Business Models for Reverse Innovation

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Abstract

As part of the globalisation process, increasingly the weight of the global consumer market has been moving towards the emerging market economies. At the same time companies from these emerging markets are becoming global players, putting increasing competitive pressure on long established western multinational companies (MNCs). The combination of these forces led western MNCs over the past decades to venture deeper into these emerging markets. Not only did many of them establish production facilities there to take advantage of lower operational costs, but also research and development operations to better serve these emerging markets. So-called frugal innovation was required to come up with functional and affordable products tailored to these markets. In some cases, products and services successfully developed in and for those emerging markets were also successfully introduced in more developed markets. This process of innovating in and for emerging markets and later bringing the same products and services to developed markets is known as reverse innovation. It basically mimics the same path as that followed by successful companies native to those emerging markets.

This research analyses the business models that western MNC have adopted in emerging markets in order to foster reverse innovation. Case studies of three purposively selected western MNCs are presented, analysed and compared. In the analysis of these business models the emphasis lies on the following three main elements: a) value proposition; b) value creation and delivery; and c) value networks. Comparisons are drawn upon the way the selected companies operated in each of these elements in their pursuance of reverse innovation. There are obviously differences, but also some striking similarities in the way these companies responded to the challenges that operating in and for emerging markets implied and how they responded to opportunities for reverse innovation and potentially disruptive technologies.

Keywords: reverse innovation, business model, frugal innovation, MNCs, emerging markets, EMNCs.

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1. Introduction

In recent years, the importance of emerging markets and developing economies in the global economy has risen considerably (International Monetary Fund, 2017). According to Astmon, Child, Dobbs & Narasimhan (2012), the annual consumption in emerging markets will reach $30 trillion in the year 2025, up from US$ 12 trillion in 2010, making it the "*biggest growth opportunity in the history of capitalism*" (p. 4).

The list of emerging economies is long and includes some of the most populous nations in the world, such as China (1.41 billion people), India (1.34 billion people), Indonesia (264 million), Brazil (209 million), Mexico (129 million) and Turkey (81 million) (United Nations, Department of Economic and Social Affairs, Population Division, 2017). Together these countries comprise the bulk of the world population. With globalisation, more and more production capacity was established in those countries and they have become global manufacturing hubs. At first the increased production capacity was focused on export, benefiting from the much lower cost of the production factors in those poorer countries, but later on the industrial growth became much more focused on serving the rapidly increasing internal consumption by their large and increasingly more prosperous populations. Nowadays, these economies have become essential destinations for consumer goods, accounting for nearly 85 percent of growth in global consumption (Gruss, Nabar, & Poplawski-Ribeiro, 2017). Mancini, Namysl, Pardo and Ramaswamy (2017) estimate that by 2025 the emerging markets will be the destination for 65 percent of the world's manufactured commodities.

New technologies and products used to be primarily created in developed markets and eventually also marketed in emerging markets and less developed economies. However, today's global economy has allowed a change in the innovation flow (von Zedtwitz, Corsi, Søberg, & Frega, 2015). It is expected that the consumer preferences in the emerging markets will drive global innovation in, for example, product design, manufacturing, and distribution

channels (Astmon et al., 2012). How innovation is increasingly "trickling up" from developing and emerging economies to the developed economies is known as the concept of reverse innovation (Govindarajan & Ramamurti, 2011).

It is not sufficient for western multinational corporations (MNCs) to serve the emerging markets through glocalisation (Immelt, Govindarajan, & Trimble, 2009; Govindarajan, 2012 Brem & Wolfram, 2014), where products from the developed economies are introduced to the emerging economies (Corsi & Di Minin, 2014). These products are not specifically tailored to the needs of the latter (Agarwal & Brem, 2012; Brem & Ivens, 2013; Zeschky, Winterhalter, & Gassmann, 2014; Ostraszewska & Tylec, 2015; Ernst, Kahle, Dubiel, Prabhu, & Subramaniam, 2015). Through reverse innovation, western MNCs may be able to better respond to the needs of customers in the emerging markets and may even tap into opportunities further down the economic pyramid (Radojević, 2015) and find a fortune there (Brem & Wolfram, 2014). Ideally these innovations can be introduced into the developed economies (Radojević, 2015). Innovating for new markets requires taking into account the different contexts in which a company will operate, and hence demands the adoption of a value proposition for each market (Radojević, 2015). In other words, a profound change in the mind-set of western MNCs in every aspect of their operations is needed in order to attract consumers in emerging and developing markets (Astmon et al., 2012).

While previous research on reverse innovation has mainly focused on what it entails, little research has thus far been conducted on the business models that organisations employ to foster their reverse innovation efforts. This research paper aims to partly fill this void and focuses on specific business model elements used by Western MNCs in their reverse innovation efforts. Therefore. the central research question for this paper is:

How did the business models adopted by Western MNCs in emerging markets aid in embracing and fostering reverse innovation?

In order to respond to this question, the following sub-questions are identified:

- *What triggered Western MNCs to engage in reverse innovation?*
- *What factors made Western MNCs consider alternative business models for their operations in emerging markets?*
- *How do these business models differ from those that Western MCNs apply in the developed economies?*

Throughout the following sections of this paper, these research questions are analysed. The next section focuses on a literature review covering reverse innovation, and the growing attractiveness of emerging markets, as well as the different conditions these markets offer and the challenges that they pose. This section then continues by focusing on business models, the importance of organisational strategy, and the nexus between strategy and business models. The third section provides the conceptual framework of covering the importance of organisational strategy and business models that are suitable to the different environments of these emerging markets to foster reverse innovation. The fourth section focuses on the research methodology used and the selection of different experiences by Western MNCs that have been promoting reverse innovation. This is followed by the fifth section, which provides a brief description of the companies chosen and examples of reverse innovation these have engaged in and an analysis of the characteristics of the business models business models followed. In the sixth section, the findings of these various case studies are presented and compared. In the seventh section, these findings are discussed against the literature analysis presented in the second section, followed by concluding remarks in the eighth and final section.

2. Literature review

2.1 Reverse innovation

Reverse innovation is, according to Agnihotri (2015), in essence, based on value and frugal innovations, which, in other words, are low-cost but high in value. Such frugal innovations are not developed with the intent *per se* to market the products back to developed economies (Govindarajan & Ramamurti, 2011; Agarwal & Brem, 2012). According to Govindarajan, a reverse innovation does not necessarily have to be low-cost innovation, it rather depends on whether the upper, middle or lower class in emerging and developing markets is targeted (Govindarajan & Euchner, 2012). Successful adoption by any of these classes in emerging and developing markets may lead to these products also being adopted in developed economies, either directly or after some further adaptation to make them better fit the customer preferences in these more developed markets.

Innovations in general may have the potential to be disruptive, displacing existing products and services and wiping out complete businesses, which especially tends to affect the more developed economies (Chang-Chieh, Jin, & Subramian, 2010; Corsi & Di Minin, 2014; Sinha, 2013). According to Govindarajan, reverse innovation may be disruptive, but disruptive technologies are not necessarily the driving force that enables reverse innovation (Govindarajan & Euchner, 2012). A product developed through reverse innovation that has a better performance at a more economical rate has the potential to be dispersed worldwide, and can be disruptive to existing products and product platforms in the developed economies (Winter & Govindarajan, 2015). On the other hand, a completely new product developed through reverse innovation in a developing or emerging economy may be attractive too to users in developed economies, and fill a new found need among the population at large. This product does not necessarily displace existing industries and can include the potential to form the basis of an entirely new product platform.

Govindarajan and Ramamurti (2011) identified three stages of reverse innovation; 1) adoption of innovation in emerging markets, 2) the transfer of this innovation to other emerging markets and lastly 3), transferring the innovation selectively to developed economies. Initially, reverse innovation was practiced by companies in emerging markets. However, due to substantial growth of the middle-class segment in emerging markets (Hadengue, de Marcellis-Warin, & Warin, 2015), western MNCs have noticed the market potential of reverse innovation (Sarkar, 2011; Zeschky, Winterhalter, & Gassmann, 2014).

In order for the Western MNCs to capitalise on this opportunity, Brem and Wolfram (2014) argue that these companies need to decentralise their product development by allocating people and resources to the local markets they wish to serve. The different market contexts of emerging and developing markets, challenge the traditional value creation approach of western MNCs (Brem & Wolfram, 2014). It requires them to understand these markets truly and immerse themselves in these markets. This requires a total rethinking of each company's business model.

For the purpose of this research, reverse innovation is referred to as an innovation that was developed for emerging markets, and has since also been introduced in developed countries (Immelt et al., 2009; Govindarajan & Ramamurti, 2011; Zeschky et al. 2014).

2.2 Emerging markets

Emerging markets are markets that previously were commonly referred to as 'less developed countries', or 'Third World countries', which have gone through often profound economic liberalisation processes (Arnold & Quelch, 1998). Initially, emerging markets tended to be primarily attractive to Western MNCs as a source of low-cost offshore production operations (Arnold & Quelch, 1998). Nowadays, with a relatively young consumer base whose spending power is increasing rapidly, the revenue potential in these same markets has grown

significantly (Petrick & Juntiwasarakij, 2011; Meyer & Tran, 2006; The Economist, 2010). However, in these markets, it may not be sufficient to simply try and export products from the developed markets to these emerging economies, or produce and sell these same products in the emerging markets. Many a time, these products do not cater to the preferences of the local customers or are simply too expensive for the majority of the customers (Govindarajan & Trimble, 2012). To successfully engage in these emerging markets, a company needs to start producing specifically for that market and this generally implies focusing on value, frugal and resource-constrained innovations.

Emerging markets offer the opportunity of low-investment experiments with potentially high returns. Due to globalisation, competition in emerging economies has increased and these markets are increasingly evolving into centres of innovation (Sinha, 2013) as large corporations are establishing R&D centres in these markets. As Crosi and Di Mini (2014) state, research in reverse innovation *"…emphasises the role of emerging economies as the new laboratory in the global economy…"* (p 82). With more companies establishing R&D centres to address local customer needs in emerging and developing markets, western MNCs are also challenged by prospected higher levels of competition (Brem & Wolfram, 2014).

Winter and Govindarajan (2015) argue that companies continue encountering difficulties in emerging markets because they fail to grasp the economic, social and technical contexts of these markets. In the emerging markets, usually five need gaps can be identified that companies can use as a starting point for their reverse innovation efforts. These five need gaps, as identified by Govindarajan & Trimble (2012), are: 1) the performance gap; 2) the infrastructure gap; 3) the sustainability gap; 4) the regulatory gap; and 5) the preferences gap. A common denominator of these gaps is that they represent problems that have *not* already been solved by the developed world and consequently adapting developed economy products for emerging markets is often not successful (Govindarajan & Trimble, 2012).

Besides the need to be aware of the importance of taking the different contexts into account, another point of attention for Western MNCs are the institutional voids present in emerging markets, such as the absence of contract enforcing mechanisms, regulatory systems and specialised intermediaries, that could hamper their efforts in emerging economies (Khanna, Palepu, & Sinha, 2005). In order to be successful in emerging markets, organisations must try to work around these institutional voids (Khanna, Palepu, & Sinha, 2005) or treat them as business opportunities (Khanna & Palepu, 2006). By doing so, a company will gain a better understanding on how to adapt their business model to better suit the country's context (Khanna et al., 2005). Additionally, Bhattacharya and Michael (2008) acknowledge that the strategies of large corporations have often been unsuccessful in developing economies, partly due to holding the assumption that emerging markets eventually would become similar to those of the developed ones.

Clearly, context has to be taken into account to identify what the problems and needs of the populations in the emerging markets are and to understand that developed economies differ substantially from emerging markets (Meyer & Tran, 2006; Ernst et al, 2015). For instance, Western MNCs should heed the difference in the product market of emerging markets. According to Khanna and Palepu (2006), it can be classified into four categories namely, the global customer segment; the glocal segment; a local segment; and lastly the bottom of the pyramid (BoP). The first group represents the wealthy, who tend to prefer the same quality goods as those available in the developed economies and are willing to pay the same global price. The glocal segment, are categorized as the higher-middle income class, that fancy products of global quality adapted to local requirements and at lower than global prices. The local segment, identified as the lower-middle income class, prefers local products at local prices. Finally, the BoP oftentimes represent the vast majority of people in emerging economies

and developing economies, and they can only afford inexpensive products (Khanna & Palepu, 2006).

When targeting the BoP, one approach that has been regarded as successful, is to create products and services that are designed for functionality (Petrick & Juntiwasarakij, 2011). Often through the combination of existing knowledge and technologies, organisations can create novel solutions, and/or business models that address specific local problems (Govindarajan & Ramamurti, 2011; The Economist, 2010), bearing in mind that central to the BoP are not premium pricing and abundance, as it is in developed countries, but rather affordability and sustainability (Zanello, Fu, Mohnen, & Ventresca, 2016).

Due to globalisation, according to Ernst et al. (2015), emerging market firms are gradually internationalising, becoming emerging multinational corporations (EMNCs), and acquiring new capabilities outside their country of origin (Ernst et al., 2015; Wright, Filatotchev, Hoskisson, & Peng, 2005; Borini, de Miranda Oliveira, Silveira, & de Oliveira Concer, 2012; Kedia, Rhew, Gaffney, & Clampit, 2016). As the EMNCs gradually internationalise and acquire new capabilities, it opens up the possibility of EMNCs outperforming Western MNCs not only in the emerging markets, but eventually in the developed economies as well (Agnihotri, 2015).

Bhattacharya and Michael (2008) found six common strands among successful emerging economy companies. Firstly, EMNCs initially pursue economies of scope, customising products and services to the different consumer requirements. Secondly, their business models overcome the institutional voids and roadblocks in the market, whilst yielding a competitive advantage. Furthermore, they are adept to turning globalisation to their advantage, using the latest technologies by developing or buying them. They also find innovative ways to benefit from the low-cost labour pool and overcome the shortage of skilled talent. Moreover, local companies quickly scale up and go national to prevent regional

competition from challenging them. Lastly, western MNCs often underestimate the management skills and talent of local companies.

Hence, western MNCs should execute strategies that help them overcome the obstacles they encounter in these emerging markets to operate successfully. To do so, Immelt et al. (2009) emphasise the importance of local growth teams (LGTs) as independent units from the MNC's headquarters. This view is also shared by Brem and Wolfram (2014), stating that reverse innovation requires a new way of thinking to innovate for emerging economies, by decentralising the product development. These LGTs are important to tailor innovations to the local requirements and also help overcome local constraints (Corsi & Di Minin, 2014; Zhu, Zou, & Hu, 2017). In the same vein, Sarkar (2011) and Ernst et al. (2015) proposed the creation of local networks by partnering with local firms and non-governmental organisations (NGOs) to overcome institutional voids present in developing economies.

London and Hart (2004) put forward that western MNCs that enter emerging countries, aiming at the low-income market segment ought to reconsider their business models. Radojevć (2015) argues that innovating for such a new market automatically entails creating a new value proposition and that the other building blocks of the business model, as identified by Osterwalder and Pigneur (2009), also need to be adapted to fit to the primary market. However, Khanna et al. (2005) provide a contrasting view, arguing that the core value proposition must be retained, even if all other aspects of the business model are to change. They have misgivings that too radical shifts will cause the organisation to lose its competitive advantage in global scale and global branding (Khanna et al., 2005). Before diving deeper into the necessity of business model alterations, firstly the concept of business models is reviewed in the following sub-section.

2.3 Business models

The term business model in its current use in the literature does not refer to one single concept. There are rather multiple interpretations of what a business model entails (Zott, Amit, & Massa, 2011). This subsection is devoted to understanding what business models are, and whether there is some level of consensus on the various elements that make up a business model.

Chesbrough and Rosenbloom (2002), view the business model as a tool that mediates between technology development and economic value creation. To them a business model has several purposes as it: a) expresses a *value proposition*; b) clarifies the *market segment* it wants to target; c) determines the structure of the *value chain*; d) approximates the *cost structure* and *profit potential*; e) portrays the position of the firm within the *value network* thereby linking suppliers and customers, and identifying complementors and competitors; and f) articulates how the firm will gain and hold advantage over competitors through its *competitive strategy* (Chesbrough & Rosenbloom, 2002). Johnson, Christensen and Kagermann (2008) narrow this view down to proposing that a business model consists of four elements, namely, the customer value proposition, a profit formula, key resources and processes. Osterwalder and Pigneur (2009), on the other hand, expand this view with the concept of the business model canvas, consisting of nine building blocks: the value proposition, key activities, key resources, key partners, customer relationships, channels, revenue streams and customer segments.

In other words, there does not seem to be much agreement on one singular definition of a business model. However, there does seem to be a common thread in the literature that a business model refers to how an organisation operates and creates value for its stakeholders (Casadesus-Masanell & Ricart, 2010; Baden-Fuller & Morgan, 2010). McGarth (2010), refers to the value proposition as a "*unit of business*" (p. 249), which reflects the organisation's products or service offerings. Zott and Amit (2010) take an activity-system perspective on business models, which encompasses how an organisation conducts business, how it delivers

value to stakeholders and how it links factor and product markets. This is in line with DaSilva and Trkman (2014) who argue that the business model portrays the organisation and how all aspects in the organisation work together. The value creation and delivery concerns the activities an organisation performs to deliver value to stakeholders, which bears close resemblance to Porter's (1985) value chain (Amit & Zott, 2001; Zott & Amit, 2013). In short, an organisation's business model defines the organisation's architecture that supports the key elements of creating a value for the customer and the ability to capture value (Teece, 2010).

Despite the absence of a singular definition of what a business model is, considerable agreement can be found on the key elements which make up a business model. The vast majority writes about the value the organisation can offer to its customers: a) the value the organisations can capture for itself; b) the creation and delivery of the value to its customers (Amit & Zott, 2001; Chesbrough & Rosenbloom, 2002; Johnson, et al., 2008; Osterwalder & Pigneur, 2009; Teece, 2010; Casadesus-Masanell & Ricart, 2010; Zott & Amit, 2011, 2013; Cortimiglia, et al., 2016; Tallman, Luo & Buckley, 2017); and c) the organisation's value network (Chesbrough & Rosenbloom, 2002; Tallman et al., 2017; Demil & Lecoq, 2010; Zott & Amit, 2010). In the analysis of the business models employed by western MNCs in this study, the emphasis therefore lies on the following three main elements: a) value proposition; b) value creation and delivery; and c) value networks.

An organisation can employ one business model, or several, according to the different market segments in which an organisation operates (Di Carlo, Fortuna, & Testarmata, 2016). Every organisation has a business model, yet not every business model is suitable to every context and in the long run few will prove to be sustainable over time and space (Casadesus-Masanell & Ricart, 2010). To ensure sustained value creation, it is important that organisations adapt their business models to the context in which they operate. Business models also need to be altered overtime to fit the corresponding ever-changing environment (Osterwalder, 2004;

Achtenhagen, Melin, & Naldi, 2013; Wirtz, Pistoia, Ulrich, & Göttel, 2015; DaSilva & Trkman, 2014). Such alterations of the business model can involve incremental changes, or disruptive changes that replace the organisation's existing model (Khanagha, Volberda, & Oshri, 2014).

Besides the need to alter a business model overtime due to the changing environmental contexts, an organisation may also need to consider adopting a new business model when entering a new market, such as the emerging markets. While the business models in their home markets might have been successful, the same may not be useful when entering emerging markets. To better suit the organisations business model to an emerging market, it needs adaptation and innovation. The organisation's business model needs to fit the new context (Landau, Karna, & Sailer, 2016). The changing market contexts, or contingencies, have an effect on an organisation's strategy, resources and capabilities, which in turn play a role in how an organisation must innovate its business model (Tallman et al., 2017). Innovating a business model is hard, there are barriers to overcome within an organisation and without, yet organisations should not fear trial and error to break free from entrenchment (Chesbrough, 2010).

According to Lanadu et al. (2016), there are four phases in which firms alter their business models, namely; 1) international extension, 2) local emergence, 3) local expansion, and 4) local consolidation. These phases occur as step-wise adjustments of the business model components as the firm acclimatises to the emerging markets, developing their local emerging market business model (Landau et al., 2016). Entering the emerging and developing markets, means stepping away from the traditional sense of business strategy, as not all markets in emerging and developing markets progress similarly to those of developed markets (London & Hart, 2004). As already mentioned earlier, exporting products or services will likely not foster growth in emerging markets. To grow in emerging markets, organisations need to

innovate (Govindarajan & Trimble, 2012), especially when targeting the BoP. Furthermore, when targeting the BoP, London & Hart (2004) suggest that western MNCs should not simply focus on strategies that try to overcome the limitations and institutional voids in emerging and developing markets. Instead, they should rather create a strategy that conceptualises the external environment in emerging markets and use this as a means to create competitive advantage (London & Hart, 2004).

As mentioned before, this research will primarily focus on the following three key elements that make up a business model, on which there is a wide consensus in the literature: a) the *value proposition*; b) the *value creation and delivery;* and c) the *value network*.

2.4 The nexus between MNCs strategy and business models

Although an organisation's business model makes implied expectations about customers and how best to go to market, it is not synonymous to an organisation's strategy (Teece, 2010). Strategy is concerned with execution and implementation (Osterwalder, Pigneur, & Tucci, 2005), while a business model articulates what value will be delivered for the customers and how the organisation captures a portion of this value in revenue. In itself the business model does not guarantee a competitive advantage, yet coupled with strategy an organisation can create sustained competitive advantage (Teece, 2010).

According to Casadesus-Masanell & Ricart (2010), "*strategy refers to the choice of business model through which the firm will compete in the marketplace*" (p.196). In the same vein Khanagha et al. (2014) argue that crafting and employing a new business model is a function of an organisation's strategy. Similarly, research conducted by Cortimiglia, Ghezzig and Frank (2016) highlighted that business models can serve as a strategy operationalisation tool, specifically useful in the implementation phase of the strategy making process. Thus, the

business model can be regarded as a framework for strategy execution (Casadesus-Masanell & Ricart, 2010; Teece, 2010; Khanagha et al., 2014; Cortimiglia et al., 2016).

Through strategy an organisation can align itself with its environment, while the business model frames an organisation's value creation and appropriation. However, as the environment around and within the organisation is dynamic and constantly changing, the task of strategy is to maintain a dynamic, not a static balance (Porter, 1991). Therefore, internal and external factors must be reviewed regularly to adapt and fit strategies to the organisation's environment (Hitt, Ireland, & Hoskisson, 2013, and Wirtz, Pistoia, Ullrich & Göttel, 2016).

Hitt, Ireland and Hoskisson (2013) describe strategy as the goals and commitments that sets the organisation apart from its rivals. Likewise, Porter (1996), refers to a company's competitive strategy which distinguishes it from others. An organisation's strategy defines the arrangement of activities and their interrelations (Porter, 1991). The choice of these activities and how they are conducted in a different manner compared to the competition is the source of competitive advantage (Porter, 1996; 1991). Porter (1991) argues that to gain a competitive advantage an organisation can pursue either one of two generic strategies; the differentiation strategy, or the low-cost leadership strategy.

While innovating for emerging markets western MNCs may favour a low-cost leadership strategy, yet for the developed markets these same companies may be inclined to favour a differentiation strategy. According to Porter (1991), when trying to pursue both, an organisation could get "stuck in the middle", creating a conflict in activities of the organisation. To build on, or avoid, conflicting activities, organisations can become ambidextrous by implementing dual business models (Winterhalter, Zeschky, & Gassmann, 2015). There are several forms in which an organisation can leverage ambidexterity which consist of; organisational separation, temporal separation, domain separation, and contextual separation (Winterhalter et al., 2015).

Two other dominant views on strategy are the resource-based perspective and the dynamic capabilities perspective (McGrath, 2010). Within the resource-based perspective the focus lies on capitalising on the organisation's distinctive capabilities, that give it a competitive advantage (Peteraf, 1993; Teece, Pisano, & Shuen, 1997; Teece, 2007). The dynamic capability perspective, is an extension of the resource based view, which centralises on the notion that an organisation can create new forms of competitive advantage by rearranging and combining internal and external competencies (Teece et al., 1997; Al-Aali & Teece, 2014). DaSilva and Trkman (2014) claim that through its strategy an organisation can develop dynamic capabilities that allow it to respond to contingencies through its business model. An organisation's strategy in this sense is what it aspires, a vision, and the business model frames that aspiration and portrays the organisation at a given time (DaSilva & Trkman, 2014).

By defining a strategy, an organisation can create a business model to execute this strategy. As mentioned earlier, when engaging in reverse innovation, western MNCs are compelled to establish dual business models. The organisation needs a business model suited to engage with, and innovate for the emerging market. Yet, when attempting to bring these innovations back to the developed markets, these might require alterations to suit the developed markets, and a business model tailored to these markets.

This apparent duality in business models, and the need for western MNCs to adopt context-specific business models to be successful in emerging markets is something that this study will be concerned with, particularly focusing on the three key elements of business models that were mentioned before.

3. Conceptual framework

Based on the reviewed literature, the conceptual framework as portrayed in figure 1 has been developed. The strategy of an organisation depicts its vision, which can be realised through an organisation's business model. For an organisation to be able to engage in reverse innovation, it must develop a strategy fit for the emerging market in which it needs to operate. This strategy can then be employed through the development of a business model fitting to that particular emerging market. The framework of the business model in this research is made up of the organisation's value proposition, value creation and delivery, and value network. How the organisation identifies the necessities of each element can be done through strategic analysis.

Markets tend to be dynamic, reacting to changing market conditions. Due to globalisation, markets are in constant flux. These changing market contexts have an influence on both the organisation's strategy and business model. This influence is shown in figure 1 by the dotted line arrow, directing at both strategy and business models. A change in market conditions, means that a change in strategy and business model may also be required.

A company may decide to engage in a strategy focused on reverse innovation. If it has successfully developed an innovation for the emerging markets, it may also start to consider the possibility of adapting and diffusing this innovation to the developed economies.

In an attempt to connect the so-called reverse innovation good practices to the elements of a business model, several of these elements should be linked. Taking the *value proposition*, contrary to what normally occurs with a glocalisation strategy, for reverse innovation efforts this means uncovering the specific needs in emerging or developing markets first. For the *value creation and delivery* dimension in relation to reverse innovation, this reflects how the organisation is able to firstly conceptualise a specific need it wants to address, secondly it means uncovering what the organisations resources and capabilities are to create a solution to this need, and thirdly, how this solution is made available to the targeted market segment. The

literature on reverse innovation points to several suggestions, such as the establishment of LGTs, or partnerships with local organisations in emerging and developing markets (Immelt et al., 2009; Sarkar, 2011; Ernst et al., 2015), which refers to the *value network* dimension.

To be a reverse innovation, this innovation must be diffused to developed markets. This also means that a strategy and business model must be defined to help get this innovation adapted to and accepted in developed markets.

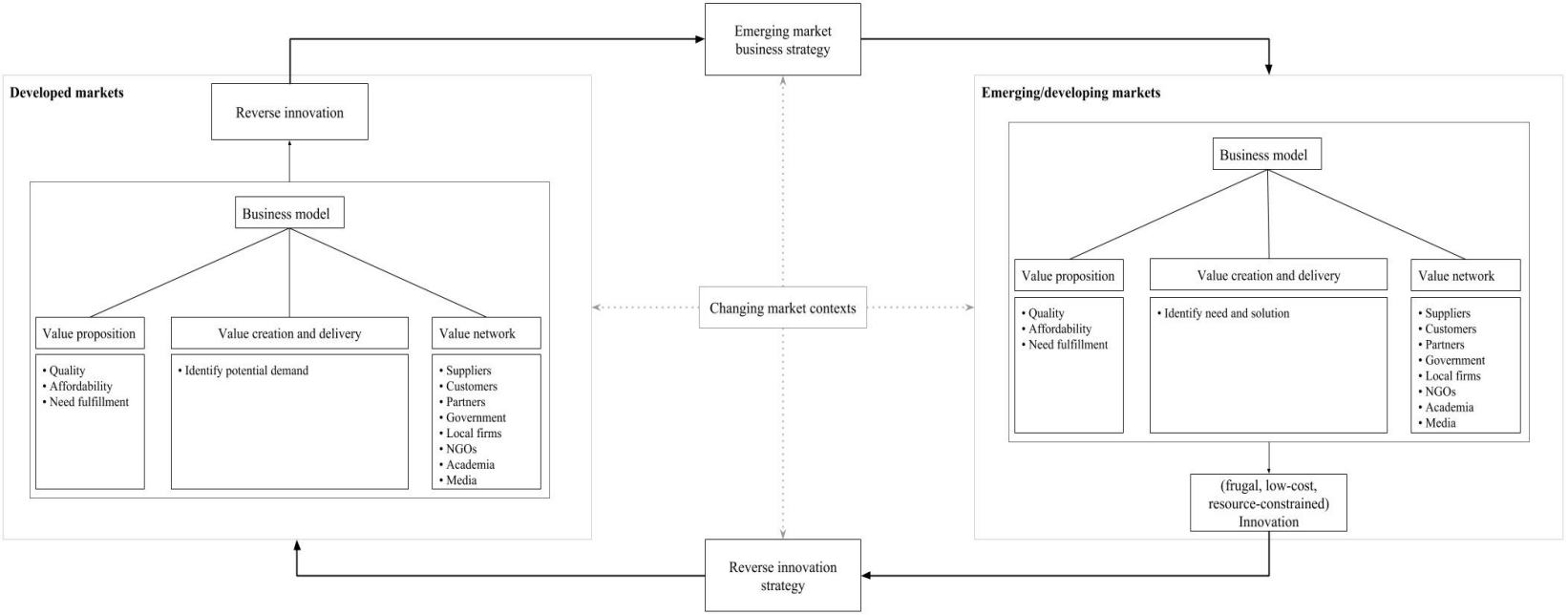

Figure 1 Conceptual framework (Author's own illustration)

4. Research methods

This chapter will focus on the overall research design, including the research strategy, intended data collection methods and the purposive sampling used to select a couple of companies that represent case studies on proactive reverse innovation. The case studies provide for comparative analysis concerning the central research question at the basis of this research paper.

4.1 Research strategy

This research is an explanatory research aimed at how the business models adopted by Western MNCs have fostered reverse innovation. This objective was chosen as more research is necessary on this subject in the discussion on reverse innovation. In order to understand the nexus between reverse innovation, emerging markets, business models and strategy and how they relate to companies engaged in reverse innovation, a review of secondary literature was conducted. Furthermore, the research strategy employed multiple in-depth case studies. This method is considered to be an appropriate approach, as theory and research in this area has not yet matured (Darke & Shanks, 2002). Moreover, the multiple-case study design enables a comparative analysis between the three sampled western MNCs, in order to understand their similarities or differences (Yin, 1994; Baxter & Jack, 2008; Bryman & Bell, 2015). Secondary data was collected and analysed that relate to western MNCs that have created reverse innovated products or services in the past. Reverse innovation efforts of several western MNCs are described as separate cases. The cases are compared in relation to the business models they used to drive product development and what the organisational capabilities were that enabled reverse innovation.

4.2 Data collection

For the literature review, secondary data was collected through the electronic database Scopus, Web of Science and FindUT. From these databases articles were selected that were accessible using the University of Twente credentials. Using the keyword "reverse innovation" in Scopus eventually led to 45 articles, of which access was granted to 23. The full search query for the Scopus database can be found in appendix II. Through the Web of Science database, eventually 28 documents could be accessed that had "reverse innovation" as a keyword. Similarly, using the FindUT database, access was provided to 22 articles. The full search queries for Web of Science and FindUT can also be found in appendix II. Besides these databases, articles were also used using Google Scholar. It is worth to mention many of the articles did not strictly limit themselves to reverse innovation, but also included other innovations occurring in emerging markets, such as frugal innovation and low-cost innovation in general.

To understand how organisations can operate in these emerging markets, the literature search for emerging markets was a result of snowballing from the reverse innovation literature. Although some literature hints to the importance of business models for organisations conducting reverse innovation, none of the articles went in depth on this matter. To understand the phenomena of business models, the most influential works such as that of Chesbrough and Rosenberg (2002), Amit and Zott (2001, 2010, 2013) and Teece (2010) were reviewed, and from there it snowballed into other literature. Besides this snowball effect, literature on business models with a specific focus on organisations operating in emerging markets was also reviewed. Furthermore, to get a better understanding of the nexus between a business model and strategy, literature was also reviewed on this topic, such as Casadesus-Masanell & Ricart (2010).

To understand the underlying organisation of the sampled Western MNCs, publicly available information was gathered consisting of the organisations' official website, annual

reports, press releases and articles. Furthermore, other media websites were consulted such as newspapers and previously conducted interviews with the leadership of these organisations. In addition, previously conducted case studies of the sampled organisations were also reviewed. The articles for these case studies were found through the University of Twente's electronic library, Google Scholar, the wider Internet and published books.

To enable a comparative analysis, the gathered information was combined and outlined in an individual case description for each sample organisation. A brief overview of data sources can be found in table 1. The data sources are grouped by each individual case study. By reviewing an extensive amount of sources, the data was collected and integrated in a separate case description for each company. To increase the validity of the data sources used, all sources were cross-checked to verify their legitimacy. An elaborate overview of the data sources used to build each case description is provided in Appendix III. The use of multiple sources enhances the construct validity of this research (Yin, 1994).

Table 1 - Brief overview of data sources

Public Company information	Annual reports	Press releases	Event presentations	Conference call transcripts	Company reports
News articles (periodical)	Volkskrant	South China Morning Post	China daily	Times of India	Reuters
Website's	Company website's	Business Insider	U.S. Food and Drug Administration	Financial Times	Financial Times
Case studies	GE Healthcare (A): Innovating for emerging markets. (Singh 2011)	Sustainability - The technology challenge: General electric white paper (Hilton et al., 2013).	Implication of reverse innovation for socio-economic sustainability: A Case study of Philips China (Shan & Khan, 2016)		
Books	Reverse innovation - create far from home, win everywhere (Govindajaran & Trimble, 2012	Innovation landscape in developed and developing markets (Agarwal, 2016)	Siemens: Flying with the Dragon - Innovation in China (Boutellier, Gassman, & von Zedtwitz, 2008)	Innovative minds: A look inside Siemens' idea machine (Eberl & Puma, 2007)	
Interviews	PwC - Interview John Flannery (GE)	Thomson Reuters – Interview CEO Philips			

4.3 Sampling

The sample for the cases is based on purposive sampling and this resulted in the selection of three corporations namely, Siemens A.G., General Electric, and Royal Philips as examples of global companies which, among others, are focused on healthcare technology. The healthcare technology industry was chosen as the industry scope, with a view to strengthen the comparative quality of this research. The three above-mentioned MNCs have been chosen because: a) they are well-known Western MNCs; b) they have been known to proactively engage in the process of reverse innovation, and c) of the public availability and accessibility of relevant information. The purpose is to study how the business models of these organisations allowed them to foster and engage in reverse innovation.

Table 2 - Overview of chosen companies

Company	**Focal industry**		**Reverse innovation examples**
Siemens A.G	Healthcare	Health Technology	SOMATOM (CT scanner)
General Electric	Healthcare	Health Technology	Vscan (ultrasound)
Royal Philips	Healthcare	Health Technology	VISIQ (ultrasound)
	Personal Health	Domestic Appliances	Soymilk maker

4.4 Data analysis

The collected secondary data relates therefore to the reverse innovation efforts of Siemens A.G., General Electric and Royal Philips. These reverse innovation efforts are described in individual case descriptions of each company in the next section. Besides providing insight into these companies and several of their reverse innovation efforts, the case descriptions focus on the business models each adopted. This will also focus on the question whether these organisations used an ambidextrous approach which contributed to their reverse innovation efforts.

As mentioned earlier in chapter 2.1, for the purpose of this research reverse innovation is regarded as any innovation that has been developed for emerging markets and has subsequently been introduced in developed markets (Immelt et al., 2009; Govindarajan & Ramamurti, 2011; Zeschky et al. 2014). As figure 2 illustrates, reverse innovation is the opposite of what is known as glocalisation. With glocalisation the intent is to introduce products and services that have been innovated and marketed in developed markets first, to emerging and developing markets with or without slight alterations.

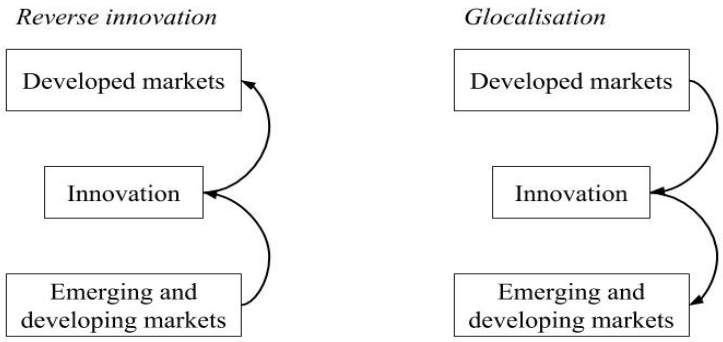

Figure 2: Reverse innovation vs. Glocalisation (Author's own illustration)

In order to judge if there is reverse innovation, it must be clear that an organisation has developed a product or service specifically for the emerging markets, and was also able to diffuse it to developed markets, with or without some minor adaptations. This was a key requirement for the case selection, which is why the sampling strategy was based on purposive sampling. In establishing whether organisations fit to these preconditions, a background research was conducted.

The research is not focused on the fact whether western MNCs were able to engage in reverse innovation. That has already been clearly established in numerous studies, including the corporations chosen for this study. Rather, the emphasis in this research has been put on the business models these western MNCs employed when engaging in reverse innovation.

Analysing a business model in its entirety for each organisation is a cumbersome and unwieldy task (Casadesus-Masanell & Ricart, 2010). While, as was already explained in the literature review, no single definition exists on business models, throughout the semantic discussion considerable agreement can be found on the key elements that make up a business model, as described in table 3. This research focuses on those key elements, namely a) the value proposition, b) value delivery and creation, and c) value network.

Table 3 - Key elements of the business model

BM elements	**Description**	**Authors**
Value proposition	What product or service did the organisation offer that is of value to its customers	Chesbrough & Rosenbloom, 2002; Johnson, et al., 2008; Osterwalder & Pigneur, 2009; Teece, 2010; Casadesus-Masanell & Ricart, 2010; Zott & Amit, 2013; Cortimiglia, et al., 2016; Tallman et al., 2017
Value creation & delivery	The value chain activities of the organisation and the resources and capabilities that enabled the development of the customer value proposition	Amit & Zott, 2001; Chesbrough & Rosenbloom, 2002; Teece, 2010; Zott & Amit, 2010, 2011, 2013
Value network	Resources provided to the companies' by external stakeholders, such as suppliers customers, complementors and competitors, that aided in the development of the product.	Chesbrough & Rosenbloom, 2002; Demil & Lecoq, 2010; Zott & Amit, 2010; Tallman et al., 2017

For the value proposition element, this research aims at identifying whether the organisation's reverse innovation efforts were firstly developed to meet the demands of emerging markets and secondly how this need could also be found in the developed markets. The *value delivery and creation* element focuses on the value chain activities of the organisations and its resources and capabilities that enabled the creation and delivery of the value proposition. The *value network* dimension in this research will entail whether the organisations made us of external stakeholders that provided the organisation with external resources to enable product development.

5. Case descriptions

The case selection covers three western MNCs that have been successful at developing products for emerging markets, and that subsequently diffused these products in developed markets. In this section the key characteristics of these organisation's business models are presented and discussed. The comparative analysis, identifying similarities or what sets these business models apart, will be presented in section six.

The three global companies that were chosen for this study all concern technology companies that are partially focused on healthcare technology. The case descriptions of these companies' experiences highlight each organisation's strategy and key elements of their business models that have contributed to their reverse innovation successes. Some of these reverse innovation successes are also described in the case study of each company. The first case covers the endeavours undertaken by the German company Siemens A.G, and more specifically by its healthcare division, which since 2014 is an independently managed unit under the Siemens A.G. umbrella called Siemens Healthineers (Siemens - Vision 2020, 2014) and which was recently floated as an independent company in March 2018. The second case covers the undertakings of the General Electric (GE) Healthcare division. The third case concerns Royal Philips, which has transformed itself into another major western health technology firm, especially after having spun off Philips Lighting as an independent company in 2016.

These three companies were not only chosen for the fact that they are operating in the health technology sector, but they have also realised that merely simplifying innovations and introducing them in the emerging markets is not a successful strategy to gain market share in these economies. The healthcare market is rapidly transforming in the emerging and developing markets, and growing at a substantially faster rate than that of developed markets, which caught the attention of these health technology firms (Donoghoe, Gupta, Linden, Mitra & von

Morgenstern, 2012; Guillén, 2017). By the year 2020 the global healthcare spending is expected to reach $8.7 trillion, of which one third will be accounted for by emerging markets (Deloitte Touche Tohmatsu Limited, 2018; World Economic Forum, 2014). Besides the growing market potential, emerging markets also enable the companies to innovate and create healthcare solutions that can eventually be used in the developed markets – where costs have increased significantly – what makes these western MNC health technology firms to pursue reverse innovation. Another factor that played a role is that this strategy also allows them to stay ahead of the growing competition from emerging market MNCs (Guillén, 2017).

Two major demographic trends, the growing and aging population, are driving continued growth in demand for healthcare technologies trends and the driving force behind the R&D investments. Related to the trend of ageing are the sharply rising costs in healthcare. In ageing societies, an ever-larger proportion of healthcare costs tend to be dedicated to diagnosis and treatment of non-communicable diseases. Healthcare technologies can provide huge efficiency gains in these areas. Focusing on the healthcare divisions of Siemens A.G., General Electric, and Royal Philips, not only provides insight in how their business models facilitated their strategies to pursue reverse innovation in the emerging markets, but also enables a comparison between these three companies, which will be discussed in section six.

A sideways look will also be provided to the Personal Health division of Philips and how it focused on developing consumer products for emerging markets, like air purifiers and several kitchen appliances, that since their inception have also found their way to developed markets.

5.1 Case 1: Siemens Healthineers

5.1.1 Company information.

Siemens Healthineers is a global supplier of technology to the healthcare industry. It is a leader in imaging and laboratory diagnostics and also provides software solutions and clinical consulting services (Siemens A.G., 2015). The company is headquartered in Erlangen, Germany and employs over 46,000 people worldwide (Siemens Healthcare GmbH, n.d) generating Euro 13.6 billion in total revenues in 2017 (Siemens A.G., 2017a). While a large part of its R&D and production facilities are located in Germany and other developed markets, over the past 15 years the company has increasingly sought to establish R&D and production capacity in emerging markets, notably China. The following paragraphs are dedicated to provide a brief history of how Siemens Healthineers came about and what its plans are for the near future. This subsection also provides an impression on the company's engagement with emerging markets.

Advances in digital technologies and information processing, coupled with a growing demand for access to these technologies by the rapidly growing populations of emerging markets, made healthcare technologies an increasingly important part of Siemens. In 2001 this division was named Siemens Medical Solutions, which changed to Siemens Healthcare in 2008. In 2014 Siemens A.G. restructured itself and transformed the Healthcare Division into a separately managed unit in order to better respond to the needs in the healthcare market (Siemens A.G., 2014a), as the company foresaw major changes in business models and technologies in this market (Siemens A.G., 2014b). Siemens Healthcare experienced several changes in the year 2016. The business unit was rebranded into Siemens Healthineers and restructured into six different business areas namely, Diagnostic Imaging; Laboratory Diagnostics; Advanced Therapies; Ultrasound; Point of Care Diagnostics; and Services (Siemens A.G., 2016a). In the same year the Healthineers business area in-vitro diagnostics

experienced expansion *"…due to population and income growth in emerging markets…"* (Siemens A.G., 2016a, p. 7). Siemens Healthineers placed emphasis on becoming the leader in imaging systems, reflective of the fact that since 2010 the number of patients in emerging countries with access to the Siemens imaging systems increased from 760 million to 1,270 million in the year 2016 (Siemens A.G., 2016b).

Further change came in March 2018, when Siemens launched an initial public offering of Siemens Healthineers, whereby the former health division will continue as a completely separate company (Hübner & Scheutze, 2018). This move aims to better reflect the stand-alone value of this former business division of the large Siemens conglomerate. It will also allow the business to become more flexible and able to better respond to the growing competition, anticipate future changes, *inter alia* to enable it to generate the funds required for acquiring other firms or investments for organic growth in the healthcare sector (Hübner & Scheutze, 2018).

As indicated earlier, the rapid growth Siemens experienced in demand for its healthcare technologies was to a large extent generated by the growing importance of emerging markets. In part, the demand for high-end technologies for developed markets rose, but a large part can be attributed to Siemens engaging in emerging markets and developing functional healthcare technologies for these markets (Siemens A.G., 2015). In the year 2002, Siemens established its first R&D centre in China to serve the Asia Pacific region (Donoghoe et al., 2012). Whereas the markets in developed economies remained relatively weak due to healthcare reforms and budgetary constraints, emerging markets like China were booming (Siemens A.G., 2014b). In China, the move Siemens made was in response to the fact that demand for large hospitals diminished and more investments were being made (by the State) in smaller and mid-sized regional hospitals and clinics (Siemens A.G., 2014b). This increased pressure to focus more on

entry level products that could be marketed at a much lower price, while staving off increasing competition (Siemens A.G., 2014b).

Following the demographic trends the healthcare sector is experiencing, Siemens tries to supply healthcare providers with efficient and effective healthcare measures (Siemens A.G., 2014b). One of the R&D practices of Healthcare also concerns the development of products that meet the specific, targeted requirements of the healthcare systems of emerging markets (Siemens A.G., 2014b). The growth of Siemens Healthcare over the past years was in part driven by emerging markets and the company expects these markets to grow at a faster rate than the developed economies (Siemens A.G., 2015; Siemens A.G., 2016a), as emerging economies are still building up their healthcare infrastructure to provide everyone, including rural areas, with access to affordable medical technology (Siemens A.G., 2015).

While the company develops global technological innovations, it has also committed itself to designing and producing solutions tailored to the demand in different contexts (Siemens A.G., 2017c). To foster and capitalise on the growth in emerging markets Siemens implemented the SMART imitative, where SMART stands for simplicity, maintenance-friendly, affordable, reliable and timely-to-market (Siemens A.G., 2010; Siemens A.G., 2012). This initiative was implemented at Siemens' Corporate Technology department, which works closely with the R&D teams of the healthcare division to ensure that local needs of the healthcare markets are met (Siemens A.G., 2010), through the development of products for the entry-level segments (Siemens A.G., 2012). Through the SMART initiative, Siemens wanted to create a strong position in the Chinese market by increasing its local competitiveness and create more growth in China by staying in close contact with customers, build on an extensive local production base, and local innovation capabilities (Siemens A.G., 2011b). To further innovation capabilities, Siemens has increased its R&D investments from €4.5 billion in 2015 to €5 billion in 2017 (Siemens A.G., 2017b).

Siemens has established R&D hubs in many emerging markets, including India (Jayakumar, 2010), but China seems to be the ideal innovation location for Siemens. China now represents Healthineers´ second largest market and it now has three important large R&D and manufacturing sites. These include the Siemens Shanghai Medical Equipment Ltd. (SSME), the company's only CT R&D and manufacturing hub outside of Germany, for the development of CT and X-ray systems (Siemens A.G., 2017d). The development of X-ray tubes is done in the only R&D and manufacturing base outside of Germany, called the Siemens X-ray Vacuum Technology Ltd. (SXVT) located in Wuxi (Siemens A.G., 2017d). Likewise the only R&D and manufacturing base for magnetic resonance imaging (MRI) outside of Germany is the Siemens Shenzhen Magnetic Resonance Ltd. (SSMR), which operates in close collaboration with headquarters in Erlangen, Germany and a site in Oxford, U.K. (Siemens A.G., 2017d). The SSMR base is further divided into Angiography Imaging (AX) and Component and Vacuum (CV) (Siemens A.G., 2017d).

In addition to the factors already mentioned that made Siemens engage in innovation in China to better respond to the local needs, the Government of China also wants to fuel innovation in China. It had started a campaign to stimulate endogenous innovation, moving away from the notion of being a manufacturing country, towards an innovative nation by the year 2020 (Boutellier, Gassman, & von Zedtwitz, 2008). In response to this commitment, Siemens' focus on the Chinese market has shifted from a purely manufacturing country to an innovation destination (Boutellier et al., 2008). By 2016 a total of 20 R&D hubs had been established by Siemens in China, employing more than 4,500 R&D researchers and engineers and generating over 11,000 active patents and patent applications (Siemens A.G., 2017c). The above-mentioned R&D and manufacturing facilities in Shanghai, Shenzhen and Wuxi, are also part of these 20 R&D hubs. These three important facilities are seen by Healthineers as an

important move to strengthen its ability to support Chinese healthcare reform, aiming to deliver better outcomes at a lower cost to its customers (Siemens Ltd, China, 2016).

Besides close partnering with Government, in cooperation with China International Medical Foundation (CIMF), Siemens Healthcare supports "Healthy China" initiative and from 2012 till 2015 hosted trainings for doctors and hospital presidents in rural areas (Siemens A.G., 2014d). Siemens has a long tradition of creating partnerships with top universities, which helps the company in on-campus recruiting, but also in creating goodwill and potential future demand for its products, for instance by the medical doctors that graduated from those universities. In China, Siemens has also established partnerships with many universities and vocational schools, where it helped build university and institutional labs (Siemens A.G., 2017c). Siemens also provides scholarships to promote cooperation on scientific and technical exchanges, as well as talent cultivation. For example, Siemens established an educational scholarship in medical physics with Tsinghua University, and created the Siemens Management Institute in Beijing. It also sponsors the "Siemens Cup" China Intelligent Manufacturing Contest for 10 years to support development of innovative engineering talents (Siemens A.G., 2017c). These efforts were made to tackle the typically high attrition rates in this field (Donoghoe et al., 2012).

5.1.2 Some reverse innovation successes.

Multix Select DR digital X-ray system

In 2011 Siemens´s Healthcare Division revealed a digital X-ray system named the Multix Select DR (Siemens A.G., 2011a). Siemens was able to conceive this innovation through its SMART initiative (Siemens A.G., 2012; Agarwal, 2016). The product was developed to meet the demand for affordable, modern and reliable technologies aimed at local customer needs in emerging markets (Siemens A.G., 2012). The price of this device was set at one third of

Siemens' similar X-ray machines (Siemens A.G., 2011c). This made the device attractive for small and medium-sized hospitals in emerging markets, as well as to small hospitals and private practices in developed countries (Siemens A.G., 2012). This X-ray system has received clearance from the U.S: Food and Drug Administration (FDA) in 2014 (Siemens Medical Solutions USA, Inc., 2014).

Besides affordability and reliability, the Multix Select DR was also developed to be easy in use, with a robust and efficient design that enables the examination of many patients on a single day, which tends to be quite common in emerging market hospitals (Siemens A.G., 2012). Whereas comparable X-ray devices are stationary and have multiple detectors that are separate, in order to be able to x-ray patients when lying down or standing up, the Multix Select DR is mobile and can be positioned to take different images of patients (Siemens A.G., 2012).

For the development of the X-ray system, the Siemens' Shanghai facility received assistance from other divisions in Germany, India and Spain; the German R&D centre provided the developers in Shanghai with training, whereas the Indian colleagues contributed their know-how to the design of mechanical subsystems and the X-ray table, and the engineers from Spain provided the digital imaging software (Siemens A.G., 2012). The X-ray system is produced in Shanghai, and from there it is also shipped to distribution centres in Germany and Brazil. The German distribution depot, assembles and tests the X-ray devices before delivery to customers in Europe. The same accounts for Brazil, from where it is distributed throughout South America (Siemens A.G., 2012).

Computed tomography (CT) scanners

Other success stories of reverse innovations refer to Siemens' development of computed tomography (CT) scanners. These scanners were developed in Siemens' Shanghai division in China, the only CT R&D and manufacturing site outside of Germany (Siemens A.G., 2017d),

and aimed to serve the local and global market (Boutellier et al., 2008; Dubiel & Ernst, 2013). Most of these CT scanners were developed with the Siemens' SMART criteria in mind (Dubiel & Ernst, 2013).

SOMATOM Smile. In the year 2000, Siemens introduced the world's most compact and cost-effective CT scanner for the entry-level segment such as private radiology practices and smaller medical facilities in China, Southeast Asia and Brazil, which is known as the SOMATOM Smile (Boutellier et al., 2008; Siemens Healthcare GmbH, 2015). The SOMATOM Smile won the Design Prize of the Federal Republic of Germany in 2002 and the iF Design Award in China in 2003 (Boutellier et al., 2008; Siemens Healthcare GmbH, 2015).

SOMATOM Spirit. The successor of the SOMATOM Smile was the SOMATOM Spirit, which was completely developed by the Siemens R&D hub in Shanghai (Siemens A.G., 2010). The SOMATOM Spirit received clearance on September 14, 2004 (Food and Drug Administration, 2014, p. 5) and was introduced that same year (Business Wire, Inc., 2004). This device was designed for the local market and rural areas as an entry-level scanner, mainly used for clinical routine examinations (Siemens A.G., 2010). However, this device has since also been well received in the global market as an entry level CT (Dubiel & Ernst, 2013). The main reason it was also received well in developed and ageing countries, is because healthcare providers are increasingly coming under cost pressure (Eberl & Puma, 2007).

Before the device was developed, the knowledge and experience of the development team was gathered and bundled together to create a clean slate strategy for the development of this follow-up scanner. For example the engineers were sent to hospitals to gather information on the specific use of CT scanners (Eberl & Puma, 2007). For the development of this product, emphasis was placed on creating an affordable, reliable and easy to use device, that could be operated by low skilled workers (Eberl & Puma, 2007; Bessant, 2017). Another important element to take into account was efficiency. In China some hospitals use the CT scanners for

diagnostic purposes ranging from 60 to 100 patients per day, as opposed to 20 to 30 patients per day in European hospitals (Siemens A.G., 2005; Eberl & Puma, 2007). To ensure that the device was easy in use, the SOMATOM Spirit device only has the basic necessities of a CT scanner (Eberl & Puma, 2007). In the end, while all value-chain activities took place in the Shanghai R&D centre, the development was an international effort (Eberl & Puma, 2007).

The development of the SOMATOM Spirit was again done under Siemens' SMART strategy; simple, maintenance-friendly, affordable, reliable and timely-to (Siemens A.G., 2010).

SOMATOM Emotion 16-slice CT scanner. The SOMATOM Emotion 16 received FDA clearance on March 1st, 2005 (Food and Drug Administration, 2014) and became commercially available in the fall of 2005 (Business Wire, Inc., 2005). It is economically priced, has low-life cycle costs and minimal space requirements, which contributes to the cost efficiency, making it particularly attractive to community hospitals and diagnostic imaging centres with limited budget or space consideration (Business Wire, Inc., 2005). In 2010 Siemens introduced the SOMATOM Emotion Excel 16-slice CT scanner and the SOMATOM Definition AS Excel 64-slice scanner (Freund, Bell, & Kusama, 2010). The SOMATOM Emotion Excel Edition is especially designed to make it easier for small and medium-sized hospitals and practices to enter the world of 16-slice computed tomography. It continues the success story of the Emotion platform that remains the most popular CT in the world. The success of the SOMATOM Emotion platform to date has been due to superb image quality, a simplified and efficient workflow, the ability to save money over the life of the CT system (Freund, Bell, & Kusama, 2010). To date, there are around 7000 systems installed worldwide. The SOMATOM Emotion Excel Edition builds on the prior success of this imaging platform to bring these advantages to more customers and patients (Freund, Bell, & Kusama, 2010).

The country-level hospitals in China provide healthcare to around 70 percent of the population (Siemens A.G., 2014d), and use the 16 slice CT scanners for diagnostics purposes on many patients every day. For this purpose the SOMATOM Emotion IRIS 16 slice CT was developed. This device is built for efficiency and quality (Siemens A.G., 2014d).

SOMATOM Scope. In addition, the R&D hub of Siemens in Shanghai introduced the independently developed SOMATOM Scope, a 16-slice CT scanner, in the year 2014 (Siemens A.G., 2017d). This CT scanner was also developed for the entry-level segment, representing 35% lower operating costs (Siemens A.G., 2014c). Siemens has offered the CT-scanner in two editions, the cost-effective SOMATOM Scope, for entry level and the SOMATOM Scope Power, a more higher-end product (Siemens A.G., 2014c). On September 15, 2014 both CT scanners received FDA clearance for sales in the US (Food and Drug Administration, 2014).

5.1.3 Main factors contributing to reverse innovation success

In the above sections, a description was provided of Siemens A.G. and in particular its Healthineers division, as well as several successful reverse innovations. By analysing the manner in which those innovations were developed, and the general company information regarding the strategies it employed in emerging markets, several key factors were identified that have contributed to their success. These factors are summarised in table 4.

Table 4 - Main factors contributing to Siemens A.G. reverse innovation success

Main factors contributing to reverse innovation success - Siemens A.G.	
Localised R&D Departments	Shanghai R&D and manufacturing site
	Shenzhen production and R&D facility
	Wuxi production and R&D facility
Importance of localised R&D departments	Only R&D and manufacturing plant for imaging systems outside of Germany
	Catering to growth of Chinese healthcare market, the Wuxi and Shenzhen production and R&D facilities were also opened
Collaboration between departments	Collaboration with between R&D centres across the globe
Local Lead users/hospitals	Take into account the needs of local hospitals and healthcare providers
	Build extensive local production base and local innovative capabilities
	Staying in close contact with customers
NGO collaboration	Agreement with CIMF to host trainings for doctors and hospital presidents in rural areas
Academia collaboration	Partnerships with universities and vocational schools for recruiting
	Provide scholarships to promote cooperation on technical and scientific exchanges
	Provide scholarships for talent cultivation
	Creating goodwill and potential future demand for products
Government collaboration	Collaboration with Chinese government
Value for emerging market population	Affordable Reliable
	Cost-effective
	Easy in use
	Robust

5.2 Case 2: General Electric Healthcare

5.2.1 Company information.

General Electric Healthcare comprises the healthcare business of GE, an industry in which GE has been active for more than 100 years (GE Healthcare, n.d.a). Until 2016 GE Healthcare headquarters were in the United Kingdom, but has since moved to Chicago in the United States (General Electric, 2017b). GE Healthcare focuses on harnessing data and analytics across hardware, software and biotech (GE Healthcare, n.d.a) and is currently structured around nine primary business units (GE Healthcare, n.d.b). Its sales in 2017 topped $19 billion and it employs circa 50,000 employees in 100 countries (GE Healthcare, n.d.a) and serves customers in approximately 140 countries (General Electric, 2017b). Sales have been relatively flat for GE Healthcare since 2008 when sales stood at 17.4 billion (General Electric, n.d.a).

In its long history, most of General Electric´s R&D and production facilities used to be located in North America and other developed markets. However, as globalisation helped developing countries to transform into emerging markets, GE wanted to be part of that process and over the past 25 years the company has increasingly sought to establish R&D and production capacity in emerging markets. At present, the biggest R&D centre of GE Healthcare outside the United States is located in Bangalore, India (General Electric, 2017a).

The GE Healthcare Division´s primary focus lies on: a) Diagnostic imaging and service; b) Mobile diagnostics and monitoring; c) IT and digital solutions; and d) Life Sciences (GE Healthcare, 2016a). It has a total of nine primary business units: Detection and Guidance Solutions, specialised in X-ray solutions; Healthcare IT, which provides clinical & financial information technology solutions across the healthcare systems; Life Care Solutions, providing health care providers with innovative solutions to optimise care delivery for critical care, personal care, intensive care, perinatal care, perioperative care, subacute care and cardiac care.; Life Sciences, providing tools for drug discovery, biopharmaceutical manufacturing and

cellular technologies; Magnetic Resonance (MR), provider of MR imaging systems; Molecular Imaging & Computed Tomography, providing CT systems, positron emission tomography (PET), diagnostic tools that use nuclear medicine, and PET Radiopharmacy providing complete solutions that enable access to PET; Surgery, which provides tools and technologies that help guide minimally invasive surgical procedures; Ultrasound, providing portable, non-invasive and non-ionizing imaging devices.; and Global Services, developing and delivering quality, productivity and service solutions for healthcare providers worldwide (GE Healthcare, n.d.b).

While it has offices around the globe, GE Healthcare has major regional operations in Yizhuang (suburb of Beijing), China; and Bangalore, India. It also has major R&D facilities in both China (notably Shanghai) and India (Bangalore) (Singh, 2011).

GE in China. Although GE has had a presence in China since 1906, it was not until 1979 that GE Healthcare started operating in China and opened its first office in 1986 and entered its first joint venture in 1991, called GE Hangwei Medical Systems Co. Ltd (GE Healthcare, n.d.b; General Electric, n.d.b). GE Healthcare has also established several global manufacturing sites, which include a CT and X-ray site in Beijing; ultrasound and patient monitoring facilities in Wuxi; a Bio-sciences plant in Shanghai; paper filter facility in Tonglu; and a MRI site in Tianjin (General Electric, n.d.e). In the year 2000, GE began localising R&D efforts in China with the launch of a global research centre in Shanghai (General Electric, 2014d). This centre was opened in 2003 as the China Technology Centre (CTC) (General Electric, 2003). Besides steering towards localised R&D, the CTC also aims for global innovation efforts (General Electric, n.d.b). The CTC also houses a learning facility, the China Learning Centre, which is dedicated to employees, customers and suppliers (General Electric, 2003). In 2011 GE Healthcare moved its X-ray headquarters from Waukesha, Wisconsin, USA, to Beijing (General Electric, n.d.b) to take advantage of the rapidly growing Chinese market (Badkar, 2011). To further strengthen its local innovation capabilities, the company established

China Innovation Centres (CIC) in Chengdu, Xi'an and Harbin (General Electric, n.d.e; General Electric, n.d.f). Within the Healthcare division the CICs connect Chinese customers and GE engineers to jointly develop primary health-care solutions (General Electric, 2014d). In 2014, GE Healthcare innovation's resulted into the development of over 40 products since 2010, of which 70% were designed for county and rural hospitals and clinics (General Electric, 2014d).

To foster this growth, the company collaborated with the Chinese government to develop affordable healthcare, provided local healthcare professionals with training and boosted medical distribution networks across China (Badkar, 2011). In addition, GE partnered with the Chinese Medical Doctors Association (CMDA) to provide training to over 2,000 doctors in county and rural hospitals over the course of 2014 (General Electric, 2014d).

GE in India. Having a presence in India since 1902 (General Electric, 2015), it was not until the early 1990's that this presence started to intensify (PwC, 2013a). In 2000 General Electric (GE) started with building a multidisciplinary R&D lab in Bangalore, India, called the John F. Welch Technology Centre (JFWTC). This was GE's first largest R&D centre outside the United States (General Electric, 2017a). However, the JFWTC in India, was initially solely focused on premium priced technology destined for the global (developed) markets (Ramdorai & Herstatt, 2015), and not on commercial applications tailored to the domestic market in India (PwC, 2013a). The main driver to create a presence and establish R&D centres in India was to have access to a vast amount of engineers (Leahy, 2010) at a much lower cost than in the developed markets. This also led to the establishment of other sites for its R&D efforts, such as the CTC in Shanghai, China (Singh, 2011; General Electric, n.d.c).

Over time, however, GE has become more focused on the emerging market needs. The R&D Centre in Bangalore now has a double focus. Its primary focus is still concerned with global research, whilst it also has a secondary focus on research for the India market (PwC,

2013a). As the pace of change, *inter alia* through the use of information and communication technologies, has become faster, GE needed to rethink its business operations, as it was difficult to be a centralized business whilst also being effective simultaneously in emerging markets (PwC, 2013b).

For the Indian market, this meant that GE healthcare needed to pinpoint the actuality of the healthcare situation. The organisation started looking at the operations of healthcare providers in rural areas in terms of the labour skills, the funds they had and how much their customers were able to pay (PwC, 2013c). The organisation moved from a technology backed product development approach towards a "market-backed" product development focus (PwC, 2013c). Thus, it firstly identified a need and based product features and technological necessities on this need to provide a solution. GE is optimistic that products developed in India can eventually be diffused to developed markets, as the healthcare costs in Europe and the USA are rising (PwC, 2013c).

In India this increased focus on emerging markets has also led to establishing partnerships with several Indian companies across various businesses, such as, BHEL (engineering and manufacturing), State Bank of India, Wipro (IT services) and Triveni (engineering and industry) (General Electric, 2014c). For instance, GE Healthcare and Wipro created a 51:49 joint venture to gain a larger foothold in the Indian market (The Hindu Business Line, 2011). This joint venture aims at developing, selling and manufacturing 50-70 percent of the products in India, with the intent to export them (The Hindu, 2009). GE Healthcare also formed partnership with other organisations, such as the Bill and Melinda Gates Foundation, the National Institutes of Health, the University of Washington and Columbia University (General Electric, 2014b).

Traditionally GE tried to market its high-end medical systems in India, yet this proved rather unsuccessful. Several issues came to light, namely the price was too high and handling

the machine required specialized skills (Govindarajan & Trimble, 2012). Over the past years, in order to be able to grow, GE Healthcare has focused more on the emerging markets (Trefis Team, 2014) and emphasized on market-backed innovation for the development of new products that suit the local environment (GE Healthcare, 2011; PwC, 2013c). The Bangalore R&D centre increased its emphasis on the development of products that addressed local needs and were also affordable and more importantly, accessible also by the rural population (Govindarajan & Trimble, 2012).

Through the "Make in India" commitment, a government initiative, GE wants to locally design and develop solutions in India, creating healthcare more accessible for the population by making it more inexpensive, for the Indian population as well as the rest of the world (General Electric, 2015). To enable this, GE established a global design lab in the Bangalore R&D centre named eCube, that centres its focus on GE Healthcare´s commitment to innovate and make in India, and to serve the underserved segments in emerging markets (General Electric, 2015). This global design lab works together with healthcare providers and uses immersive research and co-creation to develop the optimal solutions (General Electric, 2015).

In 2009, GE announced the 'Healthymagination' initiative, in which the company will spend $6 billion over six years to provide better healthcare to more people at a lower cost (General Electric, 2010). With this initiative GE challenges the "status quo of global healthcare quality" and uses it as an innovation stimulus for global health challenges (General Electric, 2014a). The initiative focuses on the following three areas: 1) building healthier populations; 2) innovations to improve global health; and 3) new frontiers in health and technology (General Electric, 2014a). Through 'healthymagination' GE steers towards customer-driven innovation, with a focus on information acceleration, efficient technology, local access and engaging patients (Herhausen, Trumann, & Schögel, 2011) It also involves having a multiple stakeholder orientation, where not only physicians and hospitals are in dialogue with GE, but

also consumers, governmental organisations, competitors, cooperation partners and employees (Herhausen, Trumann, & Schögel, 2011). With the healthymagination initiative, the company embraced open innovation by including internal and external partners of GE to drive its innovation capabilities. Furthermore, by combining GE Ventures with healthymagination the company invests in start-ups and entrepreneurs, giving them access to company resources and expertise, thus allowing the same to accelerate growth and commercialise innovation ideas (Herhausen, Trumann, & Schögel, 2011; General Electric, 2014a; General Electric, n.d.g). With this initiative and the establishment of the Bangalore R&D centre in India, GE emphasised the fact that an increasing part of its operations focuses on emerging markets, stepping away from its traditional focus on developed market customers (Ganguly, 2010; Singh, 2011).

In 2015 GE Healthcare created a new business unit, Sustainable Healthcare Solutions (SHS), for the development of robust and value-based products to strengthen its affordable healthcare portfolio (Business Wire Inc., 2015). GEs SHS business is committed to the UN Sustainable Development Goal (SDG) number 3. The UN SDG 3 is aimed at ensuring healthy lives and promoting wellbeing for everyone at any age (United Nations, n.d.).

Whilst having created an extensive network of global research centres, GE has announced serious downsizing with increasing pressure of shareholders to cut down costs. One such effort has been to streamline its global research centres from nine to only two, the JFWTC in Bangalore and the global research site in Niskayuna, New York (General Electric, 2018). Although no longer conducting corporate research in Shanghai the company says to be doubling down on localisation in China (He, 2017), yet sheds one of its R&D labs with *"fundamental research capabilities"* (General Electric, n.d.b). Together with GE Ventures, the capital arm of GE, the company intends to utilize the remaining two global research centres as technology accelerators (General Electric, 2018).

5.2.2 Some reverse innovation successes.

MAC 400 Electrocardiogram (ECG). In 2005, engineers in the Bangalore R&D centre started the development of a portable electrocardiogram (ECG) machine that could be used in rural areas and be affordable for the population in these areas (GE Healthcare, 2011; Govindarajan & Trimble, 2012). An (LGT) was established to identify the requirements for this new ECG device, and build it from the ground up (Govindarajan & Trimble, 2012). The LGT first established a price point that would be acceptable, and from there looked at ways in which it could develop the ECG (Mukerjee, 2012), by combining existing resources in a different manner to serve the customers (Tallman et al., 2017; Govindarajan & Ramamurti, 2011). The result was the MAC 400, a compact ECG device that was developed and manufactured in India for India (General Electric, n.d.d).

The State Bank of India provides rural doctors with no-interest loans, and through its partnership with this bank, GE was able to provide the ECG device in rural areas (Mukerjee, 2012). Besides being sold in India the product was also sold in Europe, however not in the United States or Canada, because here the MAC 800 ECG device is sold (Govindarajan & Trimble, 2012). As in Bangalore, a GE Healthcare LGT situated in China wanted to develop a ECG device that was suited to the Chinese market. Building upon the accumulated knowledge of the Bangalore LGT the Chinese team developed the MAC 800 ECG (Singh, 2011).

Vscan. In 2010 GE introduced the Vscan, a hand-held portable ultrasound device (General Electric, n.d.d) that was derived from an earlier model developed for rural China in 2002, known as the Logiq Book (Govindarajan & Trimble, 2012; Zeschky et al., 2014).

For the development of the Vscan a LGT was set up in China, with full autonomy, to develop the technology to meet local needs, to provide care solutions in rural and county areas (General Electric, 2014e; Hilton, et al., 2013). In the end the development of the Vscan was a collaborative effort, using the design specification that came from India, drawing on telematics

from Norway and the user interface from France, and system integration from the USA and eventually manufacturing expertise from China (Hilton, et al., 2013). The Vscan was developed for antenatal care in developing markets, where it could also be used in rural areas by making it lightweight, and solar-charged (Karti, 2014). Its design enables healthcare providers to travel to the remote community clinics (General Electric Company, 2013), and it has been made easy in use, so that paraprofessionals can also use this device (Karti, 2014). To date, the Vscan has become commercially available not only in China and India, but also in North America and Europe (General Electric, 2012). The device has received FDA clearance, Medical Device License from Health Canada, and the CE Mark by the European Union (General Electric, 2010b). To date, the device has now been rolled out in over 100 countries (General Electric, 2014e).

The Norfolk and Norwich University Hospital (NNUH) in England have been given a National Health Service (NHS) funding to provide for 25 Vscans, that helps the NNUH diagnose breech positions when women arrive in the hospital during labour and those who come in for induction (GE Healthcare, 2016b). The NNUH is used as a pilot site, to determine how the device aids the NNUH in assessing the breeches (GE Healthcare, 2016b).

GE made a commitment to address the erstwhile United Nations (UN) Millennium Development Goals (MDGs). With a specific focus on MDGs 4 and 5, GE aimed at developing technologies that help improve maternal and infant health (General Electric Company, 2013). The development of the Vscan fits this commitment to meet the demands of local markets and addressing the MDGs 4 and 5 (GE Healthcare, 2014). Besides addressing these MDG goals through the development of technology, GE also partners with international organisations and NGOs to train healthcare workers in the use of the Vscan (GE Healthcare, 2014).

Lullaby Warmer. Where the Vscan is aimed at the antenatal care in developing countries, GE is also geared towards new-born care (Karti, 2014). The Lullaby Warmer, is an example of reverse innovation in new-born healthcare (Karti, 2014). The Lullaby Warmer is an incubator that was brought to market in 2009, approximately 70% less-expensive than traditional incubators, aimed at reducing infant mortality rates in India (Govindarajan & Trimble, 2012; Kannan, 2013; General Electric Company, 2013; Karti, 2014). Developed at the JFWTC, it was designed with the Indian The Lullaby warmer was developed in the Bangalore centre (Govindarajan & Trimble, 2012). It was designed with the Indian market in mind and its use in rural areas, e.g. by reducing the power usage in comparison with traditional baby warmers (General Electric Company, 2013). In addition, the design of the Lullaby Warmer facilitates less skilled, and illiterate healthcare workers to operate this device, by giving it a colour coding and photographic warnings (Kannan, 2013). The Lullaby Warmer is now sold in over 80 countries, including developed countries such as Belgium and Switzerland (General Electric Company, 2013).

Lullaby LED Phototherapy. In addition to the Lullaby Baby warmer, GE's Bangalore R&D centre has developed the Lullaby LED Phototherapy for the Indian market (Kellner, 2012; General Electric Company, 2013). This system treats neonatal jaundice and has since its inception found its way into European maternity wards (Kellner, 2012). Again, both the Lullaby Warmer and the Lullaby LED Phototherapy have been developed with the MDGs 4 and 5 in mind (General Electric Company, 2013).

The Brivo CT325/385. The Brivo CT325 and the Brivo CT385 scanners were developed in China for China by GE Healthcare. For the development of these scanner GE aimed at creating a low-cost, but high in quality product that help rural doctors with routine CT imaging needs, but can also support advanced applications (World Health Organisation, 2015). The CT scanners are an entry-level product, sold at approximately 20% of a high-end CT

scanner (General Electric, 2013). It has been developed to be a compact and easy to use CT scanner, at an affordable price, which makes it accessible to clinics and hospitals in rural areas (General Electric, 2013). The at the time product manager of GE Healthcare in China, called this CT scanner "*reverse innovation at its best*" (General Electric Company, 2011, p. 10).

Revolution ACTs. Following the 'Make in India' commitment, GE introduced the Revolution ACTs, a CT scanner developed in India (General Electric, 2015) and manufactured at GE Hangwei Medical Systems Co., Ltd. (Food and Drug Administration, 2017). In collaboration with healthcare providers from rural and urban settings, GE created an affordable, cost-effective and easy to use CT scanner (General Electric, 2015). The development of the CT scan was steered towards healthcare providers in India, however, the CT scanner is currently also commercially available and in clinical use in various other countries including Japan, EU countries and China, and has been cleared by the FDA on the 5th of June, 2017 (Food and Drug Administration, 2017).

5.2.3 Main factors contributing to reverse innovation success

Similar to the previous case study, by analysing the manner in which reverse innovations were developed by GE and the strategies the company employed in emerging markets, it was possible to identify several key factors that contributed to their reverse innovation successes. These factors are summarised in table 5.

Table 5 - Main factors contributing to General Electric reverse innovation success

Main factors contributing to reverse innovation success - General Electric	
Localised R&D Departments	JFWTC, Bangalore
	Shanghai (expected to close or downsize significantly) Focused on Value Computed Tomography
	Moved X-ray headquarters to Beijing.
Importance of localised R&D departments	Localised R&D departments focused on innovations for the local markets, as well as global market
	X-ray headquarters moved to Beijing
Collaboration between departments	Collaboration with R&D departments for the development of MAC 800, VScan
Working with Local Firms	Partnerships with local firms to gain a foothold in the country
	Joint Venture with Wipro
	Partnership with State Bank of India
	Partnership with BHEL and Triveni
Local Lead users/hospitals	Collaboration with healthcare providers and hospitals to match solution to need
	Build extensive local production base and local innovation capabilities
	Staying in close contact with customers and consumers
NGO collaboration	Partnered with CMDA to provide training doctors and hospitals in rural areas
	Collaboration with Bill and Melinda Gates Foundation
	Collaborate with NGOs to train healthcare workers in the use of the Vscan
Academia collaboration	University of Washington and Columbia University
	National institutes of Health
Government collaboration	Collaboration with Chinese government
	Collaboration with Indian government
Value for emerging market population	Affordable
	Cost-effective
	Easy in use
	Portable
	Robust

5.3 Case: Royal Philips

5.3.1 Company information.

Royal Philips N.V. (henceforth referred to as Philips) is a Dutch health technology company, with a current sales portfolio of 17.8 billion euros, employing 74,000 people worldwide in over 100 countries (Koninklijke Philips N.V., n.d.a). Founded in 1891, the company started as an electric light bulb manufacturer, and quickly became one of Europe's largest producers (Koninklijke Philips N.V., n.d.b). In 1918 the company diversified by adding X-ray and radio reception to its product lines, started protecting its innovations with patents and started to establish a sales organisation throughout Europe (Koninklijke Philips N.V., n.d.b). Over time it became a global consumer electronics firm, famous for the many innovations that it generated (video, CD, laserdisc, etc.), but which it was not always able to bring to market successfully, and for some large and well-known companies that it spun-off (notably ASML and NXP that both nowadays surpass Philips in market value).

In 2004, Philips repositioned its branding towards *"Sense and Simplicity"* reflecting the ambition to create more meaningful innovations, that make sense in the lives of people (Koninklijke Philips N.V., 2005). In the same year Philips set up a new business unit named Consumer Health & Wellness, tapping into the large personal healthcare and monitoring market (Koninklijke Philips N.V., 2005).

Although well known for its lighting, which was Philips' core business since its founding, the company announced in 2014 to create two stand-alone companies to increase its strategic focus, one for HealthTech and one for Lighting (Koninklijke Philips N.V., 2016). From the first of January 2015, the company started amalgamating its Consumer Lifestyle and Healthcare divisions into one company focused on HealthTech (Koninklijke Philips N.V., 2015). On the 27th of May, 2016, Philips Lighting was listed at the Euronext and (Royal)

Philips has since then continued to reduce its stake in Philips Lighting, with the intent to fully sell its stake over the next years (Koninklijke Philips N.V., 2017a).

With the separation of its Lighting business, Philips now considers itself to be primarily a provider of health technologies. Philips' HealthTech has been segmented into Personal Health, Diagnosis & Treatment and, Connected Care & Health Informatics (Koninklijke Philips N.V., 2017a). Through its product and service offering it promotes healthy living and provides solutions for prevention, diagnostics, curative, and home care (Koninklijke Philips N.V., n.d.a; Koninklijke Philips N.V., 2017a).

This massive endeavour to transform its businesses was achieved through a program Philips initiated in the year 2011 called "Accelerate!", with the aim to become a more agile and entrepreneurial company (Koninklijke Philips N.V., 2016). With this program, the company also increased its focus on the development of meaningful innovations for customers in local markets, placing more importance on market opportunities (Koninklijke Philips N.V., 2011).

Creating meaningful innovations to customers in local markets was facilitated by a three-step approach consisting of; 1) explicit dialog between market organisation and business group on growth opportunities; 2) allocating funds to priority opportunities; and 3) removing complex decision making procedures by authorising market organisations to act (Koninklijke Philips N.V., 2011). Building on Philips' commitment to create meaningful innovations that can make a difference, and improve people's lives, the company introduced its current slogan in 2013; *"Innovation and You"* (Koninklijke Philips N.V., n.d.f).

Philips tries to create "*global leadership through local relevance*" (Koninklijke Philips N.V., 2012a) and considers emerging markets to be of great importance, both for its global presence as well as its local presence. The company has a long standing presence in emerging markets, for example in 1920 the company started sales in China (Koninklijke Philips N.V., n.d.c) and it has a long term strategy in place committed to these markets (Thomson Reuters,

2016). By operating in emerging markets, Philips is not only catering to the needs of the local market contexts, but it is also accumulating knowledge on how to create more cost effective solutions than they would be able to achieve in developed markets.

The healthcare market in emerging markets is growing, fuelled by population growth, ageing, a rise in chronic diseases and increasing income (Gharib, 2017). With local research and development efforts, Philips aims to better understand the societal needs and the best solutions to serve these needs. It recognises that the emerging markets are highly competitive with many local competitors. Therefore, the organisation aims to act as if it were a local company in emerging markets, in order to blend in and generate the ability to collaborate with other organisations in that local context. Through this Philips tries to offer solutions that are superior in value, and locally relevant. For instance, Philips Design division has innovation hubs in all Philips' chief markets, ensuring close alignment with all of Philips' businesses. In total there are 19 design studios located in the Netherlands, USA, India Brazil, UAE, Israel, Hong Kong, Belgium, China and Singapore (Koninklijke Philips N.V., n.d.m). With designers from various disciplines, Philips Design ensures that people's needs and desires are translated into relevant solutions.

The largest emerging markets for the company are China, India and Africa. While China is Philips's first priority, the organisation also heavily invests in India and Africa as major growth of the middle classes is anticipated in these markets, exemplified by the establishment of a local market research hub in Nairobi, Kenya (Thomson Reuters, 2016).

Philips in Africa. In 2014, Philips launched an innovation hub in Nairobi, Kenya, known as the Research Africa Lab, in collaboration with the Africa Market Organisation (Koninklijke Philips N.V., 2017a). This research lab was established in collaboration between Philips Research and the Africa market organisation (Koninklijke Philips N.V., 2017a). This lab collaborates with local universities and institutions to deliver meaningful innovations aimed

at healthy living and healthcare, developed in Africa, for Africa (Koninklijke Philips N.V., n.d.n; Koninklijke Philips N.V., 2017c). Furthermore, the centre partners with UN bodies, incubators, NGOs and academic research institutions (Koninklijke Philips N.V., n.d.n). The Research Africa team has seventeen scientists, which work in close collaboration with the labs in India, Shanghai and Philips' core lab in Eindhoven to enhance Philips' global research portfolio (Koninklijke Philips N.V., n.d.n; Koninklijke Philips N.V., 2014c).

In Africa, Philips is striving to transform healthcare and has therefore introduced the Community Life Centre (CLC) Platform (Koninklijke Philips N.V., 2017c). The first CLC was launched on the 23rd of June, 2014 in Kenya, in partnership with the local government of Kiambu County, Kenya (Koninklijke Philips N.V., 2017d; Koninklijke Philips N.V., n.d.n). The second CLC in Kenya was opened on the 13th of July, 2017, in collaboration with the United Nations Population Fund (UNFPA) and the Government of Mandera County (Koninklijke Philips N.V., 2017e). The aim of the CLCs is to strengthen primary and community healthcare, through a flexible, modular and open platform (Koninklijke Philips N.V., 2017c), thereby addressing the UN SDG 3.

A CLC was also introduced in Tadu village in the Democratic Republic of Congo in 2016 (Koninklijke Philips N.V., 2017d), in collaboration with *Centre d etudes pour la promotion des actions de development* and with support of the Ministry of Health DCR (Koninklijke Philips N.V., 2017c).

Philips in China. The importance of emerging markets for Philips is further highlighted by the fact that China was proclaimed as the third global home market in 2010, next to the Netherlands and the United States (Kung, 2013). Until some two decades ago, and since the 1920s, China was only considered to be an important export market for Philips, but has since become a global production and R&D centre (Koninklijke Philips N.V., n.d.c; Kung, 2013).

To expand Philips' presence in the Chinese medical systems market, and to create more economical and mid-range products for the Chinese and other emerging markets, the company created a joint venture with Neusoft Corporation in 2004, named the Philips and Neusoft Medical Systems Co., Ltd. (PNMS) (Koninklijke Philips N.V., 2005). In this venture Philips held a 51% stake while Neusoft held 49% (Neusoft Corporation, 2013). However in the year 2013, both Neusoft and Philips made the announcement that Philips would sell its stake in PNMS to Neusoft (Neusoft Corporation, 2013; Koninklijke Philips N.V., 2013b), which was finalised by 2014 (Koninklijke Philips N.V., 2015). As part of the deal, Philips took over some 100 engineers and support staff from the joint venture for its new development centre in Shenyang (Koninklijke Philips N.V., 2013b). Besides the Shenyang development centre, Philips has other manufacturing and R&D centres located in Suzhou and Shanghai (Saragnese, 2012).

Established in 2000, the Philips Innovation Campus Shanghai has grown to be Philips' second biggest global lab (Kung, 2013; Koninklijke Philips N.V., 2015). This centre focuses on the professional healthcare and personal health by providing solutions tailored to the Chinese market for the professional healthcare and locally fitting innovations for personal health, varying from kitchen appliances, air control systems and respiratory health (Koninklijke Philips N.V., n.d.d). This division works closely with local hospitals, universities, research institutes and standard bodies (Koninklijke Philips N.V., n.d.d).

The establishment of the Suzhou Imaging Systems Industrial Campus was announced in 2009 (Kung, 2013), to strengthen Philips' portfolio in imaging systems (Euronext, 2009), and was opened in 2012 (Koninklijke Philips N.V., 2012b). This campus holds a manufacturing, production and assembly site with an integrated R&D centre. At this location Philips is able to tailor to the Chinese medical systems market, with the production of midrange imaging systems that are accessible to county hospitals and rural clinics (Euronext, 2009;

Moleman, 2012). Besides serving the value segment, this campus will also focus on more advanced systems (Euronext, 2009), positioning Philips to serve the global healthcare market. In 2010 the company established the Philips Healthcare China Academy in Shanghai and expanded the same to Suzhou in 2012, to provide value added training to customers (Kung, 2013).

Part of the strategy of Philips to expand its reach in emerging markets also entails acquiring local companies. For instance, Philips acquired Povos to enhance its product portfolio in kitchen appliances to better serve Chinese consumers (Reuters, 2011; Spittle, 2012). Povos was well known in China for its rice cooker platform, and with its acquisition Philips' was able to leverage this knowledge to introduce the Multicooker in Russia, which was tailored to address the kitchen appliances sector in Russia (Koninklijke Philips N.V., 2013a). The acquisition of Povos was completed on July 11, 2011 (Koninklijke Philips N.V., 2013a), and became part of Philips' domestic appliances within its personal health division (Euromonitor, 2011). By acquiring Povos, Philips was able to accelerate its locally-driven innovation and increase the proportion of the Chinese kitchen appliances market it addresses from 15% to 95% (Koninklijke Philips N.V., 2012).

Philips has created an extensive distribution network in China that covers over 600 cities with more than 7,800 counters and approximately 9,400 promoters and is able to bring consumer care closer to consumers with more than 800 service centres (Spittle, 2012).

Philips in India. To address the Indian market, Philips established the Philips Innovation Campus (PIC) in Bangalore in 1996, through which the company is producing innovations that can be managed using the local existing infrastructure (Frost & Sullivan, 2015). When founded, the PIC was used as a software centre, but now has grown into a broad development centre in which healthcare is the largest R&D facility (Koninklijke Philips N.V., n.d.j). PIC is responsible for the creation of software and product innovations for healthcare

and personal health, and engages with the market to understand relevant solutions make healthcare affordable and accessible in India and other emerging markets such as Africa and Indonesia (Philips India Limited, 2017). Besides its focus on healthcare, the PIC also engages in developing solutions for smart products for home appliances such as the air purifiers, coffee makers and oral care products (Philips India Limited, 2017).

Another important centre in India is the Philips Healthcare Innovation Centre (HIC) in Pune. This centre is also referred to as the Healthcare Innovation Campus (Koninklijke Philips N.V., n.d.k). The HIC is a global design and manufacturing centre that plays a pivotal role in developing meaningful innovations to improve healthcare (Kabra, 2016; Philips India Limited, 2017), with activities spanning from product innovation to manufacturing of interventional and diagnostic X-ray systems, for both the India and global markets (Koninklijke Philips N.V., n.d.k; Koninklijke Philips N.V., n.d.l). The HIC has become a global hub for Mobile Surgery and X-ray, focusing on the development of X-ray imaging, such as diagnostic x-ray and interventional x-rays (Nadhe, 2014; Philips India Limited, 2017).

In 2015, Philips entered a Public Private Partnership with HealthMap Diagnostics to provide affordable and accessible healthcare services for the low income segment by creating a health diagnostic network in India (Koninklijke Philips N.V., 2017b).

In the year 2011, Philips acquired the Indian company Preethi, to gain a foothold in the kitchen appliances market in India (Reuters, 2011). The acquisition of Preethi strengthened Philips' position in the kitchen appliances market in India, and the company intends to leverage Preethi to create a portfolio beyond kitchen appliances (Koninklijke Philips N.V., 2013a).

5.3.2 Reverse innovation successes.

Personal Health.

Philips' Domestic Appliances business used to be part of the Consumer Lifestyle division, yet since the amalgamation of this division with Healthcare it has been restructured into the Personal Health business. The Personal Health segment has four focal business areas, which are; Health & Wellness, Personal Care, Domestic Appliances and Sleep & Respiratory Care (Koninklijke Philips N.V., 2018). Philips' Domestic Appliances business centres around kitchen appliances, coffee, air, garment care and floor care, and is the largest of its Personal Health segment accounting for 32% of sales in 2017 (Koninklijke Philips N.V., 2018). This business area has generated several innovation successes for emerging markets that have been distributed globally such as air purification systems and within the kitchen appliances category; the soymilk maker and noodle maker (Koninklijke Philips N.V., 2015). The focus on Personal Health puts forward Philips' mission to develop innovations across the health continuum, which also involves the promotion of healthy living.

In 2017, the Personal Health segment had approximately 23,170 employees, with a global sales and services organisation covering more than 50 developed and emerging markets (Koninklijke Philips N.V., 2018). Moreover, it comprises of manufacturing and business creation organisations in Argentina, Austria, Brazil, China, India, Indonesia, Italy, the Netherlands, Romania, the UK and US (Koninklijke Philips N.V., 2018).

Air purification. Responding to its commitment to deliver meaningful innovations, Philips took on problems China faces with its air quality and developed the GoPure air purifier.

GoPure. The Chinese population´s health is greatly affected by the suffers from a large air pollutant problem it faces. This problem not only manifests itself on the streets of the cities in China, but the polluted air also finds its way back to the homes of people and in their cars. A survey conducted among Chinese drivers revealed that this group was concerned about the

air quality in the cars (Fusheng, 2014; Shan & Khan, 2016). With the help of a local mobility R&D team based in Shanghai, Philips created an air purifier that can be placed on the floor of the car, which helps improve the in-car air quality (Moleman, 2012; Shan & Khan, 2016). The air purifier is a portable device and easy to use device that can purify the in car air quality within 10 minutes (Koninklijke Philips N.V., 2013d).

Kitchen appliances. Driven by Philips' mission to improve people's health, the company innovates to help consumers with the tools to make healthier choices (Royal Philips, 2014). The Philips Design division initially designed global products for the European market, yet altered this strategy to create more innovations that would increasingly be suitable to other markets as well by establishing design hubs in all Philips' chief markets (Koninklijke Philips N.V., n.d.e). In the year 2011, Philips moved the leadership of Kitchen Appliances to Shanghai (Koninklijke Philips N.V., 2012), to better recognise and meet the demands of Chinese consumers. This has led to numerous successful innovations, with the noodle maker and soy milk maker predominantly standing out as reverse innovations.

Noodle maker. The Kitchen Appliances team in Shanghai originated the idea of a noodle maker, to help new generations of Chinese people to maintain the traditional art of noodle making (Shan & Khan, 2016). Furthermore, the noodle maker was developed to promote healthy living, by helping people ensure proper food safety and control over the ingredients used for the noodles, (Shan & Khan, 2016) attracting natural product devotees.

After its introduction in China, the noodle maker was introduced as pasta maker in the USA, Australia and European markets. (Shan & Khan, 2016) and was well received as witnessed by the receipt of the Good Design Australia Award in 2015 (Koninklijke Philips N.V., n.d.g; Good Design Australia, 2015). It was developed to be easy in use, saving consumers time in the kitchen. The machine mixes, kneads and thrusts out the noodles after three minutes (Good Design Australia, 2015). Interesting to note is the fact that although the

noodle maker was developed for and introduced in China, it enjoyed less success there than outside China and its largest market is now North America (Shan & Khan, 2016).

Soy milk maker. Similarly in light of the importance of food safety in China, Philips created a soy milk maker, which allows consumers to make fresh soy milk (Koninklijke Philips N.V., n.d.e). The soy milk maker was a localised product development aimed at Chinese consumers. However, having quickly realised the soy milk platform could find a potential different use in other countries, Philips introduced the same device as SoupMaker in Europe, the Middle East and Latin America (Koninklijke Philips N.V., 2013a; Koninklijke Philips N.V., 2014a).

Healthcare

Besides a strong focus in emerging markets within the personal health domain, Philips also strives to improve people's health through innovations for the professional healthcare providers. Several innovations stand out that have been created for emerging markets, but can now also be found in developed markets.

Ultrasound technology ElastPQ. Developed by the R&D team in Shanghai in response to the high level of liver cancer in China, Philips introduced an ultrasound technology named the ElastPQ (Shan & Khan, 2016). This technology is based on a shear-wave elastography technique, which measures the stiffness of the liver tissue to identify abnormalities that can indicate liver disease (Shan & Khan, 2016; Koninklijke Philips N.V., 2015). With the ElastPQ, Philips enabled diagnosing liver diseases with a non-invasive machine as opposed to the traditional invasive liver biopsy (Koninklijke Philips N.V., 2015). Philips partnered with the fourth largest hospital in China, the West China Hospital in Chengdu, to match technology with the actual clinical need (Koninklijke Philips N.V., 2015). The

ElastPQ is available on the EPIQ 7, EPIQ 5, Affiniti 70 ultrasound machines (Barr, 2016), which are available in developed countries such as the USA and the Netherlands.

VISIQ. Another medical device introduced by Philips in the year 2014 is the VISIQ ultrasound (Koninklijke Philips N.V., n.d.h). Philips developed the VISIQ ultrasound to address the need for diagnostic imaging in emerging markets for small clinics and rural areas where there is a lack of accessible ultrasound screening. The ultrasound is designed to be small, energy-efficient, portable and user-friendly, with high image quality, developed to address problems women in emerging markets face when there is no access to ultrasound screening such as, premature death during pregnancy or preventable complications during childbirth (Koninklijke Philips N.V., n.d.i). The device can be used in primary health centres, small outpatient clinics or community centres, enabling fast diagnostics (Koninklijke Philips N.V., n.d.i; Frost & Sullivan, 2015). With this device Philips was contributing to MDGs 4 and 5 and to SDG 3 at present .

The VISIQ ultrasound was developed by PIC in Bangalore, using insights Philips gained from the field (John, 2014; The Hindu, 2014; Koninklijke Philips N.V., n.d.i). The VISIQ ultrasound was a unique ultrasound, as it was the first USB-based tablet ultrasound systems (Philips India Limited, 2015). Contrary to traditional ultrasound devices, VISIQ can also act as a communication tool and holds the potential to be a disruptive technology solution (Frost & Sullivan, 2015). The device received FDA clearance in 2014, and is already commercially available in emerging markets such as Kenya, China and India, and in developed countries such as the Netherlands, France and Germany (Koninklijke Philips N.V., 2014b).

BV Vectra. The BV Vectra is a mobile fluoroscopic system, also known as a C-Arm X-ray system that is used in orthopaedic surgical procedures. The BV Vectra was conceptualized, developed and manufactured by the HIC in Pune, from which it is shipped to Asia-pacific countries, Europe and (Philips India Limited, 2016). The HIC has also developed

a version of the Vectra that is suitable to the different voltage configurations found in Latin-America and Japan, to be able to cater to these markets as well (Philips India Limited, 2016). Although not available in the US, the device is available in western European countries, such as The Netherlands.

ClearVue. In 2012 Philips introduced ClearVue, a platform of ultrasounds, developed by the PIC in Bangalore targeted at emerging market such as India and China (Kawathekar, Moorthy, & Chandrappa, 2012). The first models were the ClearVue 350 and ClearVue 550 ultrasounds systems. The ultrasounds are affordable and easy-to-use with low operating costs. These ultrasounds came with a new proprietary technology developed by Philips, called Active Array (Koninklijke Philips N.V., 2013c). With Active Array key imaging technologies are integrated into the transducer, enhancing manoeuvrability and image quality (Koninklijke Philips N.V., 2013c). Insights for the development of the ClearVue were collected by researching the conditions in Indian healthcare, in partnership with key healthcare stakeholders (BioSpectrum Bureau, 2012). Ultimately, the development of the ClearVue was a collaborative effort between various of Philips' global R&D locations, including North America, China and India (Kawathekar, Moorthy, & Chandrappa, 2012). Both the ClearVue 350 and ClearVue 550 have received FDA clearance in 2012 (Food and Drug Administration, 2012).The ClearVue 850 received FDA clearance in 2015 (Food and Drug Administration, 2015).

5.3.3 Main factors contributing to reverse innovation success

As with Siemens and GE, a summary of the main factors that have contributed to Philips' reverse innovation successes, were derived by analysing the manner in which those innovations were developed and the company's strategies in engaging in emerging markets. These key factors are summarised in table 6.

Table 6 - Main factors contributing to Royal Philips reverse innovation success

Main factors contributing to reverse innovation success - Royal Philips	
Localised R&D Departments	Philips Design Hubs, globally dispersed.
	Philips Innovation Campus, Bangalore
	Philips Healthcare Innovation Centre, Pune
	Philips Innovation Campus, Shanghai
	Imaging systems Industrial Campus, Suzhou
	Philips Africa Innovation Hub, Nairobi
Local company acquisitions	Acquisition of Provos and Preethi in China and India.
Importance of localised R&D departments	Headquarters of mobile surgery and x-ray moved to HIC
	Moved Headquarters kitchen appliances to Shanghai
Collaboration between departments	Collaboration between Philips Research and Philips Design
	Eindhoven innovation campus, collaborates with other R&D centres and innovation hubs
Working with Local Firms	Philips Africa innovation hub is a collaboration between Philips Research and the African Market Organisation
	Establishment of joint venture Neusoft
Local Lead users/hospitals	Partnership with West China Hospital in Chengdu
	Collaboration with healthcare providers and hospitals to match solutions to need
	Staying in close contact with customers
Academia collaboration	Local universities in Africa
	Collaboration with academic research institutions
	Local universities in China
Government collaboration	Collaboration with Chinese government
	Collaboration with Indian government
	Collaboration with local governments in Africa
Collaboration with international development agencies	Collaboration with UNFPA
	Collaboration with UN
Value for emerging market population	Affordable
	Cost-effective
	Easy in use
	Portable
	Robust

6. Results

Value creation and delivery

All three companies presented in the previous section have adapted their business strategies to be able to operate in emerging markets. Whilst these markets were previously considered primarily for products to be exported to, or as a base for manufacturing taking advantage of low-cost production factors, primarily the availability of cheap labour, these western MNCs saw potential for R&D and innovation capabilities in emerging markets as well (notably China and India). This is exemplified by the investments the companies have made in establishing local R&D centres. To a varying degree, all three companies have focused on gathering insights from the field and have made use of LGTs (or equivalent) to identify the best solutions for the emerging market needs. It also appears that there are geographical clusters that attracted the companies to certain cities or regions in these emerging markets. For example in India, Pune and Bangalore are popular destinations, while Shanghai stands out in China.

Collaborative innovation is also something that characterises the three companies, albeit again to varying degrees. All have stimulated collaborative efforts between different departments, be it R&D departments from different regions, or different business segments, such as between R&D and design studios. The localisation of R&D and the collaborative efforts have been the driver for value creation and delivery. In some cases the companies even moved some departmental headquarters to these emerging markets, highlighting the shifting global point of gravity of their businesses.

Value networks

The collaborative effort does not limit itself internally, but also extends externally. The success of many of the reverse innovations in the case studies highlight co-creation with customers such as doctors and hospitals, as well as with consumers, such as patients. This co-creation ensured that a befitting solution was found that responds to the needs of both customers and consumers.

Value proposition for emerging markets

The companies have adapted their business models to foster product development in these markets, by adopting a value proposition tailored to emerging markets, different from the one they were applying to developed countries. The Western MNCs initially took a 'low cost', 'frugal' or 'resource-constrained' innovation approach. With this in mind the organisations designed equipment that could easily be used by less skilled workers, at a lower cost, whilst also being efficient and reliable. Thus products were developed that could also be used in rural areas in emerging markets, providing accessibility to smaller clinics and hospitals, which serve the majority of the population. In some cases these initiatives were taken as a commitment to the UN MDGs (since 2015 replaced by the UN SDGs).

Whilst creating solutions for local healthcare providers in emerging markets generally emphasised on creating 'low cost', 'frugal' or 'resource-constrained' innovations that eventually became reverse innovations, this was not necessarily the case for products developed by Philips' Personal Health division. Some of the products developed by this division eventually found a market responding to a different need and their success was not based on affordability, as these products were rather targeted at the rising middle-class in emerging markets. For example, the noodle maker and soy milk maker were developed in an effort to provide easy personal health solutions for people interested in healthy food choices. It

turned out that these products also worked well for other purposes, such as the soy milk maker finding use as a soup maker, and the noodle maker as a pasta maker. Whereas the GoPure was developed for to improve the indoor air quality in cars, providing a local solution for a local problem, also targeted at the middle-class.

Value creation by reverse innovation

It was through the development and marketing of products tailored to the needs of emerging markets, that the Western MNCs saw market potential for these products in the developed markets as well. This was mainly driven by budget controls and increasing costs in healthcare in the developed markets, caused in a significant part by the need for higher decentralisation and increased use of health monitoring and diagnostics among the rapidly ageing populations. Thus, reverse innovation, at least initially, was not the main driver for their business operations in emerging markets. In most cases, it tended to be with hindsight that the Western MNCs saw reverse innovation potential. This appears to have been changing in the last couple of years, where products developed in and for emerging markets, like the SOMATOM EMOTION 16 of Siemens, Vscan of GE, the VISIQ and the ClearVue of Royal Philips, were also simultaneously launched in developed markets. This shows how the global point of gravity of their businesses is increasingly moving to these emerging markets and how the products developed for these markets can also increase the availability of diagnostics equipment at lower costs in the developed markets.

Although there are many similarities in the approach the three companies took to engage in emerging markets and in dealing with reverse innovation, several differences are noteworthy to highlight. The first being that while Philips is still strengthening its position in emerging markets by establishing R&D centres, innovation hubs and even moving businesses headquarters to emerging markets, it appears that GE is moving away from that approach. Over

the past decades, GE had established various global R&D centres in emerging markets, but recently announced a serious downsizing of these R&D locations and staff across the globe, in an effort to cut down on costs. It aims to only maintain the global research centres JFWTC in Bangalore, India and in Niskayuna, USA. Regardless to the current development as to GEs downsizing, the reverse innovation examples highlight the two fold focus of the R&D and manufacturing sites; innovating for the local and global market simultaneously.

Both Siemens A.G. and Philips have listed their Healthcare business on the stock market. Siemens has done this by bringing Healthineers to market as a separate business, while Philips did this through a complex transformation process, restructuring itself as a HealthTech company and divesting its other business areas, among which Philips Lighting. On the other hand, GE is still a huge conglomerate, made up of a large variety of business units, and listed on the stock exchange as a single company. Its recent moves to diminish its presence in so many global R&D hubs is clearly aimed to save costs and streamline operations, reducing complexity and focusing on those areas where it can maintain competitive advantages. This may also be reflective of the stronger competition it perceives from Philips and Healthineers, as well as other fully independent health technology companies.

Both Siemens and GE were triggered to respond to national innovation programs from the governments in China and India. In essence, they were executors of a national interest to create local innovations. Take the example of Siemens, whose R&D focused on a specific need of the Chinese government to get affordable equipment in country and rural hospitals. Effectively, this is an order-driven reverse innovation trigger for Siemens. Also because the sales market of health organisations mainly concerns governments and therefore not directly the consumer market as is the case in other industries.

There are many contributing factors that have led to successful reverse innovation for each of the three companies and these can be grouped as follows: 1) under value creation and

delivery: a) Localised R&D departments and b) Collaboration between departments; 2) under value networks: a) working with local firms; b) local lead users and hospitals; c) collaboration with NGOs; d) collaboration with academia and e) collaboration with governments; and 3) under value proposition, the value offering by each company to the emerging market customers and consumers. Table 7 provides an overview of these main contributing factors to the reverse innovation successes of each of the three companies, grouped by the three key business model elements that this study focused on.

Table 7 - Main factors that contributed to reverse innovation success

Key business model elements	**Contributing factors**	**Companies**		
		Siemens A.G.	***General Electric***	***Royal Philips N.V.***
Value creation and delivery	*Localised R&D Departments*	Shanghai R&D and manufacturing site	JFWTC, Bangalore	Philips Design Hubs, globally dispersed.
		Shenzhen production and R&D facility	Shanghai (expected to close or downsize significantly), focused on Value Computed Tomography	Philips Innovation Campus, Bangalore
		Wuxi production and R&D facility	Moved X-ray Headquarters to Beijing.	Philips Healthcare Innovation Centre, Pune
		All three are the only R&D and manufacturing for imaging systems outside of Germany	Use LGT	Philips Innovation Campus, Shanghai
				Imaging systems Industrial Campus, Suzhou
				Philips Africa Innovation Hub, Nairobi
				Headquarters of mobile surgery and x-ray moved to HIC, Pune
				Moved Headquarters kitchen appliances to Shanghai
	Collaboration between departments	Collaboration with between R&D centres across the globe	Collaboration with R&D departments for the development of MAC 800, Vscan	Collaboration between Philips Research and Philips Design
				Eindhoven innovation campus, collaborates with other R&D centres and innovation hubs

Value networks	*Working with Local Firms*		Partnerships with local firms to gain a foothold in the country	Philips Africa innovation hub is a collaboration between Philips Research and the African Market Organisation
			Joint Venture with Wipro	Establishment of joint venture Neusoft
			Partnership with State Bank of India	
			Partnership with BHEL and Triveni	
	Local Lead users/hospitals	Take into account the needs of local hospitals and healthcare providers	Collaboration with healthcare providers and hospitals to match solution to need	Partnership with West China Hospital in Chengdu
		Build extensive local production base and local innovative capabilities	Build extensive local production base and local innovation capabilities	Collaboration with healthcare providers and hospitals to match solutions to need
		Staying in close contact with customers	Staying in close contact with customers and consumers	Staying in close contact with customers
	NGO collaboration	Agreement with CIMF to host trainings for doctors and hospital presidents in rural areas	Partnered with CMDA to provide training doctors and hospitals in rural areas	
	Academia collaboration	Partnerships with universities and vocational schools for recruiting	University of Washington and Columbia University	Local universities in Africa
		Provide scholarships to promote cooperation on technical and scientific exchanges	National institutes of Health	Collaboration with academic research institutions
		Provide scholarships for talent cultivation	Collaborate with NGOs to train healthcare workers in the use of the Vscan	Local universities in China
		Creating goodwill and potential future demand for products	Bill and Melinda Gates Foundation	
	Collaboration with international development agencies			Collaboration with UNFPA
				Collaboration with UN
	Government collaboration	Collaboration with Chinese government	Collaboration with Chinese government	Collaboration with Chinese government
			Collaboration with Indian government	Collaboration with Indian government
				Collaboration with local governments in Africa
Value proposition	*Value for emerging market population*	Affordable	Affordable	Affordable
		Cost-effective	Cost-effective	Cost-effective
		Easy in use	Easy in use	Easy in use
		Reliable	Portable	Portable
		Robust	Robust	Robust

7. Discussion

The purpose of this research was to identify how the business models adopted by Western MNCs in emerging markets aided them in embracing and fostering reverse innovation. This was done by focusing particularly on the following three key elements of the business models: a) value proposition; b) value creation and delivery; and c) value network. The value proposition concerns the customer's value perception of a product. Central to the value creation and delivery is the organisation's value chain, whereas the value network extends to external stakeholders that have aided in the value creation and delivery.

To effectively engage in emerging markets, over time all three companies realised that their traditional glocalisation efforts would not let them gain more or even hold on to their market share in these fast growing markets, as their products did not tailor well to the emerging market needs. They all realised that they had to adopt specific business strategies and corresponding business models for these markets.

Healthcare industry

The global healthcare market is growing and changing rapidly. Total global healthcare spending is expected to reach $8.7 trillion by the year 2020 (Deloitte Touche Tohmatsu Limited, 2018). One third of this spending will be accounted for by emerging markets (World Economic Forum, 2014). With a growing and aging population, coupled with increasing disposable income, the need for healthcare in emerging markets will experience a surge with a rise in chronic diseases (Donoghoe et al., 2012; Guillén, 2017). This follows to a large extent the experience of more developed economies, where ageing set in earlier and which have already experienced sharply rising needs for monitoring, diagnostics and treatment.

It appears that all three companies are fighting to capture a sizeable portion in these emerging economies, using innovations tailored to local needs as the strategy to enter those

markets, while also identifying potential for reverse innovation to respond to changing market conditions in developed countries.

To better capitalise on the dynamism of the healthcare market and sustain value creation, Philips has restructured itself into a full HealthTech company by divesting other business operations over the course of five years. Siemens, for the same reasons, has managed its healthcare division independently from the rest of the organisation, and has now also listed Healthineers on the stock exchange. These changes reflect how an organisation needs to alter its business model in response to its environment, ensuring alignment (Osterwalder, 2004; Achtenhagen et al., 2013; Wirtz et al., 2015; DaSilva & Trkman, 2014). These rigorous changes are in line with Khanagha et al. (2014), who state that sometimes disruptive changes can replace an organisation's existing model.

Innovating for emerging markets

Where once emerging markets were seen as export, or manufacturing offshore locations, they came to be seen as a source of innovation and growth. To take advantage of the opportunities provided by the emerging markets, the companies started to invest heavily in these markets. Similarly to what Brem and Wolfram (2014) proposed, the results of the case studies have shown that the western MNCs decentralised their structures to better capitalise on the innovation capabilities in the emerging markets, and therefore established R&D labs and eventually even moved department headquarters to these emerging markets. It is worth to note that in doing so, these companies also valued the importance of clustering and location of their R&D facilities in areas where they could draw from a local highly skilled workforce. For example, the analysed companies all have established R&D facilities in Shanghai, China, and Philips and GE have also established R&D centres in Bangalore, India.

All three case study companies have favoured a low-cost leadership strategy by creating entry-level value products tailored to the emerging markets. At the same time, these same

companies pursued a differentiation strategy in developed countries, creating premium products. Whilst Porter (1991) argues that pursuance of both strategies can be a cause of trouble for organisations, this actually worked to the advantage of the companies studied in this research. To avoid conflicts in activities, in line with the literature, the companies have created dual business models (Winterhalter et al., 2015) to suit to the different conditions in and segmentation of in emerging and developed markets (Di Carlo et al., 2016).

Taking the dynamic capabilities perspective, the organisations were able to create a competitive advantage in emerging markets, by rearranging and combining internal and external competencies (Teece et al., 1997; Al-Aali & Teece, 2014) by establishing local R&D centres and even re-allocating department headquarters to emerging markets. Due to this process the organisations were able to accumulate local market knowledge and acquire local innovation capabilities that strengthened their positions in emerging markets.

To further harness local innovation capabilities and overcome institutional voids in emerging markets the companies created local value networks by partnering with, or acquiring local firms, NGOs and other institutions (Ernst et al., 2015; Sarkar, 2011). Examples of such partnerships are the creation of joint ventures by Philips and GE, in China and India respectively, to gain a stronger foothold in these markets. Further references to the importance of these value networks and collaborative innovation are also mentioned in table 7.

Govindarajan & Ramamurti (2011) argue that reverse innovations are firstly adopted in emerging markets, then the innovation transfers to other emerging markets and lastly to selected developed countries. This research finds that the occurrence of these three stages are rather similar. However, the time period has shortened. The time of introduction of an innovation in emerging markets nowadays almost falls in the same period as its introduction in developed markets. In addition, this research proposes that a stage 0 can be added to the above-mentioned stages. Stage 0 refers to the necessity of first having to establish a solid presence in

emerging markets before a successful reverse innovation can come into effect. As was highlighted in the case studies, the companies first invested in strengthening their presence in emerging markets, hiring highly qualified local staff, setting up local growth teams and building value networks, among others. It would be difficult for organisations to engage in reverse innovations without having established a solid presence first.

Value proposition

Contrary to the views of Khanna et al. (2005), that an organisation can alter its business model, as long as the core value proposition is conserved, the cases above highlighted that the core value proposition for these markets has shifted. Where once glocalisation was attempted and failed, the companies steered towards local innovations, suiting to local needs. As a result, the organisations altered their value proposition to create affordable, reliable, robust, cost-effective and easy-in-use products, rather than technically complex and premium priced products, for the emerging markets.

Whilst the medical equipment market in emerging market is geared towards creating innovations that are lower in cost, but high in value, a different need was found in case of Philips' Personal Health division. The argument can be made that in this case not the lower class in emerging markets was targeted, rather the upper and rising middle class in these markets.

Business models for reverse innovation

The western MNCs adopted a business strategy and business model that is responsive to the market conditions they face in emerging markets. While each company pursued different tactics in their emerging market strategies and where they may have had varying emphasis on each of the key elements of their individual business models for operating in these markets, to a large extent they adopted similar business models, exploiting the same factors that helped

them to create successful frugal and low-cost innovations and eventually embrace a reverse innovation strategy aiming to bring these products also to market in developed economies. These contributing factors were already mentioned in detail in section 6 and schematically in table 7.

A number of preconditions in an organisations' business model must be present to guarantee success. The most important and mutually reinforcing preconditions are: a) having local market knowledge; b) ability to identify local user needs; c) having a flexible organisational structure that enables collaboration to foster innovation to respond to these needs; and d) the ability to establish a sound value network in emerging markets. Business models for operations in emerging markets, basically come down to defining a value proposition that emphasises affordability, cost-effectiveness, ease of use, portability and robustness. Regarding value creation and delivery, local R&D capacity, ability to identify local needs and solutions through LGT (or equivalent), decentralised organisational structures and collaborative innovation appear to be essential. When it comes to value networks, the business model should emphasise co-creation and extensive interaction with a broad range of stakeholders, involving suppliers, customers, professional associations, NGOs, local firms and joint ventures, academia and others.

The conceptual framework presented in section 3 depicts the nexus between emerging market and reverse innovation business strategies and business models very well, including the importance of the contributing factors under the key elements that make up these business models. Following is that same framework again (figure 4), with some slight modifications. While reverse innovation in the past used to happen with hindsight, it has become more and more a co-driving force for innovation in emerging markets and lately new reverse innovated products tend to be launched virtually simultaneously in emerging and developed markets.

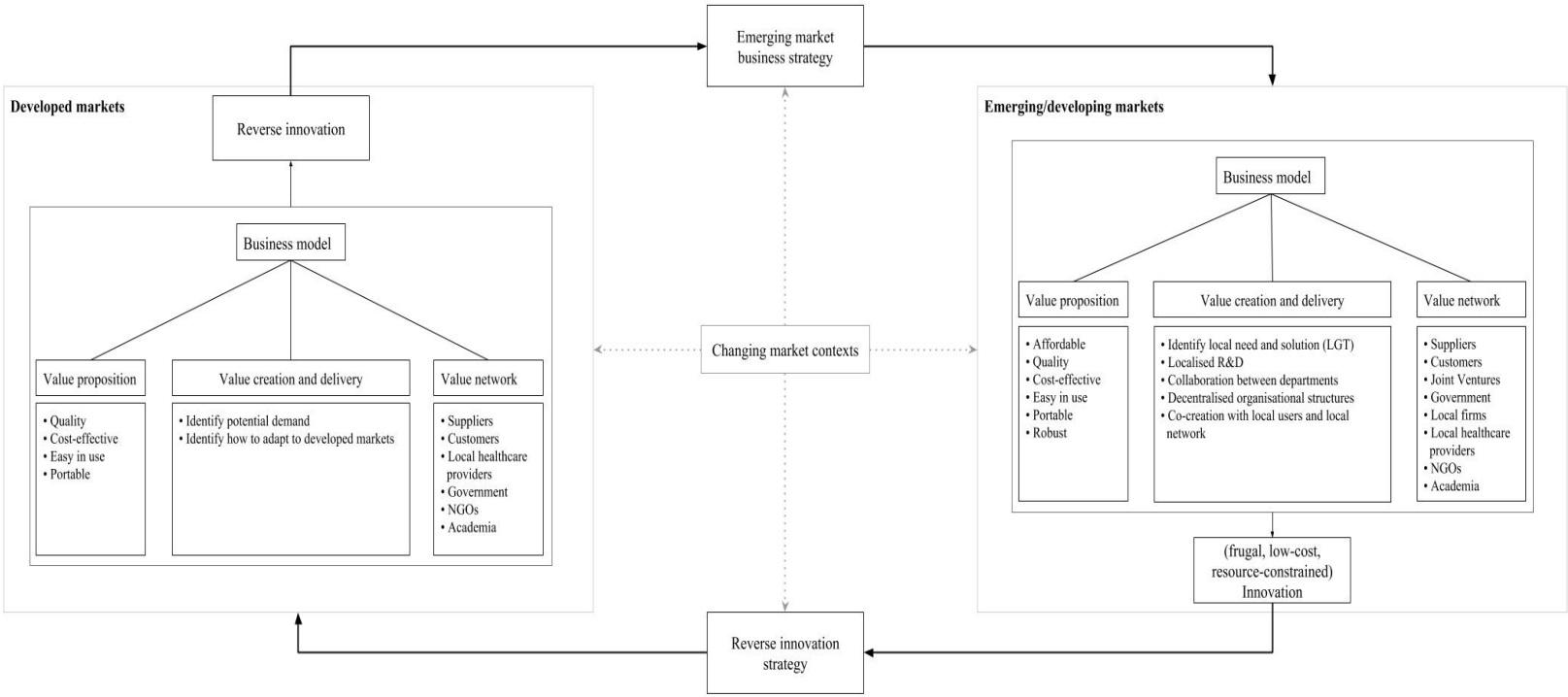

Figure 3: Organisational framework for reverse innovation (Author's own illustration)

Academic and practical relevance

This research contributes to the ongoing academic discussion on reverse innovation, and in particular provides more insights into the facilitating role of an organisation's business model in reverse innovation. Moreover, it has provided insights into the changing nature of reverse innovation, with respect to the manner organisations' launch their products. While firstly these products were introduced in emerging markets first, this research shows that the timeline is shifting and moving up. Therefore, it is recommended that future studies dive deeper into this phenomena, to uncover whether the same is true for organisations in other industries.

The practical relevance of this research can be found in its usability for western MNCs who are either partaking in or considering reverse innovation for their company. It exposes best practices and the case studies offer valuable lessons for organisations interested in reverse innovation in emerging markets, particularly in China and India.

Limitations and recommendations

Whilst extensive research has been conducted, no insider information on each of the companies is included in this research. First-hand information, through interviews with key informants could help enrich the research by providing more insight and detail into the decision making processes concerning the business models implemented to carry out each companies' emerging market business strategy or their reverse innovation strategy.

The scope of this research has limited itself to the healthcare technology industry. Therefore generalisations of this research might not be applicable to other industries. Further research involving other sectors would be required in order to be able to understand whether the same results would also be applicable across different industry sectors.

In addition, there is a geographical limitation. This research has mainly focused on western MNCS operating in China and India, and in the case of Royal Philips to a limited

extent Africa. The same results may not be replicable or be applicable to other emerging countries. A recommendation for future studies, therefore, is to conduct more research on reverse innovation in other countries.

Appendix I - List of Abbreviations /Acronyms

BoP	Bottom of the Pyramid
CE	Conformité Eurpéene (European Conformity)
CIC	China Innovation Centre
CIMF	China International Medical Foundation
CLC	Community Life Centre
CMDA	Chinese Medical Doctors Association
CT	Computed Tomography
CTC	China Technology Centre
DCR	Democratic Republic of Congo
ECG	Electrocardiogram
EMNC	Emerging market multinational corporation
EU	European Union
FDA	Food and Drug Administration
GE	General Electric
JFWTC	John F. Welch Technology Centre
HIC	Healthcare Innovation Campus
LGT	Local growth team
MNC	Multinational corporation
NGO	Non-Governmental Organisation
NHS	National Health Service
NNUH	Norfolk and Norwich University Hospital
PIC	Philips Innovation Campus
PNMS	Philips Neusoft Medical Systems Co, Ltd.
PPP	Public Private Partnership

PwC	Price Waterhouse Coopers
R&D	Research and development
SHS	Sustainable Healthcare Solutions
UAE	United Arab Emirates
U.K.	United Kingdom
UN	United Nations
UNFPA	United Nations Population Fund
UN MDG	United Nations Millennium Development Goals
UN SDG	United Nations Sustainability Development Goals
USA	United States of America

Appendix II – Literature review search strategy

Scopus

Using the search query 45 documents with the keyword “reverse innovation” were found in the Scopus database, of which eventually 23 were accessible.

KEY (“Reverse Innovation”) AND (LIMIT-TO (DOCTYPE,"ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English)) AND (LIMIT-TO (SRCTYPE, "j") OR LIMIT-TO (SRCTYPE, "p"))

Web of Science

Using the keyword “reverse innovation” and limiting the document types to articles, reviews, or case reports revealed 83 records in total. Of these records, eventually 28 records were open access.

FindUT

Using the University of Twente electronic database with the keyword “reverse innovation” and language limitation “English” led to 395 results. By further specifying content, format, year and accessibility the end result revealed 22 articles available.

Search strategy	Results
KW:(“reverse innovation”) AND (Limit-to (Language, “English”))	395
KW:(“reverse innovation”) AND (Limit-to (Language, “English”)) AND (Limit-to (Content, “Peer Reviewed”))	162
KW:(“reverse innovation”) AND (Limit-to (Language, “English”)) AND (Limit-to (Content, “Peer Reviewed”)) AND (Limit-to (Format, “Article”))	141

KW:(“reverse innovation”) AND (Limit-to (Language, “English”)) AND (Limit-to (Content, “Peer Reviewed”)) AND (Limit-to (Format, “Article”)) AND (Limit-to (Year, “Last 10 Years”))	137
KW:(“reverse innovation”) AND (Limit-to (Language, “English”)) AND (Limit-to (Content, “Peer Reviewed”)) AND (Limit-to (Format, “Article”)) AND (Limit-to (Year, “Last 10 Years”)) AND (Limit-to (Format, “Downloadable Article”))	22

KEY ("Emerging market" AND "strategy") AND (LIMIT-TO (SRCTYPE , "j ") OR LIMIT-TO (SRCTYPE , "p ")) AND (LIMIT-TO (DOCTYPE , "ar ") OR LIMIT-TO (DOCTYPE , "cp ")) AND (LIMIT-TO (SUBJAREA , "BUSI ")) AND (LIMIT-TO (LANGUAGE , "English ")) AND (LIMIT-TO (SUBJAREA , "BUSI")) AND (LIMIT-TO (EXACTKEYWORD , "Emerging Markets") OR LIMIT-TO (EXACTKEYWORD , "Strategy") OR LIMIT-TO (EXACTKEYWORD , "Competitive Strategy") OR LIMIT-TO (EXACTKEYWORD , "Corporate Strategy") OR LIMIT-TO (EXACTKEYWORD , "Emerging Market")

Appendix III – Overview of data sources individual cases

Case 1: Siemens A.G.

Source type	Authors	Title	Publication date	Publisher	URL
Annual reports	Siemens A.G.	Annual report 2010	2010, December 2	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/siemens_ar_2010.pdf
	Siemens A.G.	Annual report 2012	2012, November 28	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/siemens_ar_2012.pdf
	Siemens A.G.	Annual report 2014	2014, December 3	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/Siemens_AR2014.pdf
	Siemens A.G.	Annual report 2015	2015, November 30	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/Siemens_AR2015.pdf
	Siemens A.G.	Annual report 2016	2016, November 30	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/Siemens_AR2016.pdf
	Siemens A.G.	Annual report 2017	2017, November 29	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/Siemens_AR2017.pdf
Company reports	Siemens A.G.	Siemens in China - Accelerating our success.	2011, June 28	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/financial_publications/speeches_and_presentations/cmd_emerging_markets_2011/part-2-cmd-emerging-markets-china-mei-wei-cheng.pdf
	Siemens A.G.	Siemens - Vision 2020	2014, May 7	Siemens A.G.	https://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2014/corporate/2014-q2/axx20140534.htm
	Siemens A.G.	Sustainability information 2016	2016, November 30	Siemens A.G.	https://www.siemens.com/investor/pool/en/investor_relations/siemens_sustainability_information2016.pdf
	Siemens A.G.	Research and development: Fact and figures.	2017	Siemens A.G.	https://www.siemens.com/press/pool/de/feature/2017/corporate/2017-09-innovation-china/background-research-and-development-e.pdf
	Siemens A.G.	Siemens in China.	2017, February	Siemens A.G.	https://www.siemens.com/cn/en/home/company/about/research.html

Company Magazines	Freund, J., Bell, S., & Kusama, R.	SOMATOM Sessions: The difference in computed tomograpy - Affordable performance in 16- and 64-slice CT.	2010, May	Siemens A.G.	https://static.healthcare.siemens.com/siemens_hwem-hwem_ssxa_websites-context-root/wcm/idc/groups/public/@global/@imaging/@ct/documents/download/mdaw/mjiz/~edisp/somatom_sessions_26_int-00079316-00270153.pdf
	Siemens A.G.	Sieens SOMATOM Sessions	2005, June	Siemens A.G.	https://static.healthcare.siemens.com/siemens_hwem-hwem_ssxa_websites-context-root/wcm/idc/groups/public/@global/@imaging/@ct/documents/download/mdaw/mjiz/~edisp/somatom_sessions_16-00079282-00270173.pdf
	Siemens A.G.	Pictures of the future - The magazine for research and innovation.	2011	Siemens A.G.	https://www.siemens.com/content/dam/internet/siemens-com/innovation/pictures-of-the-future/pof-archive/pof-spring-2011.pdf
Company press releases	Siemens A.G.	Siemens makes digital radiography more accessible with the Multix Select DR digital X-ray system	2011, March 3	Siemens A.G.	https://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2011/healthcare/h201103022.htm
	Siemens A.G.	Siemens - Vision 2020	2014, May 7	Siemens A.G.	https://www.siemens.com/press/en/pressrelease/?press=/en/pressrelease/2014/corporate/2014-q2/axx20140534.htm
	Siemens A.G.	Siemens presents new 16-slice CT scanner Somatom Scope.	2014, March 7	Siemens A.G.	https://www.siemens.com/press/en/pressrelease/?press=%2Fen%2Fpressrelease%2F2014%2Fhealthcare%2Fimaging-therapy-systems%2Fhim201403015.htm
	Siemens A.G.	Innovation for Healthy China: Siemens shows latest solutions at CMEF 2014.	2014, April 7	Siemens A.G. - China	http://w1.siemens.com.cn/news_en/news_articles_en/2589.aspx
	Siemens Healthcare GmbH	The history of computed tomography at Siemens: A retrospective	2015	Siemens A.G.	https://www.siemens.com/press/pool/de/feature/2015/healthcare/2015-07-ct-40/background-history-ct-siemens-e.pdf
	Siemens Ltd, China	Siemens Healthineers to build diagnostics manufacturing facility in China	2016, September 19	Siemens A.G. - China	http://w1.siemens.com.cn/news_en/news_articles_en/3236.aspx
	Siemens Medical Solutions USA, Inc.	FDA clears Siemens' Multix Select DR floor-mounted digital radiography system.	2014, April 24	Siemens Healthineers USA	https://usa.healthcare.siemens.com/news/fda-clears-multix-select-dr-floor-04-24-2014.html
Company website	Siemens Healthcare GmbH	About Siemens Healthineers - Together.	n.d.	Siemens Healthineers	https://www.healthcare.siemens.com/healthcare-company-profile/about/together
Journals	Agarwal, N.	Innovation landscape in developed and developing market: A conceptual and empirical study on technology convergence and low cost innovations.	2016	University of Bamberg Press.	

	Donoghoe, N., Gupta, A., Linden, R., Mitra, P., & von Morgenstern, I. B.	Medical device growth in emerging markets: lessons from other industries.	2012, June 22	In Vivo-Business and Medecine Report	
Books	Bessant, J.	Riding the innovation wave: Learning to create value form ideas.	2017	Emerald Publishing Limited.	
	Boutellier, R., Gassman, O., & von Zedtwitz, M.	Riding the innovation wave: Learning to create value form ideas.	2008	Springer.	
	Dubiel, A., & Ernst, H.	Success Factors of New Product Development for Emerging Markets. In K. B. Khan (Ed.), The PDMA Handbook of New Product Development	2013	John Wiley & Sons, Inc.	
	Eberl, U., & Puma, J.	Innovative Minds: A look inside Siemens' idea machine. (S. Aktiengesellschaft, Ed.)	2007	Publicis Corporate Publishing.	
Periodicals (online) / News agencies	Hübner, A., & Scheutze, A.	Siemens to list Healthineers unit in March: sources.	2018, January 8	Reuters	https://www.reuters.com/article/us-siemens-healthineers-ipo/siemens-to-list-healthineers-unit-in-march-sources-idUSKBN1EX0QQ
Websites	Business Wire, Inc.	Siemens introduces dual and 40-slice Computed Tomography at RSNA; Spirit and Sensation 40 Join the SOMATOM Family, offering multislice CT for all needs.	2004, November 30	Business Wire - A Berkshire Hathaway Company	https://www.businesswire.com/news/home/20041130005148/en/Siemens-Introduces-Dual-40-Slice-Computed-Tomography-RSNA
	Business Wire, Inc.	Siemens expands successful computed tomography portfolio with introduction of SOMATOM Emotion 16; new system benefits any medical facility, regardless of size or budget.	2005, March 14	Business Wire - A Berkshire Hathaway Company	https://www.businesswire.com/news/home/20050314005902/en/Siemens-Expands-Successful-Computed-Tomography-Portfolio-Introduction
	Food and Drug Administration.	Special 510(k) Premarket notification: SOMATOM Scope and Scope Power.	2014, September 15	Food and Drug Administration.	https://www.accessdata.fda.gov/cdrh_docs/pdf14/K140912.pdf
	Jayakumar, P.B.	Siemens makes India R&D hub.	2010, January 31	Business Standard	http://www.business-standard.com/article/companies/siemens-makes-india-r-d-hub-110013100032_1.html

Case 2: General Electric

Source type	Authors	Title	Year of publication	Publisher	URL
White papers	Hilton, I., Nelson, J., de Oliveira Neto, V., Robins, N., Setiloane, T., & Tripathi, S.	Sustainability - The technology challenge: General Electric white paper. *A GE Briefing*	2013	General Electric	http://www.climateactionprogramme.org/images/uploads/documents/Sustainable_technology_-_General_Electric_white_paper.pdf
Annual reports	General Electric	Annual report 2009	2010, February 19	General Electric	https://www.ge.com/ar2009/pdf/ge_ar_2009.pdf
	General Electric	Annual report 2012	2013, February 26	General Electric	https://www.ge.com/ar2012/pdf/GE_AR12.pdf
	General Electric	Annual report 2015	2016, February 26	General Electric	https://www.ge.com/ar2015/assets/pdf/GE_AR15.pdf
	General Electric	Annual report 2016	2017, February 23	General Electric	https://www.ge.com/ar2016/assets/pdf/GE_AR16.pdf
Company reports	Kellner, K.	Forward in reverse: How "reverse innovation" helps win future markets.	2012	General Electric	https://www.ge.com/reports/post/74545042782/forward-in-reverse-how-reverse-innovation-helps/
	General Electric	Innovation Localization & Collaboration: 2014 China Sustainability Report.	2014	General Electric	https://www.ge.com/cn/sites/default/files/GE%202015%20Report%20_EN.pdf
	General Electric	Progress - Ultrasound: Local solutions, global health benefits - in annual report 2013	2014, February 27	General Electric	https://www.ge.com/ar2013/#/progress/a-simpler-company/local-solutions-global-health-benefits
	General Electric Company	GE Healthcare - GE's commitment to addressing maternal and infant health	2013	General Electric	http://files.publicaffairs.geblogs.com/files/2014/08/GEs-Commitment-to-Addressing-Maternal-and-Infant-Health.pdf
	General Electric	GE in China Fact Sheet	n.d.	General Electric	https://www.ge.com/cn/sites/www.ge.com.cn/files/GE_in_China_fact_sheet_EN_0811.pdf
	General Electric	Ge in China	n.d.	General Electric	https://www.ge.com/cn/sites/default/files/GE%20in%20China%20EN.pdf
	Karti, K	GE Reports - Perspectives: Spending money, saving lives	2014, May 30	General Electric	https://www.ge.com/reports/post/93343722633/spending-money-saving-lives/
	Kellner, K.	GE Reports - Forward in reverse: How "reverse innovation" helps win future markets	2012, April 10	General Electric	https://www.ge.com/reports/post/74545042782/forward-in-reverse-how-reverse-innovation-helps/
Company magazines	GE Healthcare	Vscan View	2014, Fall	GE Healthcare	http://www3.gehealthcare.nl/~/media/documents/us-global/products/ultrasound/journal%20abstract/vscan/gehealthcare-vscan-view-september-edition.pdf
	General Electric Company	GE Healthcare CT Clarity	2011, June	General Electric Company	http://www3.gehealthcare.co.uk/en-GB/Products/Categories/~/media/Downloads/uk/Product/Computed-

					Tomography/General/GEHealthcare_CT-Clarity-Magazine-2011-spring.pdf
Investor Updates	GE Healthcare	GE Healthcare - Investor update	2016, March 11	GE Healthcare	https://www.ge.com/sites/default/files/ge_webcast_presentation_03112016_0.pdf
Press releases	GE Healthcare	Market-relevant design: Making ECGs available across India.	2011, September 30	Ge Healthcare	http://newsroom.gehealthcare.com/ecgs-india-reverse-innovation/
	GE Healthcare	Pocket-Sized scanner used to spot breech babies.	2016, March 17	GE Healthcare	http://newsroom.gehealthcare.com/pocket-sized-scanner-used-to-spot-breech-babies/
	General Electric	GE opens technology centre in China.	2003, October 25	General Electric	https://www.genewsroom.com/press-releases/ge-opens-technology-center-in-china-270997
	General Electric	Vscan, GE Healthcare's newest pocket-sized visualiztion tool for point-of-care imaging, to support physicians providing medical care for atheletes, visitors and trainers at Vancouver 2010 Olympic Winter Games Competition.	2010, February 18	General Electric	https://www.genewsroom.com/press-releases/vscan-ge-healthcares-newest-pocket-sized-visualization-tool-point-care-imaging-1
	General Electric	GE Healthcare introduces a new version of Vscan	2012, May 10	General Electric	https://www.genewsroom.com/press-releases/ge-healthcare-introduces-new-version-vscan-218383
	General Electric	What's the value of healthcare technologies in today's global context?	2014, May 21	GE Healthcare	http://newsroom.gehealthcare.com/financing-for-health-post-2015-and-the-best-interventions-for-value-added/
	General Electric	GE Healthcare strenghteness "Make in India" capability for accessible, affordable, healthcare.	2015, April 2	General Electric	http://www.genewsroom.com/press-releases/ge-healthcare-strengthens-%E2%80%9Cmake-india%E2%80%9D-capability-accessible-affordable-healthcare
Company website	GE Healthcare	About GE Healthcare	n.d.	GE Healthcare	http://www3.gehealthcare.com/en/news_center#tabs/tab4539D2D9A98543ACA263AD1C341C471F
	GE Healthcare	GE Healthcare Fact Sheet - About Us	n.d.	GE Healthcare	http://www3.gehealthcare.com/en/About_Us/GE_Healthcare_Fact_Sheet
	General Electric	Healthymagination	2014, August 28	General Electric	https://www.ge.com/about-us/healthymagination
	General Electric	GE in India - Fact Sheet 2014	2014	General Electric	https://www.ge.com/news/company-information/india
	General Electric	Locations	2017, December 18	General Electric	https://www.geglobalresearch.com/locations#locations-map
	General Electric	About us - History | 2001-2004.	n.d.	General Electric	https://www.ge.com/in/about-us/history/2001-2004
	General Electric	About us - History | 2005-2010.	n.d.	General Electric	https://www.ge.com/in/about-us/history/2005-2010
	General Electric	GE Sustainability - China	n.d.	GE Sustainability	http://www.gesustainability.com/where-we-work/china/
	General Electric	Healthymagination Progress	n.d.	GE Sustainability	http://www.gesustainability.com/performance-data/healthymagination/

Journals	Ahmed, F., Ahmed, N. E., Briggs, T. W., Pronovost, P. J., Shetty, D. P., Jha, A. K., & Govindarajan, V.	Can reverse innovation catalyse better value health care?	2017	The Lancet Global Health	
	Herhausen, D., Trumann, M., & Schögel, M.	Learnings from "healthymagination" - How GE provides better care to more people at lower cost	2011	Marketing review St. Gallen	
	Mukerjee, K.	Frugal Innovation: The key to penetrating emerging markets	2012	Ivey Business Journal	
	Zeschky, M. B., Winterhalter, S., & Gassmann, O.	From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness.	2014	Research Technology Management	
Books	Govindarajan, V., & Trimble, C.	Reverse Innovation: create far from home, win everywhere.	2012	Harvard Business Review Press	
	Ramdorai, A., & Herstatt, C.	Frugal innovation in healthcare: How targeting low-income markets leads to disruptive innovation	2015	Springer International Publising.	
Case studies	Singh, J.	GE Healthcare (A): Innovating for emerging markets.	2011	INSEAD	
Periodicals (online) / News agencies	Ganguly, D.	How GE's Bangalore engineers are taking on technology challenges	2010, October 1	Economic Times India	https://economictimes.indiatimes.com/features/corporate-dossier/how-ges-bangalore-engineers-are-taking-on-technology-challenges/articleshow/msid-6660951,curpg-2.cms?from=mdr
	He, L.	GE Shutters R&D centre in Shanghai as markets eagerly await CEO Flannery's strategic review.	2017, October 20	South China Morning Post	http://www.scmp.com/business/companies/article/2116209/ge-shutters-rd-centre-shanghai-markets-eagerly-await-ceo
	Kannan, S.	The low cost technology saving premature babies' lives.	2013, August 26	BBC News	from http://www.bbc.com/news/business-23817127
	Leahy, J.	Financial Times India: A nation develops	2010, January 10	Financial Times	https://www.ft.com/content/445586ac-fe13-11de-9340-00144feab49a
Websites	Badkar, M.	GE moves healthcare divisions X-ray unit headquarters to China	2011, July 25	Business Insider	http://www.businessinsider.com/general-electric-x-ray-headquarters-china-2011-07?international=true&r=US&IR=T
	Business Wire Inc.	GE Healthcare announces $300 million commitment to support emerging market health.	2015, September 23	Business Wire Inc.	https://www.businesswire.com/news/home/20150923005242/en/GE-Healthcare-Announces-300-Million-Commitment-Support
	Food and Drug Administration	Special 510(k) Premarket notification: Revolution ACT.	2017, June 5	Food and Drug Administration	https://www.accessdata.fda.gov/cdrh_docs/pdf17/k171013.pdf

	General Electric	Revenue of General Electric Healthcare from 2008 to 2016 (in billion U.S. dollars)	n.d.	Statista - The Statistics Portal	https://www-statista-com.ezproxy2.utwente.nl/statistics/277734/revenue-for-general-electric-healthcare-segment-since-2008/.
	The Hindu	GE merges healthcare unit with Wipro.	2009, October 2	The Hindu	http://www.thehindu.com/business/companies/GE-merges-healthcare-unit-with-Wipro/article16884454.ece
	The Hindu Business Line	GE Healthcare exploring distribution tie-ups.	2011, March 10	The Hindu Business Line	http://www.thehindubusinessline.com/todays-paper/tp-corporate/ge-healthcare-exploring-distribution-tieups/article986057.ece
	Trefis Team	GE Healthcare is focusing on emerging markets, R&D and cost cuts to drive growth.	2014, September 3	Forbes	https://www.forbes.com/sites/greatspeculations/2014/05/22/ge-healthcare-is-focusing-on-emerging-markets-rd-and-cost-cuts-to-drive-growth/#49f8e3da512f
	United Nations	Sustainable Development Goals	n.d.	United Nations - Sustainable Development	https://sustainabledevelopment.un.org/sdgs
	World Health Organization	WHO Compendium of innovative health technologies for low-resource settings.	2015	World Health Organization - Department of Essential Medicines and Health Products.	http://www.who.int/iris/handle/10665/202537
Video files	PwC	John Flannery on India's strategic importance to GE	2013, April 23	YouTube	https://www.youtube.com/watch?v=DaWRqPO4bOI
	PwC	John Flannery on how the global organization changed its structure for India	2013, April 23	YouTube	https://www.youtube.com/watch?v=VREJO57v6tc
	PwC	John flannery on exporting healthcare innovations from India	2013, April 23	YouTube	https://www.youtube.com/watch?v=sowxfOwclJM

Case 3: Royal Philips

Source type	Authors	Title	Publication date	Publisher	URL
Annual reports	Koninklijke Philips N.V.	Annual report 2004	2005, January 27	Koninklijke Philips N.V.	https://www.philips.com/b-dam/corporate/about-philips/investors/financial-results/annual-reports/Philips_AnnualReport2004_2-13833.pdf
	Koninklijke Philips N.V.	Annual report 2010	2011, February 17	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/financial-results/annual-reports/Annual_Report_English_2010.pdf
	Koninklijke Philips N.V.	Annual report 2011	2012, February 23	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/financial-results/annual-reports/Annual_Report_English_2011.pdf
	Koninklijke Philips N.V.	Annual report 2012	2013, February 25	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/financial-results/annual-reports/Annual_Report_English_2012.pdf
	Koninklijke Philips N.V.	Annual report 2013	2014, February 25	Koninklijke Philips N.V.	http://www.annualreport2013.philips.com/index_en.html#s2
	Koninklijke Philips N.V.	Annual report 2014	2015, March 10	Koninklijke Philips N.V.	http://www.2014.annualreport.philips.com
	Koninklijke Philips N.V.	Annual report 2015	2016, December 18	Koninklijke Philips N.V.	https://2015.annualreport.philips.com/#!/home/tab=videos
	Koninklijke Philips N.V.	Annual report 2016	2017, July 24	Koninklijke Philips N.V.	https://www.results.philips.com/publications/ar16#/downloads
	Koninklijke Philips N.V.	Annual report 2017	2018, February 20	Koninklijke Philips N.V.	https://www.philips.com/static/annualresults/2017/PhilipsFullAnnualReport2017-English.pdf
	Philips India Limited	Annual report 2015-16	2015, August 18	Philips India Limited.	https://images.philips.com/is/content/PhilipsConsumer/Campaigns/CA20160509-EN-IN-reports/CA20160509_CO_001-en_in-Philips_india_Limited_Annual_Report_FY_2014_2015.pdf
	Philips India Limited	Annual report 2016-17	2017, July 18	Philips India Limited.	http://images.philips.com/is/content/PhilipsConsumer/documents/PIL-Annual-Report-2016-17.pdf
Company reports	Barr, R.	Noninvasive liver fibrosis assessment: ElastPQ ultrasound shear wave elastography.	2016	Koninklijke Philips N.V.	https://www.usa.philips.com/c-dam/b2bhc/us/feature-details/Shear-wave/LiverAssessment_DrBarr_WhitePaper_V4_LR.pdf
	Koninklijke Philips N.V.	Q2 2012 Quarterly report and Semi-annual report.	2012	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/financial-results/q-results/archive-q-results/2012/q2-2012/R_2Q12.pdf
	Koninklijke Philips N.V.	Philips Fabric of Africa: The Community Life Center - A community-driven and holistic platform for strengthening primary healthcare.	2017	Koninklijke Philips N.V.	https://images.philips.com/is/content/PhilipsConsumer/Campaigns/CA20150326_CO_001/CA20172102_CO_001-AAA-en_AA-Community-Life-Center-brochure-feb-22-2017.pdf

	Koninklijke Philips N.V.	Philips in Asia - Country Backgrounders.	n.d.	Koninklijke Philips N.V.	http://www.newscenter.philips.com/pwc_nc/main/shared/assets/Downloadablefile/Philips-in-Asia-Country-Backgrounders-download(3)-4029-1660.pdf
	Koninklijke Philips N.V.	Kitchen appliances - A recipe for the future	n.d.	Koninklijke Philips N.V.	https://www.90yearsofdesign.philips.com/article/29
	Koninklijke Philips N.V.	History of healthcare at Philips: 110 years of healthcare innovation and design.	n.d.	Koninklijke Philips N.V.	https://www.90yearsofdesign.philips.com/article/71
	Koninklijke Philips N.V.	VISIQ portable ultrasound: Designing an ultramobile ultrasound system.	n.d.	Koninklijke Philips N.V.	https://www.90yearsofdesign.philips.com/article/54
Company presentations	Chang, D.	Winning with China: An integrated view of Philips China Strategy [PowerPoint].	2004, June 9	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/financial-results/q-results/medical-systems-and-china-june-9-2004/2-david-chang-final-2842.pdf
	Kung, P	Building on a strong foundation - Philips: Morgan Stanley China Industrial Summit [PowerPoint].	2013, May 30	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/broker-conferences/2013/2013_05_30_Morgan-Stanley-Presentation-Patrick-Kung-2013_final.pdf
	Royal Philips	HSBC SRI conference [PowerPoint]. Frankfurt, Germany.	2014, February 4	Royal Philips	https://www.philips.com/c-dam/corporate/about-philips/investors/broker-conferences/2014/2014_02_04_DeBruin_HSBC_SRI_Frankfurt.pdf
	Saragnese, G.	Imaging Systems - Philips capital market days (Healthcare). Boston, Massachusetts, United States of America	2012, May 10	Koninklijke Philips N.V.	https://images.philips.com/is/content/PhilipsConsumer/Campaigns/CA20151021_Teamsite_Decommision/CA20151210_CO_001-AAA-10-saragnese-20120510.pdf
	Spittle, W.	Winning in Southeast Asia and India - Philips capital market days. Boston, Massachusetts, United States of America	2012, May 10	Koninklijke Philips N.V.	https://www.philips.com/c-dam/corporate/about-philips/investors/financial-results/q-results/philips-capital-markets-day-boston-usa-may-10-2012/16-spittle-20120510.pdf
Company Website	Koninklijke Philips N.V.	Company - About	n.d.	Koninklijke Philips N.V.	https://www.philips.com/a-w/about/company.html
	Koninklijke Philips N.V.	Our Heritage - Company - About	n.d.	Koninklijke Philips N.V.	https://www.philips.com/a-w/about/company/our-heritage.html
	Koninklijke Philips N.V.	Introduction - Company - About.	n.d.	Koninklijke Philips N.V.	https://www.90yearsofdesign.philips.com/awards
	Koninklijke Philips N.V.	About PIC.	n.d.	Philips India	https://www.philips.co.in/a-w/about-philips/philips-innovation-center/about-us.html
	Koninklijke Philips N.V.	Healthcare Innovation Campus.	n.d.	Philips India	https://www.philips.co.in/a-w/about-philips/healthcare-innovation-campus.html
	Koninklijke Philips N.V.	HIC	n.d.	Koninklijke Philips N.V.	https://www.philips.com/a-w/asiapac/careers/healthtech/locations/india/healthcare-innovation-centre.html
	Koninklijke Philips N.V.	Philips 90 years of - Our people and places.	n.d.	Koninklijke Philips N.V.	https://www.90yearsofdesign.philips.com/our-people-and-places

	Koninklijke Philips N.V.	Philips Research Africa.	n.d.	Koninklijke Philips N.V.	https://www.philips.com/a-w/research/locations/nairobi.html
Press releases	Koninklijke Philips N.V.	Philips intends to sell shareholding in Philips-Neusoft Medical Systems joint venture to Neusoft Medical Systems.	2013, February 5	Koninklijke Philips N.V.	https://www.philips.com/a-w/about/news/archive/standard/news/press/2013/20130205-Philips-intends-sell-shareholding-Philips-Neusoft-to-Neusoft.html
	Koninklijke Philips N.V.	Philips' new advanced imaging ultrasound system provides a cost-effective solution to clinicians in a wide range of care settings.	2013, May 7	Koninklijke Philips N.V.	https://www.philips.com/a-w/about/news/archive/standard/news/press/2013/20130506-advanced-imaging-ultrasound-system.html
	Koninklijke Philips N.V.	Philips receives FDA 510(k) clearance for its innovative ultra-mobile VISIQ ultrasound system.	2014, July 8	Koninklijke Philips N.V.	https://www.usa.philips.com/a-w/about/news/archive/standard/news/press/2014/20140708-philips-visiq.html
	Koninklijke Philips N.V.	Philips to establish Research & Innovation Hub in Africa.	2014, March 20	Koninklijke Philips N.V.	https://www.philips.com/a-w/about/news/archive/standard/news/press/2014/20140321-Philips-to-establish-Research-and-Innovation-Hub-in-Africa.html
	Koninklijke Philips N.V.	Philips India to extend healthcare services through PPP model	2017, August 31	Koninklijke Philips N.V.	https://www.philips.co.in/a-w/about/news/archive/standard/about/news/press/2017/20170831-philips-india-to-extend-healthcare-services-through-ppp-model.html
	Koninklijke Philips N.V.	Philips partners with the government of Kenya and the United Nations to advance the African healthcare agenda.	2017, May 2	Koninklijke Philips N.V.	https://www.philips.co.ke/a-w/about/news/archive/standart/news/press/2017/20170502-philips-announces-collaboration-with-un-to-establish-the-first-sdg-healthcare-partnership-platform-in-africa.html
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Journal	Kawathekar, D., Moorthy, E., & Chandrappa, N.	Impact of FMEA on improving software reliability of an ultrasound system designed for emerging market countries.	2012	Proceedings of the 5th India Software Engineering Conference (pp. 22-25). Kampur, UP, India: ACM.	
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Periodical (online) /	Fusheng, L.	Philips breathes life onto onboard air purification	2014, September 15	China Daily	http://www.chinadaily.com.cn/business/2014-09/15/content_18598079.htm

News agency	John, S.	Philips India shrinks ultrasound, ECG machines.	2014, April 4	The Times of India	https://timesofindia.indiatimes.com/business/india-business/Philips-India-shrinks-ultrasound-ECG-machines/articleshow/33216826.cms
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Website	BioSpectrum Bureau	Philips launches new ultrasound solutions.	2012, May 14	BioSpectrum - Asia Edition	https://biospectrumasia.com/news/49/4554/philips-launches-new-ultrasound-solutions.html
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	Food and Drug Administration	510(k) Premarket Notification - Summary of Safety and Effectiveness.	2012, 17 February	U.S Food & Drug Administration	https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm?ID=K120321
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Interview	Kabra, N.	Interview with Rekha Ranganathan - Philips Healthcare Innovation Center Pune.	2016, December 8	Pune Tech	https://punetech.com/interview-with-rekha-ranganathan-philips-healthcare-innovation-center-pune/
Video files	Thomson Reuters	Philips CEO Frans van Houten on emerging markets	2016, January 20	YouTube	https://www.youtube.com/watch?v=85wGAjkhkJQ

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