development activities were started as the local engineers had a sufficient technological knowledge about the product. The data reveals that even technological knowledge diffused from the Chinese development team to their Western counterparts. In the case of Siemens Healthcare, the Western product adopted online maintaining after the Chinese engineers had equipped their products with this feature.

The differentiation of technological knowledge and market knowledge has implications for the knowledge management within the MNC. The free flow of technological knowledge seems to foster emerging market innovation. In the analyzed cases, the flow was only restricted as intellectual property was a risk due to the weak legal enforcement regime in China. Market knowledge seems to be closer tied to the locus of development and the development task. The cases show that some companies distinctively separate high-end development from emerging market development as market requirements strongly differ. The separation was done to prevent a dilution of both innovation concepts that may lead to a product that neither fits high-end nor low-end markets.

Thus, the management for both knowledge types is different. While free flow of technological knowledge fosters emerging market innovation, market knowledge is tied to the development task and should not diffuse.

In all cases, the development leaders and the majority of the development teams were locals from China or Asia. They closely interacted with local customers to address latent market needs. The empirical data indicates that the local engineers established their own innovation process that enabled a pragmatic way to use existing technologies and to translate market needs from resource-constrained customers in new product

offerings. According to the data, local personnel mark a prerequisite for the development of reverse innovation.

Emerging market innovation – new value proposition

The cases studies show that emerging market innovation flows from emerging markets to developed markets and thus reverses the traditional flow of innovation. The innovations are characterized by a significant cost reduction compared to the established Western equivalent. They are designed to operate in extreme use cases prevalent in emerging markets. This forms a new value proposition that also attracts customer in developed markets. In some cases, these innovations serve a market that has never been addressed before.

Reverse innovation initiative

The global commercialization of emerging market innovations involves in many cases additional adaptation. Each market has different preferences and regulations that require additional development effort. The business case decides whether new revenues outweigh the additional effort. The cases show that predominantly the initiative for global commercialization that require an adaptation of MNC strategy came from the emerging market subsidiary. The subsidiaries were incentivized by internal transfer prices received for every sold unit. The global commercialization – also in developed markets – was a joint decision between the headquarters and the emerging market's subsidiary. Thus, based on the initiatives of the subsidiary the MNC headquarters has to rethink business strategy. Nevertheless, the initiative for global commercialization does not lie exclusively with the subsidiary. According to local market demand, the local market organization or the headquarters can also initiate a global commercialization.

Figure 11 summarizes the concept of reverse innovation.

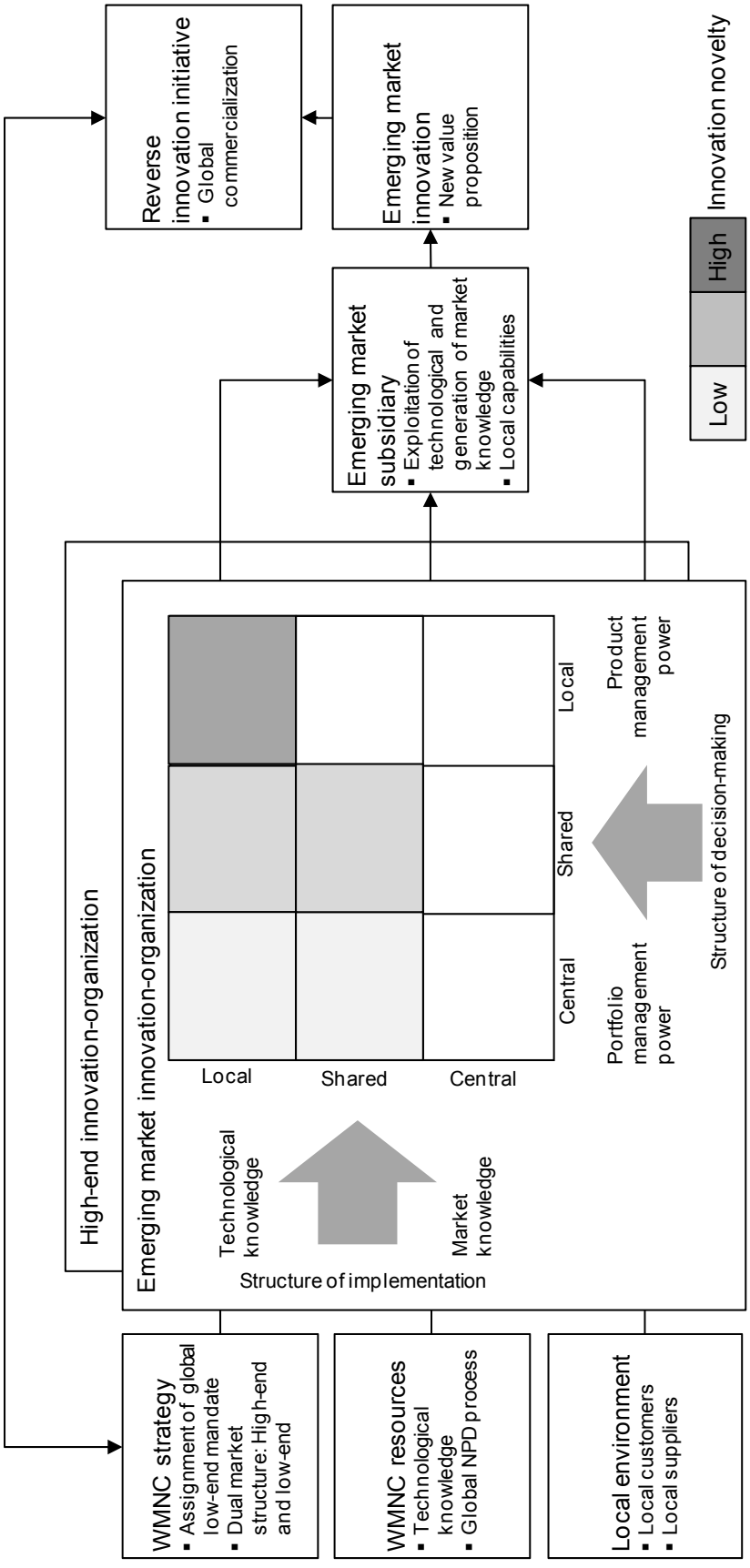


Figure 12: Concept of reverse innovation

7. Theoretical implications

Based on the cross-case analysis and on the conceptualization of reverse innovation, I reflect the gained insights on theory and literature. The empirical results are discussed on the current state of literature. Using a theoretical perspective, the subsequent chapters derive propositions extending existing literature.

Overview: Chapter 7.1 revises the preliminary definitions for emerging market innovation and reverse innovation of chapter 1.3. Based on the empirical insights, the goal is to provide a more precise scientific picture of the analyzed innovation concepts. In chapter 7.2, I outline the implications on the theory of the product life cycle and innovation diffusion. Chapter 7.3 discusses the new insights into literature on MNC management. Chapter 7.4 provides implications on R&D management and new product development.

7.1. Categorization and definition of reverse innovation

The literature review revealed that there are currently numerous definition, terms, and examples that describe 'emerging market' and 'reverse innovation' (e.g., Brown & Hagel, 2005; Gadiesh et al., 2007; Immelt et al., 2009; Williamson, 2010). Based on the empirical data and current literature, I propose scientific working definitions for emerging market innovation and for reverse innovation. For emerging market innovation I adopt the term 'frugal innovation', as the frugal – simple, costing little, sparing, and economical[10] – character well describes the core of the innovation.

7.1.1. Frugal innovation

As we have seen, frugal innovation is a response to acute resource-constraints that require extreme cost advantages compared to existing solutions. The products of frugal innovation often look inferior to existing solutions because they provide limited functionality and are often made of simpler, cheaper materials.

[10] Oxford Dictionary; retrieved on June 26, 2012, from http://oxforddictionaries.com.

The empirical insights show that frugal innovations are based on a new value proposition that serves a market segment of resource-constrained users that was not served previously. Thus, frugal innovation addresses a dark side – a segment that is served with standard offerings and is not specifically addressed – of the existing market. The new value proposition is based on two dimensions. *First,* frugal innovation is characterized by a significant cost reduction. Significant cost reduction means that a large number of people who could not afford the product before now become consumers. In the analyzed cases, a significant cost reduction ranges from 30 % to 80 % compared to the Western equivalent. *Second,* the product adaptation to local use cases in a resource-constrained environment changed innovation characteristics. Product features were added or removed. Some of the products were adapted to smaller size and simpler handling. Less costly materials were used.

While the significant cost reduction marked a basic requirement in all analyzed cases, the degree of adaptation to use environment varied. Thus, I define the cost reduction as a necessary requirement, whereas the feature adaptations are optional. Next, I propose a definition for frugal innovation:

> *Proposition 1a: Frugal innovation is based on a new value proposition that serves a new market segment in a resource-constrained environment. The value proposition is based on a significant cost reduction and potentially new product characteristics to meet resource-constrained requirements.*

The proposed definition shares the focus on resource-constrained customer of Christensen's (1997) low-end disruption. In contrast to Christensen's concept, frugal innovations do not necessarily disrupt existing markets but create new markets, which can coexist with the existent ones.

The empirical results indicate that frugal innovation marks not only a physical product but also an innovation capability. In all cases, the development teams sensed local needs and translate them into effective, low-cost products. Living conditions, culture, value system, and overall societal relationships in emerging markets are very different from those in developed countries. Local engineers brought personal experience of the environment in which the product will be used.

Additionally, the local engineers followed a resource efficient course of development. They used existing technologies or established platforms for the development of frugal innovation. In the course of the data analysis, it appeared that the local teams had a special sense for using resources carefully. It seemed that they were more likely to facilitate frugal innovation as they were better able to sense local needs and translate these needs into product offerings than people educated in the West. Compared to their Western counterparts, the Chinese engineers seemed more focused on cost and efficiency issues. This result is in line with the findings of Anokhin, Grichnik, and Hisrich (2008) on Chinese and German entrepreneurs. Prior research has shown the importance of a firm's absorptive capacity to sense and use information to improve innovation competencies (Cohen & Levinthal, 1990). Thus, I define frugal innovation also as a firm capability to develop frugal innovation.

> *Proposition 1b: Frugal innovation is a firm capability that draws on local customer empathy in resource-constrained environments and low-cost design knowledge.*

7.1.2. Reverse innovation

Despite many anecdotal examples of reverse innovation in literature, there is no unitary definition of the term. Based on the current understanding of literature, the term reverse innovation applies to any innovations that are developed in an emerging market and commercialized in a developed market. Some scholars have highlighted the disruptiveness of reverse innovation and its effects on future business models (Brown & Hagel, 2005; Immelt et al., 2009).

The term reverse indicates that innovations invert the traditional flow from emerging to developed markets. All empirically analyzed innovations were developed in an emerging country, characterized as being frugal, and commercialized in developed and emerging markets.

Based on these notions, I define reverse innovation as frugal innovation, which is developed in and for emerging countries and taken to the markets of developed countries. This definition emphasizes the physical dimension of reverse innovation, notwithstanding the broader implications that reverse innovation may have on future

competition between MNCs from developed and emerging countries and the design of future business models.

> *Proposition 2: Reverse innovation is a frugal innovation that is developed and commercialized in emerging markets and commercialized in developed markets.*

This definition is in line with the thoughts of scholars that have focused more on the disruptiveness of the emerging market products that underlie reverse innovation (Hang et al., 2010; London & Hart, 2004; Ray & Ray, 2010).

According to the definition, reverse innovation constitutes three main aspects: (i) locus of development. The idiosyncratic development of frugal innovation in an emerging country; (ii) innovation characteristic. Frugal innovation meets the basic requirements of resource-constrained customers by providing a new value proposition; and (iii) locus of commercialization. The commercialization of frugal innovation in emerging and developed countries.

The proposed definition focuses on frugal innovation as an answer to emerging market requirements. In this way, reverse innovation is based on the assumption that a certain value proposition based on a resource-constrained use context in one market can address market needs in another market, which have been addressed to a limited extent or entirely neglected previously.

7.2. Theory of innovation diffusion

As outlined in chapter 4, existing literature on innovation diffusion and product life cycle is based on the assumption that innovations flow from developed to emerging countries (Vernon, 1966, 1971). Innovations are based on new technologies that disrupt existing markets and substitute present products. Thus, the source of competitive advantage is located at technologically more advanced countries and is leveraged to a globally dispersed network of subsidiaries through technology transfer (Dunning, 1981; Vernon, 1966).

The analyzed phenomenon of reverse innovation questions these implicit assumptions. In the analyzed cases, innovations were not based on new technologies but on existing technologies or a combination of existing technologies. In fact, the innovations were based on extreme market needs of a resource-constrained environment prevalent in emerging countries. Existing theory argues that technology and income gaps between developed and emerging countries are the main driver of innovation diffusion. The phenomenon of reverse innovation indicates that the diffusion of innovation is rooted in a need gap. Originally developed for a specific geographic market in the emerging world, these analyzed frugal innovations found also customers in developed market. Thus, innovation diffused from East to West. In this regard, the existing theory is extended:

According to the empirical insights, I expand theory on product life cycle in the following way. Innovation diffusion is based on a new value proposition that can be rooted in technology and/or market needs. Thus, an innovation is not necessarily based on new technologies but on a combination of new/existing technologies that address new market needs. The market needs can refer to any group of consumers that benefit significantly by obtaining a solution to those needs and that face needs that will be later general in others markets (von Hippel, 1986, 2005). The locus of the innovation development can be in either developed or emerging markets. The diffusion is not restricted to a particular direction. Proposition 3 expands product life cycle theory referring to the specific case of reverse innovation.

> *Proposition 3: The innovation diffusion of reverse innovation is based on a new value proposition of the innovation that can be rooted in new technologies and/or new market needs.*

Based on proposition 3, innovations can also diffuse from emerging to developed markets. In contrast, product life cycle theory assumes that innovation diffuses from more developed to less developed countries. Thus, reverse innovation indicates that the degree of country development plays a minor role in explaining innovation diffusion, as existing literature currently assumes.

As a consequence of reverse innovation, it even appears that the technological advancement of a country becomes less important for innovation diffusion. Due to the globalization of firms, technology becomes increasingly globally available as Western

MNCs leverage their technologies within their global network. Research shows that there is a high tendency of technology flow within MNCs (Ciabuschi & Martìn, 2010; Gupta & Govindarajan, 2000). According to the analyzed cases, the Western MNCs successfully distribute their technologies through their global network of subsidiaries. Technological knowledge is easy to codify and transfer. In contrast to technological knowledge, market knowledge is more bound to the local environment. Consequently, the product life cycle may start where for the first time new strong market needs emerge rather than where new technologies are developed.

The expansion of product life cycle theory has also implication on the concepts of lead markets. Typically, lead markets contain technologically leading companies and highly innovative and affluent customers who are open to new products, willing and financially able to adopt early (Albach, 1993; Beise, 2004). The data showed that not only technologically advanced countries but also countries with extreme market demand (e.g. resource-constraint customers in emerging markets) based on local use cases (e.g., high mobility of local doctors, small practices) can become lead markets. In the case of frugal innovation, new solutions do not address the innovative, affluent customers, but people at the bottom of the economic pyramid. The examples reveal that the new value proposition based on the extreme low-cost structure and local customization makes the innovation attractive also in developed markets.

Lead market theory argues that local designs in lead markets become globally dominant and squeezes out other locally preferred designs (Beise, 2001, 2004). The outlined cases indicate that frugal innovation does not squeeze out existing solution in developed or emerging markets but serves a market segment, which has not been addressed previously. Thus, frugal innovation creates a new market segment by a new value proposition of the underlying product.

According to lead market theory, innovation diffuses as the environmental characteristics that the innovation is based on diffuses as well (Bartlett & Ghoshal, 1990). The data indicates that frugal innovation serves a need that was existent, but has never been addressed previously.

This new perception of innovation diffusion has also implication on the drivers of FDI on internationalizing R&D. FDIs on R&D have been dominantly interpreted as the attempt of Western MNC to leverage and exploit home-generated knowledge to foreign

markets and/or to augment home-based knowledge by gaining access to technological knowledge (Kuemmerle, 1997, 1999). The emergence of reverse innovation also has implications on FDIs on R&D. FDI can be driven to gain access to local market needs. The acquired market needs can be used to address the local market but may also create new segment in other markets. The empirical data indicates that for frugal innovation specific R&D capabilities are required that are bound to the resource-constrained environment and interrelated to market knowledge. The new market knowledge is not necessarily intended to augment home-based knowledge but to complement it. Thus, I expand Kuemmerle's (1999) motive on FDI in R&D by the concept of *home-base-complementing*. Firms may pursue FDIs in R&D to gain access to market knowledge and establish locally bound capabilities for innovation that complement existing capabilities at the home base.

> *Proposition 4: Motives on FDI in R&D can be based on home-base-exploiting; home-based-augmenting; and/or home-base-complementing.*

This means that the complementation of existing capabilities aims to advance global offerings in terms of new value propositions.

7.3. Management of the MNC

Current theory on the multinational corporation has been shaped by the model of the transnational corporation. MNCs can enable high global efficiency by being at the same time highly local responsive (Bartlett & Ghoshal, 1990). Numerous studies highlighted the importance of free flow of knowledge within the MNC network (Gupta & Govindarajan, 2000; Kogut & Zander, 1993; Nohria & Ghoshal, 1997; Yang et al., 2008). Additionally, studies pointed to the importance of decentralized decision-making and subsidiary autonomy (Birkinshaw, 1999; Birkinshaw & Fry, 2003; Birkinshaw et al., 1998). While the results of the present research do not conflict with existing literature, they provide a more nuanced and detailed picture on the management of the MNC.

7.3.1. Management of market and technological knowledge

While the results confirm that the local embeddedness enhances the innovativeness of the subsidiary (Frost, 2001; Mu et al., 2007), the data shows that in contrast to the prevalent notion in literature, this depends more on the access to market knowledge than on access to technological clusters.

Many studies stress that a multilateral knowledge transfer is *per se* beneficial for the MNC network (e.g., Doz & Santos, 1997; Gupta & Govindarajan, 1994, 2000). In particular, existing literature argues that reverse knowledge flows from the subsidiary is regarded as beneficial (e.g., Ambos et al., 2006; Frost & Zhou, 2005; Håkanson & Nobel, 2001). These insights are predominantly based on the analysis of patent citation data that represents coded technological knowledge (Frost, 2001; Phene & Almeida, 2008).

The present results call for a more contingent approach for knowledge transfer. In contrast to existing literature, the study differentiated between market and technology related knowledge flows. While I find that the free flow of technological knowledge is beneficial for the MNC and its innovation development, the data indicates that this is only conditionally true for market knowledge. In all cases, the frugal innovation team was separated from the high-end innovation teams. While high-end and frugal innovation was partially based on the same technologies, the market knowledge was kept separate to prevent dilution.

Proposition 5: While the free flow of technological knowledge is beneficial for reverse innovation within the MNC, this applies only conditionally to market knowledge.

The results of the empirical analysis also indicate that there is a high interdependence between the two knowledge types. The existing technological knowledge of the corporate network marks a prerequisite for frugal innovation in an emerging market subsidiary. Contrary, the specific market knowledge of frugal innovation is purposely not shared as it may weaken the high-end segment position.

The outlined differentiation between market knowledge and technological knowledge and their interaction effects have wide effects on the literature on knowledge flow in MNCs. For example, Ambos and colleagues (Ambos et al., 2006) found that cultural and geographic distance does not constrain the transfer of technological knowledge. Nevertheless, the opposite can be true for market knowledge, as it is much more location bound. Until now, MNC literature has not differentiated between knowledge types. The results show that a different management of technological knowledge and market knowledge is required if firms want to be successful in both emerging and developed markets. While free flow of technological knowledge enhances MNC innovation, the free flow of market knowledge may have negative effects on innovation.

7.3.2. Market based center of excellence

The presented differentiated view of technological and market knowledge has implications on the literature regarding centers of excellence. According to literature, their local competences are based on technological knowledge. They rely on their peripheral, professional network (Frost, 1998; Frost & Zhou, 2005). Spatial proximity to technological communities and research institutions play a vital role for the development of a center of excellence (Frost, 2001).

In line with literature, the analyzed Chinese development teams can be regarded as centers for excellence as they have a specific capability for the development of frugal innovation that is of high relevance to the firm (Frost et al., 2002; Moore & Birkinshaw, 1998).

Nevertheless, the results of the study indicate that the importance of technological knowledge is overvalued and the importance of market knowledge is undervalued in current literature. None of the interviewed managers referred to the importance of the external technological network for the development of frugal innovation. Moreover, the local teams strongly relied on exchange with local customers and user. The internal network provided the technological knowledge required for the development. This study highlights that also the local network of customers and users can be highly relevant for the development of centers of excellence.

> *Proposition 6: Centers of excellence for the development of frugal innovation depend more on the access to user communities than on the access to external technological communities.*

7.3.3. Location-bound firm specific advantages

In literature it is argued that MNCs are only able to achieve a sufficient economic performance if they can build some type of firm specific advantages that are not bound to the location and are easily transferable across the MNC network (Kogut & Zander, 1992, 1993; Nobel & Birkinshaw, 1998). A non-location-bound firm specific advantage can be based on two sources. *First,* it can consist of a functional or production-related proprietary asset (e.g., market or technological know-how). *Second,* it can be based on an organizational capability to efficiently coordinate and control the MNC's asset base.

The empirical data shows that it also could be beneficial for the company to establish location-bound firm specific advantages that are not leveraged across the MNC network. Based on the insight, it can be argued that the frugal innovation capability is bound to the locus of development, namely the resource-constrained environment of emerging countries.

> *Proposition 7: Frugal innovation capabilities are locally bound to the resource-constrained environment of emerging markets.*

While subsidiary mandates and their relation to subsidiary innovativeness are well described in literature (e.g., Birkinshaw & Hood, 1998; Birkinshaw et al., 1998; Frost et al., 2002), little is known about the subsidiary's type of product development capabilities. This study extends insights on this question by showing that the

subsidiaries of Western MNCs in emerging countries may actually build value-creating innovation capabilities, which depart from developing advanced product technologies towards developing frugal innovation capabilities.

7.3.4. Subsidiary initiative and autonomy

Current literature emphasizes the importance of autonomy for subsidiary initiative and innovation (Birkinshaw, 1999; Birkinshaw et al., 1998; Rugman & Verbeke, 2001). The analysis of the reverse innovation cases call for a more contingent approach of headquarters control and subsidiary autonomy. Despite its long history of the MNC subsidiaries in China, the original initiative for frugal innovation came from the headquarters.

The locus of initiative for reverse innovation varied within the sample. In one case, the initiative came from the subsidiary. This is interesting since the reverse innovation initiative was not in line with the original MNC strategy as a premium provider. This is in conflict with the existent perception of subsidiary initiatives that *"expand the subsidiary's scope of responsibility in a manner consistent with the strategic goal of the MNC"* (Birkinshaw & Fry, 2003, p. 745). The data indicates that making the subsidiary profit from every unit sold via internal transfer prices set the incentive for reverse innovation. In this way, the subsidiary initiated a business model that had not been in line with the persistent strategy.

Thus, in the case of reverse innovation the physical innovation was a headquarters' decision. The global roll-out and the subsequent adaptation of strategy were partly based on an initiative from the subsidiary. It seems that for using physical resources the subsidiary was reluctant and avoided risk. The headquarters had to initiate the project. An explanation might be that the process of physical innovation is more visible to the headquarters and the subsidiary feared an early intervention. In contrast, the development of a business case did not involve major physical resources and could be easily executed by the subsidiary. In line with the previous argument, the execution of the business case might not been as visible as the physical innovation. Thus, the final results could be present without fearing an early intervention.

Thus, the present research calls for a more contingent approach for subsidiary autonomy and initiative. For tasks demanding physical resources, a headquarters initiative might

be required as the subsidiary is reluctant to take risk. Subsidiary initiatives are more likely to happen in fields that do not involve many physical resources. Consequently, the headquarters is still required to execute top down strategy. This is even the case when its subsidiary enjoys a high autonomy and has an ample mandate.

> *Proposition 8: Physical resource intensive development projects are rather driven by the headquarters than by the subsidiary.*

7.3.5. Decision-making structure and implementation of innovation

Considering the strategic importance and the size of reverse innovation, the data suggests that decisions of strategic importance are centrally made at higher hierarchical levels rather than being delegated down to the local subsidiary, as is the case with GE Healthcare. This approach is in line with existing theory on the organization of strategic decision-making (Kim & Mauborgne, 1995; Zannetos, 1965).

While strategic decisions are mostly still made at the Western headquarters, reverse innovations are largely implemented by local R&D subsidiaries of Western MNCs in emerging countries. The empowerment of the local subsidiaries in China seems to be in line with extant research that has emphasized the empowerment of local subsidiaries for innovation generation (Birkinshaw, 1996; Birkinshaw et al., 1998; Moore, 2001; Phene & Almeida, 2008).

On a broader level, the insights on decision-making and implementation are in line with existing literature. A substantial degree of autonomy for those local R&D subsidiaries can facilitate the development of reverse innovation.

Current research has called for a more detailed view on decision-making within the MNC (Foss & Pedersen, 2004). To the best of my knowledge, the present study is the first to analyze decision-making and implementation structures with more granular concepts of portfolio management power, product management power, technological knowledge, and market knowledge. Interestingly, the locus of portfolio management power marked the decisive proxy for the degree of centralized decision-making. It seems that the portfolio management power determines subsidiary autonomy. GE Healthcare represented the only case where portfolio management power resided at the Chinese subsidiary. Within the sample, the portable ultrasound has the highest

innovation novelty. It seems that the localization of portfolio management power has a positive effect on the novelty of innovation.

Current literature provides a static picture of the management of the MNC. Global efficiency and local responsiveness are achieved by free flow of knowledge and high autonomy of peripheral units. The results of this research calls for a contingent management approach of the MNC. The cases show that central decision-making is required when initiating reverse innovation activities. Nevertheless, decentralized decision-making has a positive impact on the development activity itself and the later global diffusion. To be both globally efficient and locally responsive, the MNC has to implement a contingent approach on centralization and decentralization.

7.4. Global R&D management

Influenced by the product life cycle theory, existing literature on R&D internationalization (Chiesa, 1996a; Niosi, 1999; Patel & Vega, 1999), its structural (Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; von Zedtwitz & Gassmann, 2002) and its process related manifestation (Boutellier et al., 1998; de Brentani et al., 2010; Kleinschmidt et al., 2007) is still based on the conjecture that innovations are centrally driven by a Western mindset and then locally adapted to specific needs.

The empirical data on reverse innovation reveals new insights on the management of global R&D, its structure, and potential drivers. Next, the implication on R&D organization literature and NPD process literature are presented.

7.4.1. New capabilities as a driver for global R&D

According to literature, firms started to establish local engineering units allowing for a customization of global product platforms (von Zedtwitz & Gassmann, 2002). Within the last decade, the need to understand local market requirements and adapt products accordingly has become a significant driver for global R&D (Belderbos et al., 2008; Niosi, 1999; Patel & Vega, 1999).

The empirical data shows that new products are necessary to meet local requirements and to achieve a high customer value in emerging markets based on an entirely different value proposition from the existing Western products. As proposed by literature, the approach of pure adaptation proved inappropriate to compete in the aggressive price/performance context that is typical for mass markets in emerging countries (Hang et al., 2010; London & Hart, 2004; Williamson, 2010).

Thus, the prevalent role of foreign R&D units to adapt centrally developed products to local needs by exploiting existing competencies has changed (Gassmann & von Zedtwitz, 1998; Pearce, 1999). Foreign R&D units can be the source of innovation capabilities that complement existing capabilities.

This research highlights the importance of acquiring complementing R&D capabilities. For example, frugal innovation is a capability that does not exist in the Western

network. Yet, it is locally bound to the emerging market R&D unit. Thus, acquiring complementing innovation capabilities marks a driver for global R&D.

7.4.2. Dual R&D structures

As we have seen, frugal innovation is based on a different value proposition than the standard Western innovations. In all analyzed firms, the development activities were located at the emerging market subsidiary. One local R&D team was responsible for the development of frugal products. Parallel, all firms maintained also high-end development teams for the same product category. Thus, all firms established a dual R&D structure separating high-end and low-end development, each of which account for a local-for-global mandate in the same product category.

> *Proposition 9: Western MNCs can facilitate frugal innovation through dual R&D structures for the high-end and low-end segment.*

Nevertheless, there are some interfaces between the high-end and the low-end R&D. Both rely on technologies available within the corporate network. However, their market knowledge base is different. It seems that frugal innovation capabilities may contradict high-end innovation capabilities. Thus, within the MNC network there are two distinct capabilities for specific development task. The development tasks are bound to a specific location. To avoid dilution, both teams were separated in the analyzed cases.

Existing structure models of global R&D have so far not accounted for dual R&D structures based on the same product category and different underlying capabilities (Gassmann & von Zedtwitz, 1999; Gerybadze & Reger, 1999; von Zedtwitz & Gassmann, 2002). Additionally, this research shows that the role of R&D units located in resource-constrained environments may change from a local adaptor to a global innovator in terms of frugal innovations. This would extend existing models of international R&D organizations by the role of a center for frugal innovation.

7.4.3. Local NPD processes

Existing literature proposes one global innovation process. This is seen as a capability that is leveraged throughout the MNC network (de Brentani et al., 2010; Kleinschmidt et al., 2007). The global innovation process is not bound to a specific location but available throughout the MNC network.

A recent study indicates that NPD processes strongly differed between local companies and Western MNC subsidiaries in an emerging market (Al-Shalabi & Rundquist, 2010). The results of the present research indicate that the NPD processes differ within one company. At the Western MNC subsidiary a local NPD process for the development of frugal innovation emerged that differed from the standardized process. It seems that it is bound to the location of the emerging market.

8. Managerial implications

For many Western firms the question is not if but how to engage in reverse innovation. Based on the findings of this research, this chapter derives managerial implications for how Western firms can innovate in emerging markets and enable its reverse diffusion as a means to stay competitive in the long term.

The rich data of four Western medical equipment manufacturers within this research shows that Western MNCs are challenged to compete with emerging country MNCs – especially from China – in global low-cost markets. How Western firms can face the increasing global competition marks an important question in management practice.

In the course of the present research, data of 30 Western MNCs was collected in two research phases (see table 1). In this sample, several other companies were involved in reverse innovation activities, i.a., Mettler Toledo, Logitech, and Hilti. The following success factors and implication are based on the results of the present research. This also includes illustration from the extended sample. The insights are combined in the model of the threefold innovation process (see figure 13), which can guide Western firms to successfully develop reverse innovation.

Overview: Chapter 8.1 describes the threefold innovation process model. It includes the identified success factors to facilitate reverse innovation. Chapter 8.2 provides direct implication for the management of R&D. Finally, chapter 8.3 gives a summary of the management implications for Western firms.

8.1. Threefold innovation process

For long-term success in emerging markets, Western MNCs must rethink their established business models. They have to realize that acute changes in the innovation strategy and structure are necessary when they are planning to compete with low-cost competitors from China. Western MNCs are required to make a deliberate strategic

decision to engage in the low-cost segment in emerging markets. This decision also includes local resource commitment.

Based on the results, I present a threefold innovation process, as shown in figure 13. The following paragraphs describe the threefold innovation process in detail. The threefold innovation process outlines how Western MNCs can reshape and adapt their innovation structure in order to stay competitive in the long term. Each process step is reasoned in detail.

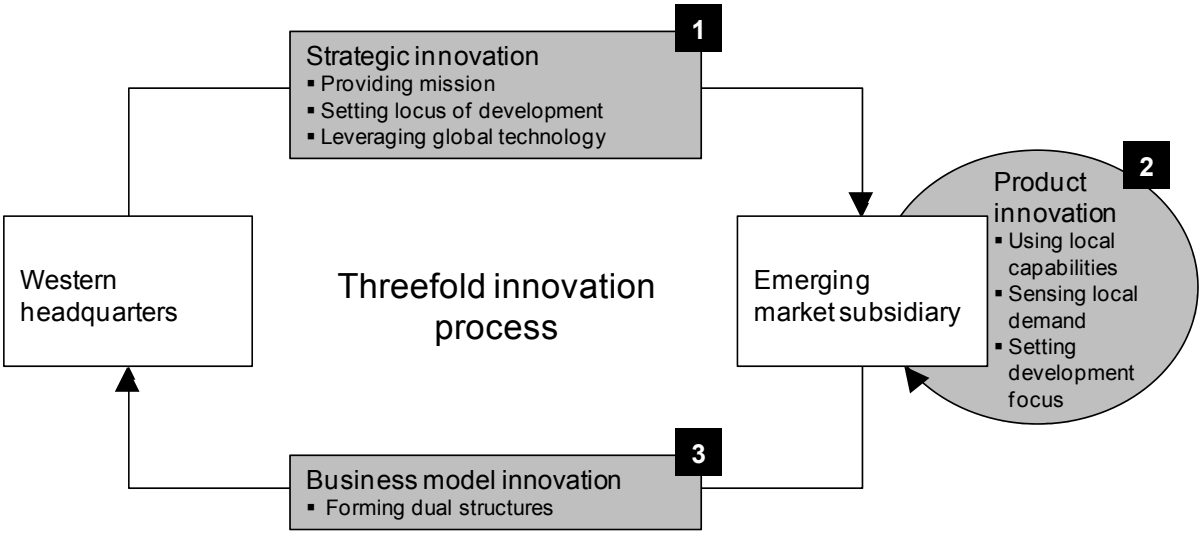


Figure 13: Threefold innovation process

8.1.1. Strategic innovation

The headquarters need to drive the strategic decision to engage in frugal innovation. All analyzed successful practices show that the initial decision came from the Western 'home base'. A clear task was set to develop products especially for local markets in emerging countries like China or India. The possibility of a reverse transfer was not included in most cases, as this could have diluted market fit. Thus, no compromises should be made to meet local market needs. When generating an emerging market strategy, Western MNCs should carefully consider and assess five drivers and two inhibitors. The following paragraphs outline these drivers.

(i) Growing middle class in China with increasing purchasing power. Within the last decade, the growing middle class in China and its purchasing power drastically

increased. An entire new market of resource-constrained first buyers has emerged. It is estimated that the Chinese middle class alone will account for 1.4 billion consumers by 2030 (Rapoza, 2011). The enormity of this market offers new business opportunities. This has attracted the attention of many MNCs worldwide and raised the question of whether a MNC can afford not to address this new market. The critical questions are how and to what degree particular Western MNCs can profit from the new market potential.

(ii) Demographic and cultural differences in China. Due to demographic and cultural differences, companies are required to understand local market peculiarities and adapt their product offerings accordingly. In most analyzed cases, the localization (local sourcing of components) of Western products was insufficient to meet local requirements. New product designs are necessary to meet local demand. Therefore, Western MNCs must understand the local customers.

After being in China for several years, Logitech realized that their products are used in a significantly different way than in Europe or the U. S. In most Chinese households, the PC is used as a TV and for home cinema application, which demands special requirements of its sound system. This market understanding led to entirely new products in China. Additionally, Logitech found that Chinese customers are value conscious and that all non-value generating features need to be removed. Its most successful computer mouse in China comes with a minimum of packaging and fewer buttons than its Western equivalent but is equipped with the latest wireless technology.

(iii) Growing local competition from Chinese firms. For decades, Western MNCs multiplied their existing business model to China. They focused on the few affluent customers who could afford Western products and neglected resource-constrained customers at the bottom of the pyramid. Especially in the last years, Chinese companies started to provide frugal, low-cost products to a vast number of resource-constrained customers winning tremendous market share not only in the low-end segment. They succeeded to develop their own competencies in product development and technology application. With time, the increased acceptance of frugal innovations across all income groups undermined the comparatively small basis of affluent people on which Western MNCs currently still earn high margins. Western MNCs have to reassess their business model and judge whether they can afford not to benefit from the enormous economies of scale of frugal products.

In 1996, Haier revolutionized the Chinese market for washing machines with a washing machine called Mini Magical Child designed for the local market. Designed for small daily loads, it offered a genuine alternative to large and expensive washing machines. The Mini Magical Child was an immediate success and challenged less adapted Western products.

(iv) Fear of competition from Chinese firms in Western markets. Due to the enormous market size and low cost structure, a local success allows Chinese MNCs to benefit dramatically from economies of scale by minimizing their fixed costs for product development and manufacturing. This advantage has put the companies in the position to serve the global low-cost markets with highly cost-competitive products. In addition, their increasing financial power may put them in the position to advance towards high-end products, as the previously described example of Huawei illustrates (see chapter 3.3.1).

In 1992, the Chinese firm Galanz developed an energy-efficient microwave that was small enough to fit inside the often highly cramped Chinese kitchens. Since 1993, Galanz has managed to develop what had been a minor market, in which initially only 2 % of the Chinese households could afford a microwave, into a mass market. Today, Galanz controls more than 60 % of this market, making the company one of the largest microwave manufacturers in the world (Ge & Ding, 2008; Hang et al., 2010). Thus, Galanz leveraged its Chinese market success on a global scale.

(v) Stagnating performance as a chance. In the interviews, some managers pointed out that at the beginning of the new century their companies entered a phase of globally stagnating growth and performance. Some of these companies used this situation to introduce new strategies and to approach new opportunities for growth. Driven by an unsatisfactory situation, the willingness to try something new and to take risk was higher than before. This window of opportunity was used to increase business in emerging markets and opened the way for reverse innovation.

According to the conducted interviews, Western MNCs have to overcome two major inhibitors to adapt the innovation strategy and implement reverse innovation:

(i) Jeopardizing own high-end products in Western markets. A couple of Western MNCs encountered an acute fear that a back flow of their own low-cost innovations

from emerging markets could jeopardize existing premium products in the West. Nevertheless, it transpired that reverse transferred frugal products established rather a new market than addressing existing ones. All analyzed companies agreed that the cannibalization effect was less distinct than initially expected. In the end, the companies also reasoned that if the company does not cannibalize its own products then a low-cost provider would do. Thus, the companies rather jeopardized themselves.

(ii) Negative effects on brand image. A few companies feared that the new low-cost products could weaken the existing brand image in the West. The fear of losing market share to Chinese competitors outweighed the risks of negative effects in the brand image. Two of the analyzed companies established a second, low-cost brand to commercialize their products in the local Chinese and in the global market.

The outlined drivers and inhibitors should help companies to make a profound strategic decision in its emerging market engagement and frugal innovation.

8.1.2. Product innovation

Once the strategic decision is made to engage in frugal, low-cost innovation, the question of how and where the product innovation will take place arises. As existing R&D processes and structures in the West are often optimized for the development of advanced products and technologies, new structures and capabilities are needed. It is necessary to give a dislodged development group a strategic mission for the development of frugal innovations. As we have seen in the previous chapter, autonomy and focus are crucial for the development of frugal innovations.

In the analyzed cases, the locus of innovation was transferred to R&D units in emerging markets based on four reasons:

(i) Leverage existing engineering and manufacturing capabilities in emerging countries. In the course of the establishment of manufacturing facilities in China in the 1980s, many Western MNCs built up additional engineering capabilities to enable local sourcing. The localization of manufacturing and engineering helped the local staff to gain product-specific and technological knowledge. In the majority of cases, the local subsidiaries had the necessary know-how to build new products on their own with only little support from corporate R&D.

(ii) Make use of Chinese staff as they have better market understanding and sourcing capabilities. Since the majority of employees in the Chinese subsidiary of many Western MNCs are locals, they are better able to anticipate local needs. Their social background puts them in the position to have a deeper understanding of what kind of products are needed to meet the local demand.

Additionally, local engineers are more capable of sourcing local parts, which is a precondition to meeting the low price point. In contrast, Western engineers are used to implicit standards and assumptions that do not exist in China. For example, drawings and specification need to be much more detailed in China than in the Western world. The Siemens Healthcare case shows that Chinese engineers have the capability to meet the right degree of specification.

(iii) Benefit from low development costs in China. In the last years, salaries in emerging countries – especially in China – dramatically increased. Nevertheless, the salaries are still much lower than in the Western world. This cost advantage can be used to reduce significantly the development cost compared to Western R&D units. Expatriates should only be involved in exceptional cases, as this will increase costs.

(iv) Overcome motivation problems of Western developers and engineers. Up to now, Western R&D personnel followed the doctrine that the most ingenious and sophisticated product will win the market. Western developers looked for ways to use the latest technologies for new features. Confronted with the task of developing frugal products – basic functionality yet high quality at very low-costs – the Western personnel are difficult to motivate. Giving Chinese engineers the responsibility for product development marks a promising alternative.

Once the decision is made where the low-cost products will be developed, decisions are required on how the products will be developed. The findings of this thesis reveal five success factors that became apparent for frugal product development:

(i) Use local R&D teams and put local R&D leaders in charge. Practical examples suggest that the successful development of frugal innovation requires a deep understanding of the resource-constrained environment for which such products are developed. People who grew up in China have a better understanding of what kind of products are needed and how market needs can be translated into products.

(ii) Foster local sensing. As a means to strengthen the local sensing, the exchange of the development teams with customers and users has to be fostered. The frugal innovation team should have the chance to talk to customers and users. Consequently, the development team should have close linkages to the local marketing teams that can provide them with market insights and put them in contact with the local lead users.

(iii) Give frugal innovation team a high level of autonomy. High autonomy gives the subsidiary and its engineers a sense of ownership. This can boost motivation and ensures that the aspired products show a high fit to local requirements and needs. Giving the frugal development team high autonomy may include the responsibility for product management and product portfolio.

(iv) Keep frugal innovation team focused. In many cases, engineering and R&D in the Chinese subsidiaries perform contracted development tasks for their Western R&D headquarters. To avoid mixing high-end products and innovation for low-end markets, development teams have to be split into frugal innovators and internal R&D service providers. High-end development and low-end development has to be separated to avoid mutual dilution.

(v) Leverage corporate technology to frugal innovation. To achieve frugal innovation it is sometimes necessary to build a completely new product architecture that allows providing basic functionality at very low costs. In some cases, the new product architecture is based on technologies that have never been used for this particular product category before. Therefore, the frugal development team should be provided with access to the corporate technology base. This puts them in the position to devise a new combination of existing technologies that may form a disruptive low-cost innovation. Nevertheless, there is still a risk of knowledge drain in China. Concerning technologies that belong to the core competences of the company a more contingent approach is required. One solution is to provide core parts still from the West, as a black box.

8.1.3. Business model innovation

The success of frugal innovation in emerging markets will challenge the existing business model. Innovation success will attract the attention of the global sales organizations and may lead to global demand. However, Western MNCs may fear that a

global roll-out could have negative effects on the sales of the high-end products. However, if the Western MNCs will not jeopardize their own products, the Chinese competitors will do so and take over market share. Consequently, Western MNCs that develop high-end products earning high margins on their premium offerings now also compete in a global low-end market.

To enable reverse innovation an adaptation of the existing business model is necessary, as high-end products and low-end products follow an entirely different rationale. Based on the empirical data, three measures are identified that enable business model innovation:

(i) Create incentives for reverse innovation. The cases show that once the frugal innovation is developed, initiative for its global diffusion came from the development team or the subsidiary. To motivate for global distribution, the team should profit from every unit sold by internal transfer prices. This formed the heart of the incentivizing themes in all successful cases.

(ii) Sequential business development. The analyzed cases show that successful reverse innovation was pursued in sequential steps and emerged as a strategy that changed the business model. In a first step, a business case should only be developed for one particular emerging market or for several emerging markets. This secures fit to market needs. In a second step, the business case should be developed for Western markets by an independent team that it is not biased and does not over- or underestimate the business potential. Nevertheless, the team should be part of the same subsidiary. Profiting from a global commercialization motivates the team. Moreover, the team can directly interact with the development team in case of ambiguity. For example, GE Healthcare added an additional team to the low-cost ultrasound machine that devised the business case for the U.S. and other developed markets. Once there is a first reverse innovation case, this forms the nucleus for subsequent projects that can follow a similar path.

(iii) Allow dual structures. Frugal innovation significantly differs from high-end innovation. As we have seen, different, separated teams are required for the development of high-end and frugal innovations. The same seems to be true for marketing and sales. Thus, to benefit the most from high-end and frugal products, management practices suggest allowing a dual structure that integrates two business

models. This may include the establishment of dual R&D structures, product management, product portfolio management, and sales.

8.2. Implications on R&D management

A crucial point for Western firms to enable reverse innovation is the development of frugal innovation. The setup of the R&D plays a vital role in achieving frugal innovation. Frugal innovations follow a different rationale than the typical Western innovations. To be successful, a good understanding of the value architecture of frugal innovation and an adapted R&D structure are required. The following sections outline both aspects in greater detail.

8.2.1. Understand the value architecture of frugal innovation

Resource-constrained environments like those found in emerging markets present a fertile ground for frugal innovations. What frugal innovations have in common is that they are all born of a situation of constraint and designed to meet the relatively basic needs of poorer consumers. To compete in this context, Western firms must change their mindset and see low-income populations as potential markets that offer great business opportunities for the right products.

The development of frugal innovations can be supported by several design-to-cost instruments, such as value analysis, target costing, or quality function deployment. However, the key to success is the attitude of the development team, which must be oriented towards meeting a radical cost goal. Three factors are vital if a company wants to meet the aggressive price-performance needs of resource-constrained consumers: low-cost manufacturing; simple, low-cost materials and design; and a focus on basic functionality and minimal feature sets.

For example, Mettler Toledo, a Swiss weighing-instrument manufacturer, developed a basic entry scale in China that incorporated all three of these factors. Since it was developed and manufactured entirely in China, the scale achieved cost advantages in manufacturing. The scale incorporates more cost-efficient materials, relying on high-quality synthetic materials in place of the metal construction common in Metter Toledo's higher-end product lines. Finally, the basic scale features only the most basic functions and design elements and offers high-quality but good-enough gauging accuracy that meets local use requirements. To achieve these requirements, Mettler Toledo relied on the low-cost competence of its Chinese engineers. The basic scale's cost advantage is a result of reduced development and manufacturing costs and savings

due to the use of different materials and the inclusion of fewer features. Other frugal products build on the same cost structure.

8.2.2. Establish local R&D structures to enable frugal innovation

Most Western firms maintain local R&D units in emerging countries in order to profit from direct access to the market and access to local talent. Local R&D units also enable them to build a presence in the centers where new technological developments are originating (Gassmann & Han, 2004). The value architecture of frugal innovations requires development capabilities that are difficult, if not impossible, to build in the central headquarters. To build such capabilities effectively, Western firms should empower local R&D subsidiaries to access the power of local knowledge. Autonomy from central R&D headquarters seems to be a necessary but not sufficient condition to enable the local development of frugal innovations. The subsidiary must also be able to understand local needs and translate those into appropriate product solutions.

Mettler Toledo's entry-level scale was to a large degree developed by the Chinese R&D subsidiary, comprising solely Chinese engineers. Having local people on the team facilitated access to local customers and ensured an understanding of the essential functions those customers required. For example, the Chinese R&D teams of Siemens Healthcare and Philips Healthcare also consist almost exclusively of local engineers who collaborate with local doctors and institutions. Based on this collaboration, the teams have developed products that fit into tiny rooms, are robust enough to handle dirt and frequent power fluctuations, and can endure intense usage. Building effective capabilities for frugal innovations depends largely on the ability of the R&D team to sense local needs and translate them into effective, low-cost products. Since the living conditions, culture, value system, and overall societal relationships in emerging markets are very different from those in developed countries, it is often difficult, if not impossible, for engineers raised and trained in the West to understand fully the needs of foreign customers. Successful frugal innovation is facilitated by having local people on the R&D team, local people who bring personal experience with the environment in which the product will be used.

In emerging markets, it is not the most ingenious solution that will win but the most good-enough. This is often difficult for highly trained Western engineers to anticipate.

8.3. Summary

Competition from low-cost producers, many of them in emerging markets, is entering a new phase as companies from emerging markets have begun to export homegrown products designed to meet local needs to developed markets. Western firms should embrace reverse innovation as an opportunity rather than fear it as a threat. Although reverse innovations might compete against existing products in both emerging and developed markets, the potential for massive low-end profits may well outweigh losses in higher-end product lines. Western firms should therefore consider adapting existing strategies to the development of reverse innovation and eventually expand their current business model.

Successful reverse innovation begins in the mind. Before Western firms can effectively engage in reverse innovation, they must understand the unique characteristics of frugal innovations: very high customer benefits at very low costs. The path to successful frugal innovation also demands attention to promoting a mindset of frugality within R&D teams and establishing the necessary structures by empowering R&D subsidiaries in emerging markets. The way Western firms engage in frugal innovation has wider implications for globally dispersed R&D and business in general. The case insights presented in this thesis imply that in the future power and responsibilities will be increasingly shifted to the periphery where unique frugal innovation capabilities are grown. Central R&D headquarters are likely to take on the role of network coordinators that bundle resources in the network to initiate new development activities anywhere in the world. In this regard, the ability to develop frugal innovation represents a specific and significant competency.

To facilitate successfully reverse innovation, Western firms have to allow and to encourage initiative taking inside the firm. Eventually, a new business model emerges and the Western parent company has to endorse an adaptation of the existing R&D and sales structures. This can even lead to the establishment of dual R&D and sales structures for high-end/Western innovations and for reverse innovations. Top-level management will have the responsibility to mediate between both innovation concepts.

In summary, the empirical insights offered important strategic and organizational lessons for Western firms pursuing reverse innovation. *First,* reverse innovations are based on frugal innovations. Frugal innovations are home-grown products that cannot be easily derived from existing Western products. Instead, they are the result of a

unique value architecture that is grounded in the drive to meet basic requirements at the lowest possible cost. *Second,* developing frugal innovations requires local organizational structures and resources that help to develop an understanding of the needs of the resource-constrained consumers who are the target market for frugal innovations. *Third,* the reverse diffusion of frugal innovation eventually leads to a new business model that requires the establishment of a dual R&D and sales structure.

9. Conclusion

Based on the analysis and discussions of the previous chapters, this chapter summarizes the key findings of this research and highlights the central theoretical and managerial implications.

Overview: Chapter 9.1 outlines the theoretical implications and summarizes the developed propositions. Chapter 9.2 recapitulates the managerial implications. Finally, chapter 9.3 provides limitations of this research and further research opportunities.

9.1. Summary: theoretical implications

The theoretical implications pertain to the insights gained from the case-study analysis and the conceptualization of reverse innovation as well as propositions derived from them. Table 9 provides an overview of the developed propositions.

Clarifying the concept of reverse innovation

Based on the empirical results, the present thesis offers a unitary and more comprehensive definition of reverse innovation. Currently, literature considers reverse innovation interchangeably as a phenomenon, a process, or a type of product innovation. By reviewing current understandings and by providing a comprehensive definition, it is hoped that future research on reverse innovation is unambiguous.

The present thesis understands reverse innovation as the reverse diffusion of frugal innovation. The term reverse indicates that innovations flow from emerging to developed countries and thus invert the conventional flow from developed to emerging countries (Vernon, 1966). Frugal innovations are based on a new value proposition that serves a new market segment in a resource-constrained environment. The value proposition is based on a significant cost reduction and potentially new product characteristics. This implicates that the local use environment plays a vital role for frugal innovations.

Table 9: Summary of propositions

Number	Proposition
Categorization and definition of emerging market innovation	
1a	*Frugal innovation is based on a new value proposition that that serves a new market segment in a resource-constrained environment. The value proposition is based on a significant cost reduction and potentially new product characteristics to meet resource-constrained requirements*
1b	*Frugal innovation is a firm capability that draws on local customer empathy in resource-constrained environments and low-cost design knowledge.*
2	*Reverse innovation is a frugal innovation that is developed and commercialized in emerging markets and commercialized in developed markets.*
Theory of innovation diffusion	
3	*The innovation diffusion of reverse innovation is based on a new value proposition of the innovation that can be rooted in new technologies and/or new market needs.*
4	*Motives on FDI in R&D can be based on home-base-exploiting; home-based-augmenting; and/or home-base-complementing*
Management of the MNC	
5	*While the free flow of technological knowledge is beneficial for reverse innovation within the MNC, this applies only conditionally to market knowledge.*
6	*Centers of excellence for the development of frugal innovation depend more on the access to user communities than on the access to external technological communities.*
7	*Frugal innovation capabilities are locally bound to the resource-constrained environment of emerging markets.*
8	*Physical resource intensive development projects are rather driven by the headquarters than by the subsidiary.*
Global R&D management	
9	*Western MNCs can facilitate frugal innovation through dual R&D structures for the high-end and low-end segment.*

The provided definition of reverse innovation does not include high-end innovations that are developed in emerging markets and commercialized in the West. These innovations do not depend on a local use environment, but on global demand. The differentiation between high-end innovation and frugal innovation in emerging markets is reasonable as high-end innovations are not bound to emerging market use environments and do not require a distinction of the direction of innovation flow. The global high-end innovations address global needs and are directly connected to the MNC strategy. In contrast, the present research shows that frugal innovations are directly bound to the local use environment. Thus, frugal innovation can be in conflict with the persistent innovation concepts in the West. In this case, the direction of innovation flow is decisive as it may affect corporate strategy.

Frugal innovation as a capability

According to the results, it seems that the development of frugal innovations differs from the development of persistent innovation concepts in Western MNCs. Local engineers are required to develop frugal innovation that are allowed to digress from standard innovation processes. Thus, the present thesis argues that frugal innovation forms a capability that is locally bound to the emerging market location.

Expand product life cycle theory

The previously outlined concept of reverse innovation directly affects product life cycle theory. Based on the results, the present research expands product life cycle theory in two ways.

First, the thesis calls for a different understanding of innovation. Formerly, innovations were understood as new to the world technologies (Vernon, 1966, 1971), which disrupt existing markets and substitute present products. The results show that innovations can also be based on existing or a combination of existing technologies that address new market needs. Thus, innovations do not necessarily substitute present products but complement the product offering.

Second, the present research reveals that innovations could also flow from emerging markets to developed markets that invert the innovation flow proposed by product life cycle theory, which argues that a technology and an income gap between developed and emerging markets are the drivers for innovation diffusion. In contrast, the developed definition of reverse innovation implicates that the diffusion of innovation is based on a need gap. Originally, developed for specific needs in emerging countries, frugal innovations find also customers in developed market. Thus, innovation diffuses from emerging to developed countries.

Innovation diffusion is based on a new value proposition that can be rooted in technology and/or market needs. The market needs can refer to any group of consumers that benefit significantly by obtaining a solution to those needs and that face needs that will later be general in others markets. These needs can have their origin either in developed or emerging markets. Thus, the diffusion is not restricted to a particular direction.

Drivers of FDI for R&D

This new perception of innovation diffusion has also implication on the drivers of FDI on internationalizing R&D. Existing literature differentiates between two drivers of FDI for R&D (Kuemmerle, 1997, 1999): (i) home-based exploiting. Firms leverage their home-generated knowledge and competences to foreign markets. Products are adapted to local preferences; (ii) home-base augmenting. Firms acquire new knowledge in foreign markets by gaining access to technological know-how. This is done to strengthen the knowledge base of the firm. This research calls for a potential third driver: (iii) home-base complementing. Firms establish foreign R&D units that use local knowledge and resources to build specific R&D capabilities that are bound to local environment. This may not necessarily be intended to augment home-based knowledge but to complement it at a foreign site to enable innovation concepts that differ from the home-base concepts. This means that the complementation of existing capabilities target to advance global offerings in terms of new value propositions.

Extending the understanding of the MNC management

The present research extends the understanding of the MNC management in two ways. On a specific level, it reveals insights into the management of reverse innovation for Western MNCs. On a broader level, it provides a more detailed understanding of innovation implementation and decision-makings structure within the MNC.

To the best of my knowledge, this study is the first to provide empirical evidence on the organizational implementation of reverse innovation by Western MNCs. It provides empirical insights into how Western MNCs organize reverse innovation. The findings show that frugal innovation and its reverse diffusion are based on two processes that affect the organization. *First,* frugal innovation is developed in the firms' local subsidiary in China. Local embeddedness and a strong focus on the development of good-enough products enable the MNC to generate locally frugal innovation capabilities. Especially, the local cultural origin of the developers plays a vital role. *Second,* the global commercialization is dislodged from the frugal innovation development to secure the 'frugal' characteristics of the innovation. Subsequent to the development, R&D and sales structures business are adapted to exploit fully its global business potential.

While frugal innovations are initiated by the headquarters, the development takes place in the emerging markets subsidiary. The headquarters mostly exerts a supervising and

controlling function over these businesses. The local management of a product portfolio at the Chinese subsidiary facilitates frugal innovation and increases the degree of innovation and local fit.

On a more general level, this study reveals several insights into the management of the MNC. The findings highlight the difference between the management of technological and market knowledge within the MNCs. While the free flow of technological knowledge enhances innovation with the MNC network, the market knowledge is kept at the locus of generation. The differentiation between the two knowledge types also affects the perception of the center of excellence. While literature stresses the center of excellence as the locus of technological knowledge, the results indicate that a center of excellence can also rely on market knowledge.

Additionally, the results also contribute to the scientific discussion of subsidiary autonomy by proposing a more contingent approach of central decision-making and local autonomy. The findings indicate the locus of product portfolio power is a key determinant for the autonomy of units.

Implications for R&D structures

The results call for dual R&D structures that separate high-end innovation development from frugal innovation development. Both innovation types rely on different market knowledge but may use the same or similar technologies. To avoid dilution both R&D structures are separated. Furthermore, the results indicate that the innovation processes from high-end innovation and frugal innovation differ. Local innovation processes may contribute to frugal innovation.

9.2. Summary: managerial implications

The managerial recommendations are based on insights derived from the conducted case studies as well as the theoretical propositions. The process of how to engage in reverse innovation is valuable to corporate management, innovation managers, and R&D professionals in Western firms. Reverse innovation is a business reality. New low-cost competition from emerging markets threatens existing business models of Western firms. Thus, Western firms are required to evaluate reverse innovation as a new business strategy if they want to stay globally competitive in the long term.

Implementing reverse innovation: threefold innovation process

This study offers a threefold innovation process that can guide Western managers to implement reverse innovation. The threefold innovation process includes important consideration, steps, drivers, and inhibitors of reverse innovation. An evaluation of the named factors will help Western companies to make deliberate decisions on reverse innovation. The implementation of reverse innovation follows three steps. *First,* Western firms have to be aware of a 'strategic innovation'. That means giving an emerging market subsidiary the freedom and power to develop local frugal innovations. *Second,* measures have to be undertaken to facilitate the 'product innovation' in emerging market. *Third,* the firms have to understand the impact of frugal innovation on the existing business model. To facilitate reverse innovation, the Western firm has to be willing to allow 'business model innovation'.

Aligning R&D for the development of reverse innovation

For the development of reverse innovation, R&D plays a vital role. The study reveals two success factors for the development of reverse innovation. *First,* it is crucial to understand the value architecture of frugal innovations. This includes choice of materials, use of technology, and an in-depth understanding of required functionality. *Second,* it is important to implement local R&D structures. Spatial proximity to users and local staff in emerging countries enable the development of frugal innovation and thus build the basis for reverse innovation.

9.3. Limitations and future research

This section first outlines the limitations of the present research that also represent opportunities for future research. Subsequently, this chapter illustrates potential future research directions and trends emerging in the field of innovation management.

Limitations and research opportunities

The findings of this study must be considered in the light of several limitations, which, at the same time, mark promising future research avenues.

(i) Broader industry focus. This study used the medical equipment industries as the setting to investigate how firms facilitate reverse innovation. This industry was chosen as it offered the highest learning potential of all analyzed industries (see table 1). Medical equipment is a B2B industry that is characterized as being technology and investment intensive. The case studies of research phase one (see table 1) indicate that the results are also applicable in industries with the same characteristics, e.g., electronics and machinery. Nevertheless, while medical equipment industry is known for producing frugal and reverse innovation, other industries might differ in terms of their attractiveness and opportunities to develop reverse innovations. For example, B2C industries might be more receptive to reverse innovations than B2B industries as goods that directly address basic human needs such as, e.g., health, energy, and mobility in developing countries also are of increasing importance in the growing metropolises of the Western countries. Future studies may therefore investigate other industries and how, if at all, MNCs manage and organize reverse innovation there.

(ii) Enlarge sample size. The study analyzed extreme cases with the goal to reveal new insights to theory and management. For this purpose, a total of four case studies is sufficient (Eisenhardt, 1989). Nevertheless, the study is limited in the generalizability of the results due to the small sample size. A wider sample would certainly improve our understanding of how firms facilitate reverse innovation. *First,* the study used single reverse innovation projects as a vignette to derive organizational implementation. An analysis of more reverse innovation projects may further validate the results. *Second,* the study is based on insight from four companies. A larger sample can improve generalizability. Yet, since reverse innovation is a young and emerging phenomenon, further exploratory research to examine how reverse innovation is facilitated marks a promising approach.

(iii) Comparing successful and non-successful reverse innovation cases. According to the exploratory research setting described in chapter 2, the goal of this research was to provide first empirical insights on reverse innovation. The study analyzed successful examples of reverse innovation that offer a high learning potential. Non-successful examples were not analyzed. This is partly due to the novelty of the phenomenon. The analyzed companies were not willing to share non-successful examples. For most reverse innovations, it was too early to classify them as unsuccessful. Future studies that differentiate between successful and non-successful reverse innovation examples can reveal new interesting insights on the performance dimension and on success factors of reverse innovation.

(iv) New variable describing organizational structure. According to the results, the structure of decision-making and structure of implementation proved to be valid organizational variables to describe the choice of the firm's organization approach. While this distinction reveals interesting insights, there may be other variables through which the organizational approach could be measured. For example, the question of the structure of decision-making could be detached from geographical considerations and adopt a perspective based on individual roles and concrete tasks.

Trends for future research

The findings of this research offer new research opportunities on the subject of innovation in MNCs. Based on the concepts provided throughout this study, the following points represent trends and directions for future research that mark promising opportunities to gain deeper insights about the management of the MNC in general and the management of reverse innovation in particular.

Based on the present research, several new research questions emerged. Thus, while the present study provides answers to the raised research questions, the findings reveal new directions for further research.

(i) The role of MNC in innovation diffusion. Existing theory on innovation diffusion has so far explained how innovation diffuse between countries (Beise, 2004; Porter, 1990; Vernon, 1966). The diffusion of innovation is assumed to rely on country characteristics that influence the decision of innovation adoption. However, existing theory neglects the effect of already internationalized firms and their role in innovation diffusion. Western MNCs are fully internationalized and transfer technologies within

their global network. They translate local needs into new products with the help of existing technologies. Thus, MNCs can enable diffusion of innovation. The role of internationalized firms in lead market theory has been undervalued. This limitation calls for a reciprocity model of internationalization.

(ii) Multilevel analysis. This study reveals that reverse innovation is a multilevel phenomenon. The conducted research represents a first attempt to understand firm internal mechanisms that facilitate reverse innovation. Therefore, decision-making and implementation structures were analyzed in detail. Nevertheless, our understanding of reverse innovation is still limited. Research would profit from investigating in more depth the organizational interdependencies between the firm and the subsidiary level. For example, we have a limited understanding of how local subsidiary managers negotiate with firm level managers regarding the allocation of corporate budgets or the determination and consolidation of local and global product strategies. Furthermore, while effective knowledge transfer between headquarters and subsidiaries is important for the competitive advantage of MNCs (Ambos & Ambos, 2009; Ambos et al., 2006; Rabbiosi, 2010; Song & Shin, 2008), little is known about how corporate technological know-how is transferred and used for competences development in the subsidiary.

(iii) Comparing Eastern and Western MNC practices. This study has explicitly adopted a Western MNC perspective on the organization of reverse innovation. Therefore, it would be fruitful to adopt an emerging market MNC perspective since the strategy and organization underlying reverse innovation is likely to differ between Western and emerging market MNCs. For the latter the emerging market represents the home market and home market products are leveraged to foreign countries. Thus, there are potential differences in how Western and emerging market MNCs use local resources in emerging markets and how they generate local competences.

(iv) Conformation of results. The limited number of case studies provides an opportunity to test the results of this research in a larger, quantitative approach to validate the results. A larger sample and the validation of the insights of this paper will provide a more robust basis for future research on the topic. Especially, the conformation of the motives FDI on R&D internationalization marks a promising starting point for quantitative studies.

In summary, this research addresses several areas that are important for theory and management practice. The findings extend existing theory and provide new empirical results. Nevertheless, literature on product life cycle, management of the MNC, R&D management, and NPD is still limited regarding insights about reverse innovation. The findings in this study provide first insights into this area and thus serve as guidelines for the management of reverse innovation. Furthermore, this study serves as a starting point for further research on managing challenges imposed by emerging markets, in particular China, to Western MNCs. Mastering these challenges may be a crucial basis for the future competitiveness of Western MNCs.

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Appendix

Appendix 1: Data collection phase 1 – interview-guideline

Questionnaire on global R&D management

Date:
Place:
Company: *Company name*
Interviewee: *Interview name (position)*

Central question: How is the R&D of your company organized?

Note: No questions are asked that can be extracted from public information. Before every interview a detailed internet research is conducted that provides general company information (e.g., products, mission, sales, number of employees, business fields, locations of operations ...). If information is available on the internet, the related question is omitted.

The questionnaire is separated into in two parts. The first part focuses on basic company data and on R&D management including global structure. The second part targets the R&D process and evaluates how R&D projects are executed.

Part 1: Basic data

1. Company Organization

1.1. How is your company organized? Note: Can you send us an organization chart?
1.2. Where is the R&D management organizationally located?

2. R&D Management

2.1. How many R&D employees does your company have?
2.2. What are your company's R&D expenditures?
2.3. How many 'R&D dollars' are spent in your home country?
2.4. How many 'R&D dollars' are spent abroad?
2.5. How is the R&D management organized? (Roles, setup …)

3. Global R&D Management:

3.1. How many R&D sites does your company have?
3.2. Where are they located?
3.3. What is the task of each R&D site? Note: Please differentiate between Research and Development
3.4. How many 'R' and 'D' employees work in each site?
3.5. How is 'R' and 'D' coordinated and controlled? ('degree of central control')

Part 2: Product level process/project

Please describe a typical R&D project for your most internationalized product in terms of dispersed R&D activities and locations.

1. Project setup

1.1. Which 'R' and 'D' sites were involved?
1.2. What was/is the task of each 'R' and 'D' site?
1.3. Which of your company's sites contributed to the different phases of the products' innovation process and product life cycle? (Research, Development, Localization)
1.4. Who controlled the R&D activities?
1.5. Who initiated new R&D projects?

2. Project process

2.1. How did the R&D project proceed? (gates, evaluation, milestones)
2.2. How was the interaction between the R&D sites organized?

3. Project analysis

3.1. SWOT-analysis: What are your strengths, weaknesses/opportunities, and threats regarding the R&D activities for your most internationalized product? What are problems? What works well?
3.2. How do you decide which activities are performed at what location? What are the criteria? What are challenges?
3.3. How do technology platforms determine the localization of R&D activities? To what extent can existing technology platforms be altered by international R&D locations? What is the challenge with managing platforms for international R&D activities?

3.4. How do local markets influence R&D activities? How is local market information used?
3.5. How do you measure or evaluate the performance of the international R&D activities respectively for the entire location?

4. General analysis & outlook:

4.1. For the specific product, and from a historical perspective, how did you arrive at today's global R&D setup? What were the drivers?
4.2. What do you intend to do in the future to improve the existing global R&D organization? Why?
4.3. Is the setting described above typical for other products in your company? Why?

Final Remark

If any, what kind of R&D activities does your company have in emerging markets?

Appendix 2: Data collection phase 2 – interview-guideline

Questionnaire on innovation in emerging markets

Date:
Place:
Company: *Company name*
Interviewee: *Interview name (position)*

> *Central question: Which structures and processes allow innovation in emerging markets and its subsequent global commercialization?*

The questionnaire is separated into three parts. The first part focuses on a single case (product) illustration of an emerging market innovation and its global commercialization. The second part evaluates on how the single case is representative for other cases of emerging market innovation. Additionally, it focuses on how the first case of an emerging market innovation in the company was eventually different. The third part asks for the personal opinion of the interviewee; why was the innovation successful and what were the major challenges?

If your company does not have an emerging market innovation or the innovation is not commercialized in the West, please refer to why your company is not considering doing so.

Part 1: Single case illustration

Leading question: What is the most prominent example of an emerging country innovation that was later also commercialized in developed countries? Please illustrate.

1. Initial decision to develop the emerging market innovation

1.1. What were the initial drivers to develop the innovation? What were the inhibitors?
1.2. Who initiated the innovation development?
1.3. Who finally decided on the development?
1.4. Who was also involved in the decision process? Which hierarchy level?
1.5. Who was consulted with respect to the decision and who was informed?

Please give a brief overview of the product organization & product portfolio

1.6. Which department/unit financed the development? Is it a profit and loss center?

2. Locus of development

2.1. Where was the innovation developed? At which site?

2.2. Why was it developed at that specific site?

2.3. Who decided to develop the innovation at that particular site?

2.4. When was the site established?

2.5. How was the site established? Acquisition? Joint venture? Green field investment?

2.6. How big is the site? Employees? Which parts of the value chain are represented at the site?

3. Initial task an focus of the development:

3.1. What was the initial market focus? Local/global? Which market?

3.2. What were the initial product specifications? Who specified them?

3.3. Who was the initial customer?

4. Innovation Development

4.1. Who was the project leader? Which unit/site did he/she belong to?

4.2. Where was he/she located?

4.3. What is his/her cultural origin?

4.4. How was the development team set up? Cultural origin? Site origin?

4.5. Which parties where involved in the development process?

4.6. Which sites were represented? Why were they involved? What were their roles?

4.7. Where did the technology come from? Was new technology developed?

4.8. How was market knowledge gained?

4.9. How was the IP management set up? How did your company protect itself against IP infringement?

4.10. Did the development team receive corporate support?

4.11. How can the autonomy of the development team be described?

4.11.1. Financial autonomy?

4.11.2. Autonomy with respect to product definition?

5. Product Characteristics

5.1. How can the product be characterized with respect to the Western equivalent?

5.2. What features does the product have? How can they be compared to the Western equivalent?
5.3. What is the price point of the products? What is the price point of the Western equivalent?

6. Sales and evaluation of market success

6.1. Who decided where the innovation is sold?
Please give a brief overview of the sales organization
6.2. Who decided to sell the innovation in the West? Why?
6.3. Were there challenges selling the product in the West?
6.4. What are the sales of the product by region?
6.5. How do the sales compare to Western products?

Part 2: Generalization and impact

1. Were there emerging country innovations before and/or after? How many in total? In which country?
2. To what degree is the underlying innovation / commercialization process similar? What are the differences?
3. To what degree can the displayed innovation / commercialization process of the innovation of ***Part 1*** be generalized?
4. How did the development and commercialization process differ to the historically first emerging market innovation?
5. Did the first case affect product strategy?
6. Were there any organizational changes? Product or market organization?
7. Why did it work with the mentioned product categories? Why are there no emerging market innovations in other product categories?

Part 3: Personal opinion

1. Why do you think ‘reverse innovation’ worked? What are the premises for reverse innovation?
2. What were the biggest hurdles?
3. How was the threat of a cannibalization of other products overcome?
4. Do you know other companies engaged in reverse innovation activities?

Appendix 3: Data collection phase 2 – list of interviewees

Company	*Interviewee*	*Location of interviewee*	*Date*	*Place of interview*
Draeger Medical	Head of R&D Portfolio Management / Controlling / Global Project Office	Luebeck (Germany)	September 29, 2010 January 1, 2011 March 07, 2012 March 26, 2012	Munich (Germany) Forchheim (Germany) Telephone Telephone
Draeger Medical	President Global R&D	Andover (U.S.)	September 29, 2010 January 25, 2011	Munich (Germany) Forchheim (Germany)
GE	Director GE Global Research – Europe	Garching (Germany)	May 4, 2010 July 16,2010	Luebeck (Germany) Telephone
GE Healthcare	General Manager GE China Technology Center *Former:* General Manager of Global Technology, GE Healthcare in China	Shanghai (China)	September 2, 2010 November 17, 2010	Telephone Telephone
Philips Healthcare	Senior Vice President Head of Research and CTO Asia	Shanghai (China)	November 24, 2010	Telephone
Philips Healthcare	Vice President and General Manager Specialty & Emerging Markets Patient Care and Clinical Informatics	Andover (U.S.)	December 13, 2010	Telephone
Siemens	Corporate Technology Corporate Research and Technologies	Munich (Germany)	October 11, 2010	Telephone
Siemens Healthcare	General Manager Computed Tomography Siemens Shanghai Medical Equipment *Former:* R&D Project Leader CT Siemens Shanghai Medical Equipment	Shanghai (China)	November 29, 2010	Telephone
Siemens Healthcare	Head of System Engineering Imaging & IT Division	Forchheim (Germany)	May 22, 2010 November 5,2010	Dusseldorf (Germany) Telephone
Siemens Healthcare	Vice President Computed Tomography Head of Global R&D	Forchheim (Germany)	December 15, 2010	Telephone
Siemens Healthcare	Vice President Engineering Imaging & IT Division	Forchheim (Germany)	January 24, 2012	Zurich (Switzerland)

Curriculum Vitae

Bastian Ludwig Paul Widenmayer

Education

2011 - 2012	**University of Cambridge – United Kingdom** Visiting PhD at the Judge Business School
2008 - 2013	**University of St. Gallen (HSG) – Switzerland** Research associate and PhD candidate at the Institute of Technology Management *Degree sought:* Doktor oec.
2005	**National University of Singapore – Singapore** Visiting student at the NUS Business School
2003 - 2008	**Technische Universität München – Germany** *Course of study:* Business Administration *Degree:* Diplom Kaufmann (Dipl.-Kfm.)
1998 - 1999	**Darlington School Rome – GA/USA** *Degree:* High-School Diploma
1991 - 2001	**Schiller-Gymnasium Hof – Germany** *Degree:* Allgemeine Hochschulreife (High School Diploma)

Work Experience

2007 - 2008	**Fujitsu Siemens Computers AG – Germany** Diploma thesis in the field of open innovation
2007	**BMW AG – Germany** Research study in quality management
2006 - 2007	**OSRAM GmbH – Germany** Working student in global purchasing merchandise
2006	**Goetzpartners Management Consultants GmbH – Germany** Internship in business consultancy

Military Service

2001 - 2003	**German Federal Armed Forces – Parachute Battalion 261** *Rank:* Reserve First Lieutenant