

Innovation Landscape in Developed and Developing Markets

A Conceptual and Empirical Study on
Technology Convergence and Low Cost Innovations

von Nivedita Agarwal



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Abstract

Innovation is proven to be an absolute requirement for growth in both developed and developing countries, but the type and motivation of innovations differ depending on various surrounding factors like socio-cultural attributes, geography, infrastructure, political environment and income-levels of customers. In developed countries innovations are often technology-driven and associated with delighting the end customers. On the contrary, in the developing or emerging markets due to the unique setting and infrastructural gaps innovations are focused towards meeting customer's fundamental needs. Innovations in emerging markets are also seen as one of the drivers, utilized to address urgent developmental challenges such as poverty, illiteracy and lack of access to healthcare services. Considering these vast differences in driving factors, this research focuses on the comparison of the on-going innovation fostering in both developed and developing world individually. This thesis is an attempt to understand the innovation landscape across these two worlds and focus on specific innovation approaches based on their potential and relevance.

In developed world, information technology (IT) is emerging out as the key enabling technology across different innovation approaches. This thesis focuses on one such innovative application of IT called technology convergence, which is an integration of information and operational technologies (Gartner, 2011). Significant financial and productivity benefits are expected from this convergence and therefore many industrial companies are investing heavily into this alignment and undergoing huge business transformations. This study analyses the case of General Electric undergoing such a strategic business transformation. Study conceptualizes a theoretical framework around this new concept by expanding the Venkatraman's (1994) IT-enablement model and exhibiting evidences of non-linearity and overlap across different transformation stages. Study discloses, IT localized exploitation stage as a default stage for initiating technology convergence and illustrates that each stage of the transformation has an impact on a unique set of organizational dimensions. Business scope redefinition stage influences the dimension of strategy and vision while internal integration stage influences the organization's structure dimension. The two dimensions that are impacted most during the business process and network redesign stages, are business process and products and markets respectively.

In contrast to the developed world where innovation approaches are focused on IT enabled performance enhancements, emerging markets are observing innovations centred on frugal products that are cost effective and provide value for money. Past two decades have seen a tremendous growth in emerging markets as they are developing their own innovative capabilities (Jiatao and Rajiv, 2009).

Country like India, which is also a focus of this thesis, initially playing secondary roles has now become a breeding ground for frugal and social global innovations. This thesis discusses various types of innovation approaches adopted by local firms and multi-national companies in emerging markets such as frugal innovation, jugaad, disruptive innovation, gandhian innovation, catalytic innovation, indigenous innovation, resource-constrained innovation and bottom-up innovation. It identifies the increasing complexity and terminology confusion across these approaches in the growing and fragmented literature revolving around emerging markets. Targeting this shortcoming of the literature, this study attempts to consolidate the research insights into a unified framework defining eight main requirements of emerging markets namely cost-effective, easy-to-use, sustainable, problem-centric, no-frills, fast-to-market, resourceful and breakthrough. Additionally, study also analyses the priorities of these requirements during the buying and designing process from end customers and manufacturers point of view respectively. Research confirms “cost-effective” and “easy to use” as the absolute requirements of bottom-of-pyramid (BOP) customers and reveals the growing awareness towards eco-friendly products. It also introduces two additional important features from customer perspective namely – low/no maintenance or consumables and customized solutions to the framework.

Furthermore, research also touches upon the topic of social enterprises, medium to diffuse social innovations into emerging markets to address social challenges and developmental issues like poverty and access to healthcare services. Study uses event structure analysis and four growth stages identified by Perrini et al. (2010); opportunity identification, opportunity evaluation, opportunity exploitation and opportunity scaling-up to analyze two social healthcare enterprises in India. It proposes an abstract model of a social enterprise with the contributing generalized actions and their causal interactions. Thesis ends with a conclusion giving an overview and a consolidated view of innovation approaches existing in developed world and emerging markets. Additionally it re-emphasises some of the limitations experienced during the research work and suggests related future research propositions.

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List of Abbreviations

AHP	Analytic Hierarchy Process
VOC	Voice of Customer
ANMs	Auxiliary Nurse Midwifery
BOP	Bottom of Pyramid
BSC	Business Source Complete
CT	Computed Tomography
CEO	Chief Executive Officer
COE	Center of Excellence
EA	Enterprise Architecture
ESA	Event Structure Analysis
et al.	et alii: and others
FHM	Fetal Heart rate Monitor
GE	General Electric
GNMs	General Nursing and Midwifery
GNP	Gross National Product
HCIT	Healthcare IT
HLL	Hindustan Latex Limited
HMI	Human Machine Interface
i.e.	id est , “that is”
IFC	International Finance Corporation
IOL	Intraocular Cataract Lenses
IT	Information Technology
LSH	LifeSpring Hospital
MNCs	Multinational Companies
OECD	Organization for Economic Co-operation and Development
OT	Operational Technology
p.	page
R&D	Research & Development
RBV	Resource-Based View
USA	United States of America
USD	United States Dollar
viz.	videlicet, “namely” , “that is”

Chapter 1 : Introduction

1.1. State of Art

The term innovation is a cherished topic in research field. Growing importance of the topic is reflected in the dramatic increase in literature addressing a wide gamut of aspects including the role, nature and measurement of innovation (Johannessen et al., 2001, Garcia and Calantone, 2002, Christensen, 2003, Govindarajan and Trimble, 2005, Chandy et al., 2006, Raisch and von Krogh, 2009, Lafley and Charan, 2008, Brem, 2011). Innovation as defined by OECD is, “the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (Oslo Manual OECD/Eurostat, 2005). It is described as the best-known indicator of organizational competitive advantage (Drazin and Schoonhoven, 1996, Christensen, 1997). 80 of the Fortune 500 companies that have focused on organic growth through innovations have “earned handsome rewards” for the shareholders, compared to companies with lower rates of organic growth (Raisch and von Krogh, 2009). While innovation has proved to be crucial for socio-economic growth (Brem, 2011), rapid technological advancements and ‘globalization’ has increased the complexity in understanding the innovation systems across interconnected continents, countries and regions (Crescenzi and Rodríguez-Pose, 2012). This changing scenario poses a number of challenges for scholars in analysing the innovation frameworks and strategies useful for understanding the complexities of the regional innovation processes. The ultimate aim of this thesis is to understand the current innovation strategies and develop conceptual framework to enhance learning in both developed and developing countries.

Research also acknowledges that due to different environmental conditions such as socio-cultural attributes, geography, infrastructure, political environment and income levels (Rauch et al., 2013), innovation systems and strategies are distinct for developing and developed countries. For example, since the economic melt-down of 2008, developed countries have experienced major economic reforms, cost pressures and higher productivity demands. Growing performance pressures have forced companies to look for newer innovation strategies and processes. In the same context, most of on-going innovation strategies adopted by industrial world is inclined towards standardization, lean manufacturing and real-time/ predictive analytics. Across all these strategies Information technology (IT) has emerged out as the single most influential enabler. Hence, companies in developed world are considering informational technology as an important resource for innovations and growth. To remain competitive, companies have invested heavily in IT and have willingly undergone tremendous transformation in their

vision, strategies, markets, business models, processes and even core values (Agarwal and Prasad, 1998).

In contrast to the IT oriented innovations in developed world, developing countries because of their large market size, growing demands and plentiful workforce are experiencing a significant growth in low cost and social innovations. Due to the significant untapped potential residing in these markets, scholars have referred to them as “Emerging Markets”. The origin of the term “Emerging Markets” dates back to 1981, coined by economists at the International Finance Corporation (IFC), when the group was promoting the first mutual fund investments on developing countries (Khanna et al., 2010). Since then, the term “Emerging Markets” is used for countries that are observing a steady growth in gross national product (GNP) per capita and are undergoing economic reforms for alleviating problems of poverty, poor infrastructure and overpopulation.

In emerging markets, the fundamental objective of innovation is not just about delighting customers but rather is about meeting customer’s fundamental needs (Petrick, 2011). The unique conditions and basic unmet customer needs of the developing world are driving newer low-cost and problem centric innovations. Moreover, over time some of these innovations have been even utilized to address urgent societal and developmental challenges existing in these emerging markets such as poverty, illiteracy and lack of access to healthcare services.

Although the overall innovation processes and systems in both, the developed and developing parts of the world are interconnected, they are however driven by a distinct set of motivations. This study is a deep dive into selected dominant innovation approaches for each of these markets exclusively. The thesis focuses on IT/predictive analytics related innovations in the context of developed world and low-cost and social innovations in the context of the emerging markets.

1.2. Research Gap and Relevance

1.2.1 Information & operational technology convergence in developed world

In the last two decades, the world has experienced an evolution of the Internet and information technologies that has brought about ubiquitous connectivity, believed to be the biggest game-changer in the history of business since the industrial revolution. It is revolutionizing not only the consumer industry but also the industrial world. This revolution has affected all fields of business, from consumer to industrial sectors, and has introduced new challenges in managing the pace of rapidly changing technology (Conway, 1999). There has been significant research done in analysing the value of investment in IT as a source of competitive advantage and in examining how firms realize these benefits (Bharadwaj, 2000, Mata, Fuerst and Barney, 1995). There is strong evidence in the literature that IT

alone cannot provide sustainable performance gains unless other resources or skills in an organization complement it (Bharadwaj, 2000, Tippens and Sohi, 2003, Teece, Pisano and Shuen, 1997). Prior research has theoretically and empirically proven the benefits of IT investment when it is embedded and complemented by other resources or skill sets. (Bharadwaj, 2000, Powell and Dent-Micallef, 1997, Mata, Fuerst and Barney, 1995, Tippens and Sohi, 2003). In this context, Gartner (2011) has studied the collaboration of IT and operational technology (OT), and claims that the combination and convergence of these two technologies offers a unique opportunity to companies, with the potential to revolutionize the world. Having recognized the potential of information and operational technology convergence, traditional industrial heavyweights in the developed world such as General Electric (GE), Siemens, and Schneider are investing heavily in realigning and embedding their IT capabilities into their physical equipment. This convergence is expected to enable companies to offer value added services like advanced analytics and real time intelligence to their customers. Companies, based on their focus, have assigned different names to this initiative. GE, focusing more on connecting machines and people, is following the industry term “Industrial Internet” given by industry experts. Siemens has recently launched its Vision 2020, which is about exploiting the opportunities offered by digitalization and adding value to the customers through software solutions and intelligent data analysis. Schneider has dubbed their approach to this merging of technologies as “EcoStruxure” (Agarwal and Brem, 2015).

This phenomenon of embedding IT into physical equipment-oriented technologies is a relatively new strategy and is currently in the early phases of implementation. However, considering the investments and upcoming business transformations, it is certainly a bigger initiative than the enablement of IT into business processes and calls for academic research. For theory building and initial research on this on-going innovation process originating in developed world, it is important to begin with case study methodology and study the implementation cases and identify initial challenges and learning. This study proposes to develop a conceptual model to understand the determinants of this innovative strategy and analyse the strategic transformation businesses are undergoing to embrace this new phenomenon.

1.2.2 Low cost innovations in emerging markets

In contrast to the developed world, where companies are moving ahead from IT enablement to technology convergence for better performance and productivity, emerging markets are experiencing distinct bottom-up innovations focused on meeting customer’s fundamental needs (Petrick, 2011). Due to significant num-

ber of constraints like poor infrastructure, low income, political instability, innovations in these markets are not just about advanced technologies but more about product redesigning. Innovations here address the unmet fundamental needs of the customer and tackle social challenges of poverty and service divide prevailing in these markets for decades.

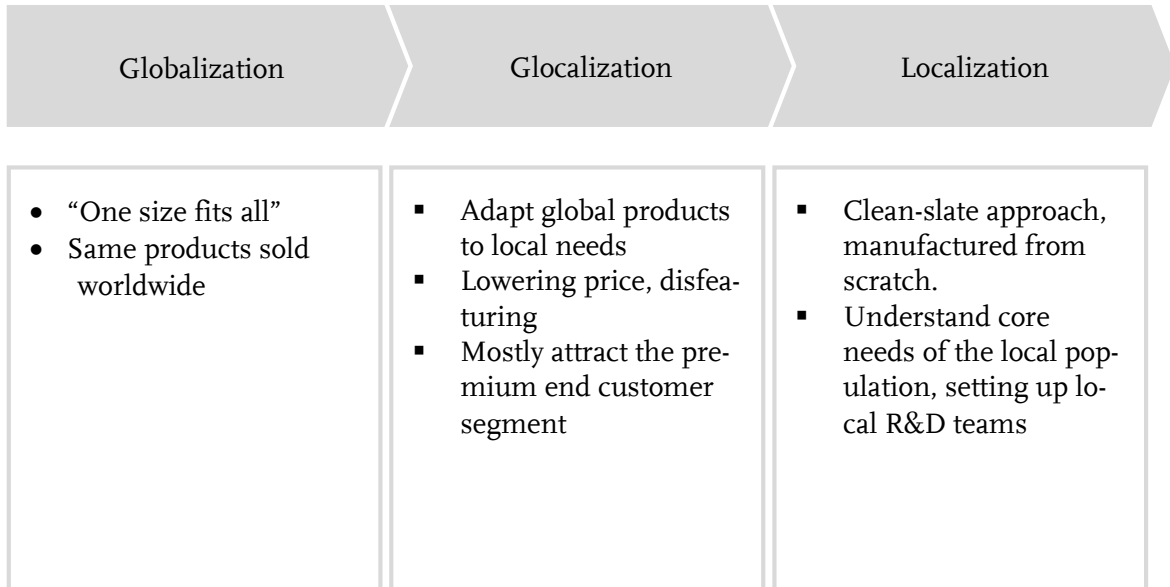
Prahalad (2005) was one of the earlier researchers who introduced the world to the huge economic potential residing in emerging markets at the “Bottom of the pyramid” (BOP). He coined the term BOP to refer to the majority population of emerging markets, who were earning less than \$2000 per year. He pointed out the significant potential financial benefits of developing products and services for BOP. Realization of the huge economic potential existing in these countries transformed emerging markets into attractive and rapidly growing markets.

Literature suggests that deregulation policy in mid-1980's played a major role in technology imports and promoted R&D efforts in emerging markets (Aggarwal, 2000). Initially, multinational companies (MNCs) from developed markets entered emerging markets with an intention to exploit and harvest their home-grown innovations in these markets. This labour arbitrage facilitated knowledge spill overs and technology transfer in emerging markets, which helped emerging markets move up the value chain from imitators to innovators.

With the growing population and expanding middle class even foreign multinationals started to adapt and customize the products intended for developed world to the needs of emerging market customers by de-featuring and cutting down the cost. This move of adapting global products to local needs was called “Glocalization” (Agarwal and Brem, 2012). However, this strategy was not very successful with majority of the MNCs trying to attract local customers. The unique environment and specific customer needs of emerging markets forced companies to rethink their strategies. The demand for so called ‘good enough’ products was a distinctive challenge to western multinationals and their differently orientated business models (Zeschky et al., 2011). This inherent difference in the local needs and lack of infrastructure led to emergence of local players with newer innovation paradigms (Saraf, 2009, Economist, 2010) that were beyond merely adapting existing products. In order to maintain their competitive position, multinationals were forced to focus on developing products and solutions locally in these emerging markets. In other words, multinational companies were obliged to participate in these new innovation paradigms. Companies started new phenomenon of “localization”. This strategy included setting up of research and development centres in emerging markets and hiring local talent (Agarwal and Brem, 2012). Companies started “localizing” their complete value chain including R&D in these regions. Figure 1-1 shows a gradual shift in product development strategies of multinationals for emerging markets from “Globalization” or “One-size-fit-all” to

“Glocalization” (adapting global product to local needs, for example: by de-featuring and lowering price) and subsequently to complete “localization” (Corsi and Minin, 2014).

Figure 1-1: Gradual shift in strategies



Emerging markets over the years have become a beneficiary of global exchange of talent, technology and resources. Emerging markets have become new centres of gravity for technology because of their large market size, growing demands, plentiful workforce and rising income levels. These markets are showing signs of emerging as a lead market in the segment of functional, fault resistant and cost effective goods and services. Industrial companies in these countries have recognized their chances and are investing heavily in research and development (R&D) activities.

Considering the gradual shift in product strategies and resultant technology transfers, emerging markets have attracted a significant amount of attention from both the academia and industry in last two decades. Increasing number of academic research (Prahalad and Mashelkar, 2010, Zeschky, Widenmayer and Gassmann, 2011, Govindarajan and Trimble, 2012, Radjou, Prabhu and Ahuja, 2012, Agarwal and Brem, 2012, Brem and Wolfram, 2014, Rao, 2013, Corsi and Minin, 2014, von Zedtwitz et al., 2015) in this field has revealed different perspectives and introduced different innovation approaches and theories. For example, Theory of frugal innovation (Zeschky, Widenmayer and Gassmann, 2011), Jugaad (Radjou, Prabhu and Ahuja, 2012), Grassroots innovation (Gupta, 2013), Catalytic innovation (Munshi, 2010), Indigenous innovation (Lazonick, 2004) Gandhian innovation (Prahalad and Mashelkar, 2010), Disruptive innovation (Christensen, 1997, Christensen and Bower, 1996), Reverse innovation (Immelt, Govindarajan and Trimble, 2009), innovation at the Base of the Pyramid (Prahalad, 2012) and Resource-constrained innovation (Sharma and Iyer, 2012). All these innovations

approaches mostly relate to the same definition of “redesigning both products and processes from scratch to take out costs” and focus on the unique needs of the underserved customer segment, which are often not fulfilled by the mature world products. However, past research shows a visible overlap in the descriptions and characteristics of these innovation approaches, leading to terminology confusions (von Zedtwitz et al., 2015). With the growing maturity of this field there is a pressing need for a structured and consolidated view of these innovation approaches for emerging markets. Therefore to study the whole innovation landscape for emerging markets, this thesis focuses on categorizing and understanding the product development centric innovation approaches and service oriented social innovation models and approaches.

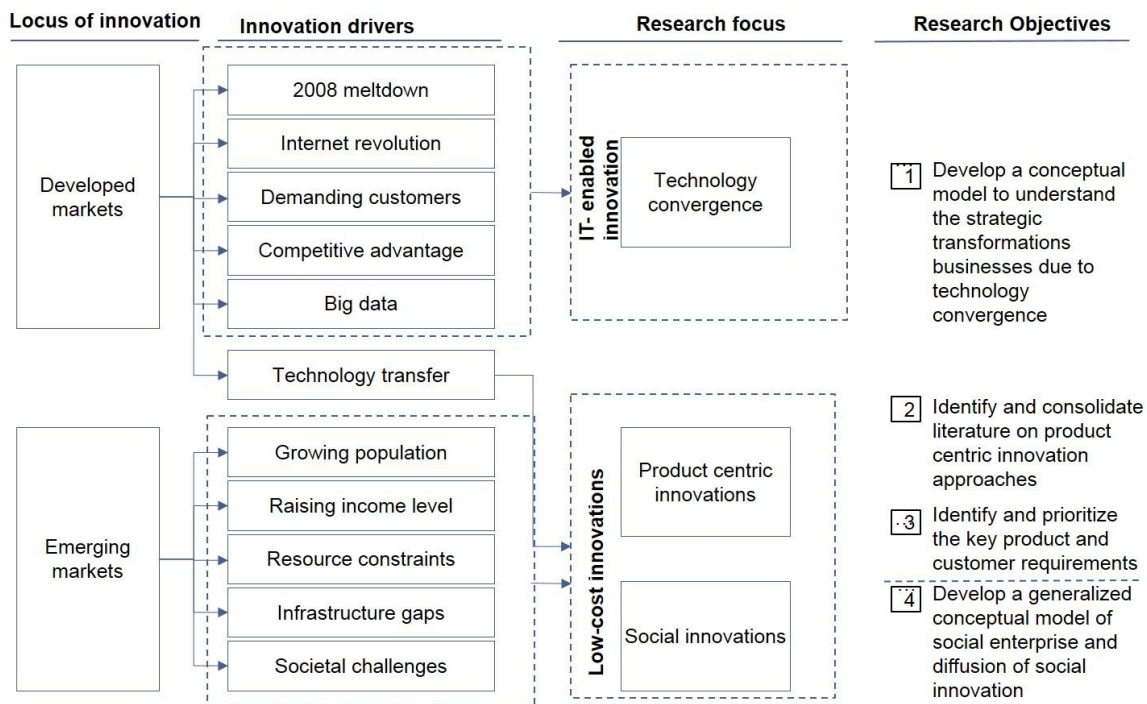
1.3. Research Objectives

As mentioned, this thesis is an attempt to understand the innovation landscape in both developed and developing countries and study the innovation strategies and frameworks in detail. Figure 1-2 is a structural illustration of the proposed research and its objectives.

As shown in the figure, this thesis is divided into two sections; first section is focused on the on-going innovation strategies for the developed world and is centred on technology convergence. The next section describes the innovations approaches fostering in emerging markets. It looks at both the product development centric innovation approaches and also service oriented- social innovation models in emerging market context.

Considering the research framework and background literature, this thesis has four main objectives. First objective is to initiate research and develop understanding of this relatively new innovation strategy, “technology convergence” and also analyse the strategic transformations businesses are undergoing for implementation of this convergence. Since it’s a new research field, thesis will first build on the current literature of a similar field of IT-enabled business transformations. Subsequently for theoretical and conceptual modelling it plans to study unique case studies undergoing business transformation due to technology convergence.

Figure 1-2: Conceptual framework of proposed research



Second objective of the thesis is to understand different product centric innovation approaches in context of emerging markets and also to provide a consolidated framework of these overlapping innovation approaches. A systematic literature review of the product centric innovation approaches is planned to clear up the literature shortcoming of increasing terminology confusions in this research field. Third objective is to identify and prioritize the key product and customer requirements for emerging markets. Unfortunately, most of the research on emerging markets is qualitative in nature and to respond to this literature gap, quantitative analysis is proposed to fulfil the third objective. The fourth and the final research objective of the thesis is to develop intimate understanding of social innovations addressing social challenges or service divides existing in emerging markets. The aim here would be to develop a generalized conceptual model of a social enterprise and illustrate how these are used to diffuse social innovation into the markets.

1.4. Overview of methodologies

Case study methodology is an important instrument for theory building research (Yin, 1994). Following this argument, case study approach is used to study technology convergence and the resultant business transformations. General Electric (GE) being the frontrunners in implementation of technology convergence, is an appropriate research subject for a case study by virtue of the fact that it is a “unique case” (Yin, 1994). Data collection is done from multiple sources of information (including interviews, observations, primary and secondary documents,

and website information) for triangulation of data. Case study approach is also used to understand the innovation approaches in context of emerging markets. German manufacturing multinational Siemens is chosen for qualitative analysis due to their growing frugal product portfolio and high focus on emerging markets.

Subsequently an explorative scanning of literature is carried out to identify most frequently used innovation approaches in the context of new product development in emerging markets. To develop a consolidated framework, thesis adopts a specific neuro-linguistic analysis technique called “semantic similarity” to identify similar characteristics across innovation approaches and uses Ward’s clustering method to statistically group similar characteristics into broad factors.

Furthermore, for quantitative analysis, voice of customer (VOC) methodology is utilized to gain insights into the customer needs in emerging markets. Research follows the steps of the voice of customer methodology, viz. identifying customer needs, grouping them, prioritizing them and finally understanding the customer perception of product performance (Griffin, 1993). Within this VOC methodology, analytic hierarchy process (AHP) is used for prioritizing the customer requirements.

For research on social innovation, a promising qualitative analysis methodology is introduced - Event Structure Analysis (ESA). It is a computer-assisted technique to analyse temporal sequence of events and understand their logical relations and causal interpretations (Heise, 1989). This methodology is relatively new and unexplored in management literature till now. This research attempts to showcase the residing potential of this technique by employing it to develop a generalized model for social innovations. Table 1-1 below gives an overview of the methodologies and research objectives.

Table 1-1: Research focus & objectives

Research Objectives	Research Focus	Methodologies used
RO1	Develop a conceptual model to understand the strategic transformations of businesses due to technology convergence	Case Study
RO2	Identify and consolidate literature on product centric innovation approaches	Case study, Systematic literature review, Semantic similarity and Ward's cluster analysis
RO3	Identify and prioritize the key product and customer requirements	Voice of customer, Analytic hierarchy process
RO4	Develop a generalized conceptual model of social enterprise and the diffusion of social innovation	Case study, Event structure analysis

This thesis, for empirical data collection and to limit the scope, focuses only on healthcare sector and on one of the most promising emerging markets- India.

1.5. Structure of thesis

Table 1-2 below provides an overview of the structure of the thesis. Thesis is divided into two sections; first section is focused on the developed world and contains a single chapter centred on technology convergence. Next section is about emerging markets that discusses both low-cost innovations and social innovations in detail. This section contains four chapters that analyse innovation landscape in emerging markets from different perspectives.

Table 1-2: Structure of the thesis

Section	Chapters	Research focus	Research objectives
Section 1: Developed World	Chapter 2	Technology Convergence	RO1
Section 2: Emerging Markets	Chapter 3	Low cost innovations	RO2
	Chapter 4		RO2
	Chapter 5		RO3
	Chapter 6	Social innovations	RO4

In section 1, Chapter 2 explains the phenomenon of technology convergence in detail. It includes a case study on GE and describes how GE is embracing this

new form of innovation and undergoing business transformation. The study conceptualizes a theoretical framework to analyse the different stages and dimensions of transformation while adapting to this new technology trend.

Section 2 of the thesis focuses on emerging markets and includes four chapters. Chapter 3, 4 and 5 provide a detailed analysis of the product centric innovation approaches existing in emerging markets and Chapter 6 elaborates on social innovation and their diffusion in the market.

Chapter 3 discusses innovation approaches adopted by Siemens for product development in emerging markets and will showcase examples of frugal and reverse innovation developed by Siemens for India and China markets.

Chapter 4 studies and analyses the evident overlap in the descriptions and characteristics of the most frequently used innovation approaches for new product development in emerging markets. This research provides a consolidated framework that summarizes important product requirements for emerging markets. This framework is derived based on the systematic literature review and clustering of similar characteristics across innovation approaches. Chapter 5 focuses on validation of the framework from manufacturers and end customers point of view. It offers insights on BOP customer requirements and their priorities of product features during the buying process.

Chapter 6 is centred on social innovations and analyses distinct social enterprises in Indian healthcare sector using event structure analysis technique. The chapter develops an abstract and generalized model for social enterprises to showcase the general sequence of events that play an important role in creation and sustaining the social innovations.

Finally, Chapter 7 concludes this thesis with a short summary and discussion of the results, research contributions, limitations and implications. Additionally it also proposes an outlook for further research.

Chapter 2 : Strategic business transformation through technology convergence: Implications from General Electric's Industrial Internet initiative

2.1. Introduction

The Internet and information technology (IT) revolution in the late twentieth century has been the biggest game-changer in the history of business since the industrial revolution, which began almost two centuries ago. This revolution has affected all fields of business, from consumer to industrial sectors, and has introduced new challenges in managing the pace of rapidly changing technology (Conway, 1999). To remain competitive, companies have invested heavily in IT and have willingly undergone tremendous transformation in their vision, strategies, markets, business models, processes, and even core values (Agarwal and Prasad, 1998).

Researchers have become increasingly interested in analyzing the value of investment in IT as a source of competitive advantage and in examining how firms realize these benefits (Bharadwaj, 2000, Mata, Fuerst and Barney, 1995). Studies have shown that IT alone has not provided firms with a sustainable advantage, but that firms have benefited from strategic planning, IT integration, organization learning, and innovative applications of IT (Powell and Dent-Micallef, 1997, Mata, Fuerst and Barney, 1995, Tippens and Sohi, 2003, Teece, Pisano and Shuen, 1997). In this context, Gartner (2011) has studied the collaboration of IT and operational technology (OT), and claims that the combination and convergence of these two technologies offers a unique opportunity to companies, with the potential to revolutionize the world. Having recognized the potential of information and operational technology convergence, traditional industrial heavyweights such as General Electric (GE), Siemens and Schneider are investing heavily in realigning and embedding their IT capabilities into their physical equipment. This convergence is expected to enable companies to offer value added services like advanced analytics and real time intelligence to their customers. This Internet revolution in manufacturing domain is often referred to as Industry 4.0. This has a strong linkage to cyber-physical systems as well (Maier, Korbelt and Brem, 2014). Companies, based on their focus, have assigned different names to this initiative. GE, focusing more on connecting machines and people, is following the industry term "Industrial Internet" given by industry experts. Siemens has recently launched its Vision 2020, which is yet to be implemented and Schneider has dubbed their approach of this merging of technologies as "EcoStruxure."

This chapter includes a case study on GE and focuses on the "Industrial Internet" initiative to analyze the business transformation stages that GE is undergoing and the impact on its various business segments. First, an extensive literature review

is presented, to reveal the current state of research in the field of IT-enabled business transformation. Then, the study conceptualizes a theoretical framework to analyze the different stages and dimensions of transformation during technology convergence.

2.2. Literature Review

2.2.1. IT-enabled business transformation

There is strong theoretical and empirical evidence attesting to the benefits of IT investment when it is embedded in, and complemented by, other resources or skill sets (Bharadwaj, 2000, Powell and Dent-Micallef, 1997, Mata, Fuerst and Barney, 1995, Tippens and Sohi, 2003, Teece, Pisano and Shuen, 1997). The resource-based view (RBV) is a comprehensive framework for studying the relationship between IT investment and a firm's performance. The RBV framework links performance to the accumulation of an organization's unique set of resources.

A significant amount of research has been conducted on the topic of IT-enabled business transformation (McKeown and Philip, 2003, Qingfeng et al., 2008, Storbacka et al., 2013, Venkatraman, 1994). These studies analyze the ways in which large corporations embrace the potential of IT (Dutta and Biren, 2001). As with other approaches to business transformation, IT-enabled business transformation is a long-term proposition that requires capital investment. Businesses have not only restructured their organizations but also redesigned business processes to reap the full benefit of IT and networking (Gregor et al., 2006). These transformations have frequently led to improved productivity and new product offerings (Brynjolfsson and Hitt, 2000), but their impact on organizational processes is still unclear (Bharadwaj, 2000).

Qingfeng et al. (2008) summarize the literature on IT-enabled business transformation (Venkatraman, 1994, Tushman and Romanelli, 1985, Dutta and Biren, 2001), and highlight five critical organizational dimensions affected during IT-enabled transformation. Table 2-1 explains the dimensions, based on additional literature review by the authors. These dimensions are used to develop the conceptual framework in subsequent sections.

The benefit of technology-enabled transformation is marginal if it is superimposed on any of these dimensions in their current state. Instead, benefits are fully realized when each of these dimensions is redesigned and adapted according to the new strategy and vision of the organization. Using research and practical evidence, Venkatraman (1994) has defined the five stages of IT-enabled business transformation, along with explaining the potential benefits of each and the level of business transformation required. Table 2-2 provides a summary of those five stages, which are also the bases for the theoretical framework of this study.

Table 2-1: Five dimensions of IT-enabled business transformation

Dimensions	Definition
Strategy and Vision	Strategy is the method of aligning a company and its environment; it defines a firm’s configuration of activities and the manner in which they interrelate (Porter, 1991 and 2001). Vision comprises the purpose and goals defined by an organization, and strategy is the roadmap to achieve those purposes and goals (Olsen and Denoble, 1981).
Organization Structure	Organization structure is the allocation of organizational resources that are employed to meet organizational objectives (Chandler, 1962).
Product and Market	Products are referred to as both tangible and intangible offerings and services. A market is the place where these are sold (Dutta and Biren, 2001).
Business Process	Business processes are the organizational activities that a business undergoes in its routine functioning (Besson and Rowe, 2012).
Corporate culture	The core organizational values set the corporate culture, which defines the organization behavior both internally and externally (Flamholtz, 2001).

Source: Adapted from Qingfeng et al. (2008)

Table 2-2: Five stages of IT-enabled business transformation

Stages	Stage name	Potential	Level of business
Stage 1	Localized	Low	Low
Stage 2	Internal	Moderately low	Moderately low
Stage 3	Business process re-design	Medium	Medium
Stage 4	Business network re-design	Moderately high	Moderately high
Stage 5	Business scope re-definition	High	High

Source: Venkatraman (1994)

“Localized exploitation” refers to the establishment of isolated, decentralized IT units within different parts of an organization. These are generally standard IT applications requiring minimal changes to business processes. During “internal integration,” organizations go through technical interconnectivity and business

process interdependence. Technical interconnectivity deals with the interoperability of different systems and applications through a common platform. Business process interdependence deals with roles and responsibilities among the different functions. There may be managerial resistance when there is a probability of reducing their power base because of streamlining and integration of processes. IT capabilities are used as a lever to redesign the business processes instead of merely overlaying the IT functions on the existing structure and rectifying existing weaknesses.

“Business process redesign” is the most critical stage for technology-enabled transformation. Besson and Rowe (2012) define business processes as the procedures through which a firm engages in its routine organizational activities. Merely superimposing the new technical capabilities on the current structure will not yield the same benefit as a redesign. “Business network redesign” occurs when organizations learn and leverage the IT capabilities of the networks and ecosystems of partners or joint ventures to offer better products and services and reduce time to market.

Finally, during “business scope redefinition,” the organization aligns and adapts the corporate scope based on internal capabilities and capabilities developed through the extended network. This business scope redefinition can be either a factor triggering transformation or an outcome of the transformation (Muzyka, de Konig and Churchill, 1995).

While these stages are presented sequentially, the literature does not explicitly show a specific order of the stages. Instead, the order varies from case to case, based on factors such as the size of the firm and the industry in which the firm operates. The five dimensions of Qingfeng et al. (2008), along with Venkatraman’s (1994) five stages, effectively condense the IT-enabled business transformation studies that were conducted in the past. As these models have been used in past studies (Larsen and Klischewski, 2004, Helen et al., 2003, Poon and Swatman, 1997) this study follows the same stages and dimensions to develop the conceptual framework.

2.2.2. Technology convergence—a new way of benefiting from IT investment

Technological convergence is defined as “the tendency for different technological systems to evolve towards performing similar tasks. It is the integration of previously separate technologies to interact with each other synergistically” (Olawuyi and Friday, 2012). This study focuses on the convergence of OT and IT, which have previously operated independently of each other. OT is an established term that is defined as “the techniques that an organization uses in its workflow activities” (Pugh et al., 1963, p. 310). Gartner (2011) defines it as hardware and software that detects or causes a change through the direct monitoring and/or control of

physical devices, processes, and events in the enterprise. OT revolves around automation, and involves monitoring and controlling the physical equipment. Until recently, both IT and OT operated in their own silos. However, as these two technologies advanced, they began to experience a significant amount of overlap and convergence between the silos. While the underlying technologies of OT systems, such as platforms, software, security, and communications, are becoming more like IT systems, IT is supporting OT in building standards, enterprise architecture (EA), support and security models, software configuration practices, and information and process integration (Gartner, 2011).

Businesses across sectors such as healthcare, power, aviation, energy, and transportation are experiencing the benefits of reduced costs, optimized business processes and increased productivity through the convergence of these two technologies. A smart grid is a prime example of this convergence. It is a synthesis of IT and OT, where OT is responsible for energy planning, asset and resource allocation, and decision making on real-time data and IT ensures the success of this decision-making by providing the hardware capabilities to run algorithms, yield data and application integration, enable business intelligence. This has resulted in increased reliability, greater fuel efficiency, and significant reduction in operating costs (Gartner, 2011). With technology convergence, industrial companies like GE hope to realize financial and productivity benefits by efficiently utilizing IT with their physical equipment and enhancing the intelligence of machines by offering real-time information and predictive analytics (Evans and Annunziata, 2012).

There is strong evidence in the literature that IT alone cannot provide sustainable performance gains unless other resources or skills in an organization complement it (Bharadwaj, 2000, Tippens and Sohi, 2003, Teece, Pisano and Shuen, 1997). This chapter discusses the concept of gaining a performance advantage by embedding IT into physical equipment-oriented technologies. This is a relatively new topic and is currently in the early phases of implementation. Therefore, not much research has been conducted in this area. Using GE as a case study, this study discusses the various stages and dimensions of transformation experienced by an organization and attempts to build a conceptual framework to examine the impact of technology convergence, which can be further developed to understand how other companies are managing the transition.

2.3. Theoretical Framework

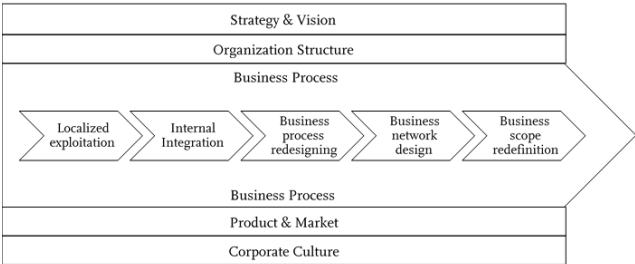
A conceptual framework that was grounded in the generic stages and steps of IT-enabled business transformation, as suggested in the literature review, was used to study how GE managed the technological convergence and redesigned its businesses. Figure 2-1 is a schematic description of the framework used for the study. This framework is a collation of the approaches and stages discussed in the current

literature on IT-enabled business transformation. Venkatraman (1994) suggested that the transformation starts at the local level in the organization, progresses to the inter-organizational level and finally, expands to a sector-wide transformation (Poon and Swatman, 1997). This model has been used for studies on technology-enabled transformation, to determine the process ownership challenges encountered during this organizational change (Poon and Swatman, 1997). Consideration has also been given to extending the framework from large-scale corporations to small and medium-sized enterprises' IT adoption (Helen et al., 2003, Poon and Swatman, 1997). This study uses the same model in conjunction with the five critical organizational dimensions proposed by Qingfeng et al. (2008) to explore GE's experiences when initiating technology convergence.

Integrating IT and OT to develop resources such as intelligent machines is a relatively new concept, with significantly higher impact on business processes than simple IT enablement, as this initiative involves the entire organization. To fully understand this phenomenon, it is necessary to look at the organizational dimension and the transformation stages together, rather than separately, as has been the case in prior research. Hence, the conceptual framework, as shown in figure 2-1 combines the transformation stages with the critical organizational transformation dimensions.

Venkatraman (1994) suggested that the transformation stages are linear and do not overlap, however, the dimensions do not follow a certain order. In the conceptual framework, this study looks at the logical order of these stages and subsequently enhances this framework with findings from the case study.

Figure 2-1: Conceptual Framework



Source: Adapted from Venkatraman (1994) and Qingfeng et al. (2008)

2.4. Methodology

The objective of this chapter is to examine the matrix of phases and dimensions when a business undergoes a technology-enabled business transformation and attempts to align its OT and IT. This study introduces the new phenomenon of

embedding IT into the equipment-oriented technology of OT, and building a software layer around the physical equipment that imparts intelligence to the machines. GE is amongst the first companies to initiate this IT–OT convergence, making it an appropriate research subject for a case study by virtue of the fact that it is a “unique case” (Yin, 1994). A qualitative case study approach was used to collect and analyze the data (Eisenhardt, 1989, Yin, 2003). This approach was chosen for the GE case study because “interviews are a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic and infrequent” (Eisenhardt and Graebner, 2007).

Ten qualitative, guided expert interviews were conducted with appropriate experts and practitioners within the organization (Witzel, 2000), each lasting between 30 and 40 minutes. Interviews were semi-structured and a questionnaire addressing the research objectives was designed. Interview partners were selected from different units and levels within the company to avoid potential bias (Eisenhardt and Graebner, 2007). The table below shows the designations and business units within GE that are represented in the interviews. Corporate documentation analysis was done using company supplied internal documents and strategy papers to validate the information gathered (triangulation).

Table 2-3: Interview participants

GE businesses	Designation	Interviews (Number)	Date
Software Center, USA	Commercial Manager, Communi- cation Team, Team Leaders	4	September 2013
Corporate Research, Germany	Principal Scientist	1	October 2013
Software Center, India	Product Managers	2	September 2013
GE Healthcare IT, USA	Marketing Managers	2	October 2013
Intelligent Platform, USA	General Manager	1	October 2013

GE was chosen as the subject of the case study because of its special market position, size, and global nature, as well as its unique initiative to converge IT and OT. Further, as GE is a multinational conglomerate operating in a wide variety of business segments, we could also study the impact of this initiative across multiple industrial sectors. Because it has been a prime example of continuous business transformation and has offered innovative services to keep ahead of the market (McKeown and Philip, 2003), GE was deemed an appropriate choice for this study.

Neither author is affiliated with, or formerly employed by GE or any of its subsidiaries, hence, there are no conflicts of interest to declare.

2.5. Case of General Electric

2.5.1. GE and the Industrial Internet Initiative

Thomas A. Edison established Edison Electric Light Company in 1878. In 1892, a merger between Edison General Electric Company and Thomson-Houston Electric Company created General Electric Company. GE exists in more than 160 countries and employs around 305,000 employees worldwide (GE company website). GE has segregated its business into eight separate divisions: Aviation, Healthcare, GE Capital, Home and Business, Power and Water, Oil and Gas, Energy Management and Transportation. In addition to these eight divisions, GE operates its corporate Global Research Centers, which focus on advanced technologies and industrial research. These centers are located in the US, India, China, Germany, and Brazil. Recently, with the Industrial Internet initiative under Global Research, GE has started a new center of excellence for software and analytics at San Ramon, California. GE began the IT enablement journey almost a decade ago and currently has approximately 13,000 software professionals worldwide. This investment demonstrates that GE, despite being an industrial company, also has a proven presence in the software. The software business within GE generates revenues amounting to \$4 billion and it is expected to grow at a steady rate.¹

GE embarked on their new initiative, the Industrial Internet, in late 2011, the following paragraphs explain the initiative from both internal and external perspectives. The new Industrial Internet solutions contributed to \$1 billion revenue in 2014.²

From an external perspective, maturing technologies like big data analytics and cloud computing were ready to become scalable into the industrial world. There was fierce competition in sustained activities to enter the big data analytics arena. Burgeoning cost pressure since the 2008 recession had combined with higher productivity demand from customers to create mounting pressures on GE, and it believed that analytics and other support capabilities could help it survive such pressures.

From an internal perspective, GE sells the equipment and follows up with service packages with guaranteed availability and reliability. Currently, GE has an equipment and services backlog of more than 250 billion USD³ and believes that the only way to grow in this scenario is to add value on top. Providing more value in

¹ <http://www.gereports.com/post/75376897042/2013-the-year-in-review>

² <http://247wallst.com/industrials/2014/10/17/ge-delivers-solid-earnings-with-record-backlog/>

³ <http://247wallst.com/industrials/2014/10/17/ge-delivers-solid-earnings-with-record-backlog/>

long-term service contracts for the already installed base can expand business in North America and Europe.

“GE’s vision inside out is, really, to transform our services business to move to the next era, so that we are more than a Gillette playbook”, Commercial manager, Software COE.

The Industrial Internet is a phenomenon that involves the merging of the digital world with the world of machines. It is the convergence of the global industrial systems with the power of advanced computing, analytics, low-cost sensing and new levels of connectivity provided by the Internet. GE describes the Industrial Internet as having three essential elements: intelligent machines, advanced analytics, and people at work. It begins with embedding sensors and advanced instrumentation in the machines and the collection of large volumes of data, which are then analyzed to offer real-time intelligence. Investment in this technology convergence had a significant impact on GE’s strategy, leading to a new vision and direction for the company. As CEO Jeff Immelt puts it, “We are making a major investment in software and analytics. We know that industrial companies need to be in the software business.”

For internal purposes, the key performance indicator that GE plans to adopt, to measure the incremental monetization of the value from industrial Internet technologies, is “dollar per installed base.” GE commenced this journey in 2011 and claims that this new initiative has the potential to increase productivity greatly. According to Evans and Annunziata (2012), a mere 1% improvement in efficiency can save trillions of dollars in the coming years across all businesses using intelligent operation capabilities.

2.6. Analysis and Results

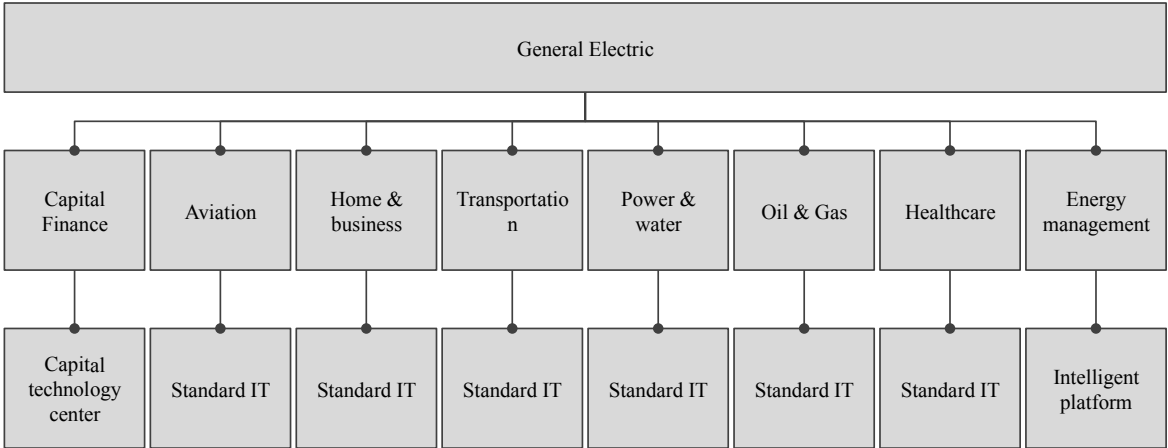
Based on the objective of this research and on the theoretical framework, GE’s strategic initiative of the Industrial Internet was analyzed through the matrix of phases and dimensions of business transition. This study found all five phases to be applicable to the current GE strategic transition and mapped GE’s journey toward the convergence of technologies onto these five phases, indicating the dimensions affected and challenges observed in each of the stages.

Phase 1: Localized Exploitation

IT-enabled transformation starts with the decentralized approach of “localized exploitation.” Here, the organization tries to leverage and exploit the potential of IT, starting with individual localized units. Standard IT applications are deployed with minimal changes to the organization structure using a decentralized approach, leading to IT capability development in these individual business units. GE adopted a unique approach to localized exploitation more than a decade ago. Before the Industrial Internet was initiated, each of GE’s business units had its own

IT or software team, historically motivated by a need for faster decision-making. Figure below shows the eight businesses of GE and their respective IT units. Businesses where IT significantly contributes to the revenue and those that conduct software development have been given different names, such as Intelligent Platform (which reports into Energy Management). In other businesses, where IT is a routine and standard function for internal use, a separate entity has not been created.

Figure 2-2: Localized IT units within GE businesses



With the implementation of localized exploitation, GE had established multiple software development units across its lines of business. However, this led to the duplication of IT technologies, as well as a reduction in organizational learning across businesses.

Phase 2: Internal Integration

GE started the Global Software Centre in San Ramon, to centralize and integrate its software activities across businesses. GE created this corporate unit to work on advanced analytics and operational technology capabilities and serve as the nerve centre for connecting and aligning all GE software development employees. The establishment of this centre was motivated by a variety of internal and external factors such as rising software costs, lack of cross learning across business units, lessons from competition failures, and the realization that 90% of the developments in today’s online world are similar and only 10% are differentiated between sectors.

GE had a history of successfully managing centralized functions such as human resources and financial planning, however, software was integrated individually into each business. This meant that various business units individually developed standards, platforms, architecture, and security controls without sharing or exchanging information and knowledge. Technical integration was needed so that different systems could operate and communicate on a single platform across

businesses, which implied a need for common standards, a technology platform, enterprise architecture, security, and controls across the businesses.

Through software center, GE wanted to renew its focus on IT and wanted to create a common platform that could be used by other business to build their respective software services on. GE also saw the competition failing because they lacked centralization and tried to embed IT into OT by building decentralized IT capabilities. Thus, GE created the center of excellence for software capabilities, to provide a common place for all its businesses to interact, share and work on common standards, technologies, platforms and architectures, irrespective of their businesses. This integration, which happened at both the technical and organizational levels, was necessary to build the underlying technology for intelligent business operations. Centralization also involved moving employees and expertise from different businesses into the software center to leverage the existing advanced analytics and machine learning skills possessed by individual businesses. Currently, GE has 13,000 software employees, and it would be unrealistic and expensive to move all these employees to the Software Center in the short term. However, GE attempts to create multiple hubs for software development across the world, such as in the USA, India, China, and Europe, wherein employees can access, and start from, the same platform.

The Center works on two different layers of software development, namely, the “Infrastructure layer” and the “Platform layer.” The infrastructure layer handles the data centers that manage and consume the structured and unstructured data, and the platform layer is the scalable software programming that overlays the infrastructure layer. For the platform layer, GE strives to develop a platform that can be operate on all GE devices as well as non-GE devices and used to develop sector-specific applications. GE draws an analogy from the iOS platform, which is installed on all Apple products and opened to specific developers to develop iApps on. This platform has been launched in October 2013 with the name “Predix™”. This internal integration and centralization is expected to offer cross-sector learning and scalability in both infrastructure and platform layers.

Phase 3: Business Process Redesign

Localized exploitation and internal integration are both evolutionary phases of business transformation. However, business process redesign is amongst the most revolutionary phases (Venkatraman, 1994). Besson and Rowe (2011) define business processes as the procedures through which businesses engage in their routine organizational activities. Most industrial companies still operate using the “industrial revolution” business processes of roles and responsibilities, line and staff functions. To reap the benefits of technology enablement, using advanced analytics to create intelligent business operations, GE needed to redesign their business processes from the foundation.

“Business transformation, in my view, is most important aspect of GE’s Industrial Internet journey. Software is bringing up a fundamental rethink of GE’s business model”, Commercial manager, Software COE.

GE defines a business process as the full value chain of activities that constitutes new product development, i.e., the end-to-end process from ideation to development to final commercialization of the product. The company contends that the most critical dimension of transformation toward this initiative of converging IT and OT has been the transformation of business processes. From GE’s perspective, even for an entity of its size, this is challenging but not impossible, with the optimal level of management commitment and support.

Traditionally, GE dominated highly technical fields such as aviation and energy, producing the most advanced jet engines and turbines. The commercialization cycle of this advanced technical equipment ranges from 10 to 15 years. However, as GE enters the software business, which is known for short commercialization cycles, it is faced with vastly different business processes in its hardware and software businesses.

Currently, without changing the legacy business processes of their traditional offerings, GE is redesigning the business processes for software development and related functions. The underlying factor behind this redesign is timeliness to market. With technical integration, GE was able to centralize its software and analytics capabilities and develop standards and platforms that were used by the individual businesses to develop their functional software products, allowing faster time to market. Traditionally as different businesses were working independently, the software developed was also traded internally for cross sector usage, which slowed down the development process and increased the cost. With the software development center, this practice is expected to stop, thereby accelerating the go to market time for the products.

The business operations for software development are changing. Instead of developing the individual platform repeatedly, business IT teams collaborates with software center teams to leverage their software capabilities and best practices. The Global Research Center helps the functional team define the scope of these efforts, as well as roles and responsibilities. The various units collaborate to work on product development, beginning with ideation and ending with the marketing of the software product.

The software center has developed a robust operating platform for analytics and big data, known as Predix™, as well as advanced software technologies and newer paradigms, such as cloud computing, which the business units use to develop industry specific applications. This requires governance activities across the different units, and highly values communication and cooperation.

Transformation at the business process level is critical. GE plans to follow a venture capitalist funding model, internally named as the “ten X” model, for its software business. This model involves initially investing in multiple software technologies and then selecting and increasing resource allocation to the one or two with the greatest potential to succeed.

Phase 4: Business Network Redesign

The three prior phases of IT-enabled business transformation were restricted to the changes occurring within the organization. Business network redesign involves developing and leveraging networks outside the organization, for example, with partners, suppliers and academia and developing new technologies or enhancing existing ones.

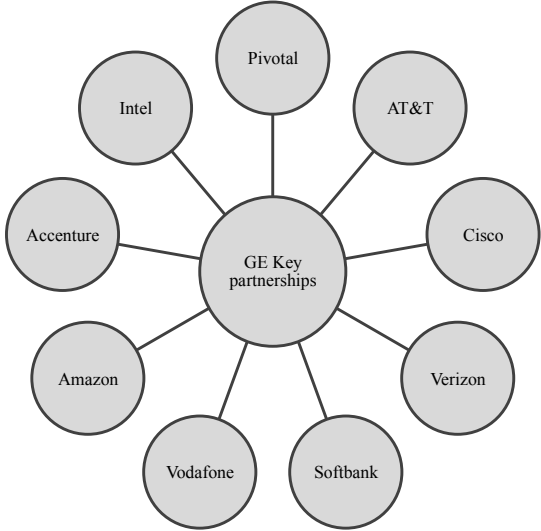
With the convergence of operational and information technologies, GE is focused on embedding sensors into its traditional machines and leveraging the collected data with software and analytics. However, instead of taking on the development of new technology all by itself, GE is partnering with information technology giants to deploy already proven capabilities in order to expedite the delivery of new products to the market.

Business Network redesign is a critical step in GE’s strategic transition, which GE calls “the ecosystem play.” There are two elements of this ecosystem play, namely technology and go-to-market. GE is not the first company to invent this technology convergence but it claims to be the front-runner of this revolution. Being a relatively new player in the software industry, GE does not aspire to develop proprietary basic software technologies from the basics. Therefore, the objective is to develop the infrastructure and platform layers and select the best available technology that allows GE to offer scalable solutions both to the GE businesses internally and to their customers. GE’s investment in the software company Pivotal is an example of a technology-focused ecosystem approach. Pivotal is developing an open-cloud agnostic platform for all cloud-based services that is highly scalable based on the open-source software technology called Hadoop. Components of the Pivotal offering will be integrated into GE’s platform architecture and will be used to collect and analyze data. The platform, Predix™, will be used as the common technology platform across the various GE business lines for further software development efforts involving big data and analytics. In contrast, the partnership with Accenture is an example of a go-to-market ecosystem approach, where GE wants to leverage the technical expertise and installed base of Accenture to develop sector specific applications and rapid commercialization.

GE has always operated in an oligopolistic environment and hence lacks experience in driving partnership ecosystems. Now, as GE enters the industrial Internet space, it plans to strategically redesign its business network and use the Ecosystem approach to successfully align and merge its IT and OT capabilities. GE plans to

leverage this ecosystem to develop the functional features required by its clients. Further, partnerships with AT&T, Intel and Cisco are helping to increase the technological sophistication that GE is able to bring to the marketplace.

Figure 2-3: Key partners of GE



AT&T will provide the wireless communications capabilities for remote monitoring and maintenance, Intel will embed virtualization and cloud-based, standardized interfaces within the GE Predix™ platform, and Cisco will provide collaborative networking capabilities. GE has partnered with Amazon to leverage its cloud infrastructure to offer and extend GE’s product offerings on cloud.

GE’s competitors, Siemens, Schneider and ABB are all striving toward this convergence in their own way. ABB acquired a company called “Ventyx” which was a leading provider of software solutions for managing energy networks, to develop the same IT capabilities. Schneider started an initiative called “EcoStruxure” that is focused on energy efficiency—this is an effort to create an intelligent energy management system that allows the measurement and management of energy usage across data centers and industrial plants. Siemens has recently announced its Vision 2020, where it talks of business analytics and data-driven services as a growth area by the year 2020. The significant differentiator between the Industrial Internet and these other initiatives is the centralized, cross-sector approach that is employed in a top-down manner directly by GE’s leadership. ABB’s Ventyx acquisition and Schneider’s EcoStruxure initiative only focus on energy efficiency and smart grid applications. Siemens’ Vision 2020 is a cross-sector approach, however, it has been launched very recently (May 2014) and is yet to be fully implemented.

Phase 5: Business Scope Redefinition

Redefining the business objectives of the organization means reconsidering the organization's future vision. GE's leadership team has clearly redefined the company's vision as moving from product to solution orientation. The Industrial Internet initiative is an outcome of this strategic redefinition. Leadership plays a very important role in communicating the vision of the organization and the company's direction, as well as in clarifying the strategy that will be employed to achieve success. It is critical, during this redefinition, to maintain the corporate culture and retain stakeholder trust in the company. GE, under the leadership of Jeff Immelt and the Board of Directors, is leading the transformation. The vision of the Industrial Internet as the new direction in the progress of the company, helping GE move towards becoming a more solutions-oriented organization, is being communicated to the employees, customers and stakeholders. The entire organization is involved in priority redefinition and there is a great deal of focus on internal and external communication.

2.7. Discussion

The Industrial Internet represents a significant business transformation for GE, with the development of new capabilities and the creation of new strategies and processes, all intended to enhance its competitive position in the market (Prahalad and Oosterveld, 1999). As Tushman and Romanelli (1985) suggested, the logical beginning of this business transformation is strategic transition, followed by the alignment of the organization structure, products, markets and business processes. The transformation in GE started with business scope redefinition, wherein GE leadership teams gave the company a new strategic orientation, shifting the focus from a product-oriented to a solutions-oriented company. The Industrial Internet appears to have been the result of this new strategic focus, which is consistent with findings from past research that business scope redefinition can be the triggering factor for transformation or can be an outcome of the transformation (Muzyka, de Konig and Churchill, 1995).

In GE's case, the localized exploitation, involving decentralizing IT and deploying standard IT across businesses, does not appear to have been part of the current business transformation initiative. Instead, this phase was likely a prerequisite to the technology convergence, which led to the embedded IT capabilities within the organization. Today, in a scenario where most of the companies, in general, are already IT-enabled, realigning IT with OT is the next logical step in organizational growth.

Technology convergence appears to be the new medium for developing unique capabilities based on IT investment. With the Industrial Internet, GE is enhancing its operational technologies as the next step to the earlier execution of localized IT

enablement. Organizations implementing technology convergence need sufficient IT capabilities across their businesses in order to build the software and analytics layer around their physical equipment. Along with its software capabilities, GE's strong history of product development is playing a crucial role in supporting the standards and architectures for the Industrial Internet. Both capabilities are being aligned and developed to further enhance the company's physical equipment and endow it with real-time intelligence.

As part of its technology convergence, GE is returning to a centralized approach to IT by establishing a common platform of IT standards, Predix™, on which all its physical equipment can easily operate. Equipment across various sectors, from CT scanners to locomotives and from transformers to jet engines, can potentially operate on this new platform.

GE recognizes that this internal integration and the corresponding changes to business processes will affect the entire company, and that the active involvement and focus of the company leadership is required for the initiative to be successful. To facilitate the internal integration, GE is changing its organization structure and centralizing IT capabilities in a new software center of excellence. As for the redesign of business processes, GE is confronting challenges requiring operational changes in software development. Instead of repeatedly developing individual platforms, business units collaborate with the software center team to leverage their software capabilities and best practices.

GE foresees many obstacles in this transformation process, the foremost among them being resistance to change and the acceptance of centralized platforms within individual business units. The top management's involvement in communicating the vision helps in breaking these barriers quickly, however, the acceptance is still inadequate. For example, healthcare IT (HCIT) is the single largest IT unit within GE. Although GE expects to have lower costs in the long term, it does not expect an immediate effect on HCIT offerings and insists on keeping the go-to-market and delivery options with the individual businesses themselves.

“There is no immediate effect on HCIT in terms of governance or change in business processes. Even in the long term, when we will use the COE platform and develop our applications on the top, the go-to-market, CRM and delivery responsibilities will be with the HCIT business only”, HCIT marketing manager.

Overall, each phase of this technology convergence appears to have been time consuming, involving significant capital investment. GE claims to have invested 1 billion USD in this initiative over the course of three years.

The business transformation phases at GE seem to be non-linear and overlapping in nature, especially at the business network and business process redesign

stages. In both these stages, companies can experience concurrent changes in organizational dimensions, such as business processes and the market and product focus.

2.8. Research Implications

Prior research has theoretically and empirically proven the benefits of IT investment when it is embedded and complemented by other resources or skill sets, whereas the direct impact of IT on a firm's performance remains unclear (Bharadwaj, 2000, Powell and Dent-Micallef, 1997, Mata, Fuerst and Barney, 1995, Tipens and Sohi, 2003). This study supports the RBV in utilizing IT capabilities to develop unique skill sets and explores the relatively new phenomenon of combining IT and OT to gain IT investment benefits. The IT–OT technology convergence is expected to revolutionize the industrial world and can be a mechanism for realizing performance gains through IT investment. This study demonstrated that the development of new capabilities through IT and OT convergence not only transforms business processes but also affects major organizational dimensions, from strategy and vision to products and markets.

Technology convergence is a bigger initiative than the enablement of IT into business processes. This study has shown that Venkatraman's (1994) model is applicable to this type of business transformation involving technology convergence. However, in this new era, most firms are already IT-enabled and strive for sustainable benefits by embedding IT or combining IT with other resources. The first stage of IT-enabled business transformation, localized exploitation, has become a default or prerequisite in organizations today. This research expands the Venkatraman model by considering both the organizational dimensions and stages and mapping the dimensions onto the transformation stages. In prior studies, the transformation stages were deemed to be linear in nature (Venkatraman, 1994), but the GE case study shows evidence of non-linearity and overlap across stages. The conceptual framework shown before relies on the hypothesis that all five organizational dimensions play an equal role during all the five stages of IT-enabled business transformation. However, the GE case study illustrates that each stage of the transition has an impact on a unique set of dimensions. Business scope redefinition influences the dimension of strategy and vision while internal integration influences the organization's structure. During the business process redesign and business network redesign stages, the two dimensions of business process and products and markets are impacted.

This study also identifies organization structure as a transformation dimension that has not been fully explored but that plays a critical role in a technology convergence process. The authors suggest that the role of corporate culture in these converging business transactions is vague. Although corporate culture did not

have a significant impact on GE, this may differ in other industries. Evaluating the role of this dimension in other organizations would be an important step in future research. For example, in the case analyzed, the strong leadership and high focus on both internal and external communication about the initiative has softened the impact on GE's corporate culture.

Finally, the study introduces the concept of convergence of IT and OT as a medium to develop unique capabilities within a firm, which can be linked to performance gains.

2.9. Managerial Implications

Strategic business transitions are both time and capital consuming processes that must be initiated early enough to provide the organization with a competitive advantage in the marketplace. The first step in the process requires redefining the business scope and transforming the strategy and vision of the company. At GE, this process began almost 3-4 years before establishing the software center in 2012, when the leadership team redefined the company's vision and repositioned it as a solutions-oriented firm. Internal integration was achieved by redesigning the organization's structure, resulting in the establishment of a new, centralized software center of excellence. The centralization of software capabilities enabled GE to leverage learning across the organization and provided a common platform to facilitate collaboration across all business units. IT integration also improved GE's time to market with new products and provided operational flexibility within organization.

Companies can experience concurrent changes in organizational dimensions, such as business processes and market and product focus. Transforming business processes is a revolutionary step (Venkatraman, 1994) for an organization, and defining the roles and responsibilities of various business units, resolving governance issues, and redesigning product ownership are areas that require management supervision and support. For industrial organizations, where the project management process for software development, from ideation to commercialization, differs substantially from hardware product development, the transition can be especially challenging. Building new skills within the organization and partnering with other business entities through the redesign process can be helpful in managing this transition.

Chapter 3 : Frugal and Reverse Innovation – Literature Overview and Case Study Insights from a German MNC in India and China

3.1 Introduction

Countries like China and India, initially playing secondary roles, have now become global innovation hubs (Jiatao and Rajiv, 2009). Local companies in these countries have creatively leveraged the region specific market requirements to become successful and grow exponentially. Companies like TATA, Haier, Galanz bear testimony to this trend. These companies have profitably wrestled market share from established global companies and in some cases like Huawei and ZTE Telecom have even pushed European and American companies to merge like Siemens-Nokia or in some extreme cases like Nortel, to go bankrupt.

During the course of development in the last couple of decades, these markets have moved away from technology imitations to new market specific innovation paradigms. In order to maintain their competitive position, multinationals are being forced to develop products and solutions locally in these emerging markets. In other words, multinational companies are obliged to participate in these new innovation paradigms and implement them in their product development processes. In the same context, this chapter analyses a case of one such MNC, Siemens AG and discusses the innovative strategy used to develop frugal products in and for emerging markets.

3.2 Literature review

The high growing economic potential of emerging countries has ensured sufficient academic and industry focus (Khanna and Krishna, 2010). The inherent differences in the local needs of emerging market customers have also initiated newer innovation theories in management literature like frugal innovation, jugaad, disruptive innovation, reverse innovation and constraint-based innovations (Saraf, 2009, Economist, 2010, Brem, 2008, Agarwal and Brem, 2012, Brem and Wolfram, 2014, Christensen and Raynor, 2003, Zeschky et al. 2011, Immelt et al., 2009). All these theories address the BOP customer segment and suggest specific product features that have high acceptance in emerging markets. Due to the same target customer segment these approaches are similar in nature and also have related business applications. To limit the redundancy and gauge the practical relevance of these innovation paradigms this chapter focuses only on two innovation approaches: frugal and reverse innovation and studies their business application in detail.

Frugal innovations are aimed at BOP customers and are associated with peculiar characteristics like cheap, simple and resourceful. Frugal innovations as defined by Zeschky, Widenmayer and Oliver (2011) are “good-enough, affordable product that meet the needs of resource-constrained consumers” and when these innovations are commercialized into developed world they are called as reverse innovations (Govindarajan, 2012). In the same context, Nunes and Breene (2011) also state that both frugal and reverse innovation involve designing the products in emerging markets but for reverse innovation these products are modified for developed countries.

Due to increasing globalization and growing cost pressures frugal innovations are assumed to have commercial potential in developed world too (Flatters and Willmott, 2009). In view of this assumption, significant numbers of multinationals have started developing global market-oriented products in emerging markets using globalized innovation teams (Immelt et al., 2009).

To exemplify the industrial application, multinationals like Siemens and General Electric (GE) have already started manufacturing such unique products, which are developed specially for the BOP customers but also have potential to succeed in the developed markets. They illustrate examples for both frugal and reverse innovation. GE initiated its program “Healthymagination” in this direction, to create at least 100 healthcare innovations that would substantially lower costs, increase access, and improve quality (Immelt et al., 2009). Siemens started its SMART (Simple, Maintainable, Affordable, Reliable, Timely to market) initiative, which is also the focus of this study, to come up with cost effective frugal innovations.

As mentioned, this chapter focuses on Siemens case and discusses the SMART strategy and product development process in detail. The research objective here is to understand the implementation process and practical relevance of frugal and reverse innovation approaches and identify their success determinants.

3.3 Research Methodology

This research follows a case study approach (Yin, 1981) to analyse the process of developing frugal products in emerging markets. The case of Siemens was selected through theoretical sampling. Typically because of the size and global presence, large multinationals are at the front end of such strategic developments (Zeschky, Widenmayer and Oliver, 2011). Siemens, with its growing focus on emerging markets and global presence came across as a perfect fit for this study. Based on the qualitative case study approach (Eisenhardt, 1989, Yin, 2003), data was collected through multiple sources like interviews, corporate presentations, market reports and internal reports shared by Siemens. Three product managers responsible for

emerging markets at Siemens were contacted and interviewed. Each interview lasted for about 40-45 minutes and was immediately documented.

3.3.1 About Siemens

Siemens AG is a German multinational conglomerate company headquartered in Munich and Berlin, Germany. In 2012, when this study was conducted, Siemens AG had divided its business into four sectors Energy, Healthcare, Industry and Infrastructure and Cities. Each of these sectors had various further divisions, for example Healthcare had four division namely Imaging and Therapy systems, Clinical products, Diagnostics and Customer solutions. Although the company has undergone significant restructuring since then, the company continues to operate in these business areas.

Siemens has been an active player in emerging markets for over 100 years and has shown a consistent focus on emerging markets across its business sectors. The pace of investment in terms of people and capital expenditure substantiates this trend. The following table shows the growth in these markets from 2005 – 2010 (Siemens Annual report 2011, Siemens investor relations – capital market day 2011 and 2012, Siemens status October 2011).

Table 3-1: Siemens' growth in emerging markets

	Workforce		Number of manufacturing facilities		Revenues (in Billion €)	
	2005	2010	2005	2010	2005	2010
Brazil	5,300	9,200	10	13	€ 0.6	€ 1.6
Russia	1,000	1,500	1	2	€ 0.6	€ 1.1
India	7,000	13,600	10	20	€ 0.6	€ 1.9
China	12,000	28,500	24	45	€ 2.3	€ 5.5
Middle East	3,400	6,100	4	4	€ 2	€ 4.6

Source: Roland Busch, Siemens Capital market day, Shanghai, June 2011

3.3.2 Siemens frugal innovations strategy: the SMART initiative

Siemens associates the following two reasons for their expansion in emerging markets and starting the SMART initiative:

1. Increasing competition from local players, endangering Siemens local and global market shares.
2. Threat from western multinationals, established in emerging countries with high local know-how and large installed base

Considering these two reasons and realizing the huge economic potential of emerging markets Siemens expanded its presence in the emerging markets and started SMART initiative to tap into these markets.

3.4 Case Analysis

3.4.1 SMART initiative

Siemens categorized the global market into four customer segments. Table 3-2 describes the various segments and respective features.

It can be argued that all these customer segments exist in both developed and emerging markets, but the share of these segments vary. Developed countries like USA and Germany have sizable proportions of top and high-end customers and low percentage of medium and low-end customers. In contrast emerging markets have large portions of the customers residing in medium and low-end segments and very few in top and high end segments.

Table 3-2: Siemens market segmentation

Market Segment	Functionality/Value/Standards
Top End Market	Most advanced functionality required Highest processing speed Strict international standard / certificate needs to be met
High End Market	Advanced but standard functionality, sometimes customized High processing speed International and local standard / certificate needs to be met
Medium End Market	Only core functionality is required Normal processing speed National standard / certificate is enough
Low End Market	Only basic functionality is required Low processing speed National standard / certificate is enough

Unlike the top and high-end markets, the medium and low-end market segments are extremely price sensitive. These customers are typically less “brand conscious” and look for easy to understand, maintenance free and user-friendly systems. Siemens started the SMART initiative to target these medium and low-end customers residing in emerging markets. SMART stands for: simple, maintenance friendly, affordable, reliable and timely to market. SMART products are more often than not

specifically designed for bottom of the pyramid customers. Developing new products with innovative features “from scratch” to meet the unique regional requirements is the cornerstone of the SMART movement within Siemens.

Siemens categorized the development process of these SMART products into three phases:

1. Need identification - Experts identify the needs of the target market and the unique selling points (core value identification)
2. Cost reduction – Reviewing whether – and if so, how – the manufacturing costs of a SMART solution can be minimized, for example by using cost-effective materials, new technologies and exploiting synergies during the production process.
3. Mix and match – Here the individual components of a solution are assembled. Focusing primarily on interactions among individual building blocks.

Siemens experts justify these products at every phase of development for its cost effectiveness, user-friendliness, accessibility and sustainable quality. After satisfying these criteria SMART products are then processed ahead for commercialization.

3.4.2 SMART stories

Siemens has had considerable success with its SMART strategy over the past years. In 2010-11, company generated significant amount of revenues from SMART products and had grown its volume by over 19%. Below are the illustrations of some specific examples from their SMART product portfolio.

SMART Line HMI panel

Human Machine Interface (HMI) is a vital factor in the world of automation and has numerous applications in various industries. Siemens develops human machine interface technology to tackle the increasingly complex processes of today’s machines and systems. These technologies are highly optimized to meet specific industrial automation needs and have open and standardized interfaces for efficient integration. Siemens SMART Line HMI panel is an interface product used for direct machine or plant visualization tasks. Through integration of industrial computers and operating units, these panels offer a rugged, high-performance and brilliant display. These panels are ideal for production processes in harsh industrial environments and include easy touch screen or membrane-keyboard operation.

Why is Siemens HMI Line panel a SMART innovation?

Initially, Siemens produced a product HMI Panel KTP 178 which was developed in Germany and was targeted towards the developed markets. Siemens brought the same product to China, with minimal adaptation for Chinese cost conscious market. The product was unable to capture the market and experienced diminishing sales. Siemens had less than 4% market share with this product in China¹.

Figure 3-1: Siemens HMI Line panel



Source: Siemens AG company website

A strategic analysis of the situation led Siemens to identify following reasons for the lower acceptance rate:

- Expensive product in a low end market - Market was dominated majorly by local players and the price of the Siemens HMI panel was almost 35% higher than the other local products
- Low adoption to customer needs - Customers needed a robust product with basic functionality and low cost and Siemens was selling a highly sophisticated product in these markets

The company realized that in order to regain market share in China a bottom-up localized product development process in needed and they redesigned the entire solution.

Siemens team in China started the product conceptualization from scratch and adopted the SMART approach of need identification, cost reduction and mix and match. The critical steps taken by Siemens were:

1. Siemens did a full localization of the value chain at Siemens Nanjing (local production, local R&D team, and local product management).
2. Autonomy given to the local product management and R&D teams.
3. Cost optimization was done through localization.

¹ Siemens Capital Market day, Shanghai, June 2011

As the result, the new redesigned SMART product was well received by the customers and showcases interesting statistics:

1. Within 9 months of its launch, it sold 15 times more than KTP 178.
2. Achieved large penetration of original equipment manufacturers in China.
3. It was well accepted by customers as the product reached the street price with additional Siemens premium.

Multix Select DR

Multix Select DR, a digital X-Ray product is another example of Siemens frugal product, which also showed successful reverse innovation flow. This is an example of a truly global product, which is developed and manufactured in China but has installations around the world, including Germany, India, Brazil and very recently, even the United States of America.

Figure 3-2: Siemens Multix Select DR



Source: Siemens AG company website

X-ray examination is one of the most common medical diagnostic procedures in today's medical world. It is estimated that 90% of all hospitalized patients get an X-Ray examination. In spite of this, X-ray systems are still not widely available and almost 4.5 billion people residing in these markets lack access to these systems (Siemens Capital Market Day, Healthcare, 2012).

In response to this accessibility challenge, Siemens developed the Multix Select DR, an entry-level system that facilitates cost-effective access to X-rays. At a price that is around 30% lower, Multix Select DR is attractive to small and medium-sized hospitals in emerging countries as well as to small hospitals and physicians' clinics in industrialized countries.

Along with cost effectiveness, Siemens also focused on clinical efficiency and reduced the dose requirements by 50%, which made it safer for the patients and doctors (Siemens Capital Market Day, Healthcare, 2012). Currently, Multix is being developed in China and is getting well accepted globally, many hospitals in developed world have started using them as back up machines too.

Fetal Heart rate monitor

Siemens Fetal Heart rate Monitor (FHM) is an example of frugal innovation that is exclusively developed for Indian market. This product is a unique example, as it never existed in Siemens global product portfolio but was specially conceptualized for Indian market. Siemens fetal heart rate monitor developed at Siemens India research centre targets Indian rural market. It is a device that can monitor the heart rate of foetuses in the womb. As compared to high-end ultrasound technology based, expensive fetal heart rate monitors this product uses special acoustic microphones innovatively to keep the cost low. Although the idea was conceived and developed into a product at Siemens' Indian research Centre, it was a global effort with joint efforts across research teams in India, Germany and USA. With huge economic potential Siemens is planning to commercialize the product soon.

3.5 Research Implications

This research enhances the literature on emerging markets and provides insights on successful product development strategies. This research concludes that end-to-end localization and core value identification are two most critical factors for developing products for BOP customers. Research also reveals that frugal product development is a highly localised interactive process, as it requires local know-how and deep understanding of customer's fundamental needs. Close proximity to the local markets throughout the entire value chain from conceptualization to commercialization is necessary. Siemens has illustrated this strategy and is believed to reaping benefits by increasing sales figures of SMART products and growing market shares. Furthermore, this research also shows practical evidences to the concept of reverse innovation. With growing cost pressures, frugal products do have high commercial potential in the developed countries. Siemens exemplifies a trend towards developing a global market oriented product in emerging markets.

Siemens considers its "Healthcare business" as a trendsetter for reverse innovation. This sector has introduced many frugal products like Multix Select DR, which were successful in gaining viable markets in developed world too. It was sold as a primary product in hospitals in second tier cities of China and was also installed as a backup system in the United States for simpler applications. This research highlights that reverse innovations also arise from different business applications of the same product in different markets.

3.6 Managerial Implications

Emerging markets show high growth potential and for western multinationals localization is an important strategy to conquer these markets. Multinationals trying

to get foothold in these markets should focus on end-to-end localization. As mentioned in the literature review and depicted from Siemens case study, understanding the core value and fundamental needs of customers is also critical for sustaining growth in emerging markets. This research also discusses and provides evidences of reverse innovation for local and multinational companies.

Chapter 4 : Systematic review of innovation approaches in emerging markets and a conceptual framework defining critical product requirements

4.1 Introduction

Almost a decade ago, Prahalad (2005) introduced the term “bottom of the pyramid” (BOP), referring to 4 billion people who earn less than \$2000 per year, and suggested significant potential financial benefit of developing products and services for BOP. Majority of this population is residing in emerging markets, which are attracting much-needed attention from both academia and industry. Significant numbers of multinational companies (MNCs) are foraying into these markets, and have implemented different product development strategies to lure BOP customers. Literature reveals a gradual transition of product development strategies over time (Govindarajan and Trimble, 2012, Prahalad and Mashelkar, 2010), from “globalization” or “one-size-fits-all” to “glocalization” (adapting global product to local needs, for example: by de-featuring and lowering price) to complete “localization” (Corsi and Minin, 2014). These strategies utilized different innovation approaches for product development, and there has been a plethora of academic research available in this field (Prahalad and Mashelkar, 2010, Zeschky, Widenmayer and Gassmann, 2011, Govindarajan and Trimble, 2012, Radjou, Prabhu and Ahuja, 2012, Agarwal and Brem, 2012, Brem and Wolfram, 2014, Rao, 2013, Corsi and Minin, 2014, von Zedtwitz et al., 2015). Well-known innovation approaches in context of emerging markets include frugal innovation (Zeschky, Widenmayer and Gassmann, 2011), jugaad (Radjou, Prabhu and Ahuja, 2012), grassroots innovation (Gupta, 2013), catalytic innovation (Munshi, 2010), indigenous innovation (Lazonick, 2004), gandhian innovation (Prahalad and Mashelkar, 2010), disruptive innovation (Christensen, 1997, Christensen and Bower, 1996), reverse innovation (Immelt, Govindarajan and Trimble, 2009), innovation at the base of the pyramid (Prahalad, 2004), and resource-constrained innovation (Sharma and Iyer, 2012). These theories might differ in their specific motivation, but all of them share the same target customer segment of BOP customers (Brem and Wolfram, 2014, Rao, 2013). All these theories focus on the unique needs of this underserved customer segment, which are often unfulfilled by the mature world products (Brem and Wolfram, 2014).

Evolving fragmented literature in this field show increasing terminology confusion in the usage of innovation approaches (von Zedtwitz et al., 2015) due to the evident overlap in their characteristics and description. As the literature is maturing, there is a definite need to consolidate the fragmented literature to provide unified and condensed insights from the research so far. Hence this study is an

attempt to fill this research gap and develop a consolidated framework that statistically summarizes the critical characteristics across innovation approaches into a group of large factors.

4.2 Literature review

From the plethora of related terminologies, this study attempts to identify the recurrently used innovation approaches for new product development in emerging markets. There have been prior attempts in the recent years to methodically understand the similarities of these approaches and give clarity to the evolved confusion (Brem and Wolfram, 2014, Reinhardt, 2014, von Zedtwitz et al., 2015). Reinhardt (2014) conducted a systematic literature review of theories and concepts around low-cost innovation and analysed them through different perspectives of emerging markets, strategy formulation and entrepreneurship. Brem and Wolfram (2014) revealed the current and most-frequently-used innovation theories from a new product development perspective in emerging markets. Von Zedtwitz et al. (2015) mainly focused on the on-going innovation flows to and from emerging markets. Table 4-1 summarizes the innovation approaches discussed in these recent studies, along with their focus type.

Table 4-1: Innovation approaches and their focus

Studies	Innovation approaches	Focus
Brem and Wolfram (2014)	Jugaad	Product development
	Frugal innovation	Product development
	Grassroots innovation	Product development
	Bottom-of-the-pyramid innovation	Product development
	Indigenous innovation	Product development
	Constraint-based innovation / Frugal engineering	Product development
	Reverse innovation	Flow/Product Development
	Gandhian Innovation	Product development
	Catalytic Innovation	Product development
Reinhardt (2014)	Bottom-of-the-pyramid innovation	Product development
	Reverse innovation	Flow/Product Development
	Resource-constraint-based innovation	Product development
	Frugal innovation	Product development
von Zedtwitz et al. (2015)	Innovation at bottom of the pyramid	Product development
	Indigenous innovation	Product development
	Jugaad / Gandhian innovation	Product development
	Frugal innovation	Product development

Reverse innovation	Product development
Resource-constrained innovation	Product development
Disruptive innovation	Product development
Blowback innovation	Flow
Cost innovation	Product development
Shanzhai innovation	Product development
Trickle-up innovation	Flow

Apart from the mentioned approaches, there are many more innovation approaches discussed in other studies that revolve around emerging markets and that explain similar and overlapping characteristics (von Zedtwitz et al., 2015). Considering the extensive literature base and methodologies used in these studies, table 4-1 is considered as the basis for the further analysis conducted in this study.

Moreover, since the scope of this research is limited to the product development field, mutually exclusive approaches focusing on product development were considered. Overarching approaches like cost innovation (Williamson, 2010) and bottom-of-the-pyramid innovation (Prahalad, 2005) was considered in conjunction with sub-terms or the underlying core innovation approaches like low-cost innovation, jugaad, frugal or resource-constrained innovations. “Shanzhai innovation”, because of its focus on low quality and cost imitations rather than innovations (Peng, Xu and Lin, 2009) did not fit with the other approaches and was hence excluded.

In the next section, the considered innovation approaches are briefly explained with their literature background.

4.2.1 Product centric innovation approaches

4.2.1.1 Jugaad

Jugaad is a fast, creative and improvised way of solving problems in a resource-constrained environment at a lower cost. It is an Indian word, which means “workaround” or “innovative fix”. It is frequently used to refer to the make shift solutions in Northern parts of India (Rao, 2013), such as using a water pump like an engine in a daily transport vehicle. But this resourceful and clever approach does have a connotation of compromising on quality (Prahalad and Mashelkar, 2010). Jugaad is an inherently imaginative and customer-oriented approach, which lacks a structured approach and is far from technology- or product-focused approaches (Lacy, 2011). It aims at overcoming harsh environmental constraints by developing an effective solution using limited resources and by adopting a frugal and flexible approach (Radjou, Prabhu and Ahuja, 2012). This approach in itself is radical in nature (Prahalad and Mashelkar, 2010).

4.2.1.2 Disruptive Innovation

Hart and Christensen (2002) discussed disruptive innovations originating from emerging economies. These were simple, cheap, small and easy-to-use products or services that cater to the need of the un-served or underserved market (Christensen 1997, Christensen et al., 2006). These products have the potential to disrupt the existing markets with their good-enough offerings, which may have lower performance but provide valuable features to attract the bottom of the pyramid (Govindarajan and Kopalle, 2006). With a high focus on affordability and acceptability, these innovations might have lower gross margins and smaller target segment but gradually has the potential to increase revenue by developing an altogether new market (Rao, 2013, Ray and Ray, 2011).

4.2.1.3 Frugal Innovation

Frugal innovation is an approach to develop “good-enough,” affordable products that suffice the needs of resource-constrained consumers (Zeschky, Widenmayer and Gassmann, 2011). Frugal innovation follows certain processes, product management methodologies and structures in the innovation approaches, which Juggad lacks (Lacy, 2011, Prahalad and Mashelkar, 2010). It is not just de-featuring the existing expensive products, nor is it arbitrages of the labour cost or using inferior material to attain lower costs, but it is a clean-slate approach of building an affordable solution from scratch. These products are cost-effective, simple, basic, compact, easy-to-use and may use cutting-edge technology if necessary to lower the price (Rao, 2013). It is a bottom-up approach to innovation (Gupta, 2012), as opposed to the top-down, sophisticated, R&D-led development process followed in the Western world (Bhatti, 2012). Affordability, availability, accessibility, usability and creating customer awareness are critical characteristics of frugal innovations (Pralhad, 2012, Varadarajan, 2011), and are specifically designed for low-income market segments (Nunes and Breens, 2011, Agarwal and Brem, 2012).

4.2.1.4 Frugal Engineering / Constraint-based Innovations/ Resource-constrained-based Innovation

Carlos Goshn, the Chairman and CEO of Renault S.A., coined the term frugal engineering to describe the competency of Indian engineers in innovating cost-effective products, quickly and in a resource-constrained environment (Kumar and Puranam, 2012, Radjou and Prabhu, 2013). Frugal engineering or constraint-based innovation focuses on awareness, and is a cognitive approach in developing new products, services, and businesses in constrictive conditions (Sharma and Iyer, 2012). The six underlying principles of frugal engineering are robustness, portability, de-featuring, leapfrog technology, mega-scale production and service

ecosystems (Kumar and Puranam, 2012). This approach targets the growing middle class in India, China, Brazil and other developing nations, and hence focuses on understanding the unique needs of emerging-market customers, which are not addressed by mature-market products.

4.2.1.5 Reverse Innovation

Reverse innovation is commercializing frugal innovations developed for emerging market consumers in the advanced countries (Govindarajan, 2012, Nunes and Breens, 2011, Agarwal and Brem, 2012). The target segment for this innovation is the low-income consumer group of developed countries, which are completely ignored by the multinationals because of their small volume (Govindarajan, 2012). Reverse innovation is creating a new market for frugal products in developed economies by adapting or modifying the good-enough products originating from emerging economies (Nunes and Breens, 2011, Agarwal and Brem, 2012). Because of their similar product orientation (and despite their different target customers), both reverse and frugal innovation share similar characteristics.

4.2.1.6 Gandhian Innovation

Gandhian innovation also addresses affordable product development for the bottom of the pyramid (Mashelkar and Sridhar, 2008). These innovations can be of three types. First are disrupting business models, wherein developing market firms take advantage of Western technologies to adapt and create improved business quality process that can offer services at a lower cost (for example: the outsourcing model followed by the Indian IT businesses). Second is modifying organizational capabilities by creating or sourcing new capabilities, developing new technologies either on their own or by collaborating with Western partners. For example, Tata Motors cooperates with numerous technologically advanced companies (for example: Bosch, Johnson Controls, Toyo, Behr) to develop the appropriate components for their Tata Nano product. Third is modifying organizational capabilities by altering internal capabilities such as speeding the deployment time, enhancing design skills or scaling up (Prahalad and Mashelkar, 2010).

4.2.1.7 Grassroots Innovation

Grassroots innovations originate from the local community. Local population is the consumers as well as the inventor (Heeks, 2012) of these innovations. The local inventors are connected through social or technical networks to develop ecologically- and socially-acceptable products and services. Seyfang and Smith (2007) explain that these innovations “operate in civil society arenas and involve committed activists experimenting with social innovations as well as using greener

technologies”. The motivations behind these civil-society-based, value-based, social and affordable innovations are community-led initiatives (Seyfang and Haxeltine, 2012) to develop new, green and sustainable solutions (Smith et al., 2014).

4.2.1.8 Catalytic Innovation

Catalytic innovations are a subset of disruptive innovations with high emphasis on social change, scalability and sustainability (Christensen et al., 2006, Munshi, 2010). These are simple, good-enough and affordable innovation that target either over-served (because the existing solution is more complex than many people require) or under-served markets and are targeted towards achieving social benefits. They often work towards generating resources through grants, donations or intellectual capital, which are ignored by existing players (Christensen et al., 2006).

4.2.1.9 Indigenous Innovation

Indigenous innovation is adoption of Western-world know how to improve and develop in-house research and development capabilities in the developing world (Brem, 2008, Chen et al., 2006). These innovations originated from the spill overs of increased technology transfer, and diffusion happened due to localization efforts of multinational companies (Fu and Gong, 2011).

Interestingly, descriptions across these identified innovation approaches show a high degree of overlap in the product features and specifications (von Zedtwitz et al., 2015). This topic is suffering from unstructured and fragmented literature (Reinhardt, 2014), and misses to provide a unified insights and guidance to practitioners. There is an urgent need for consolidation that can condense the important features across these approaches and can bring clarity to the terminology confusion. This study uses systematic literature review and cluster analysis to respond to this shortcoming of the literature (Denyer, Tranfield and Van Aken, 2008). There are two research objectives of this study. First is to conduct a systematic review (Tranfield et al., 2003), and to identify the relevant innovation approaches in the context of emerging markets. Second is to consolidate these overlapping characteristics statistically into overarching factors that are important to be successful in emerging market. Next section discusses the methodology in detail.

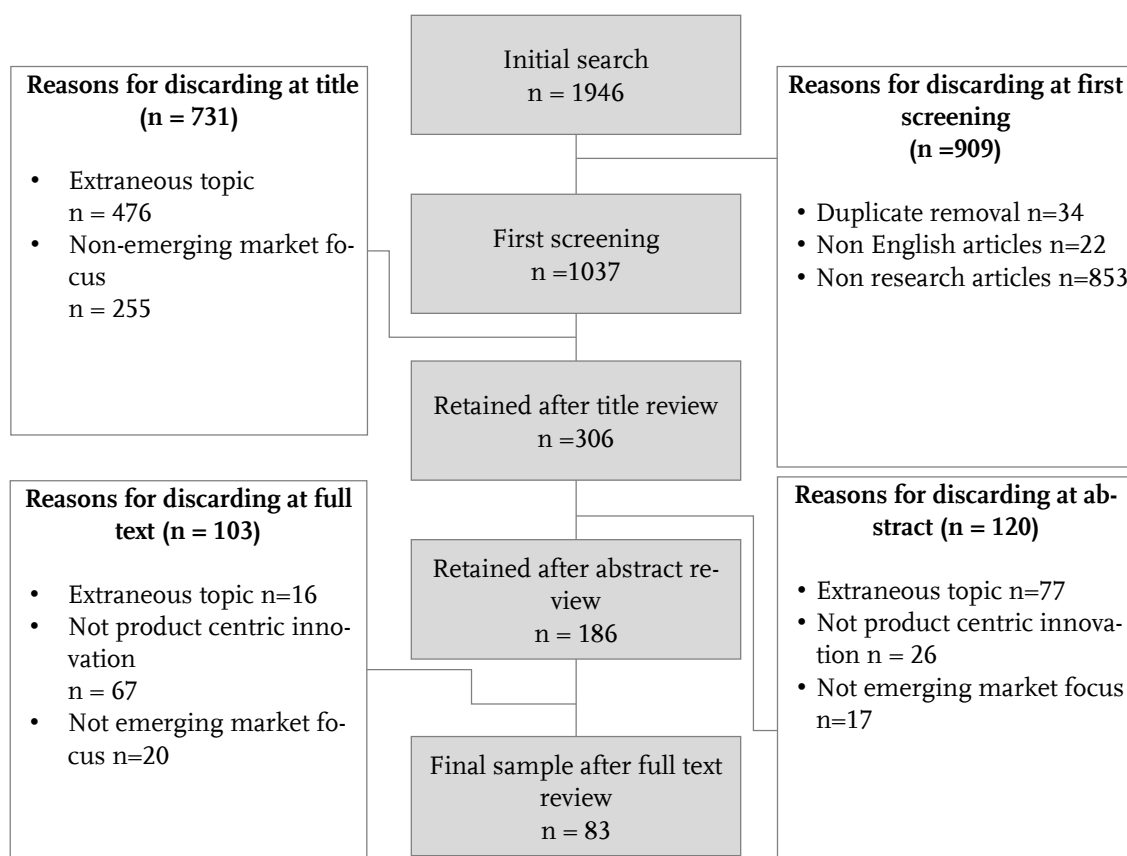
4.3 Methodology

An explorative scanning of literature was done (Tranfield et al., 2003) to identify the relevant product-centric innovation approaches in context of emerging markets. This research resulted in a plethora of innovation approaches but table 4-1 was used to filter the most recent and relevant innovation approaches. Totally, eleven product

innovation approaches (including “low-cost innovation” and “bottom-of-pyramid innovation”) were selected for systematic literature review. Identification of relevant work is the first step of the systematic review methodology (Transfield et al., 2003). Next, these approaches were used as search terms for scanning scholarly articles in the Google Scholar and Business Source Complete (BSC) databases. BSC includes 20 databases like EBSCO Host and Econ Lit and covers articles from more than 1,300 journals (Business Source Complete, 2015).

The initial search focused on terms in the title and the abstract only and resulted in 1946 articles as shown in figure 4-7. To find the relevant articles all the duplicates, non-journal articles and non-English articles were excluded.

Figure 4-1: Systematic literature review



In the title review, discarding non-product centric, non-emerging markets centric and articles on extraneous topics, the selected articles narrowed down to 306. Review of the abstracts of these 306 articles further filtered out only 186 articles. After reviewing the full text of each of these 186 articles authors selected 83 unique articles to be considered for further analysis.

4.3.1 Data Analysis

The definitions and explanations of product innovation approaches in the selected articles were qualitatively analysed to come up with a list of characteristics identified for each one of these approaches. Research revealed that the approaches “low-cost innovation” and “bottom-of-pyramid innovation” refers to more than one innovation type. For example “low-cost innovation” has always been referred to in conjunction with sub-terms like Jugaad, gandhian innovation, frugal or resource-constrained innovation (Williamson, 2010). Therefore, we re-distributed the characteristics of these two overarching approaches to the respective sub-terms. Table 4-2 lists the innovation approaches and the associated characteristics identified for each innovation approach across different studies. Table 4-2 also indicates (in italics) certain characteristics that appeared repeatedly across the different innovation approaches. These marked characteristics were either exact synonyms of other words included or were English phrases explaining already included terms. Omitting these words/phrases led us to a collection of 80 unique characteristics that consolidate the attributes described by the leading innovation approaches for emerging markets for new product development.

Table 4-2: Characteristics of various innovation theories according to relevant studies (in alphabetic order)

Innovation Theory	Studies	Characteristics
Jugaad	(Birtchnell, 2013), (Brem and Wolfram, 2014), (Radjou, Prabhu and Ahuja, 2012), (Singh et al., 2012)	Agile, austerity, cheap, cost-effective, clever, creative, effective, fast, fix, flexible, frugality, improve, inclusive, ingenuity, innate, intrinsic, intuitive, local, <i>low-cost</i> , <i>more-with-less</i> , quick, resilience, resourceful, <i>resource-constrained</i> , robust, rough, simple, sustain, unique
Frugal Innovation	(Agarwal and Brem, 2012), (Basu, Banerjee and Sweeny, 2013), (Bhatti, 2012), (Bhattacharyay, 2012), (Bhatti and Ventresca, 2012), (Brem and Wolfram, 2014), (Cunha et al., 2013), (Eagar et al.,	Accessible, adaptable, affordable, appropriate, available, basic, bottom-up, breakthrough, <i>bricolage</i> , cheap, <i>clean-sheet</i> , creative, <i>easy to use</i> , economical, <i>eco-aware</i> , efficient, environmental, <i>energy-efficient</i> , flexible, frugality, green, <i>good-enough</i> , <i>human-centric</i> , <i>high quality</i> , invent, ingenuity, intuitive, large-scale, lean, light, <i>limited functionality</i> , local, <i>low-cost</i> , modify, <i>more-with-less</i> , <i>no-frills</i> , portable, quality, radical, <i>resource-constrained</i> ,

	2011), (Gallis and Rall, 2012), (Horn and Brem, 2013), (Hossain, 2013), (Moore, 2011), (Mukerjee, 2012), (Radjou and Prabhu, 2013), (Tiwari and Herstatt, 2012), (Zeschky, Widenmayer and Gassmann, 2011 & 2014)	robust, reliable, rugged, simple, smart, social, sophisticated, sustain, technical, timely, user-friendly, valuable
Frugal engineering or constraint-based innovation	(Aiyar, 2011), (Brem and Wolfram, 2014), (Kumar, 2008), (Kumar and Puranam, 2012), (Kumar and Puranam, 2013), (Radjou, Prabhu and Ahuja, 2012), (Reddy, 2011), (Sehgal et al., 2010)	Advanced, affordable, basic, cheap, cost-effective, clean sheet <i>de-featuring</i> , frugality, invent, large-scale, light, <i>low-cost</i> , minimal, <i>no-frills</i> , portable, quality, quick, radical, reliable, <i>resource-constrain</i> , revolutionary, robust, simple, small, timely, valuable
Gandhian innovation	(Basu, Banerjee and Sweeny, 2013), (Brem and Wolfram, 2014), (Dubiel and Ernst, 2012), (Mashelkar and Sridhar, 2008), (Mehta, 2013), (Prahalad and Mashelkar, 2010), (Radjou et al., 2012)	Accessible, affordable, appropriate, cheap, creative, frugality, <i>more-with-less</i> , large-scale, local, <i>low-cost</i> , <i>people-focused</i> , radical, resourceful, robust, simple, sophisticated, sustain, user-friendly
Catalytic innovation	(Gundry et al., 2011), (Munshi, 2010), (Bright and Godwin, 2010), (Mohan and Potnis, 2010), (Brem and Wolfram, 2014)	Affordable, <i>bricolage</i> , ecological, effective, efficient, fast, <i>good-enough</i> , <i>meet observed needs</i> , new, novel, large-scale, <i>low-cost</i> , <i>low-performance</i> , radical, <i>resource-constrain</i> , simple, social, sustain
Grassroots innovation	(Brem and Wolfram, 2014), (Cooke and Memedovic, 2006), (Cozzens and Sutz, 2012), (Ely et al., 2013), (Gupta, 1997), (Gupta, 2008), (Gupta, 2012), (Gupta, 2013),	Adaptable, affordable, alternative, basic, bottom up, breakthrough, cost-effective, collective, creative, diverse, dynamic, <i>easy to imitate</i> , economic, frugality, green, improve, indigenous, informal, ingenuity, interactive,

	(Heeks, 2012), (Hua, Jiang and Lin, 2010), (Kumar et al., 2013), (Seyfang and Smith, 2007), (Seyfang and Haxeltine, 2012), (Smith, Fressoli and Thomas, 2014), (Vergragt et al., 2014)	intrinsic, large-scale, local, <i>low-cost</i> , new, organized, practical, <i>self/interest driven</i> , small, social, spontaneous, sustain, <i>folks wisdom</i> , valuable, voluntary
Reverse innovation	(Agarwal and Brem, 2012), (Brem and Wolfram, 2014), (Corsi and Minin, 2013), (Govindarajan, 2009), (Govindarajan and Ramamurthi, 2011), (Govindarajan, 2012), (Govindarajan and Trimble, 2012), (Immelt, Govindarajan and Trimble, 2009), (von Zedtwitz et al. 2015)	Adapting, cheap, clean slate, compact, <i>decentralized</i> , disruptive, <i>ease of use</i> , <i>good enough</i> , growth, high technology, local, <i>low cost</i> , modular, new, radical, scaling, simpler, portable
Indigenous innovation	(Brem, 2008), (Brem and Wolfram, 2014), (Chen et al., 2006), (Fu, Pietrobelli and Soete, 2011), (Lazonick, 2004), (Park, Ali and Chevalier, 2011), (Sergey and Breidne, 2007), (von Zedtwitz et al., 2015), (Zheng, Meng and He, 2012)	Adaptable, adjustable, adopt economic, improvised, local, modified, sustainable, unique
Disruptive innovation	(Bower and Christensen, 1995), (Christensen et al., 2001), (Christensen et al., 2006), (Corsi and Minin, 2013), (Crooker, Baldwin and Chalasani, 2009), (Enders et al., 2006), (Hart and Christensen, 2002), (Zeschky, Widenmayer and Gassmann, 2011)	Affordable, basic, better, cheap, convenient, customize, environmental, frugality, improve, new, large-scale, <i>low-cost</i> , <i>low-performance</i> , modest, <i>tailored</i> , resourceful, small, simple, social, valuable

To cluster these 80 unique characteristics into major factors “Semantic similarity” method is employed. This method generates a numerical similarity score for a pair of English words based on the concept and relation similarity. The open-

source UMBC Semantic Similarity service (Han et al., 2013) was used to find the relatedness scores across the 80 characteristics. The UMBC Semantic Similarity service calculates a similarity score in a range of 0.0 and 1.0, where a 1.0 represents an exact synonym of the word. This service employs the Wordnet database (of 3 billion English words) and Web corpus from the Stanford WebBase project (that contains 100 million web pages from more than 50,000 websites) to assign and analyse the word senses. The statistical method used to compute the similarity scores is based on distributional similarity and Latent Semantic Analysis, which works on the underlying hypothesis that words occurring in the same contexts tend to have similar meanings (Harris, 1968). Since the databases used by the UMBC Semantic Similarity service did not include the word “usable”, we were able to obtain a numerical similarity score for each pair of the other 79 unique identified. Figure 4-2 shows an excerpt of the 79x79 similarity matrix obtained for our 79 characteristics.

Figure 4-2: Similarity matrix (excerpt)

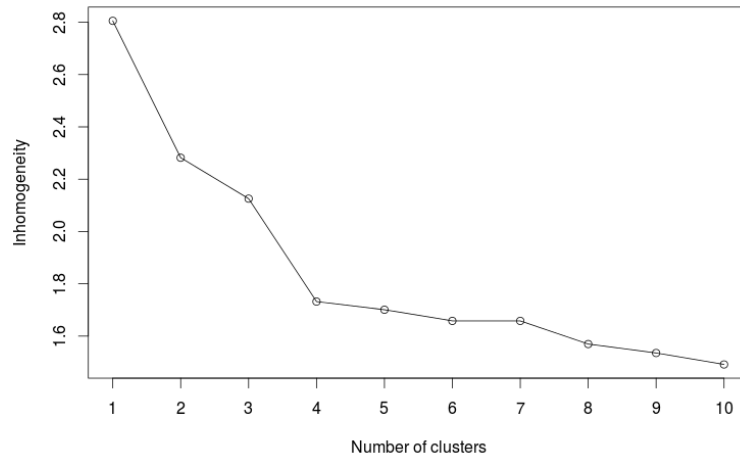
Row Labels	agile_JJ	alternative_JJ	appropriate_JJ	austerity_NN	available_JJ	basic_JJ	better_JJ	breakthrough_NN	cheap_JJ	clever_JJ	collective_JJ	convenient_JJ	cost-effective_JJ	creative_JJ	customize_VB	diverse_JJ
agile_JJ	1	0.034728903	0	0	0.09379949	0	0	0.070112765	0.10348015	0.25867066	0.0857439	0.12998308	0.34867835	0.12867635	0	0.06876747
alternative_JJ		1	0.18738087	0.04453846	0.13264866	0.02833385	0.06949274	0.016877113	0.13715635	0	0.12431502	0.24969397	0.30688253	0.082209	0.07918615	0.15617013
appropriate_JJ			1	0.029690495	0.23266771	0.01697613	0.11869934	0.034846872	0	0.01190716	0	0.15618746	0.13043268	0.07497121	0.016627911	0.0426785
austerity_NN				1	0	0	0.03321356	0	0	0.07336919	0	0	0	0.03419291	0	0.002229156
available_JJ					1	0	0.08050691	0	0.19483238	0	0.01675968	0.047138378	0.05161814	0.06187809	0.014712955	0.01141799
basic_JJ						1	0	0	0.04597466	0.01048161	0.04313039	0.015753794	0	0	0.06691409	0
better_JJ							1	0.007034629	0.04801345	0.01522455	0.04222722	0.060530074	0.02476867	0.02424105	0.023616467	0.04603148
breakthrough_NN								1	0.0670237	0.09958361	0.08236864	0.044218037	0.2083794	0.11774138	0.005086563	0
cheap_JJ									1	0.25341153	0.05560864	0.28701827	0.28069124	0.01767248	0	0
clever_JJ										1	0	0.16832141	0.31678438	0	0	0
collective_JJ											1	0	0.039578117	0.23690508	0.013798047	0.13087021
convenient_JJ												1	0	0.44295636	0.01794165	0.1170426
cost-effective_JJ													1	0.13573773	0.16452636	0
creative_JJ														1	0.05473725	0.25273985
customize_VB															1	0
diverse_JJ																1

These generated scores were used to perform a cluster analysis to group the most related and similar characteristic. Among the hierarchical agglomerative clustering algorithms, Ward’s method has shown the capability of adequately assigning objects to clusters (Backhaus et al., 2010). However, outliers in the data can distort the results obtained from this procedure (Hair et al., 2010, p. 532). Such outliers may be identified with the single-linkage method (Eckey et al., 2002, p. 234). Using the statistical software R (R Development Core Team, 2015), we therefore first applied the single-linkage algorithm to the similarity matrix of the 79 unique English words and identified five outliers (“green”, “large-scale”, “light”, “local” and “motivation”). After removing these words, we then performed a clustering analysis based on Ward’s method.

The goal of our analysis is to identify the main aspects of the different innovation theories, which are embodied in the many characteristics, gleaned from the 83 papers. On the one hand, we wish to derive a limited number of aspects by grouping the characteristics in as few clusters as possible. On the other hand, each cluster should ideally represent a single aspect, i.e., there should be a low heterogeneity between the characteristics contained in one cluster. Figure 4-3 shows the inhomogeneity incurred when choosing a certain number of clusters (instead of

forming one additional cluster), focusing on a range between one and ten clusters.

Figure 4-3: Inhomogeneity incurred for different choices of the number of clusters



This inhomogeneity is necessarily the lower the more clusters are created. Obviously, when two clusters of the four-cluster solution are merged to derive the three-cluster solution, vastly different characteristics need to be combined, resulting in a high additional inhomogeneity. Similarly, choosing seven instead of eight clusters incurs a noticeably higher inhomogeneity than moving from nine to eight clusters. In the light of the trade-off between deriving a small set of aspects and attaining a low level of inhomogeneity, we have thus decided to employ the eight-cluster solution.

Table 4-3 shows how the 74 words remaining were grouped into eight clusters. The clustering procedure has usually grouped words with a similar meaning into the same cluster. Of course, there are notable exceptions. For example, the words “economic” and “economical” have been assigned to the same cluster as “ecological”, “environmental” and “social”. This is likely due to the fact that the Wordnet Ontology, employed by the UMBC Equity Core service to compute the similarity between two concept pairs, uses all senses of concept (Pederson et al., 2004). In this case, the two concepts “ecology” and “economic” show similarity because both are studies of systems – the former is about natural systems, while the latter is about human systems. Nevertheless, looking at the commonality of the majority of words within each cluster, it is possible to identify the key factor of innovation embodied by the cluster. To express these factors, we developed both the names as well as the more detailed descriptions of the clusters, listed in. Table 4-3 provides a list of features that make a product relevant to be considered as an innovation for emerging markets.

Table 4-3: Eight clusters with description and clustered characteristics

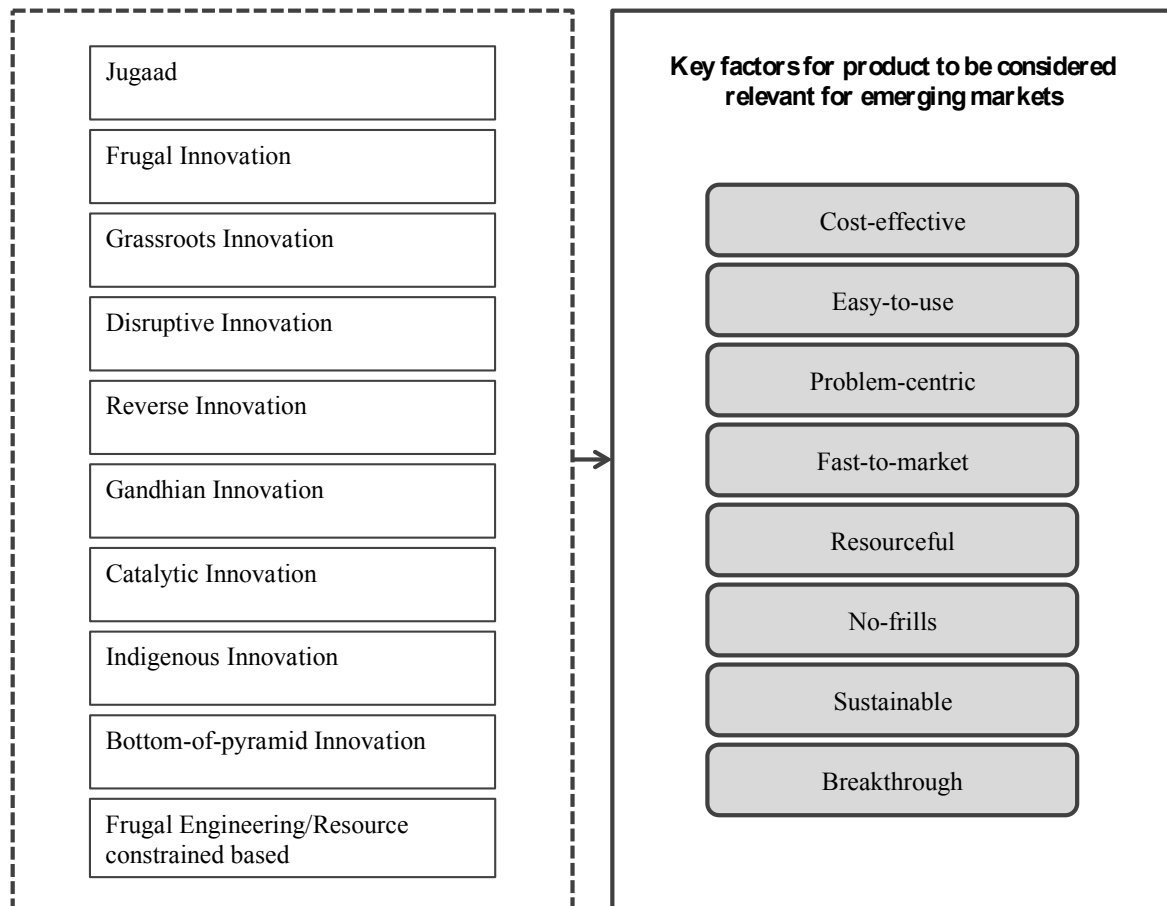
Factor	Description	Characteristics
Cost-effective	Value for money, providing quality (not luxury) at prices that are affordable to bottom-of-pyramid customers	Accessible, affordable, available, cheap, convenient, cost-effective, efficient, reliable, robust
Resourceful	Do more with less, using minimal/least possible resources in the product development efforts	Adaptable, agile, flexible, inclusive, lean, quality, resilient, resourceful
Easy-to-use	Human-centric, intuitive designs that require little to no prior knowledge or training to utilize	Advanced, clever, customize, interactive, intuitive, smart, sophisticated, user-friendly
Sustainable	Environment-friendly, considering both societal and environmental effects	Ecological, economic, economical, environmental, social
Problem-centric	Bottom-up approach, looking at the problem first and then developing a suitable solution, customer-centric rather than technology- or product-centric	Adequate, appropriate, better, effective, improve, sufficient
No-frills	Simplification, seeking minimalist features and functional requirements which get the job done	Basic, innate, intrinsic, simple, traditional
Fast-to-market	Timely to market, faster to deploy and also considering all the aspects of business from manufacturing to logistics	Fast, informal, organized, quick, spontaneous, timely, voluntary
Breakthrough	Creating a novel creative solution which eventually disrupts the existing market and helps to shape an entirely new market	Alternative, austerity, breakthrough, collective, creative, diverse, dynamic, fix, frugality, indigenous, ingenuity, invent, modest, modify, new, novel, portable, practical, radical, revolutionary, rough, rugged, small, sustain, unique, valuable

4.4 Discussion

Literature review shows a plethora of innovation approaches to understand the BOP customer needs and markets specifications, in exploratory and qualitative

studies. However, the overlapping and interrelated approaches often incorporate a potpourri of characteristics. This study is an attempt to bring clarity on the key factors considered during concept development of new products for emerging markets. This study helps academicians and practitioners to sift through the plethora of theories, and it succinctly describes what denotes a product’s relevance for the emerging markets.

Figure 4-4: The Innovation Framework for emerging markets



The various existing theories illustrated previously can be unified and represented in the eight factors of the “Innovation Framework” for emerging markets as shown in figure 4-4. A product will be considered pertinent for BOP customers if it meets the identified criteria of being cost-effective, easy-to-use, sustainable, problem-centric, no-frills, fast-to-market, resourceful and breakthrough. Depending on the motivations driving the innovation approach, a selected subset of these factors would gain priority over others. For example, Jugaad and frugal innovation have a greater impetus on cost effectiveness and resourcefulness (Radjou, Prabhu and Ahuja, 2012) rather than sustainability. On the other hand, grassroots and gandhian innovation place a premium on sustainability (Gupta, 2013) over ease of use. Disruptive innovations will show a greater propensity towards being fast to market and a no-frills approach (Hart and Christensen, 2002). Nevertheless, the Innovation Framework as showed in figure 4-4 gives the overarching framework for all the innovation

theories put together. These results can also be interpreted as a tally of criteria to be met while developing an emerging-market-specific product, or of attributes necessary to “play” in emerging markets.

Consolidated view of the literature also offers insights on important product requirements to be fulfilled by companies for success in emerging markets. For BOP customers, poverty being the biggest hurdle leads to the foremost requirement of low-cost products. Low cost here does not necessarily mean rock-bottom pricing, but rather a “cost-effective” solution with a definite price advantage over solutions purchased by the higher-end customers. The price must match with the lifestyle and limited cash that these customers have (Nakata and Weidner, 2012) and show value for money to the customer. Research also reveals that BOP customers aspiring for high price-to-performance ratio are willing to spend money, provided the products are perceived to be life-changing or “breakthrough” (Viswanathan and Sridharan, 2012). Customers at the bottom of pyramid have low disposable incomes, and they buy products when there is a pressing need or a necessity of the product, so having the product readily available or “fast-to-market” is equally critical to tap into the customer base. They are looking for a quick solution that is “resourceful” in terms of using the least possible resources to fulfil the need.

Due to the high illiteracy rate in these markets, there is a cognitive barrier with the customer. Making the products less complex with high visual comprehensibility is crucial for increased adoption (Nakata and Weidner, 2012). An “easy-to-use” intuitive product with basic “no-frills” functionalities is what these customers look for. Govindarajan and Trimble (2012) have talked about five gaps existing in these emerging markets, the infrastructural gap, the sustainability gap, the performance gap, the regulatory gap and the preferences gap. A product that directly addresses any of these gaps and is “problem-centric” (i.e., it solves the current pressing need of the customer) is highly welcome. For example, intermittent electricity drives customers to buy battery-operated products. Specifically on the sustainability gap, where these countries are rapidly developing and experiencing some of the most daunting environmental challenges environmental sustainability in terms of using economic, locally sourced raw material will also play an important role.

4.5 Research Implications

This study contributes to the existing literature in three fundamental ways. First, it builds upon existing research to offer a comprehensive definition of a product targeting the BOP customers. By creating an innovation framework it identifies the critical criteria such as cost-effective, easy-to-use, sustainable, problem-centric, no-frills, fast-to-market, resourceful and breakthrough to succinctly measure

the inherent appropriateness of a new product for emerging markets. Second, it offers a systematic and structured review of this field of management research. Despite its increasing popularity, the literature is still limited to anecdotal evidence and dissection of company practices (Cunha et al., 2013). This study uses a creative and translational empirical approach to provide quantitative inputs on theory building. Third, the study re-iterates the importance of the motivational driver of innovation in determining the importance of the attributes.

4.6 Managerial Implications

The study provides clear insights into the literature and research done on emerging markets. From a practitioner view, these factors would also intuitively be the key foci during a new innovation process. The low income of the target customer requires product to be cost-effective and low-priced. There is also a dearth of skilled labour in these countries. Combined with the problems of high employee attrition, it is necessary to design products, which can be learnt easily and used without hassles. An adequate “problem-centric” solution would also ensure that important resources are not wasted on features unwanted by the customers.

Chapter 5 : Understanding emerging market companies and customers: An empirical study of innovation constructs for new product development

5.1 Introduction

A significant amount of research has been conducted on emerging markets to understand the various innovation approaches and customer needs at the bottom of the pyramid (BOP) (Brem and Wolfram, 2014, Corsi and Di Minin, 2013, Prahalad and Mashelkar, 2010, Radjou and Prabhu, 2012, Rao, 2013, Govindarajan and Trimble, 2012, Von Zedtwitz et al., 2015, Zeschky, Widenmayer and Gassmann, 2011). In the prior chapter, a conceptual framework as shown in figure 4-4 is proposed, which presents consolidated product requirements in emerging markets. The framework is based on systematic literature review of the most frequently used innovation approaches in emerging markets, viz. jugaad innovation, frugal innovation, reverse innovation, disruptive innovation, frugal engineering, gandhian innovation, catalytic innovation, grassroots innovation and indigenous innovation. As per the framework, the eight crucial requirements for emerging markets are cost-effectiveness, easy-to-use, sustainable, problem-centric, no-frills, fast-to-market, resourceful and breakthrough.

Although this framework is based on a systematic literature review, it is not validated from the operational needs of the manufacturers or product managers, and of the end customer, i.e. the benefits to be fulfilled by the product as desired by the customer (Hauser and Griffin, 1993).

This chapter focuses on the further enhancement of the framework with empirical research on consumer and product manager perspectives and preferences. Chapter has two research objectives. First is to validate customer requirements and analyse their buying preferences using “Analytic Hierarchy Process” and second is to compare the prioritization of product requirements from manufacturer’s and customer perspectives.

For this, the chapter is divided into three parts. The first part introduces the relevant literature of new product development in emerging markets. Based on that, customer insights are gathered using the “Voice of Customer” methodology in the second section. Finally in the third section, a comparison of the prioritization of requirements from business and customer perspectives is undertaken.

5.2 Background literature and theoretical framework

Prahalad coined the term “Bottom of the Pyramid” (BOP) over a decade ago to describe a big chunk of population living in emerging markets earning less than \$2000 per year (Hart and Prahalad, 2002, Prahalad, 2005 , p. 50). He was amongst the earliest researchers to realize and promote the potential economic benefits of

addressing these customers on a global scale. Significant amount of research has been conducted in recent years to understand the BOP customers and emerging markets (Ernst et al., 2014, George, McGahan, and Prabhu, 2012, Immelt, Govindarajan and Trimble, 2009, Nakata and Weidner, 2012, Prahalad, 2005, Radjou and Prabhu, 2012, Schuster and Holtbrügge, 2014, Zeschky et al., 2011). Though most of this research work has been conceptual and qualitative in nature, it provides an understanding of these peculiar markets and their customers.

Lack of formal institutions, scarcity of resources, missing regulations and infrastructural gaps make these emerging markets very different from the developed markets (Ernst et al., 2014). The prevailing gaps in these markets such as unreliable electricity or low literacy are in complete contrast to the western markets. Literature review also reveals, BOP customers are highly price sensitive and look for high value - low cost products that are tailored to their specific requirements. Hence, it is not sufficient simply to de-feature or resell products from western markets as these provide neither value to the customers nor are they tailored for the market specific needs (Ernst et al., 2014, London and Hart, 2004, Agarwal and Brem, 2012). Success in emerging markets requires a new product development approach that involves co-creating with BOP customers and tailoring products to their needs rather than forcing features and specifications onto them (Ernst et al., 2014, Nakata and Weidner, 2012).

For co-creation in emerging markets, it is crucial to understand the requirements, unmet needs and the core values of the customer (Agarwal and Brem, 2012). Not all customer needs (problems customers intend to solve or the benefits to be fulfilled with the purchase of goods or services) are equally important, and customers are often not able to specify their needs clearly enough. Therefore, it is necessary to gather customer needs through customer insights (Lai, Xie and Tan, 2004, Li, Liu and Li, 2014) and analyse how satisfying a particular need influences the purchasing decision. One of the methodologies used for this purpose is the voice of customer (Bharadwaj, Nevin and Wallman, 2012). VOC provides detailed set of customer requirements along with relative prioritization based on customer preferences (Griffin, 1993). Analysis of past literature on VOC shows that although many studies propose theories and conceptions of using VOC for emerging markets, there are limited empirical studies available addressing the BOP customers in emerging markets. This study focuses on identifying and understanding customer requirements through VOC methodology.

5.3 Research design and methodology

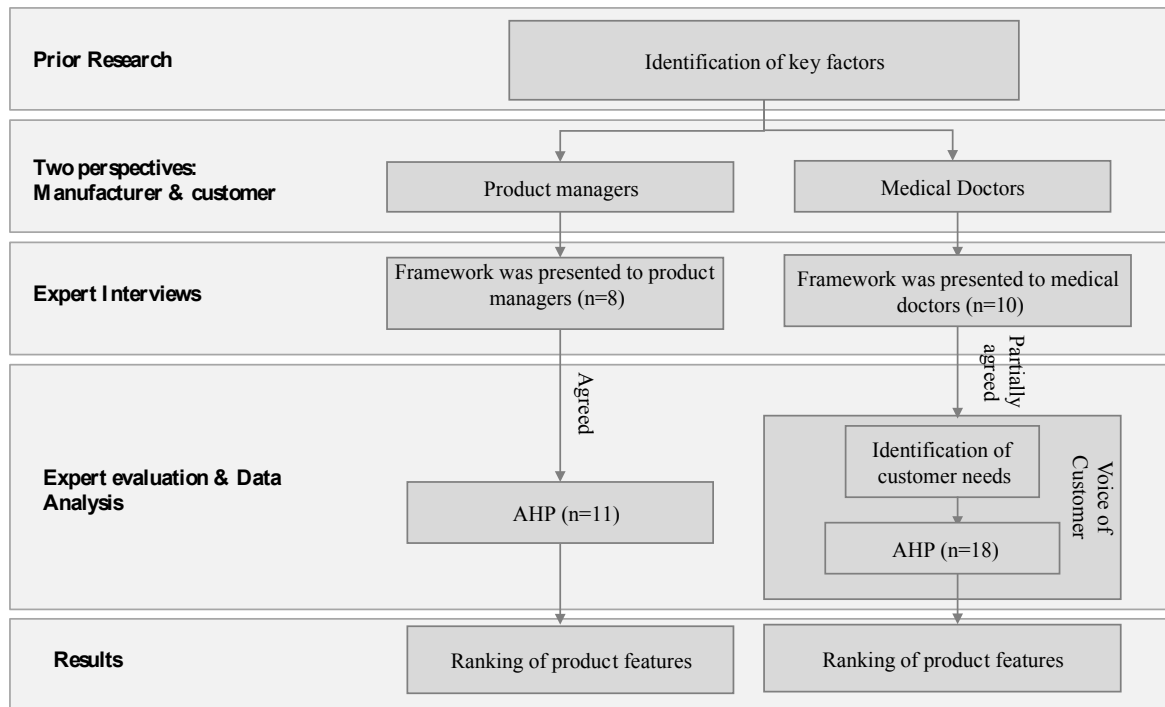
Developing markets suffering from infrastructural gaps and inadequate resources often find it difficult to provide basic services like education and

healthcare to the majority of their residing population. India, one of such emerging countries and also the focus of this study, is facing an acute healthcare service divide currently (Srivastava and Shainesh, 2015). Although India produces the largest number of doctors in the world, the doctor-to-population ratio in India is significantly below the world average (India has a ratio of 1:1700 compared to the world average of 1:666), showing a dismal picture of accessibility of healthcare service in India. The primary healthcare centres started by the government, which offer services free of cost or at nominal charges, are scarce and often lack resources and quality (Srivastava and Shainesh, 2015). Hence, most of the Indian population depends on private healthcare services, which are expensive and unaffordable to a vast majority of the population. The absence of financial protection in form of social insurance services and rising treatment cost has been dissuading people from taking the needed healthcare services. The high cost coupled with low-income level has made the quality healthcare inaccessible and unaffordable to majority of the population in India. Hence, innovations in form of healthcare service or new product development would be of high value and will help companies to tap into the large population currently deprived of basic services. In this context, the Indian healthcare market offers an ideal opportunity for this research approach.

Our study compares and contrasts both, the voice of customers and preferences of product managers, while designing a product for Indian healthcare sector. To ensure consistency in results, customers and product managers were restricted to the medical devices industry. The customers in this perspective are the healthcare service providers and medical doctors who use these devices and equipment for diagnosis and treatment of BOP customers. The purchasing decision of service providers and medical doctors are significantly influenced by requirements of their end customer: BOP customers and hence justifies the sample selection. As mentioned before, voice of customer methodology is used to gain insights into the customer needs and perceived benefits of products for emerging markets.

Griffin (1993) describes four phases of the voice of customer methodology, viz. identifying customer needs, grouping them, prioritizing them and finally understanding the customer perception of product performance. VOC consists of both qualitative and quantitative research and is considered as a necessary input for new product development, quality function deployment and for setting design specifications (Griffin, 1993). After identification of customer needs, these perceived benefits are clustered into distinct small groups, which are easy for customers to comprehend and prioritize. Figure 5-1 explains the methodology and activities carried out for this research.

Figure 5-1: Research Methodology



There are multiple ways to identify and group consumer needs, and one of them is to review the past literature with both empirical and qualitative studies and group the requirements (Griffin, 1993). The prior study of the authors (as explained Chapter 4) provides an excellent starting point for the same. The innovation framework is already based on theories targeting new product development for emerging markets. So it effectively represents the requirements from a product manager and manufacturer’s perspective. However it does not depict the customer needs and hence the framework requirements have to be mapped to the benefits as perceived by the customers. Mapping of customer needs were done through qualitative interview as explained in the next section. Subsequently, survey questionnaire were designed and implemented and the results were analysed using the Analytic Hierarchy Process. The next section describes the above steps in detail.

5.3.1 Mapping the framework requirements to customer needs

It is important that the customer needs are stated in the customers’ own words (Griffin, 1993), and not in industry or academic jargon. Therefore as the first step, list of eight requirements identified by prior study was taken to the medical doctors to enhance the base list with more criteria based on qualitative interviews. 10 medical doctors in India (6 medical doctors running private hospitals and 4 medical doctors working at key positions in government hospitals) were personally interviewed to understand the perceived requirements. In the qualitative interviews with medical doctors six out of eight features (except problem centric and

resourceful) were agreed to be important and represent the customer perspective as well. The interviews also revealed two additional features important for customers and considered in buying decision, these were: low maintenance and customization. The nomenclature of the agreed six features was changed to a more suitable synonym that was easy to understand and relate to for medical doctors in India.

Furthermore, for manufacturer’s perspective, since the eight requirements were based on the academic literature focusing on product development approaches for BOP customers, they were used without changes while interviewing the product managers. Table 5-1 summarizes the requirements from both the perspective for further analysis.

Table 5-1: Eight product requirements from customer and manufacturer perspective

Manufacturer perspective	Customer perspective	Description
Cost-effective	Affordable	Value for money, providing quality (not luxury) at prices that are affordable to bottom of pyramid customers
Resourceful	Low/no maintenance or consumables	Do more with less, using minimal /least possible resources or consumables
Easy-to-use	Easy-to-operate	Human-Centric, intuitive designs that require little to no prior knowledge or training to utilize
Sustainable	Environment-friendly	Environment friendly, considering both societal and environmental effects
Problem-centric	Customized to Indian environment	Bottom up approach, looking at the problem first and then developing a suitable solution, customized for local market (for example, shortage of electricity, water supply, bad roads)
No-frills	Simple with basic functionalities	Simplification, seeking minimalistic features and functional requirements which gets the job done
Fast-to-market	Readily-available	Timely to market, faster to deploy and also considering all the aspects of business from manufacturing to logistics
Breakthrough	Innovative	Creating novel creative solution which eventually disrupts the existing market and helps to shape an entirely new market

5.3.2 Data collection

Using these two perspectives, two questionnaires were designed. Each one contained 28 questions, one question for each pair of key features. Within each question, a respondent was asked to rate the relative importance of key feature A over key feature B, using 19 categories ranging from “extremely agree” to “extremely disagree”. The ratings given by a respondent in such paired comparisons may be inconsistent. For example, feature A might be preferred over feature B, which in turn is preferred over feature C, while feature A is rated as less important than feature C. The AHP methodology provides an approach to deriving priorities on a ratio scale from such inconsistent ratings, and to determining the extent to which the paired comparisons departed from consistency. Hence, AHP was used to derive the priorities of the features from the customer and product manager perspective. Since the study focused on a specific market segment, i.e. medical devices developed for the Indian healthcare market, getting large sample of data was difficult. To overcome the limitation of small population, a purposive and selective sampling was done to select respondents with the intention of making generalizations from that sample to the population of interest. Moreover, since AHP focuses on a specific goal, large samples may often lead to inconsistent results (Wong and Li, 2008) hence this study preferred smaller samples. For the customer data, the questionnaire based on consumer perspective was sent to medical doctors across India. A total of 60 medical doctors based in India, were contacted through phone, emails and personal visits. Out of 60 contacts 30 responded and agreed to fill out the questionnaire, which is a response rate of 50%. However, from those 30 respondents only 18 filled the questionnaire completely and hence were considered for this study. Similarly, 30 product managers working on products for emerging markets (including India) were contacted from healthcare multinationals like Siemens, GE, Toshiba and Philips through emails, over the phone and via social networks like LinkedIn and Xing. Product managers in this study refer to personnel responsible for defining product requirements and product development within companies developing and selling medical devices. A total of 11 product managers from GE Healthcare and Siemens Healthcare agreed to participate and sent us the completed questionnaire. This results in a response rate of 37 %.

5.4 Results

To this end, the ratings of all 18 Indian doctors were aggregated, using the geometric means of the individual scores (Saaty, 1996, p. 63).

Table 5-2: Customer and product manager’s priorities of respective eight requirements

Manufacturer perspective	Customer perspective	Manufacturer’s preference	Customer’s Preference
Cost-effective	Affordable	0.232	0.201
Easy-to-use	Easy-to-operate	0.251	0.173
Resourceful	Low/no maintenance/consumables	0.089	0.166
Sustainable	Environment-friendly	0.063	0.111
Problem-centric	Customized to Indian market	0.167	0.107
No-frills	Simple with basic functionalities	0.063	0.092
Fast-to-market	Readily-available	0.081	0.089
Breakthrough	Innovative	0.055	0.061

The relative priorities of the key requirements from the customers’ point of view were then derived as the first eigenvector of the aggregated comparison matrix, normalized to sum to one (Saaty, 1996, p. 51). The same approach was taken for the ratings of the eleven product managers; the resulting priorities for both, the customers and product managers are listed in table 5-2. The consistency ratios calculated for the customers and product managers were 0.032 and 0.020, respectively. Values up to 0.1 represent an acceptable level of consistency of the paired comparisons from which the priorities were derived (Saaty, 1996, p. 51). The priorities can be interpreted relative to each other. For example, the customers consider the affordability twice as important as the fact that the product has been customized to the Indian market. If all eight key features were found to be equally important, then each of them would have received a priority value of 0.125. Hence, from the customers’ point of view the importance of “affordable”, “easy-to-operate” and “low/no maintenance/consumables” is above average. Similarly for product managers “easy-to-use”, “cost-effective” and “problem-centric” importance is above average.

5.5 Discussion

Interpreting the values in table 5-2 also as percentages (for example: 20.1% for affordable), they represent the weightage assigned by doctors and product managers to each of the product requirements. For customers, “affordable”, “easy to operate” have very high prioritization with combined weightage of 37.4% and can be considered as the “absolute requirements” which every new product has to fulfil, (Lazonick, 2004, Munshi, 2010, Prahalad and Mashelkar, 2010, Zeschky,

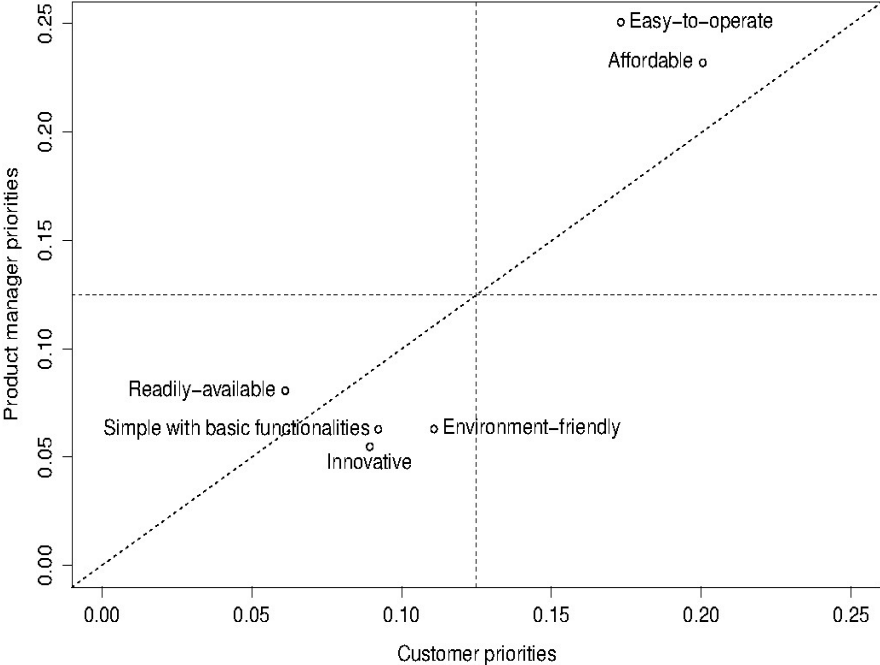
Widenmayer and Gassmann, 2011, Govindarajan and Trimble, 2012, Radjou, Prabhu and Ahuja, 2012, Gupta, 2013). Additionally “low or no maintenance or consumables” also shows an above average weightage (16.6%) implying that customers are vigilant about the total cost of ownership of their product and also consider the maintenance requirement to be important while buying the product. Taking both the affordability and low maintenance requirement together it reiterates the fact that BOP consumer are not only looking for products at rock bottom price but require value combined with low price which Ernst et al. (2014) describe in their paper as affordable value innovations. Customers in emerging markets are looking for new products that offers them value but at low price (Ernst et al. 2014, Prasad and Ganvir, 2005). Features like “environment friendly” and “customized” are given an intermediate importance, these features have the potential to be the “delighters” for the customer and their existence will positively influence the product purchase (Lai et al., 2004). The consumer considers “simple” or “innovative” features to be equally important, as long as the necessary conditions of affordable value products are met. The low weightage given to ready availability of the product when discussed with the respondents in person was explained as a pre-requisite feature for the doctors in this fast and revolutionizing time. Doctors take the ready availability of the product for granted and as a “must-be” requirement for further buying considerations.

On the other hand for product managers, in agreement to customers the “absolute requirements” while designing a product are “cost-effective”, and “easy-to-operate”. The combined score of over 48%, which almost is equal to scores given to rest of the factors put together, shows the dominance of these two requirements in product development process compared to other requirements. The above average score (16.7%) assigned to “problem centricity” reveals the sound understanding of product managers of emerging markets demanding tailored products (Nakata and Weidner 2012, Ernst et al., 2014). There is a focus of manufacturers to understand the pain points of the customer and offer a relevant product. Product managers consider “fast-to-market” and “resourceful” of intermediate importance and give lower importance to “sustainability”, “no-frills” and “breakthrough” product requirements.

Having discussed the product requirements from both the perspectives individually next step is to compare the two preferences and identify the gaps (if any) between the two. For the next research objective of comparing priorities of customers and product managers a two-dimensional plot was used, as shown in figure 5-2. Excluding “customization” and “low or no maintenance or consumable” only the six common and mapped requirements were plotted. The priorities given by the product managers are plotted against those given by the customers. As 0.125 divides above average from below-average priorities, lines indicate this value for

both the product managers and the customers, partitioning the diagram in four rectangles. Moreover, the bisecting line of the diagram is shown, in case both customer and product manager perspectives were completely aligned, the points would lie on this bisecting line.

Figure 5-2: Two-dimensional plot of customer and product manager preferences



Most of the features studied show close agreement and alignment in both the perspectives. Affordable and easy to operate features are ranked high by both the stakeholders and affirm them as absolute requirements for emerging markets. Ready availability, simple or innovative requirements though have low ranking but show high degree of alignment in customer and product manager perspectives. Interestingly, “environment-friendly” low on product manager ranking but comparatively high on customer’s ranking, emerge as an important requirement to study further. The high weightage assigned by the customers to environment-friendliness of the product, depicts the growing awareness in emerging markets towards green products. Notion that emerging market customer is not keen on “sustainability” could prove to be a blind spot for the manufacturers. Research reveals that additional “environment-friendly” feature can enhance the probability of product success in emerging markets.

5.6 Research Implications

This study assesses preferences of BOP consumers in healthcare sector. This study acknowledges the previous research and the high level of importance of “affordable value innovations” (Ernst et al., 2014) in emerging markets. The cog-

nitive barriers of the unskilled workforce in the Indian healthcare industry enforce an equally high ranking to the “ease of use” requirement of the product. The healthcare service divide in India has led service providers to work towards standardization and increased utilization of healthcare personnel. In such a scenario products that require minimal training, which are “easy-to-use” and need “no or low maintenance or consumables” are preferred. The study also compares the customer perspective to those of the product managers to create a more comprehensive view. The weightages given to “environment-friendly” requirement shed some light on growing awareness about green products in emerging markets. Research suggests that developing sustainable frugal products that have high green footprint (Brem and Ivens, 2013) can enhance the probability of success in emerging markets.

Furthermore, this is the first kind of study that compares customer and product manager preferences empirically. This research contributes and enhances the literature on emerging markets by offering both business and consumers views on product requirements. However the comparison doesn’t reveal significant differences but it does give insights on features like environment-friendliness or sustainability that has a potential if emphasized to positively influence consumer buying behaviour.

5.7 Managerial Implications

Emerging markets due to high economic potential have become increasingly attractive to multinationals. The services divide and large customer base with unmet needs offers huge economic opportunities. Innovations in form of healthcare service or new product development would be of high value and will help companies to tap into the large population currently deprived of basic services. Companies are advised to focus on developing affordable value innovations to tap into fast-growing emerging markets. Developing products that are less complex and have high visual comprehensibility is important. The study compares customer and product manager preferences empirically. This comparison has strategic implications for multinationals working on emerging markets to refocus their product designing to customer preferences. This research highlights although most of the ranking of product managers are aligned with customer preferences but there is a potential improvement on importance given to a products being sustainable and environment friendly. If a firm’s uses low consumables and work on new approaches towards solving problems it could impact the buying preferences of the consumers positively.

Chapter 6 : Qualitative model for social value creation with generalized sequence of events

6.1 Introduction

Developing countries are often characterized by significant number of barriers like poverty, accessibility, education, fragile infrastructure and inadequate resource (George, McGahan and Prabhu, 2012, Nakata and Weidner, 2012). Being paralyzed by these challenges government of developing countries is unable to provide the basic services such as healthcare and education services to a vast majority of the population. This lack of service provisioning has created a huge service divide in developing countries (Srivastava and Shainesh, 2015). One of these developing countries, India, which is also the context of this study is suffering from a major challenge of inaccessibility of basic healthcare service especially in the rural areas. However, the government has set up primary care centres in rural regions but the lack of quality care and absence of a social security system still fails in getting the footfalls.

Social security system is a government run initiative in developed world that ensures the basic services to all their citizens. Absence of this scheme in developing countries, consuming any healthcare service causes a direct impact on the disposable income of people. Where most of the population is on daily wages, any healthcare expense is perceived as a burden on the pocket and hence often pushed back in priority or are never availed. The low accessibility and poverty together has made a huge void in India, where there is both lack of healthcare services and awareness. Social entrepreneurs, a relatively new breed of people budding in these markets have taken up this void as an opportunity to serve the disadvantaged sections of the society (Mair, Martí and Ganly, 2007). So far research has been focused on definitions and related parameters of Social entrepreneurship till Perrini et al. (2010) gave a process based view to it and identified development phases from opportunity identification to scaling-up of social enterprises. But research on given intricacies; event tangles and intrusive actions taken within each of these phases are still limited. Perspective like historical understanding or sequence of events that led to creation and scaling-up of social enterprises remain largely unexplored.

Research objective of this part of the thesis is to identify the generalized sequence of events for the process of social value creation. The research is focused on Indian healthcare market and includes two case studies, one for profit and one non-profit enterprise having social missions (Lumpkin et al., 2013). Since the scope is to study the entire process of social value creation from opportunity identification to scaling-up, only successful cases were selected, as the failures by definition would not achieve all the stages (the data would end early in the process). The

two cases studied are Aravind Eye care (non-profit) and LifeSpring hospitals (for-profit). Event structure analysis technique is used to analyse critical incidents and sequence of events that guided their creation and planned scale. An abstract model is derived through comparative analysis of the two cases, which offers sequence of generalized actions with their causal interactions that play an important role in creation of a social enterprise.

6.2 Literature Review

Poverty and lack of infrastructure in emerging markets deprives the BOP customers to avail the basic benefits and services such as healthcare and education. The burgeoning cost of healthcare services and low geographical access has created a gap within the healthcare sector of India. On one side India is the largest producer of doctors in the world but on the other side India suffers from an acute shortage of doctors. The doctor population ratio of India (1:1700) is way below the world-wide average of (1:666) (Srivastava and Shainesh, 2015).

Inability of BOP segment to pay for healthcare service and unavailability of social insurance schemes by the government has resulted in imbalance of doctors in rural and urban areas. 70% of the Indian doctors reside in urban areas and rest 30% in rural India, which is a contrast to population distribution in India. 70% of Indian population resides in rural areas and only 30% in urban areas. This imbalance leaves rural India suffering from inaccessible and poor quality healthcare services.

On the positive side, this dismal picture of existing divide has actually given rise to a new breed of entrepreneurs called “Social entrepreneurs” who look to this divide as a potential opportunity to serve the poor and create social impact. Social entrepreneurs use innovative business models to orchestrate the available resources and offer basic services to the masses in a sustainable way (Mair et al., 2007). Social entrepreneurship is seen as a process of creating social value (Mair and Martí, 2006).

Creating social impact is the main goal of such entrepreneurs and generating economic value often is seen as the means for provision of social value in sustainable way. The main and recurrent challenge for social entrepreneurs is to maintain the delicate balance between the financial stability of business and quality and accessibility of their services or products.

In spite of being a high potential and vastly researched field from last two decades, it still lacks a unified definition (Choi and Majumdar, 2014, Dacin, Dacin and Tracey, 2011, Short, Moss and Lumpkin, 2009). Some studies define social entrepreneurship as a non-profit organization looking for more funding options through business activities while the other consider this as a means to serve the unprivileged section and create social impact irrespective of the involvement of

commercial activities (Choi and Majumdar, 2014). It is also viewed as a social innovation process of converting social problems into opportunities (Lisetchi and Brancu, 2014).

There is still a consensus to be reached on what qualifies under “social entrepreneurship”. For the current study a broad definition of social entrepreneurship based on past research is adopted. This study defines social entrepreneurship as a process of linking innovative activities and orchestrating available resources to create social impact in a sustainable way, irrespective of the involvement of commercial activities (Lisetchi and Brancu, 2014, Choi and Majumdar, 2014, Dacin, Dacin and Tracey, 2011, Lumpkin et al., 2013, Mair et al., 2007). Furthermore, this social impact is predominantly diffused into the market through creation of new organizations whose primary purposes are social and are often referred to as “Social Enterprises” (Lisetchi and Brancu, 2014). Social enterprises are implementations of new ideas focused on connecting the underprivileged section of societies and taking the basic services to them in most economical way. Social enterprises always drive on dual mission of financial sustainability and social value. It is always about investing in innovative business activities which can create social value to make a sustainable social impact (Doherty, Haugh and Lyon, 2014). For the scope of this study, terms “Social Entrepreneur”, “Social Entrepreneurship” and “Social Enterprises” are used interchangeably though it could be a limitation of this study. This is also mentioned later in the limitation section.

So far, research on social entrepreneurship field appears to be focused primarily on the definitions and its parameters. Few studies have acknowledged the different antecedents for social entrepreneurship as compared to commercial setups and have investigated their influence on the subsequent processes (Lumpkin et al., 2013). There are also studies discussing the process-based view on social entrepreneurship. For example, study of Perrini et al. (2010) reveals the different stages of social venture creation process namely opportunity identification, opportunity evaluation, opportunity exploitation and opportunity scaling-up (Perrini, Vurro and Costanzo, 2010). However most of the research till now has been at a higher level and do not delve into the details of each of these phases. Research on the given intricacy, event tangles and intrusive actions taken within each of these phases are limited. Perspective like historical understanding or sequence of events that led to creation and scaling-up of social enterprises remain largely unexplored.

In response to the literature gap, this chapter focuses on identifying the antecedents and sequence of intricate events within each stage of social value creation that led to success of social enterprises in Indian healthcare settings.

“The analysis of acknowledged and successful cases offer the opportunity to identify specific threats and facilitating conditions that influence the ability of social

organizations to pursue their mission” (Perrini et al., 2010). Taking this argument as basis, this study uses two well-established and successful social enterprises of India namely Aravind eye care and LifeSpring hospital. Event structure analysis technique is used to analyse critical incidents and sequence of events that guided their creation and planned scale.

For historical understanding and logical structuring many qualitative analysis techniques are available that use temporal ordering of the events to enhance the understanding of the creation process (Griffin, 1993). For this study a relatively unknown qualitative analysis technique event-structure analysis (ESA) is used, which is more rigorous. ESA is a computer-assisted technique to analyse temporal sequence of events to understand their logical relations and causal interpretations (Heise, 1989, Griffin, 2007).

6.3 Methodology

This research uses a qualitative case study based approach (Yin, 2003) and adopts the replication strategy (Eisenhardt, 1989) for data collection. Cases are selected for their similarities based on the elements important for this research. Theoretical sampling was employed for case selection. Two of the most prominent healthcare initiatives in India were chosen.

In the beginning of the research 10 social enterprises in the healthcare sector were contacted and interviewed. Out of 10, 3 were specializing in ophthalmology, 1 in maternity, 1 in emergency services, 3 in primary and secondary healthcare services, 1 in diagnostics and 1 in mobile healthcare services. Based on the available data, specialization, customer focus and stable business model two cases one from ophthalmology and one from maternity were chosen from the 10 cases for further analysis. There was a deliberate attempt to choose cases from different specialization in order to get a high level generalized model. The two cases chosen were Madurai based Aravind eye care system, a pioneer in ophthalmology and LifeSpring hospitals, Hyderabad based chain of maternity care hospitals. Both of these enterprises though having different customer focus and specialization are motivated towards increasing the accessibility of quality healthcare services to the deprived rural and poor population of India. Both the cases are well researched in the academics and have exemplified profitable business models for providing affordable quality healthcare services to the deprived section on a sustainable basis.

Since this study focuses more on theory building and adapting a new approach of event structure analysis towards social entrepreneurship small sample size allows contrasting and providing some basis for generalization. However, study realizes that two is a small sample size for generalization and acknowledge it in the limitations.

Both primary and secondary data were collected for these cases. Primary data was gathered through semi-structured interview with key organizational informants. Each interview lasted for about 60-90 minutes and a questionnaire addressing the research objective was designed. Interview partners were carefully chosen based on the involvement in the organizational set up. For data analysis, as stated before, study employs ESA for modelling of logical structure of creation of a social enterprise.

ESA (Heise, 1989) is a technique to analyse the narratives (Abell, 2004) and was developed by David Heise (1989). ESA is associated with a computer software program ETHNO for causals connections and interpretations. ETHNO is used for analysis of sequential structures of events and ask required questions for logical linking of events (Corsaro and Heise, 1990). Objective of ESA is to develop a model of logical structures that guide human actions in concrete situation (Heise, 1989). It breaks down each event into constituting actions and produces a qualitative model displaying causal explanations of what happened and why it happened as it did (Heise, 1989, Griffin, 2007, Abell, 2004). It asks a series of questions about how each event relates to previous events. It asks which prior events are prerequisites for the next event to occur, hence helps in building a logical structure of cause and effect relationship. The process of questioning and linking to prerequisites continues until the relationship is established for events. According to Heise, "ESA conducts complete and very efficient elicitations, asking every required question and never a needless question even in very complex systems with scores of events." For example, once ESA has established that A is a cause of B and B is a cause of C, it need not ask whether A is a prerequisite for C. Once the questioning is complete, ESA displays its output in a relational graphical display with nodes representing the events.

This study investigates the selected cases and translates the data into narrative sequence. "Narratives are made up of the raw materials of sequences of social action but are from beginning to end, defined and orchestrated by the narrator to include a particular series of actions in a particular temporal order for a particular purpose" (Griffin, 1993). Narrative contain action linkages and involve analysis of actions by a variety of agents (Abell, 2004). With the help of narratives and ETHNO software an individual graphical model (concrete model) for both the cases is developed.

The multilevel nature of the ESA enables researcher to perform comparative analysis and recognize the commonalities at the abstract level (Corsaro and Heise, 1990). Therefore, to show similarity between the two models a higher level model is abstracted representing the essential features present in each of the concrete models.

In the next section, a brief introduction of case studies precedes the explanation of individual concrete model.

6.3.1 Research setting and data collection

6.3.1.1 Aravind Eyecare Service

Dr. G. Venkataswamy (popularly known as Dr. V) retired at the age of 58 as the head of the Department of Ophthalmology at Government Madurai Medical College, India. During his time at the college he pioneered the task of establishing eye camps to address the healthcare service needs of people suffering from needless blindness at state level.

India as a country is suffering from increasing eye blindness cases. Statistics show that over 80% of those are needless blindness cases, which can be fully cured. Government of India has started various programs but still there is a huge gap in terms of accessibility and awareness of these services. Therefore, even after retirement in 1976, Dr. V wanted to continue offering his services and organizing eye camps. He along with his sisters and brother in law formed a non-profit trust to fund the establishment of first Aravind eye care hospital (11 bed).

From the beginning of this social enterprise, Aravind adopted a different strategy, which was combining free and paying customer. Based on the “ability to pay”, customer had the option to choose between a free or paid service. Irrespective of the choices made (free or paid) the services offered were uniform and well integrated, which circulated trust in its customers. From the beginning out of 11 beds, 6 were for free customers and 5 were reserved for paid customers. The prices were kept at very moderate level and was not used for cross-subsidization. Instead of cross-subsidization, the focus of the established hospital was on high productivity and increasing footfalls, which helped to achieve breakeven in the very first year of establishment.

Thereafter Aravind eye care started expanding from 11 beds to 30 beds to 250 beds, from Madurai to other locations within the Tamil Nadu state. However, with the business expansion came new realizations and challenges. Aravind had started with single offering of affordable cataract surgeries but soon realized the growing need of full eye care service and expanded their service portfolio. Shortage of available doctors and their high remuneration demands needed immediate attention. Increasing cost of lenses and related raw materials like sutures became a threat to financial stability of the business whose mainstay was to offer affordable services. Aravind adopted different strategies to address these challenges.

Aravind started employing paramedics and established local training centres to train them. Mostly these paramedics were recruited from local and nearby areas

and were trained to perform standard non-critical tasks of doctors to free up doctors capacities to 60-70%. This move helped in increasing doctor's utilization rate significantly and also offered employment opportunity to local population.

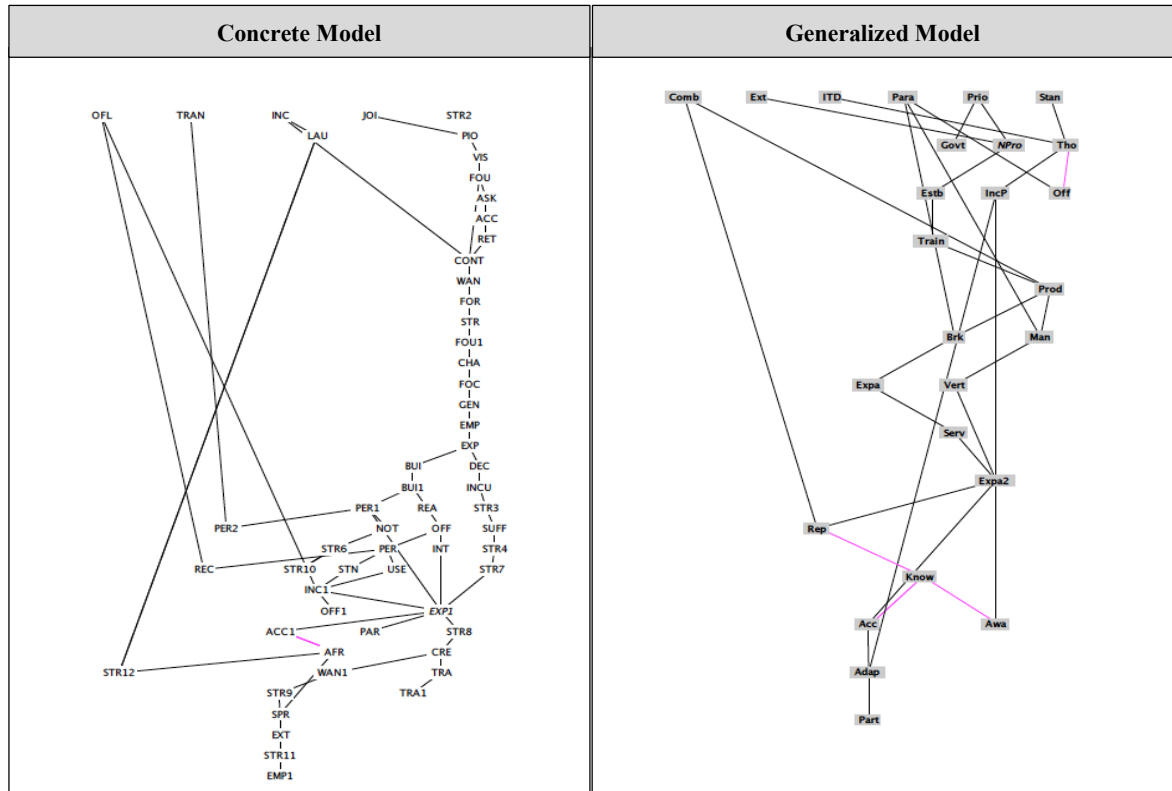
Aravind also diversified into manufacturing of lenses, sutures, blades and pharmaceuticals and used vertical integration as a strategy to hold the rising prices. This resulted in establishment of a permanent and separate business entity "Auro Lab". Auro Lab later became the manufacturing hub for lenses used for cataract surgeries and also other medical supplies like sutures and blades. This initiation from Aravind helped in developing and bringing down the lenses cost by 80-90%. This vertical integration not only helped Aravind hospitals but also other hospitals in developing nations.

Overall, standardization of services irrespective of financial status of the customer, increasing the utilization rate of doctors, vertical integration by in-house manufacturing and many more timely initiatives resulted in increasing the through put for Aravind eye care hospitals. For increasing accessibility and awareness in rural areas, Aravind started outreach centres and organized regular eye camps in far off locations. In total the eventual efforts and innovations at every step helped Aravind make quality affordable services accessible to the deprived and poor sections. But the story doesn't end there, their vision for total eradication of needless blindness keeps them innovating and adapting to new technologies like telemedicine to further enhance their reach. Through growing brand awareness, Aravind is also experiencing a significant increase in the paying customer segment that provides supports to its financial standing. Furthermore, Aravind adopts "open innovation" model and has made its business model very replicable to encourage other entrepreneurs in this field.

Based on careful screening of data and narratives from interviews, 59 significant events were identified. These events were considered critical in defining and orchestrating the development of Aravind eye care into a sustainable social enterprise. These 59 events were then inserted into the ETHNO software and given specific short names (of maximum 3 to 4 characters) to keep the output model legible. Answering the series of questions about cause and effect relationship resulted in a logical and concrete model of the events as shown in figure 6-1. As explained earlier, ESA is a multilayer methodology, where it offers to abstract the essential features and actions present in the concrete structure at a higher-level model. Generalization of critical events at an abstract level is used to perform comparative analysis and recognize the commonalities between different models. For a generalized model, specific events are related to more general categories. For example, there is a sequence of actions depicting the establishment of "Auro Lab": Incurred high cost of surgery due to expensive IOL lenses (INCUL), suffering from high prices of sutures (SUFF), diversification into manufacturing of sutures

(STR4), developing similar facilities for manufacturing blades and other instruments (STR 7). For a generalized model these concrete actions are related to general categories: Need for cost reduction of raw material (RED) and vertical integration or local manufacturing (VER). Figure 6-1 shows both the concrete and generalized models for Aravind eye care. The full names and description of each of the event depicted as nodes in figure 6-1 is given in Appendix (A-1).

Figure 6-1: Concrete and generalized model for Aravind Eye care



6.3.1.2 LifeSpring Hospitals

India has one of the highest maternal mortality rates in the world. India suffers from more than 10,000 pregnancy related deaths each year which are mostly due to lack of adequate pre and post-natal care services (“LifeSpring Hospitals : Providing Affordable , Quality Healthcare,” 2010). Unfortunately, in India the government hospitals are often overburdened and hence lack quality services. On the other side private clinic offering quality care are so expensive that they are out of reach for lower-income families. This has led to a huge void between the service providers and the deprived consumers. Mr. Anant Kumar, who was working for Hindustan Latex Limited (now HLL Lifecare), realized the prevailing gap during his experience at HLL. He sensed the business opportunity in this void and submitted a proposal to HLL to start maternal clinics providing high-quality and af-

fordable services in Hyderabad's sprawling urban slum areas. Soon after the approval from HLL, a New York-based private social investor Acumen Fund also joined in and funded the proposal.

In 2005, first maternal hospital named "LifeSpring" was started in Moula Ali, a suburb of Hyderabad. LifeSpring focused on narrow specialization, basic maternity and child care services. All the complicated cases were mostly referred out. It adopted a pricing structure based on cross-subsidization model. In this model, higher paying group is burdened to cover the expenses of lower paying segments (Troyer, 2002).

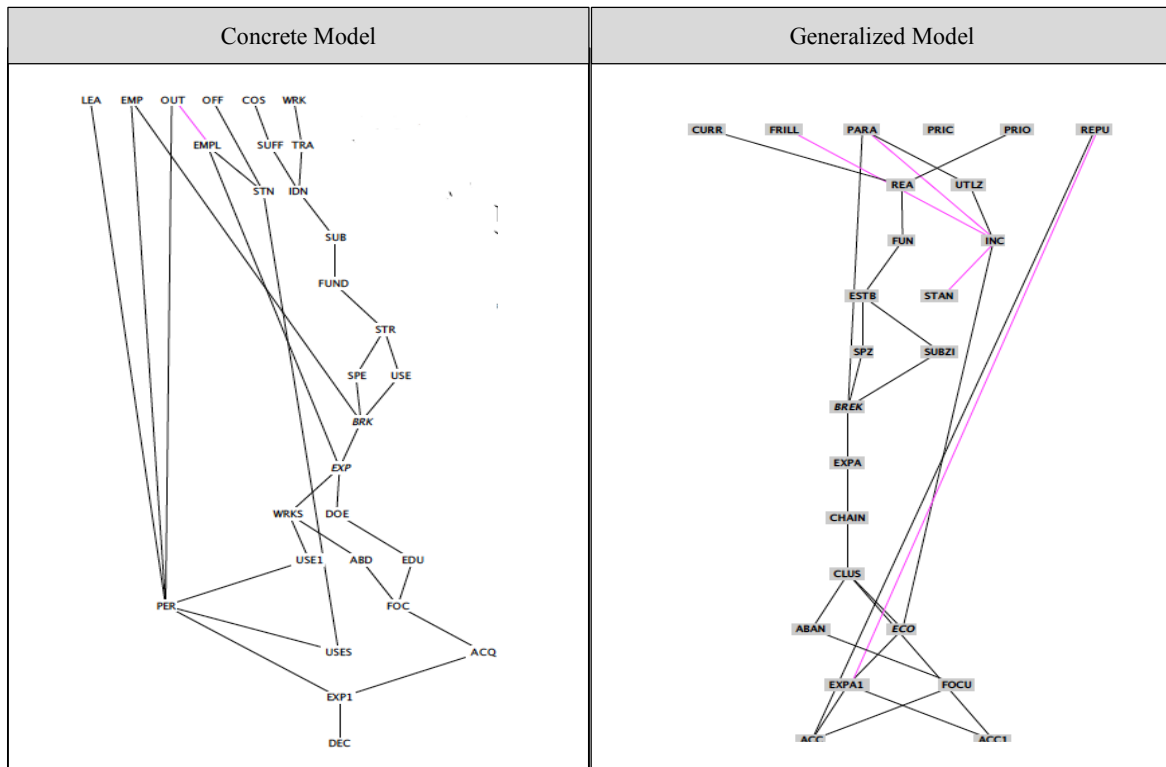
For keeping the expenses at bare minimum, LifeSpring made a strategic decision of not investing in capital infrastructure and preferred to take them on lease. They adopted a no-frill approach: no-canteens, outsourced pharmacy and laboratory services. Cross-subsidization and no-frill strategy helped LifeSpring to breakeven within 18 months of operational life.

In the business expansion phase, there was a constant effort towards efficient utilization of expensive resources. High numbers of lower skilled Auxiliary Nurse Midwifery (ANMs) instead of General Nursing and Midwifery (GNMs) were recruited. These ANMs helped in offloading the administration and non-critical tasks from doctors to a large extent. Within 3 years after the launch (2005), LifeSpring started rapid expansion and grew to 9 hospitals in 2009. After the first business expansion, LifeSpring experienced a drop in high paying customer segment as most of the sub-units were situated in slum areas. Introspection at LifeSpring at this point, led to abandoning of cross-subsidization model and refocus on lower income and poor population residing in slums. It narrowed the focus only on slum population and located all the new subsidiaries in high density, low-income areas. This approach of closely situating the subsidiaries is referred to as "cluster approach". This approach not only ensured LifeSpring higher volumes but also enabled sharing of expensive resources within LifeSpring hospitals. For higher productivity, LifeSpring standardized the maternity care and guaranteed quality of hospital procedures. Transparent pricing, standardized quality and refocus on poorer sections helped LifeSpring to build reputation and circulate trust in their customers. For increasing awareness and accessibility, regular camps were hosted with the help of outreach workers.

All these efforts helped in continuous expansion (12 hospitals in 2012) and increase in market share (52% as of 2012) of LifeSpring hospitals. Based on careful screening of data and narratives from interviews, 30 significant events were identified. These events were believed to play a critical role in defining and orchestrating the development of LifeSpring hospitals into a sustainable social enterprise. These 30 events were inserted into the ETHNO software and were given specific short names (of maximum 3 to 4 characters) to keep the model legible. Answering

the series of questions about cause and effect relationship resulted in a logical and concrete model of the events as shown in figure 6-2. As a next step like in the case study above of Aravind eye care, events from concrete model were generalized as and where it was applicable. Figure 6-2 shows both concrete and generalized models of LifeSpring hospital, in the form of linked logical events. The full names and description of each of the event depicted as nodes in figure 6-2 is given in Appendix (A- 2).

Figure 6-2: Concrete and generalized model for LifeSpring Hospitals



6.4 Discussion

For further analysis, the two generalized models representing the essential features present in each of the case studies were used. For comparative analysis, the four stages identified by Perrini et al. (2010), opportunity identification, opportunity evaluation, opportunity exploitation and opportunity scaling-up were used to categorize events into different phases. Sequence of events and intrusive action taken in each of the phases are compared for both the case studies to identify an abstract model for social enterprises.

Figure 6-3: Generalized model of Aravind Eye Care (Detailed view)

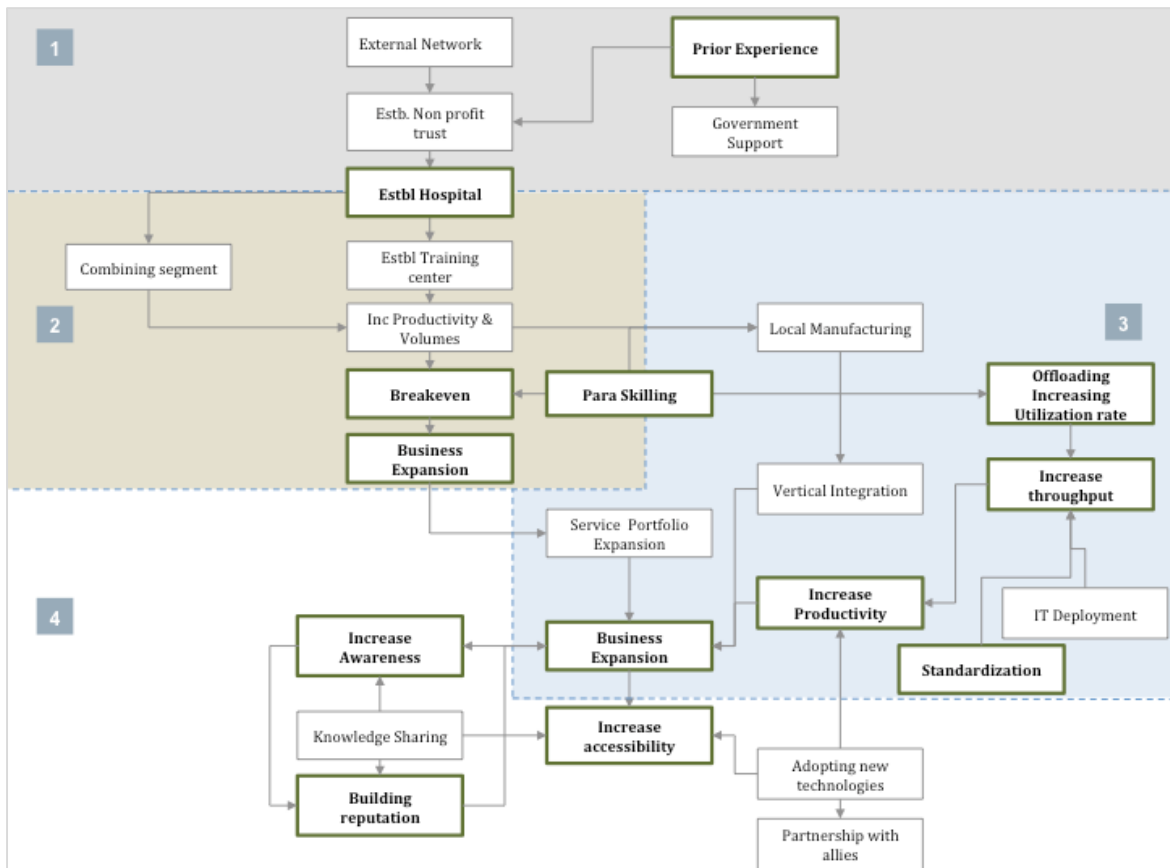


Figure 6-4: Generalized model of LifeSpring Hospital (Detailed view)

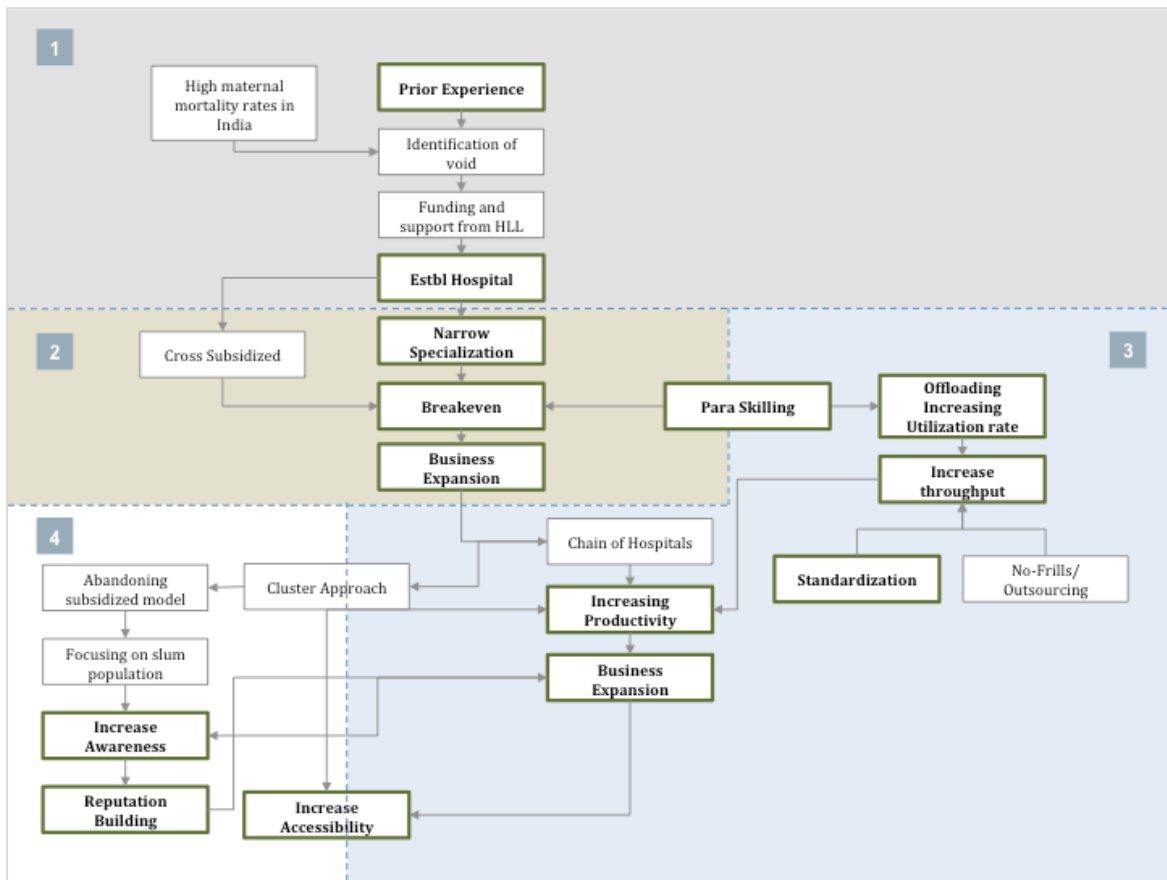


Figure 6-3 and figure 6-4 show a detailed view of generalized model for Aravind and LifeSpring respectively. It categorizes the event sequence into the four phases of developments and also highlights the similar actions across two cases.

The first phase is “Opportunity identification”, realization of an existing divide or void in the society that can be addressed by innovative business models centred on social value creation. Both the cases reveal that prior experience in similar field does impact the ability of the entrepreneur to detect the opportunity. Prior experience introduces entrepreneurs to relevant external network which in these two cases were also first sources of funding. Dr. V and Mr. Kumar both had prior experience that introduced them to the societal issues and supplied relevant network for further implementation. Dr. V had already pioneered conducting eye camps in rural areas and was well supported by the state government and got his funding from his immediate family working in the same field. Work experience of Mr. Kumar at HLL influenced establishment of LifeSpring to a large extent including offering a platform to launch the enterprise and providing financial support.

In the next phase of “Opportunity evaluation” the vision and the main social cause are defined. Evaluation of available resources is done to support the systematic achievement of social cause. This phase also gauges the economic viability of the

business model ensuring breakeven and potential of business expansion along with identifying the main customer or deprived society section. Both the studied cases focused on narrow specialization and targeted specific customer segments. Aravind's specialization was in ophthalmology and target customer segment was people suffering from needless blindness. LifeSpring concentrated only on maternity care for mothers from slum areas who were deprived of quality care services. Once the vision and targets are set, enterprises took intrusive actions to subsequently achieve their targets. Aravind started with pricing strategy of combining of free and paying patients, where patients could opt between free or paying route but the back-end service was completely integrated. Also with establishment of the hospital they started with their own training centre. This training centre supplied them with constant number of doctors, which helped in increasing the volumes of the patients operated and overall productivity for Aravind. LifeSpring opted for cross-subsidy pricing model where there were different prices depending on the paying capacities of the customer and part of the payment from high paying customers was used for subsidizing the services of the poorer section. LifeSpring employed paramedics (ANM's as explained in above section) to lower the cost of services and also increase the productivity of doctors. Overall for both the cases, narrow specialization, having pricing strategy specifically designed for target customer and use of paramedics helped to breakeven quickly.

“Opportunity exploitation” phase is an iterative phase where enterprises perform certain activities to achieve objectives. In both the studied cases the objective was to bring affordable and accessible healthcare services to the deprived sections. Affordability objective led them to adopt standardized procedures and measures, focus on increasing utilization of expensive resources and enhancement of productivity. They used paramedics extensively to increase the utilization rate and hence the productivity. Standardized procedures were used to productize the services to ensure the quality of clinical care and increased overall through put. Apart from these similar actions taken there were some case specific interventions too for achieving low cost services. In the case of Aravind eye care, increasing prices of lenses and sutures became a hindrance in offering affordable or free service to the end customer. Aravind in this situation opted for vertical integration with commencement of its own in-house manufacturing. The cost of lenses was reduced to 80-90% of the initial costs. Aravind also expanded the service portfolio around eye care to offer end-to-end service to the end customer. In the other case, LifeSpring adopted a cluster approach and situated all the subsidiaries in close vicinity, which enabled sharing of expensive resources amongst them and also increased penetration in densely populated areas.

For accessibility, both the enterprises worked with local healthcare workers and conducted outreach camps frequently in far off areas. Aravind even offered free

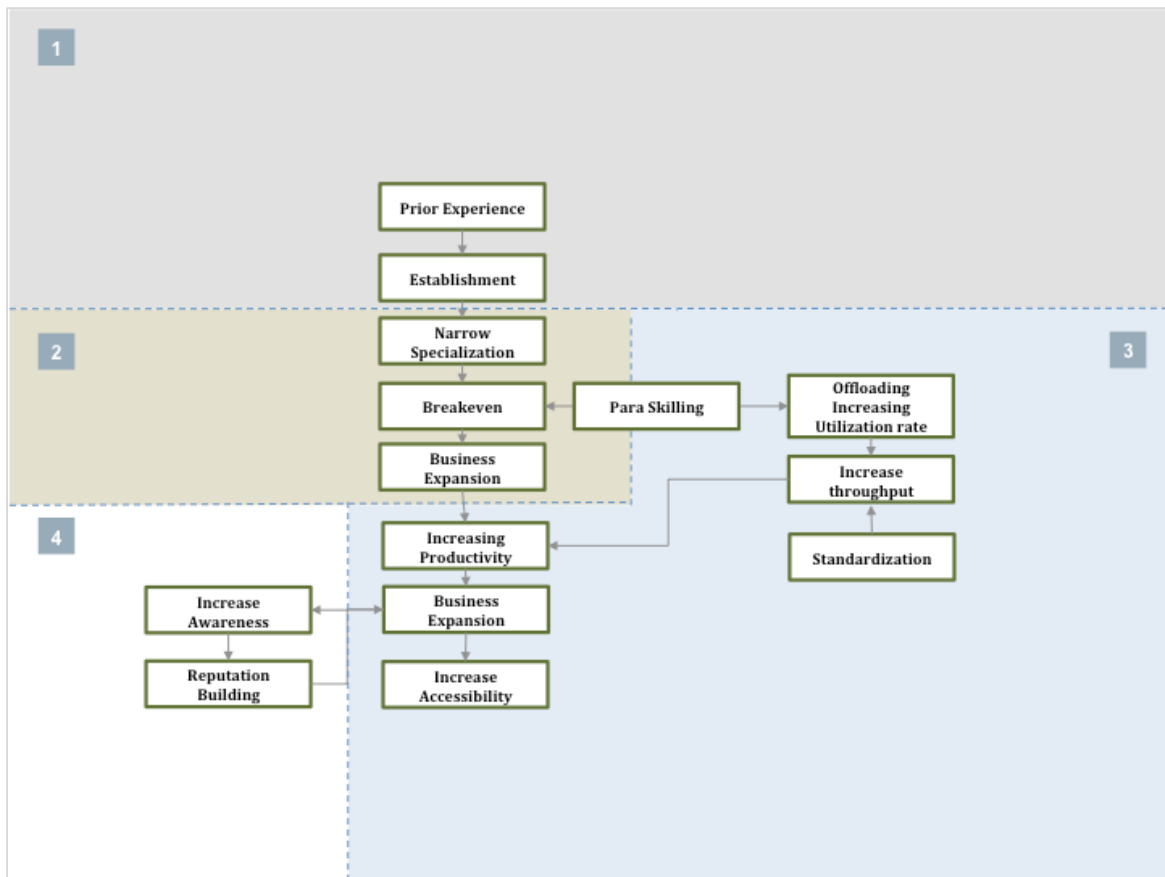
transportation service to the patients and also expanded their eye care service portfolio to be a one-stop shop for all eye related issues.

Finally the last phase of “scaling-up” is about the ability to grow and adept to new technologies and trends. Aravind worked on “open innovation” model and made its business model replicable to foster social entrepreneurship in this field. Aravind started outreach centres in far-flung areas and adopted latest technologies like telemedicine to connect to the inaccessible places. The highly standardized and well-integrated process made Aravind into a replicable model. Aravind encouraged and trained other similar social enterprises for adopting their proven model. LifeSpring on the other hand, re-tuned its pricing strategy and abandoned cross-subsidy to completely concentrate on poorer sections, which helped them increase their market share and reputation. For both the cases increased accessibility, high brand recognition, establishment of quality standards resulted in increased footfalls and enhanced sustainability.

Figure 6-5 below shows process view of creation of social enterprise with the contributing generalized actions and their causal interactions.

Prior experience of the social entrepreneur enables opportunity identification and formalization of a social enterprise. Identifying a narrow scope is critical for breakeven and economic viability. For healthcare sector where affordability is the main objective, standardization, para-skilling plays a very crucial role in increasing productivity. Moreover, brand recognition and involvement of local community workers helps in spreading awareness and business expansion.

Figure 6-5: Abstract model of a social enterprise



6.5 Research Implications

This study enhances the literature on social entrepreneurship in mainly three ways; first of all in an attempt towards theory building around social entrepreneurship, it offers an entirely new perspective of analysing the social value creation process from the causal interaction of events and through historically understanding. Secondly it introduces a relatively new qualitative analysis methodology “event structure analysis” showcasing the potential of the technique in management research field. And finally it offers an abstract qualitative model showcasing the sequence of significant actions with their causal interactions that play an important role in creation of a social enterprise. Prior experience and narrow focus or specialization is helpful in initiating the process of social value creation while standardization to a large extent and increasing utilization rate of expensive resources by substituting them or sharing them is helpful in increasing productivity and expansion. Constant quality standards and successful track records helps in brand recognition, which is necessary for scaling up and spreading the innovation to as far as possible. ESA is unique and useful methodology for qualitative modelling but has been rarely used in management research for qualitative studies.

This study is one of the first few attempts to showcase the potential and application of ESA in management literature.

6.6 Managerial Implications

This study provides useful insights to social entrepreneurs running or in process of creating a social enterprise. The generalized models offer the historical understanding of successful social enterprises and insights on sequence of events, expected challenges and various innovative intrusions taken throughout the process. The abstract model also identifies critical actions for each phase of development. It gives a process view of creation of social enterprise with the contributing generalized actions and their causal interactions.

Chapter 7 : Conclusion

Innovation is crucial for organizations to remain competitive across regions. The type and focus of innovation however differs based on the stage of economic development of the region. This thesis is an attempt to understand the innovation landscape in both developed and developing countries and hence studies the innovation strategies and frameworks in detail. Thesis is divided into two sections, the first section focuses on the on-going innovation strategies for the developed world and the second section studies the innovations approaches fostering in emerging markets.

Figure 7-1: Innovation landscape in developed and emerging markets

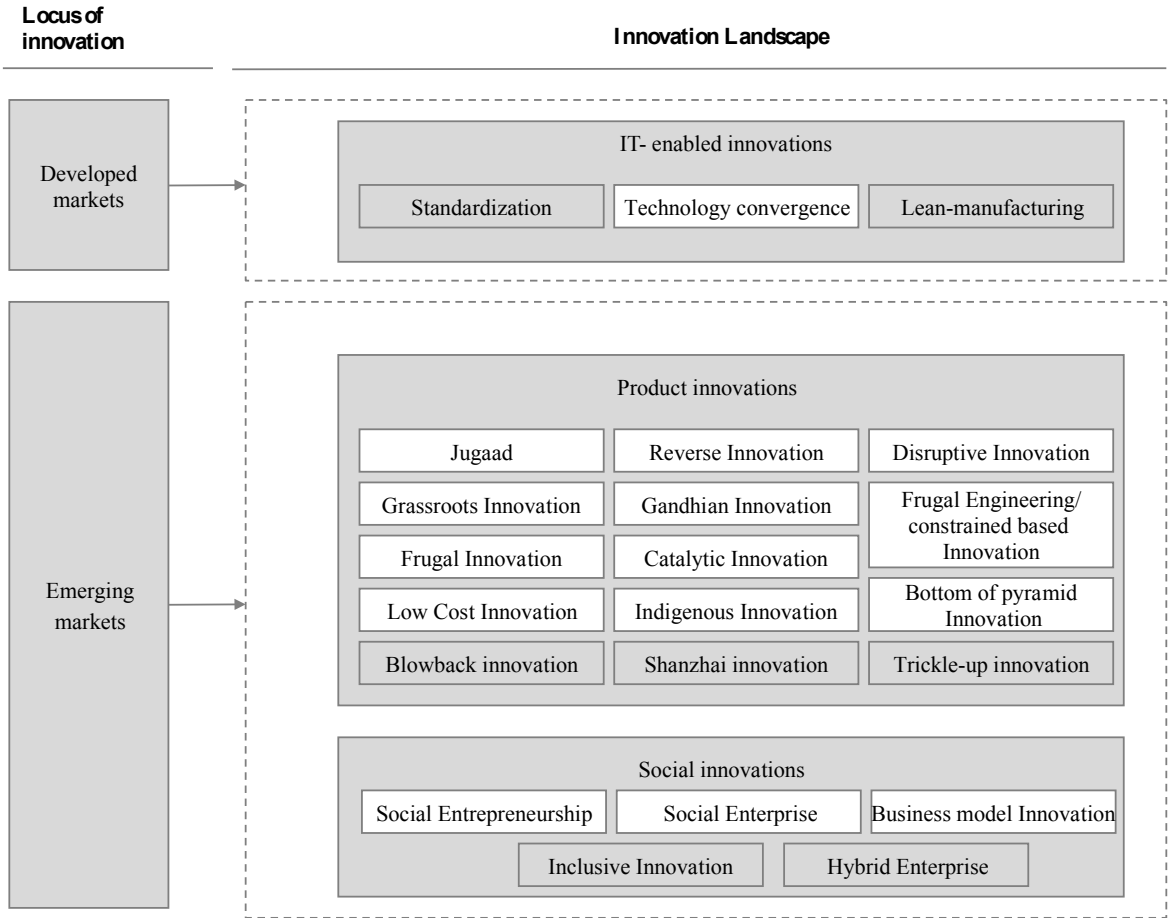


Figure 7-1 shows an overview of the innovation landscape for developed and emerging markets and indicates the main innovation approaches that are studied and analysed in this thesis. For developed markets, as shown in figure 7-1, this thesis focuses only on one of the IT enabled innovation approaches, namely technology convergence. However, for the emerging markets, thesis indulges into much more detail and studies the most frequently used and recurrent low-cost innovation approaches. For further analysis in context of emerging markets, it divides all the relevant innovation approaches into two categories: product centric

innovations and social innovations. The product centric innovations such as frugal innovation (Zeschky, Widenmayer and Gassmann, 2011), Jugaad (Radjou, Prabhu and Ahuja, 2012), grassroots innovation (Gupta, 2013), catalytic innovation (Munshi, 2010), indigenous innovation (Lazonick, 2004) Gandhian innovation (Prahalad and Mashelkar, 2010), disruptive innovation (Christensen, 1997, Christensen and Bower, 1996), reverse innovation (Immelt, Govindarajan and Trimble, 2009), innovation at the base of the pyramid (Prahalad, 2010), and resource-constrained innovation (Sharma and Iyer, 2012) are used for new product developments in emerging markets. Social innovations are used for social value creation and to address societal challenges existing in emerging markets. As mentioned before, the study discusses relevant innovation approaches from different perspectives and uses the insights to answer the four research objectives of this thesis.

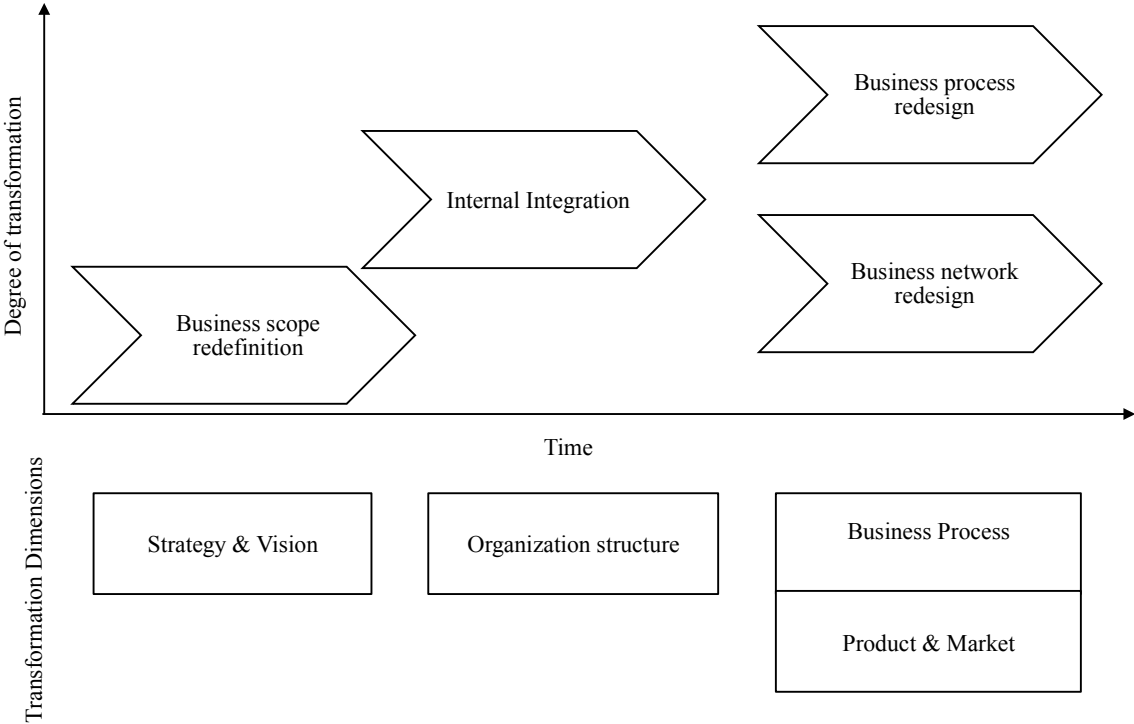
First objective is to initiate research and develop understanding of this relatively new innovation strategy, “technology convergence” and also analyse the strategic transformations businesses are undergoing for implementation of this convergence. Second objective of the thesis is to understand different product centric innovation approaches in context of emerging markets and also to provide a consolidated framework of these overlapping innovation approaches. Third objective is to identify and prioritize the key product and customer requirements for emerging markets. The fourth and the final research objective of the thesis is to develop intimate understanding of social innovations addressing social challenges or service divides existing in emerging markets.

Chapter 2, of this thesis discusses the phenomenon of “technology convergence” in detail and responds to the first research objective of the thesis. It offers a conceptual model to understand the strategic transformations businesses are undergoing due to technology convergence. Chapter analyses the case of GE to exemplify the strategic transformation due to convergence of technologies and identify the transformation stages and organizational dimensions involved. In developed world, information technology has emerged as the one of the key enabling technologies and an important driver for innovation. Industrial businesses are increasingly integrating information technology into their core functions for productivity benefits. Gartner (2011) studied this phenomenon of integration in more detail and introduced the term “technology convergence”. Gartner defines technology convergence as an integration of information technology and operational technology to develop unique capabilities within a firm for performance gains. This convergence is expected to revolutionize the industrial world and is considered to be a much bigger initiative than just the enablement of IT into business processes.

The study uses Venkatraman’s model (1994) in conjunction with the five critical organizational dimensions proposed by Qingfeng et al. (2008) to analyse GE’s implementation of the industrial internet and develop the conceptual framework as shown in the figure 7-2. This conceptual framework maps the gradual stages of transformation to the degree of transformation expected and indicates the most influenced business dimensions at each stage of transformation. For example business scope redefinition influences the dimension of strategy and vision while internal integration influences the organization’s structure. During the business process redesign and business network redesign stages, the two dimensions of business process and products and markets are influenced the most.

Study explains that GE started its initiative by changing its business outlook and focusing on solution oriented offerings. GE underwent an internal integration and consolidated its IT capabilities into a new software centre of excellence. This internal integration eventually led to transformation of business processes at a larger scale. Both these stages of internal integration and business process redesign emerge out to be the most challenging stages within the transformation process with high degree of impact.

Figure 7-2: Strategic transformation-conceptual model



Convergence-related business transformations are non-linear in nature and both time and capital consuming process. Study also show that some dimensions and stages of transformation previously thought to be relevant for IT enablement, may not be pertinent for technology convergence related business transformations. For example, currently when most of the firms are already IT-enabled, the first stage

of localized exploitation has become a default or a prerequisite for technology convergence. In GE's case also the localized exploitation phase appeared to be a prerequisite to the technology convergence. Overall, considering the revolutionizing potential of technology convergence, it is emerging as a new medium for developing unique capabilities based on IT investment in the developed countries.

The next section of the thesis focuses on emerging markets and related innovation approaches. Emerging markets are becoming breeding grounds for innovations centred on affordable and social solutions. In this thesis, chapter 3 and 4 offer a comprehensive understanding of these markets and existing innovation approaches being used. These chapters also help to respond to the second research objective of identifying and consolidating literature on product centric innovation approaches.

Chapter 3 provides a basic understanding of emerging markets and explains how these markets are gradually becoming innovation hubs of the world. The chapter reveals the shifting attention of western multinationals towards these markets and their changing outlook. Instead of customizing the western world products to local markets, western multinationals are increasingly developing products from scratch for the local consumers and localizing their product development activities to attract BOP consumers. They are engaging in frugal and reverse innovations, by developing affordable products and solutions with "good enough" functionalities and minimum frills. The study uses a case study on Siemens, a German medical equipment manufacturer to understand the innovation model and new product development strategies of western multinationals in context of emerging markets. It confirms that co-creating with customers, bottom up development approach along with end-to-end localization and core value identification are important for sustaining competitive position in emerging markets (Gollakota, Gupta and Bork, 2010). The case study reveals that BOP customers are highly price sensitive and look for high value - low cost products that are tailored to their specific requirements. It is not sufficient simply to de-feature or resell products from western markets (Ernst et al., 2014, London and Hart, 2004, Agarwal and Brem, 2012). Success in emerging markets requires a new product development approach that involves co-creating with BOP customers and tailoring products to their needs (Ernst et al., 2014, Nakata and Weidner, 2012, Agarwal and Brem, 2012). Case study discusses Siemens' "SMART" (Simple, Maintenance friendly, Affordable, Reliable, Timely to market) product development initiative, which is being extensively used in the company to develop frugal products.

Based on this understanding, chapter 4 attempts to consolidate all the required and distinct product features for emerging market that are researched in the literature so far. It identifies the most frequently used product centric innovation ap-

proaches, such as jugaad innovation, frugal innovation, reverse innovation, disruptive innovation, frugal engineering, gandhian innovation, catalytic innovation, grassroots innovation and indigenous innovation and gathers specific characteristics of each of these approaches using a systematic literature review methodology. “Sematic similarity”, a neuro-linguistic tool and ward’s cluster method is used to statistically group the characteristics into eight factors or product characteristics and develop a consolidated model of the relevant innovation approaches. The eight consolidated product characteristics thus obtained are cost-effectiveness, easy-to-use, sustainable, problem-centric, no-frills, fast-to-market, resourceful and breakthrough. The framework offers a summarized version of the academic research done so far, however is also limited by the approach of being based purely on academic literature. Therefore, for judging its practical relevance, validation from the industry and customers was needed. Interestingly this need coincided well with the next research question of this thesis “identifying and prioritizing the key product and customer requirements”.

Chapter 5 focuses on quantitative data analysis and validation of framework from customer and manufacturer’s perspective. It identifies the BOP customer requirements and analyses their priorities of product features during the buying process. To limit the scope, study focused only on Indian healthcare market and collected data from Indian doctors and medical equipment manufacturers selling in India. Data analysis was done using Analytic hierarchy process and results confirm “affordable” and “easy to use” as the absolute requirements of BOP customers. Research reveals the growing awareness of eco-friendly products within BOP customer segment and introduces two additional important features from customer perspective namely – low/no maintenance or consumables and customized solutions. Study explains that due to high resource constraints, customers prefer a product that is customized to local infrastructure and requires low consumables and maintenance. Apart from customer perspective, study validates the framework from product manager’s perspective also. Comparison of the two perspectives affirms the decent understanding of the market requirement by product managers. Although the comparison doesn’t reveal significant differences, it does give insights on features like environment-friendliness or sustainability, which can positively influence consumer-buying behaviour. Research suggests that developing sustainable frugal products with a green footprint (Brem and Ivens, 2013) can enhance the probability of success in emerging markets

Research till chapter 5, is mainly centred on product innovation approaches, which covered only a part of innovation landscape in emerging market. The other crucial part of social innovations is covered in the next chapter 6. This chapter is an attempt to understand service and social innovation in detail and respond to the last

research objective of the thesis. It develops a generalized model for social enterprises and studies the diffusion of social innovation in emerging markets.

Chapter 6 discusses the innovation theories from socio-economic perspective and show how innovations are used to convert societal challenges into business opportunities in emerging markets. Restricting the study to Indian healthcare market, with the help of two well-established and successful Indian social enterprises cases, study offers a process-based view of this social value creation. The two cases, Aravind Eye care (non-profit) and LifeSpring hospitals (for-profit), are explored using Event structure analysis to understand the process of social value creation. ESA is a relatively new qualitative data analysis technique that establishes a causal link to different events from opportunity identification to scaling-up and helps in formulating an abstract model of the whole process. Using ESA approach, the study provides a generalized model of social enterprises, showcasing the sequence of significant events happened in the diffusion process.

Social enterprise is a medium for diffusing social innovations into the market (Lisetchi and Brancu, 2014). However, social innovations are not restricted to just creation of a social enterprise but include innovative strategies employed by these social enterprises to be self-sustainable and accessible to a vast population. To understand these innovation in detail, study uses the four growth stages identified by Perrini et al. (2010), opportunity identification, opportunity evaluation, opportunity exploitation and opportunity scaling-up to analyse the cases and identify unique innovative strategies employed at each of these stages. Within the first stage, prior experience plays a crucial role in identification of business opportunity and in formalization of a social enterprise. Second or the evaluation phase is where pricing models are discussed and customer segment and specialization is fixed. Study reveals that opportunity exploitation stage is highly critical stage for such enterprises and hence includes various business model innovation initiatives. These innovations are mostly targeted towards increasing accessibility, utilization rate and self-sustainability of the social enterprise. For example, in case of Aravind eye care, they adopted vertical integration to restrict the rising cost of lenses used in cataract surgeries and in case of LifeSpring hospitals, they employed “cluster approach” to enable sharing of expensive resources to increase the utilization rate of expensive resources. Last stage of scaling-up is often a far-fetched dream of social enterprises due to their dual mission background. However, in the successful models adoption of replication strategy and knowledge sharing emerge as the main drivers.

7.1 Research Contributions

This thesis gives a comprehensive view of the innovation landscape in both developed and developing worlds and elaborates new innovation fields and methodologies in management literature such as technology convergence, semantic similarity and event structure analysis.

This thesis initiates the research in the field of technology convergence. It supports the resource-based view in utilizing IT capabilities and proposes technology convergence as an innovative application of IT for realizing performance gains through IT investment. It also expands the Venkatraman's model by mapping the transformation stages with the organization dimensions impacted.

This research also enhances the management literature by developing a consolidated conceptual framework of relevant innovation approaches in context of emerging markets. The proposed framework summarizes the critical requirements of the BOP customers in emerging markets. This consolidation helps to close the research gap of unstructured and fragmented available literature and brings clarity to the increasing terminology confusion (Reinhardt, 2014). The consolidated framework summarizes the overlapping and recurrent characteristics across the similar innovation approaches and also provides unified data insights to the practitioners. Furthermore research provides quantitative and empirical validations, which is rare and lacking in the previous research done on emerging markets. Most of the literature in this field is still limited to anecdotal evidence and dissection of company practices (Cunha et al., 2013).

This study contributes in introducing translational qualitative & quantitative research methodologies used in other fields such as a relatively new qualitative analysis methodology "event structure analysis" and "semantic similarities" respectively and showcases the potential of these techniques in management research.

7.2 Limitations and future research

Convergence of technology is a relatively new field in which only a limited amount of research has been conducted so far. For this reason, this study assumes that transforming businesses by aligning OT and IT follows similar phases and dimensions as observed in IT-enabled business transformations. Unavailability of implementation cases and insufficient past research is limitations of this study. However, as this field matures, the conceptual model proposed in the study can be enhanced and further validated for other sectors and companies working towards technology convergence. This is an evolving field and therefore needs follow-up research to better understand how other companies/sectors are adopting this phenomenon. This topic can be also developed in

the context of an RBV framework and use technology convergence to measure financial benefits of IT investments.

On the emerging market side, the consolidated framework developed in the study is limited to product centric innovation approaches only. Figure 7-1 shows a summary of innovation approaches studied in this study. It will be interesting to study and enhance the framework with flow based innovation approaches, which have not been considered in this research such as trickle up or blowback innovations. Research on emerging markets also suffers from limited and fragmented past research. Especially on innovation theories like “catalytic innovation”, “indigenous innovation”, “gandhian innovation” there are very few scientific articles available. Nevertheless these theories are considered important and have been used in the study. Another limitation of this research is that the sample studied is limited to the Indian healthcare industry. Since it’s a niche industry the sample size is small for customers as well as for product managers. Quantitative results of the thesis are limited to Indian healthcare sector only. The priorities and framework relevance might change for other sectors or emerging markets. To study the priorities differences across emerging markets is proposed for the follow up research.

Furthermore for research on social innovation, this study uses the terms “Social entrepreneur”, “Social Entrepreneurship” and “Social Enterprises” interchangeably. There are intricate differences between these terms. Since this study is an attempt towards enhancing the research on social innovation from a temporal sequence and causal interaction perspective, fine-grained analysis on these similar terms is postponed for a later study. Also, there is a potential scope to enhance the generalized model with research insights on inclusive innovation and hybrid enterprises as shown in figure 7-1 that are similar to social innovations but are not discussed in this study.

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B. Appendix

B – 1 Short names and description for Aravind Eye Care

(in alphabetical order)

Short Name	Description
ACC	Dr. V accompanied CM Karunanidhi who started eye camps supported by the government in whole of Tamil Nadu
ACC1	Aravind hospital did not advertise but good reputation was spread mainly by word of mouth
ACCK	Increase accessibility of knowledge
ACCS	Increase accessibility of services
AFR	People were afraid of operations only 7% having eye problems turn up in eye camps
ASK	Dr V and Sir Wilson went to the PM of India to ask for support of a national organization to control blindness
BRK	Quick financial / operational breakeven
BUG	Entrepreneur builds global network with experts
BUI	A 70 bed hospital meant exclusively for free patients was built
BUI1	Paying hospital was opened with 250 beds
CHA	Aravind hospital charged paying patients moderately
COM	Combining of free and affordable paid services
CONT	Dr.V wanted to continue to work he was doing at the college organizing eye camps to check sight, prescribe needed corrective glasses and do cataract surgeries
CRE	LAICO creates courses that cover the broad needs of our trainees that include paraprofessionals, ophthalmologists, eye care program managers, administrators, and others
DEC	Aravind eye hospital had decided on the IOL technique as the standard technique to be adopted in all cases (excepting those where this could not be done)
ECO	Economies of scale
EMP	AOL employed around 90% specifically trained women from rural areas
EMP1	Employed innovative Telemedicine technology to keep the cost low
EST	Established non-profit trust to collect funding
EXP	Dr.V expanded to a 30 bed hospital within a year

EXP1	Dr. V expanded services to 5 regional hospitals that perform over 200,000 cataract operations per year , 70 % without cost to the patient
EXPA	Business expansion
EXT	AEH extended camps to special areas like school including use of innovative technology tele- Ophthalmology
FOC	Dr. V focused on high productivity and volumes
FOR	Dr. V formed a non-profit trust, the Govel Trust with himself as the Chairman and his two brothers, two sisters and their spouses
FOU	Dr V became friends with Sir John Wilson founder of Royal commonwealth society for blind which was supporting eye camps in India
FOU1	Dr. V founded Aravind postgraduate institute of Ophthalmology training institute
GEN	Aravind eye hospital generated a surplus in the first year
INC	India suffering from increasing eye blindness 3.8 million new cases of blindness added each year (over 80% needless blindness), low capacity and over 80% cases of needless blindness
INC1	Aravind elevated productivity by production line approach to the actual operation where they are divided into sub-processes of preparation and actual operation and saves time for the doctors
INC2	Aravind hospital incurred high cost of surgeries as the IOL lenses (all of which were imported) were expensive and cost about \$80-100
INT	Aravind introduced the Residency (postgraduate) Program to train ophthalmologists
JOI	Dr V joined government medical college as an ophthalmologist
KNOW	Knowledge and best practice sharing
LAU	Government of India launched a cataract blindness control programme with World Bank funding and offered a subsidy for the camp patients, the camp patients were not charged this amount. In stages, the number of beds increased to the present 1468 beds (1200 free and 268 paying) in the hospital at Madurai.
NOT	Aravind noticed delay in getting the spectacles and related high cost including transportation to get that was a barrier to refractive correction
OFF	Aravind eye hospital started offering other specialities like retina, cornea, and glaucoma paediatric ophthalmology.
OFF1	Aravind hospital offered free services to over 1,50,000 people and equal number paid for their services at a very moderate rate
OFL	Aravind offloaded the 60-70% of the doctors work to increase their time spent on critical tasks

PAR	Tied up with insurance companies
PARA	Para skilling
PART	Partnering with allied services
PER	Aravind needed that surgeon can perform 2000 surgeries per year that an average of 500 Surgeons perform six to eight operations per hour
PER1	Aravind sets temporary screening camps in villages over the weekend where there is a large population of untreated patient who cannot afford displacement to main hospital
PER2	A basic model adopted by Aravind from the very beginning was that no surgeries were done at the eye camp sites which was not the case earlier
PEX	Entrepreneur has prior experience
PIO	Dr V pioneered state level programs to address blindness by establishing mobile camps
PRO	Focus on increasing productivity and higher volume
REA	Dr. V realized the need to offer full eye care service and not just cataract surgeries
REC	Aravind hired local paramedics, local girls 10+2 who were trained in the institute
RED	Cost reduction through local manufacturing
RET	DR. V retired at age of 58
SER	Services portfolio expansion
SML	Trust started a specialised small sized hospital
STAN	Standardization of care
STN	Aravind utilized simple versions of cataract operations mainly known as the manual, suture-less small incision cataract surgery or SICS which in spite of allowing high productivity with up to 18 operations per hour per surgeon doesn't compromise quality
STR	Govel Trust started a 11 bed hospital in Madurai for people who suffered cataracts and with other eye diseases
STR10	Aravind started innovative mobile optical shop study of barriers to refractive correction.
STR11	They opened primary care centres which worked like spokes
STR12	Government started the schemes for BPL
STR2	Aravind started Centre for Women, Children and Community Health (ACWCCH) to reduce nutrition related blindness in children through programs of preventive health care.

STR3	Aravind Hospital decided to set up a facility to manufacture lenses AOL
STR4	Aurolab diversified into manufacturing of sutures used in the IOL surgery. The sutures are made from silk and nylon and come attached to a tiny stainless steel needle. The cost of the sutures at Aurolab was one fourth of the price of imported sutures.
STR5	Aravind established Eye Bank affiliated to the International Federation of Eye Banks.
STR6	Aravind set up, the spectacle lens division to improve the prescription and provision of spectacles.
STR7	Aravind hospital developed similar facilities for the production of blades, pharmaceuticals and instruments
STR8	Aravind started LAICO to train doctors and paramedics in other areas and countries
STR9	LAICO started Aurosikhsha online learning system with the support of the Lions Club International, SightFirst Program, and Seva Sight Program
SUFF	Aravind hospital still suffered from high prices of sutures
SUG	Entrepreneur supported existing government initiatives
THP	Increased through put
TRA	LAICO trained more than 10,000 blindness prevention workers worldwide, year after year, across 270+ hospitals
TRA1	LAICO empower our all-women team of paraprofessionals who form the backbone (about 60%) of Aravind's workforce. These women never had the chance to go to college, now they get the opportunity to enter the work stream as mid-tier technicians
TRAI	Established training centre to develop talent
TRAN	Aravind provides free transportation to patients requiring specialized treatment
TRI	Training skilled personnel
USE	Aravind used of IT systems to automate the process and balance the load
UTI	Efficient Utilization of expensive resources
VER	Vertical integration for customer
VIS	Dr V visited US to attend a conference on rehabilitation of the blind and became friends with Sir John Wilson

WAN	DR V wanted to offer free service to poor and affordable service to people who could pay
WAN1	LAICO wanted to Collate, aggregate content to create an interactive training mechanism that does justice to the enormous data
WRD	Built word of mouth reputation

B – 2 Short names and description for LifeSpring Hospitals
(in alphabetical order)

Short Name	Description
ABAN	Abandoned cross subsidy approach
ABD	LSH abandoned cross subsidy approach
ACC	Increase accessibility of knowledge
ACC1	Increase accessibility of services
ACQ	LifeSpring's flagship hospital has a 52% market share of all the births in that area. By 2015, an estimated 82,000 women will benefit from LifeSpring's services.
BREK	Quick financial / operational breakeven
BRK	LSH 18 months hospital broke even
CHAIN	Chain of small hospitals
CHO	Anant chose a location near to peri-urban area in Hyderabad
CLUS	Cluster approach (Sharing expensive resources)
COS	Price of normal delivery in typical private clinic exceeds monthly income of over half of urban dwellers
CURR	Current maternity care in India
DEC	LSH decreased infant/maternal mortality rates
DOE	LSH does community work and outreach programs to educate people
ECO	Economies of Scale
EDU	LifeSpring convince slum dwellers that calling an families to educate them on health issues, as well as organize monthly camps
EMP	LSH employs Para skilled workers and Auxiliary Nurse Midwifery nurses (ANMs) to offload administration and non-critical tasks from doctors
EMPL	LSH employees only 2-4 doctors per clinic and needed high through put
ESTB	Established first hospital
EXP	Three years after the launch of the first clinic, LifeSpring Hospitals began its rapid expansion to other neighborhoods surrounding Hyderabad. By 2009, the chain had grown to nine hospitals located in high-density, low-income areas.
EXP1	LifeSpring expanded to 12 hospitals by 2012. LifeSpring's current locations include Bowenpally, Chilkalaguda, Boduppall, Moula Ali (Hyderabad), Mallapur (Hyderabad), Nellore, Vanasthalipuram, Vijayawada, and Rajahmundry.
EXPA	Business Expansion

EXPA1	Business Expansion
FOC	LSH focuses on poor population
FOCU	Focuses on poor population
FRILL	No-frill services
FUND	Accumen and HLL accepted to fund the project(JV)
FUND1	Acquired needed funding
IDN	Anant Identified miserable condition of maternity care at government hospital, women were not satisfied with the level of care received at government hospitals and many felt like their experience would have been better at a private clinic
INC	Increased throughput
LEA	LifeSpring made a strategic decision not to invest in the capital infrastructure of its hospitals or the land. Instead the enterprise leases them
OFF	LSH offers transparent pricing which is fixed for next two years
OUT	LSH outsourced pharmacy and lab services
PARA	Paraskilling
PER	Doctors performed four times more deliveries/surgeries to a private clinic
PRIC	Transparent Pricing
PRIO	Entrepreneur has prior experience
REA	Realizes the prevailing gap
REPU	Built word of mouth reputation
SPE	LSH specialized in only maternal and child health and referred out complicated cases
SPZ	Narrow specialization
STAN	Standardization of care
STN	LifeSpring has over 90 standard procedures including standardized surgery kits and clinical protocols. Many are ISO9001-certified, guaranteeing the quality of hospital procedures
STR	First hospital started in Hyderabad in Moula Ali, a suburb of Hyderabad
SUB	Anant submitted a proposal to HLL, to open a clinic providing high-quality, affordable maternal and child healthcare services to low-income families in Hyderabad's sprawling urban slums
SUBZI	Cross subsidized model

SUF	India has a high maternal mortality rate some of it may be to fewer birth attended by skilled labor
TRA	Anant traveled to hospitals around the country visiting women who had just undergone childbirth to learn about family planning practices and contraceptive use
USE	Lifespring used cross subsidy model for pricing
USE1	LSH uses cluster approach to share the resources
USES	LifeSpring uses a narrow range of drugs and equipment for large numbers of repeat procedures and thus bulk-purchases standard equipment and generic medicines.
UTLZ	Efficient Utilization of expensive resources
WRK	Anant Kumar worked at HLL
WRKS	LifeSpring model works on chain of small hospitals, which accommodate between 20-25 beds each



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Innovation is proven to be an absolute requirement for growth in both developed and developing countries, but the type and motivation of innovations differ depending on various surrounding factors. In developed countries innovations are often technology-driven and associated with delighting the end customers. On the contrary, in the emerging markets; due to the unique settings and infrastructural gaps innovations are focused towards meeting customer's fundamental needs. Considering these vast differences, this research focuses on the comparison of the on-going innovation fostering in both developed and developing world individually.

In developed world, where information technology (IT) is emerging out as the key enabling technology, thesis focuses on technology convergence and IT enabled business transformations. It illustrates the case of General electric and describes its Industrial Internet initiative.

On emerging markets side, thesis discusses various types of innovation approaches adopted by local firms and multi-national companies to develop bottom-up low-cost products. It attempts to consolidate the research insights into a unified framework. It also touches upon the topic of social enterprises as a medium to diffuse social innovations into emerging markets to address social challenges and developmental issues like poverty and access to healthcare services.



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