Capabilities for Mass Market Innovations in Emerging Economies

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Publication Date:
2016

DOI:
https://doi.org/10.26190/unsworks/2889

Capabilities for Mass Market Innovations in Emerging Economies

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This thesis is presented for the degree of Doctor of Philosophy at The UNSW Business School (School of Management), The University of New South Wales, Sydney Australia
2016

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ACKNOWLEDGEMENTS

I am indebted to many individuals whose contribution needs acknowledgement. A number of people have contributed to this work to whom I want to express my honest appreciations. At the outset, the inspiration behind this PhD thesis and research work is my supervisor Dr. Pradeep Kanta Ray whose constant guidance, support and encouragement throughout the work helped me to accomplish this doctoral thesis. Hence, I would like to express my sincere gratitude to Dr. Pradeep Ray. This thesis could have not been successfully completed without his help and advice.

The invaluable support I received from my school also needs special acknowledgement. I am grateful to the Head of School, Professor Karin Sarnders and former Head of School, Professor Chris Jackson, for the invaluable support and encouragement throughout this research project. I am indebted for the inspiration of my co-supervisor Professor Stephen Frenkel, which strengthened my conviction to complete the thesis. I also thank the academic, administration staff of the School of Management and graduate research school (GRS) of UNSW for providing excellent infrastructure, funding opportunities and facilities to present my research findings in a number of local and international conferences, collecting data from India and carry out various research expenditures throughout my entire PhD program.

Words cannot express my gratitude for my beloved Husband, Shajib Khadem whose encouragement is an everlasting source of inspiration in my life. I am deeply thankful to for his untiring support and unremitting patience during this work and beyond. I am also grateful to my parents, family members for their never lasting support. I share my joy with all of my colleagues and friends. My heartfelt thanks to all of you.

ABSTRACT

This study examines what capabilities are required by firms to create appropriate innovations for mass markets in emerging economies (EEs) focusing on the Indian automotive industry. Although prior research emphasizes the critical role of capabilities for innovation, the focus of these studies are on the needs of customers from developed country markets. However, EEs are often characterised by multilevel pyramid structures reflecting large income disparities and highly discerning price–performance conscious customers demanding affordable and functional products. The meagre purchasing power of mass customers implies firms attempting to serve these markets need to be driven by a frugal approach and deliberate restraint on resources. Hence, it is important to determine what should be the approach to orchestrate resources to cater to the underserved masses. The research has utilised a mixed method approach combining qualitative and quantitative methodology. The qualitative part used comprehensive empirical case studies of two emerging market firms (EMFs) and two auto MNCs coupled with a cross case analysis and validated the detailed processes of capability development for mass market innovations. The quantitative part entailed a multivariate analysis using 12 years of panel data from the Indian automotive industry to statistically validate the qualitative findings across industry population. The findings revealed the salience of linkage formation capabilities to leverage existing blocks of local resources, sharing costs and risks associated with developing products/technologies for untested mass markets with very thin profit margins. The study also observed the significance of combinative capabilities to reconfigure an established system in new ways and frugally recombine existing core technologies rather reinventing the wheel to achieve an altered price-performance package. Lastly, the study identified the significance of capability to modularize to achieve low cost level, flexibility in product development and also to serve multi-tiered market segments in EEs. The scientific and evidence – based findings from systematic case studies, cross case validation combined with statistical analysis makes a new contribution to knowledge on the capabilities required to create innovations for the masses. The results challenge the traditional view of innovation based on the assumptions of affluence and abundance of resources.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

Abbreviations and Acronyms

CBU	Completely built vehicle
CKD	Completely knocked down
CMIE	Centre for Monitoring the Indian Economy
EE	Emerging economy
EMF	Emerging markets firms
ERC	Engineering research centre
FDI	Foreign direct investment
FE	Fixed effect
GDP	Gross domestic product
GE	General Electric
GLS	Generalized least squares
HMIL	Hyundai Motor India Ltd
HML	Hindustan Motors Ltd
IDRA	Industries Development and Regulation Act
IPR	Industrial Policy Resolution
LLL	Linkage, leverage and learning
M&M	Mahindra and Mahindra
MNC	Multinational Company
MRTP	Monopolies and Restrictive Trade Practices Act
MUL	Maruti Udyog Limited
RE	Random effect
OEM	Original equipment manufacturer
OLS	Ordinary least squares
PAL	Premier Automobiles Ltd

R&D	Research and development
RBV	Resource-based view
TELCO	Tata Engineering and Locomotive Company

Chapter 1: Introduction

1.1 Background

What precisely are the capabilities that enable firms to innovate for mass markets in emerging economies (EEs) is a question of strategic importance in many industries today. EEs[1] hold immense opportunities for innovators who are willing to take a 'great leap' into large untapped mass markets in these countries (Prahalad, 2010, Prahalad and Hammond, 2002, Hart and Christensen, 2002). The past decade has seen an increase in the amount of research focused on and around EEs and their rising levels of competitiveness in the global marketplace. Furthermore, literature has been documenting a growing number of successful innovation stories that originate in EEs (Kumar et al., 2013).The extant literature on EE innovation has widely assumed that major innovations are driven by the Western countries and adopted by the rest of the world (Anderson and Billou, 2007, Seelos and Mair, 2007). Aimed for affluent elites, innovation for such markets is concerned with revolutionary new products embodied in technological breakthroughs (Arnold and Quelch, 1998, Dawar and Chattopadhyay, 2002, London and Hart, 2004, Prahalad and Lieberthal, 2003, Wooldridge, 2010). Thus, the radical innovations approach propounds how innovations aimed for most demanding and high income mainstream markets in developed countries (DCs) can establish a new dominant design (Henderson and Clark, 1990). Its mainsprings stem from the resource based view (RBV) of the firm which, among other things, emphasises that a collection of rare and unique resources of a firm can enable it to serve any existing and new markets in a sustainable way. Unfortunately, the supply-side bias of the resource based view (RBV) makes the dominant view a somewhat exclusive approach. With the growing salience of EEs in the global economy, the parameters of innovation are changing as billions of first-time customers with meagre purchasing power are joining the middle class – demanding only the most cost–effective and functional offerings (Dawar and Chattopadhyay, 2002, Prabhu and Krishnan, 2005). Hence, the demand-side view emphasises firms attempting to serve mass markets need to be driven by a different approach that can address demand heterogeneity existent in multilevel income pyramid structures in EEs. Indeed, in the emerging view (Adner, 2002), capabilities must address new demand profiles requiring adaptation in line with the features of the task environment (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). The literature does not elucidate how firms could model capabilities that would lead to successful innovations for mass markets (Amit and Schoemaker, 1993, Eisenhardt and Martin, 2000, Kogut and Zander, 1992, Leonard-Barton, 1992, Teece and Pisano, 1994, Teece et al., 1997, Dosi et al., 2000b). Moreover, companies are yet to grapple with many practical realities in EEs- often characterized by multilevel pyramid structures reflecting large income disparities and highly discerning price–performance conscious customers (Ray and Ray, 2010, Ray and Ray, 2011). If firms intend to succeed in the new world of demand heterogeneity, a new toolbox of capabilities is required. Hence, to uncover which capabilities are most significant, and how a firm develops them, research must uncover what decision-making criteria, resource allocation models, firm specific processes and method of information analyses firms follow, as they compete. It is worth noting that many of these tasks require tacit knowledge, hence resources alone are not a panacea for firms. Therefore, it is the contention of this research that insight into accumulation of capabilities is to be found in the process of tacit decision-making, especially in some industries of EEs, which are currently experiencing tremendous growth.

1.2 Significance of the study

As observed in the foregoing, the limited literature available on capabilities draws its roots mainly from the RBV literature, which emphasizes among others, concepts like dynamic capabilities, capability life cycle and so forth. Teece (1997, 2014) defines dynamic capabilities as ability to sense and then seize new opportunities and to reconfigure and protect knowledge assets, competencies and complementary assets and technologies to achieve sustainable competitive advantage. Advantages of large firms stem from their dynamic capabilities to identify, acquire, develop, recombine, and integrate resources in changing environments and circumstances (see Teece *et al*., 1997; Eisenhardt and Martin, 2000; Athreye, 2005 on related discussions). Yet these discussions draw mostly on observations of business models of large firms from the developed world. They presume pre-existing business models and product technologies can diffuse into mass markets without much additional effort (Anderson and Billou, 2007, Seelos and Mair, 2007). Although scholars acknowledge that firms aiming to operate in EEs must be willing to address the price-performance criteria of mass markets, not much attempt has been made to theoretically frame and systematically understand what capabilities are required in order to the same. This is a subject which has remained under-researched till date. This thesis addresses this gap in the academic literature. The study's significance therefore lies in its potential to contribute to and deepen the empirical literature on mass market innovation.

1.3 Research question and objectives

The gap in the literature raises an important research question namely 'what capabilities are required by firms to create appropriate innovations for mass market consumers in EEs?' In line with the research question the objectives of this research study are:

- To determine what capabilities emerge as significant in the process of creating innovations for the masses, and,
- To determine how uniquely the capabilities are developed by individual firms studied.

1.4 Main contributions

Through the lens of dominant vs. disruptive designs, this thesis traces the process of capability development for mass market innovation in EEs. The processes entailed in capability development are uncovered by combining multiple case studies of selected firms. Thereafter the study performs econometric analysis, which identifies which capabilities stand out as most significant in the success of diffusion of innovation.

This research study makes four contributions. First, an extensive multidimensional inquiry of the Indian automotive industry provides detailed insights on the evolution of technological capabilities exploring multiple aspects at industry and firm level. While the existing literature maps the growth trajectory of the automotive industry, it falls short of elucidating the sequential up-gradation from low to high-level technological capabilities along with industry structure through diverse policy regimes. In this study the relationship between key policies of the Indian government in different phases and the progression of capabilities along with consequential impact on the industry structure has been mapped through a model which conceptualises the evolution of capabilities in the Indian automotive industry.

Second, at a theoretical level, scholars in innovation management have emphasized the requirement to add new theoretical insights or develop a conceptual framework that suitably illustrates the precise capabilities required for mass market innovations (Ray and Ray 2010, 2011). This research study responds to this call for theory development. By focusing on the comprehensive case studies and cross case analysis of two Indian auto manufacturers and two multinational automakers, this study develops a conceptual framework of capabilities for mass market innovations in EEs. Thus far, there has been no empirical investigation that has focused on this subject. It is believed that the framework developed in this thesis will help move work forward in this area. The research study also attempts to formulate a set of testable propositions to observe the patterns of capability development for mass market innovations. The set of specified propositions developed represent elements of the new conceptual framework to observe the patterns of capability development for mass market innovations.

Third, methodologically, this is also one of the few studies that utilises mixed methodology to understand the precise capabilities required to innovate in EEs. Most importantly, the present study develops a set of appropriate hypotheses to examine the validity of the propositions by testing them in an empirical framework. The scientific and evidence-based findings of this study obtained through multiple case studies, a cross case validation combined with statistical analysis makes new contribution to knowledge on mass market innovation in EEs.

Fourth, apart from the theoretical and methodological significances of this study, the research has significant implications for managers of aspiring companies intending to serve mass markets. The findings of this research study are likely to be useful in providing actionable knowledge for business practitioners and policymakers. Such contributions have the potential to lead the way in advancing a parsimonious and plausible theory of capabilities for mass market innovation that will inform academic research, policy direction and prescription for prospective companies.

1.4 Research Methodology

The research has utilized a mixed method approach combining qualitative and quantitative methodology to address the central research attention. According to Christensen (2006), the descriptive stage of theory building is the preliminary stage for most researchers exploring new phenomena. Theory building steps which are: observation, categorization and association (Figure 1.1). Following an inductive process researchers develop theories in this stage moving along the three steps. In doing so, constructs, frameworks and models are derived. The researchers can then further enhance these theories utilising a deductive process cycling down from the top end to the bottom.

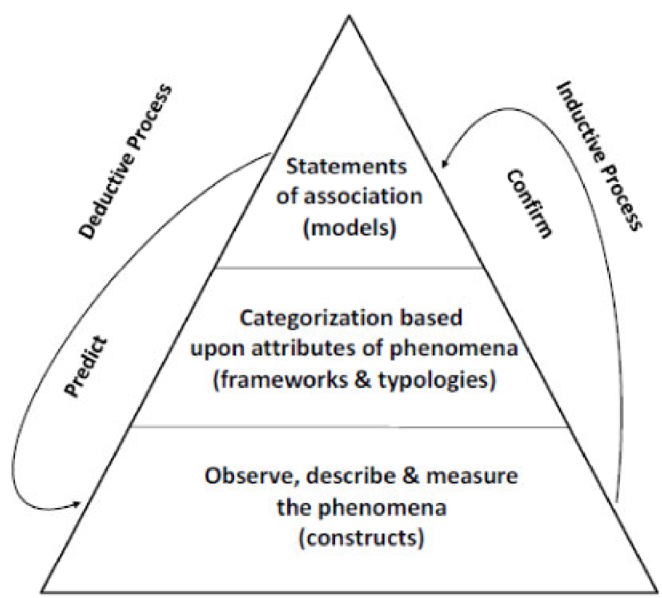


Figure 1.1: The process of theory building

Source: Adapted from Christensen (2006)

In the *observation* step researchers observe an unexplored phenomena, carefully describe and find an explanation of its cause and effects (Christensen, 2006). To quote from (Christensen, 2006):

"*In the first step researchers observe phenomena and carefully describe and measure what they see. Unless researchers lay a foundation of careful observation, documentation and measurement of the phenomena in words and numbers, subsequent researchers will have difficulty improving the theory because they will not be able to agree on what the phenomena are*"(p.40)

In this research, qualitative case studies of emerging market firms (EMFs) and multinational companies (MNCs) were used to describe in-depth process of creating appropriate innovations for mass market customers. Although the issue of suitable mass market innovation has been examined previously in a few earlier studies, the crucial problem of what capabilities are required to create appropriate innovations for mass markets in EEs remains unaddressed and largely unknown in the extant literature. After observing the phenomena of capability development processes required for appropriate mass market innovation, in the *categorization* step of theory building process, a conceptual framework was established based on the attributes of the phenomena studied from the case studies. The framework highlighted the probable substantive relationships of identified capabilities requisite for suitable mass market innovation.

Finally, in the third step, which is *association*, researchers define relationships between category defining attributes of the phenomena and outcomes seen (Christensen, 2006). In this research study based on a multivariate analysis, the hypotheses were tested to statistically validate the qualitative findings of the case studies. More specifically, the relationships between the attributes of the phenomena and the outcome examined were explored further to define correlations. In this case the association between identified capabilities and mass market innovation were made explicit distinguishing what variations in the magnitude of the attributes correlate more strongly with the patterns in the outcomes of interest. The details of qualitative and quantitative methodology are provided next.

1.4.1 Qualitative research methodology: Case study approach

This research involved qualitative methodology to identify and better understand what capabilities are required and how they are developed. Qualitative research uses the actor's meanings to understand a particular phenomenon. By doing this (Jenner et al., 2004): *"it seeks to contribute to a better understanding of social realities"*(p.3). Qualitative research focuses on processes and meanings in social sciences that are measured in terms of quantity, intensity, amount and provides detailed interpretation rather than hypothesis testing (Hesse-Biber and Leavy, 2010, Mason, 2002, Merriam, 2009, Willis, 2007). In this research, qualitative research methodology facilitated to detect and describe the processes of capability development in the creation of appropriate innovations by firms.

Case study design also obtains in–depth insight of the context (Dyer and Wilkins, 1991). Such a research approach is defined as *"an empirical enquiry that a) investigates a* *contemporary phenomenon within its real-life context, especially when b) the boundaries between phenomenon and context are not clearly evident* "(Yin, 1984).

Case study focuses on the 'how' and 'why' things happen, enabling the exploration of contextual realities. This approach examines a particular issue or a specific feature of an organisation rather than studying the entire organisation and also provides a more convincing demonstration of conceptual argument and causal forces (Siggelkow, 2007). Moreover, case study design has the potential to generate new theory due to creative insight arising from the concurrence of case evidence (Eisenhardt, 1989). The emerging new theory is most likely to be empirically testable and therefore, the resultant theory is likely to be more empirically valid (Silverman, 2010). In this research, case study method allowed exploration of the complex real life processes of selected firms to probe the area of capability development in-depth.

1.4.2 Case study design and selection of cases

As postulated by Hartley (2004), the findings obtained from case study method have the potential to be more rigorous and reliable if multiple case studies are utilised which can allow increased generalisation across different case study findings. This research study involved a multiple case design to triangulate empirical evidence. To address the central research question, four case studies were applied in the research to capture the holistic view of the capability development processes for innovation. In general, the empirical validity and testability of theory developed from case study research is better grounded when a number of cases between 4 and 10 are employed (Hedges, 1985, Perry, 1998). The selection of multiple case study design is also suitable when researcher envisages that consistent results will be found from multiple cases examining a number of different organisations (Hedges, 1985, Perry, 1998).

1.4.3 Description of research setting: Selection of industry & cases

The automotive industry of India is emerging as one of the world's fastest-growing passenger car markets and has become a preferred location for auto MNCs which intend to learn from EMFs and innovate affordable products for the masses (Economic Times, 2013, ICRA, 2011, KPMG, 2010, SIAM, 2013). Since the 90s, examples of innovations in the automotive industry in India by EMFs such as Mahindra's affordable 'Scorpio', Tata's ultra low cost 'Nano' (Chattopadhyay et al., 2012, Kumar, 2013) and global auto MNC such as Hyundai's smallest and compact 'Eon', Toyota's 'Etios' and Honda's 'Amaze' (Malini, 2013), just to name a few, have begun to alter our understanding of mass market innovation and therefore, making the phenomena worthwhile to explore. The rise of EMFs in such a technology intensive industry merits more in-depth enquiry into the elaborate processes of creating suitable innovations. Since, capabilities concern the extent of a firm's ability to innovate new products (Dosi et al., 2000a), it is logical to map the precise capabilities required by firms from the auto industry that helped them to create affordable innovations in EEs. Therefore, examining the requisite capabilities in the automotive industry to support innovations for the masses is a valuable area of knowledge. Hence, this research idea was deemed as an important and meaningful area of study in addressing an unexplored area in literature for mass market innovations.

For the process of generating theory, cases need to be selected purposefully so that they can replicate the findings from other cases employed to extend an emergent theory. For this reason it is recommended to select cases of firms that represent situations in which the process of interest is “transparently observable” (Pettigrew, 1990).

Hence, the selection criterion for inclusion in this research study was set to ensure that the processes of capability development of firms were transparently observable. The firms studied for this research study were sampled from the Indian automobile industry, one of the largest passenger car exporters of the world and a key sector for the economic development of India (ICRA, 2011; SIAM, 2013). For this study, six firms comprising of both local Indian and multinational companies were invited to participate via letters addressed to the managing directors and CEOs of the firms. Appendix 1 of this thesis includes a copy of the invitation letter. The invitation letter provided an overview of the research study including the project objectives and other necessary details for prospective participants so that they can understand project description and make informed decision regarding participation. Out of the six firms, four companies indicated willingness to participate. The choice of sample firms -local Indian companies and multinational companies working in the Indian automobile industry (and the unit of analysis) was guided by how effectively firms are addressing the unique challenges of innovation for mass markets highlighted by academic journals, books, trade journals and business press. The study therefore included 4 companies namely, **Tata Motors Ltd, Mahindra and Mahindra (M&M), Ford India and Hyundai Motor India Ltd (HMIL)**. Tata Motors Limited is a part of the Tata Group which was founded in 1868 and expanded to build the country's first steel mill and hydroelectric plant in colonial times to eventually become a diversified conglomerate by the early twentieth century (Khanna and Palepu, 2006). Being intimately familiar with the unique needs and the environment, Tata Group historically served various market tiers of India’s economic pyramid, including the masses (Khanna and Palepu, 2006). The company is also one of the major players in the passenger vehicle segment (Economy Watch, 2010, SIAM, 2014, Times of India, 2015). M&M is a subsidiary of Mahindra group – the Indian multinational automaker. Based on the consolidated revenue, it is one of the largest automobile manufacturers by production in India (Thomke and Luthra, 2009). By focusing on product development abilities and taking unprecedented risks the company has become the largest dominating player in the Indian SUV market in which almost every major global carmaker is struggling for a share (Stewart and Raman, 2008). On the other hand, HMIL is a wholly owned subsidiary of the Korean based Hyundai motor company (HMC) and the largest passenger car exporter and second largest passenger car manufacturer of India (Lansbury et al., 2006). Lastly, Ford India is a subsidiary of the American Ford motor company comprising of 3.29% market share in passenger vehicle segment (Nayyar and D'Costa, 2012, SIAM, 2014).

Along with the EMFs, the choice of including two auto MNCs is driven by the fact that at the level of product design MNCs are high-end niche players with products embodying highly specified proprietary technologies and sophisticated features demanded by their mainstream customers from the developed world (Prahalad and Lieberthal, 2003, Inkpen and Ramaswamy, 2006). Typically, products designed primarily for OECD countries are sold in emerging markets simply by converting their world prices into domestic currencies, thereby serving only the affluent few with little consideration about the purchasing power prevailing among less affluent masses (Dawar and Chattopadhyay, 2002, London and Hart, 2004). However, with the increased competitive reality a number of MNCs have begun to target the specific needs of the mass customers with emerging market specific strategies. Therefore, comparing and contrasting the innovation strategies of EMFs and MNCs provides an ideal background to examine whether a particular set of capabilities enable firms to innovate for mass markets in EEs. Moreover, both local Indian and multinational companies provided the opportunity to observe differences in the institutional context and the impact of policy framework with regard to capability development.

Purposive sampling categorised by a sense of snowballing was used in this research study as the sampling strategy for the selection of interview participants (Patton, 1990). Purposive sampling refers to " (Kidder, 1981):

"A form of non—probability sampling undertaken when strict levels of statistical reliability and validity are not required due to the exploratory nature of research" (p.427). The interview participants were selected based on the individual judgement permitted on the ground that participants possess deep knowledge and understanding of the capability development process and its importance for creating appropriate mass market innovations. Since the primary aim was to gather rich information from firms operating in the Indian automobile industry, therefore, echoing the view of Patton (1990), the strategy of purposive sampling employed in this research appeared effective.

1.4.4 Data collection methods and data triangulation

Building theory from case study research usually combines multiple data collection methods- of which interviews and archival sources are particularly common (Fontana and Frey, 2000, Kvale, 1996, Myers and Newman, 2007). This research study utilised qualitative semi-structured interviews to understand the process of capability development for mass market innovation. Semi–structured interview is one of the most important data gathering tools in qualitative research and it provides (Burgess, 2003):

"The opportunity for the researcher to probe deeply to uncover new clues, open up new directions of a problem and secure vivid and accurate inclusive accounts that are based on personal experience"(p.107).

A total number of 11 semi – structured face-to-face interviews were conducted in India between June and July 2012 with key informants assigned by the participating firms (Table 1.1).

Table 1.1: Interviewees from different organizations

Organization	**Person interviewed**	**Designation**
Tata Motors	Ravi Kant	Managing Director
	Ashok Joshi	Head, Tata Technologies
Mahindra & Mahindra (M&M)	Rajiv Mehta	Head, Product Planning
	Nitin K. Tikle	Senior General Manager
	Rajesh Pandey	Deputy General Manager
	Srinivas Ramanujam	Deputy General Manager
Hyundai Motor India Limited (HMIL)	Puneet Anand	Deputy General Manager
	K. Rajesh	Manager
	A. Alwarsamy	General Manager
Ford India	Michael Boneham	President & Managing Director
	Sandip Sanyal	Executive Director

As recommended by case study researchers, semi–structured interviews offered significant flexibility and opportunity to seek more interpretation or clarification from the informants asking questions that were not predefined (Klein and Myers, 1999). An interview schedule consisting of 19 open-ended questions (Appendix, 2) was developed as a part of the interview protocol and was sent to the interviewees four weeks prior to conducting interviews. The purpose of the interview was to investigate: what capabilities are required by firms to create appropriate innovations for mass markets in EEs and how these capabilities are developed.

Each interview lasted for about 45 minutes and was audio recorded with the permission of the participants to aid in data transcription and data analysis. In total, around 9 hours of interviews were recorded. To avoid any complication each interview recording was numbered and tagged with the participant's name (Noor, 2008). Moreover, for ensuring that no information gained was misinterpreted, notes were also taken during interviews.

For data triangulation referring to the employment of multiple sources of information for a better understanding (Gibbs et al., 2007), in addition to primary data from interviews, information was also obtained from five other categories. These included academic journals, books, specialist automotive journals, engineering and technical trade journals and selected business press including Business Week, The Economic Times, Business Today, Business World, Times of India. Data was also collected from internal documents of firms such as annual reports, company announcements, organizational charts, consultants' reports and supplier related information. Such documentary evidences acted as a method to cross validate information obtained from interviews. In this way, the corroboration of multiple information sources increased the validity and reliability of the qualitative research (Denzin, 1978).

1.4.5 Data analysis method: Within–case and cross–case analysis

Analysing data is the central feature of developing theory from case studies (Miles and Huberman, 1994). Analysing within–case evidence usually involves developing descriptive narratives of the data collected for detailed case study write-ups. The core idea of producing comprehensive write-ups is to become intimately familiar with each case as a stand-alone entity. Along with providing a rich familiarity with each case, this process facilitates the distinctive pattern of each case to emerge before researchers attempt to generalise the patterns of findings obtained from multiple cases. It has been suggested in the literature that descriptive narratives should be organized around the substantive topics of the case study focusing on the central research attention (Miles and Huberman, 1994, Patton, 2005).

In this research detailed case study reports of each sample firm was first written up describing the evidence of the innovation process. The in-depth case study reports of four firms in the Indian automobile industry captured the processes of capability development.

To provide a more persuasive demonstration of conceptual argument, the preliminary analysis at this stage involved several iterations. The analysis went back and forth between the descriptive narratives of each case and data from interview transcripts to better understand the causal relations between the identified capabilities and how they were developed in the focal firms for creating mass market innovations. Following this, detailed case study reports of the four firms describing their processes of creating appropriate innovations for mass market consumers in the Indian automobile industry was written up. In addition to the rich descriptions and contextual information, the detailed case study reports also included quotes from the interview participants to gain an in-depth insight on the innovation processes of the EMFs and MNCs.

1.4.6 Cross – case analysis

As Baxter and Jack (2008) recommends, the use of multiple cases in qualitative research allows for within–case analysis coupled with a cross–case analysis to generalize patterns across cases. In this research study, a cross–case analysis was conducted to explore the similarities and differences between cases using diverse lenses on data (Figure 1.2).

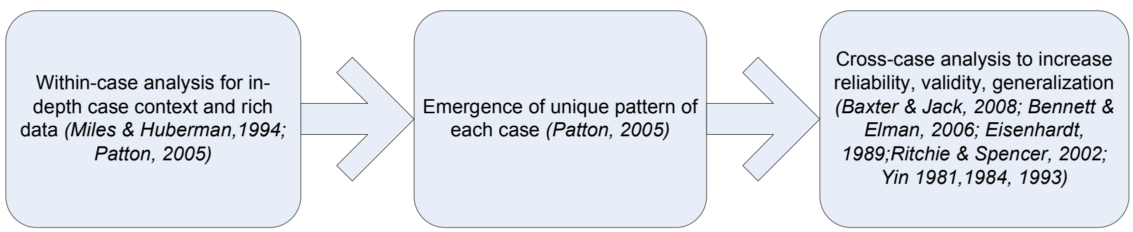


Figure 1.2: Data analysis process

This facilitated counteracting the propensity of reaching premature/false conclusions based on the limited information from single case. Moreover, examining evidence from multiple cases can enable new concepts and novel findings to emerge which can be beyond the anticipation of a researcher and the final research findings can also become stronger and better grounded (Ritchie and Spencer, 2002). In accordance with the view of (Eisenhardt, 1989) and (Yin, 1981, Yin, 1993) searching for cross–case patterns in this research study included two approaches. First, the four cases were compared according to the selected categories- which in this case included the capabilities identified. Secondly, the cross–case analysis also compared between the pairs of EMFs and MNCs to look for the subtle similarities and differences in a divergent way to facilitate a deep probing of the capability development processes.

From the within–case and cross–case analyses, plausible patterns of capability development began to emerge. Following an iterative process, the possible pattern of emergent relationship was compared systematically across cases. Moreover, utilising replication logic, the pattern of relationship obtained from a single case was also compared with the other cases to confirm or disconfirm inferences drawn from previous cases (Yin, 1984). The process of iteration and replication logic discovered the underlying theoretical reasons of why an emergent relationship exists. This eventually helped not only to establish the internal validity of the findings, but also to judge the strength and consistency of relationships within and across cases (Bennett and Elman, 2006).

Finally, to further enhance the internal validity, strengthen theoretical scope, and sharpen generalizability of the findings, the results were compared with the existing literature. According to Ahrens and Chapman (2006), this process is particularly important for theory–building research as the research findings are often derived from a limited number of cases. Therefore, comparison with literature discussing similar findings in related context strengthens the confidence and enriches the conceptual level of a research study.

1.3.7 Quantitative research methodology

In order to statistically validate the qualitative findings of the case studies, this research study utilized quantitative research methodology after the qualitative study. According to Rubin and Babbie (1993):

"Quantitative research methods emphasize the production of precise and generalizable statistical findings. When we want to verify whether a cause produces an effect, we are likely to use quantitative methods".

To serve the purpose of this research and test the hypotheses, a multivariate analysis was performed employing panel data from the Indian automotive industry. Panel data refers to multi-dimensional data frequently involving measurements over time. Panel data contain observations of multiple phenomena obtained over multiple time periods for the same firms (Greene, 2008).

The data used in this statistical analysis was obtained from the "Prowess" database of the centre for monitoring the Indian economy (CMIE), by far the most comprehensive and reliable source of data on the Indian economy. This database provides the availability of cross-sectional data on a firm-by-firm basis for domestic and foreign affiliates, as opposed to industry averages. This results in the advantage of conducting a much more sophisticated analysis. For this study, the Indian transport industry cluster was chosen which consists of passenger cars, commercial vehicles, heavy vehicles, sports utility vehicles, two and three wheelers and auto ancillaries. Panel data from 2000–2012 of the Indian automobile industry was used in this study with a sample size of 66 companies, which yielded 673 observations. For ensuring comparability of variables across the time series of 2000-2012 all data was standardized by firm size measured by sales.

For the given objective, there exists a variety of estimation models. Though most commonly used and highly useful, a simple pooled OLS (ordinary least squares) model can lead to biased and inconsistent parameters if time invariant covariates are omitted. If omitted time-invariant variables are correlated with the policy incentive variable, a FE (fixed effect) model provides a consistent and unbiased estimate of the parameters while simultaneously controlling for unobserved unit heterogeneity. On the other hand, if these omitted time-invariant variables are uncorrelated with the explanatory variable, a RE (random effect) model would provide a more efficient estimate than FE model. An advantage of random effects is that time invariant variables can be included and that the entity's error term is not correlated with the predictors, which allows time-invariant variables to play a role as explanatory variables. In RE model, one needs to specify those individual characteristics that may or may not influence the predictor variables. The problem with this is that some variables may not be available therefore leading to omitted variable bias in the model. RE allowed generalizing the inferences beyond the sample used in the model. In this study, the validity of these assumptions was examined by the Hausman test.

1.5 Thesis Structure

The chapters in this thesis are organized in the following sequence. Following this introductory chapter, Chapter 2 is concerned with literature review. This is followed by Chapter 3, which presents a multidimensional enquiry of the Indian automotive industry. Chapter 4 deals with the development of capabilities in the Indian automotive industry focusing on the case studies of four firms, which are followed by cross case validation studies and analysis. Chapter 5 is a multivariate analysis drawing on 12 years of panel data from the Indian automotive industry. Finally, Chapter 6 concludes the thesis.

In Chapter 2 the review of the literature critically examines how we should view capabilities to meet the unique price–performance criteria of low income mass markets. The review systematically explores the theoretical constructs of the traditional view of capabilities and its significance for innovation, dominant vs. disruptive paradigms and the importance of tailoring capabilities for specific demand contexts.

Chapter 3 provides comprehensive insights on the evolution of capabilities through a critical multidimensional enquiry of the Indian automotive industry. This chapter examines how capabilities in the Indian automotive industry have evolved vis-à-vis the policies that have influenced the industry's development. Scrutinising multidimensional industry and firm level facets illuminates more precisely the influence of various government interventions in each of the development phase of the industry, the span of capability accumulation, gradual progression to higher level capabilities and the resultant impact on the industry structure relating to alliances and modular relations between automakers and suppliers.

Chapter 4 comprises the qualitative case studies of two EMFs namely Tata Motors, Mahindra & Mahindra (M&M) and two MNCs namely Hyundai Motor India Ltd (HMIL) and Ford India operating in the Indian automotive industry. The chapter identifies what capabilities are required by firms and how the capabilities are developed for creating innovations for the masses drawing on rich contextual information obtained through qualitative case studies. Based on the observed and in-depth evidence from the case studies, a cross case analysis is performed to analyse the similarity and differences of the requisite capabilities and how they are developed.

In Chapter 5, a multivariate analysis using panel data of 12 years from the Indian automotive industry is conducted. This chapter tests hypotheses to statistically validate the qualitative findings of the case studies. The relationships between the attributes of the phenomena of capability development for mass market innovation and the outcome examined are explored further in this chapter.

The concluding chapter 6 summarises the findings that address the central research attention. More specifically, it identifies the intricate processes involved in managing innovation for the masses scrutinising what capabilities are required by firms and how the capabilities are developed.

Chapter 2: Literature Review

2.1 Introduction

This chapter examines the capabilities that are required by firms to create appropriate innovations for EEs.

The literature on technology strategy suggests that new radical innovations, such as a cure for life-threatening diseases or the discovery of a new synthetic fuel, establish a new paradigm, setting an industry standard (Adner, 2002). Thus, radical innovations aimed at the most demanding and high-income mainstream markets can establish a new dominant design (Henderson and Clark, 1990). Accordingly, routines and practices followed by innovating firms that are pursuing dominant designs emphasize the accumulation of resources as the main determinant of success.

This approach stems from a resource-based view (RBV) of a firm (Barney, 1986, Wernerfelt, 1984, Wernerfelt, 1995). However, a supply-side bias makes the dominant design view an exclusive approach. In examining the development of firm capabilities (Wernerfelt, 1984, Teece, Pisano and Shuen, 1997), the literature has tended to exhibit a 'supply side' bias. RBV asserts that competitive advantage of firms primarily lie in the application of a bundle of valuable tangible or intangible resources. More specifically, RBV emphasizes the importance of resources and its implications for firm performance . A resource-based view of a firm explains its ability to deliver sustainable competitive advantage when resources are managed such that competitors cannot imitate their outcomes, which ultimately creates a competitive barrier (Mahoney and Pandian, 1992). RBV explains that a firm's sustainable competitive advantage is attained by virtue of unique resources being rare, valuable, inimitable, non-tradable, and non-substitutable, as well as firm-specific (Barney, 1999). The RBV essentially asserts that a firm may reach a sustainable competitive advantage through unique resources that it holds, and these resources cannot be easily bought, transferred, or copied, and simultaneously, they add value to a firm while being rare.

However, the characteristics of abundance resource endowments/supply mentioned in the RBV are individually necessary, but not sufficient conditions for a sustained competitive advantage (Dierickx and Cool, 1989, Priem and Butler, 2001a). This is because, with the supply side bias, RBV has largely ignored the role of capabilities and the demand context of the product markets (Priem and Butler, 2001a, Priem and Butler, 2001b). Resources are stocks of available factors that are owned or controlled by a firm, and capabilities are a firm's capacity to deploy resources. Most importantly, the supply side bias of RBV does not consider the fact that with capabilities, different/unique resource configuration is possible to engage the resources within the firms to achieve competitive dynamics (Ludwig and Pemberton, 2011, Peteraf, 1993, Priem and Butler, 2001a, Priem and Butler, 2001b).

Focusing on firm's initial resource endowments and established technological position in the industry, the resource–based view of the literature has largely overlooked the role of the demand context/environment. The demand context however influences the opportunity structure that firms face and affects firm's incentives to innovate leading to different competitive advantages (Adner, 2002). It misses the relevance of many markets outside of the mainstream, even within developed countries, where diffusion of new products often fails to occur. Frequently, low-income customers base their purchase mainly on affordability requirements. Industry incumbents ignore these segments of society and focus on new technologies for high-income markets. Hence, their innovations do not quite succeed in different demand contexts.

The emerging view of capabilities is subversive. Christensen (1997) proposes that disruptive technologies with inferior performance can leverage innovation opportunities that supply underserved markets and satisfy latent customer needs. In this demand-side view (Adner, 2002), capabilities must take into account the heterogeneity in demand, requiring resources to be integrated with proper routines and structures (Dosi et al., 2000a, Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). It begins with a consideration of the importance of adapting capabilities to the needs of the environment. More specifically, examining heterogeneity in demand conditions e.g. customer demand criteria and preferences, the structure of the demand environment impact significantly on the competitive dynamics and offers a new perspective on the emergence of competition or technology rivalry. The central view of technology strategy has been that established firms are often outpaced by the new entrants in the industry as new entrants can better match their innovation performance and capabilities to the demand context (Adner, 2002). In the same vein of Christensen's (1997) arguments, Adner (2002) explain that, when customers face diminishing marginal returns to performance improvements, technology offering limited, inferior performance at lower price become increasingly attractive. This dynamic eventually leads to the emergence of different competitive regimes serving new market segments. Thus, in the demand-side view of competition, isomorphism to institutional realities requires firms to develop capabilities assessing demand factors from the environment to serve customers who would otherwise be neglected in the demand-and-supply equation.

In the then-developing world, starting with the Japanese, Asian competitors initially introduced low-cost innovations into their home markets and later brought these to the underserved niche markets in the developed world (Christensen and Raynor, 2003). Such reverse-innovations were suitable for those who were looking for not only low-cost equivalents but also for performance metrics uniquely suited to their requirements. In turn, Japanese firms such as NEC, Matsushita and Toyota then brought their innovations to the US, to become mainstream players moving upmarket as they gained ground (Christensen et al., 2001). In their wake, many Asian competitors now pose a serious threat to the industry incumbents.

Disruption of mainstream markets has opened a whole new process of rethinking about the nature of 'capabilities' and how they should be developed. To date, the literature has been sparse on how to develop capabilities to serve low-income markets and has been mainly concerned with highly specified technologies for high-income markets. The existing research does not provide insights into how capabilities, resources and technologies should be managed within a given context in order to create value for underserved markets (Seelos and Mair, 2007). The unique social, cultural and institutional characteristics of EEs imply that traditional products and management processes will not work in that context and that MNCs need to strive for new levels of efficiency by radically rethinking the whole supply chain (Prahalad and Lieberthal, 2003). For customers in the EEs, gimmicky features and over-specifications do not add value, as they do not enhance the performance of the basic functions of the product.

A number of Western MNCs have focused their attention on the mega mass markets of EEs, bearing in mind their growth potential. This is occurring even as firms from emerging markets firms (EMFs) are causing major upsets in the former's home markets (Chattopadhyay et al., 2012). Little is really known about the approach EMFs are taking to innovate for markets that are shaping the new economic competition. Some long-established MNCs (e.g. Unilever) that have historically innovated for EEs have kept these separate from their mainstream markets and have not realized the full potential of introducing reverse-innovations in their home countries. Major MNCs also have not realized that suitable innovations for low-income niche markets at home could later serve mainstream markets in EEs or seen the potential to innovate along those lines (Wooldridge, 2010).

Beyond stating that firms in EEs have the capability to craft suitable innovations for mass markets, the literature is not clear regarding the type of capabilities that are critical to innovation in EEs (Anderson and Billou, 2006, Arnold and Quelch, 1998, Hang et al., 2010, London and Hart, 2004). In general, the impression conveyed by these studies is that firms aiming to operate in EEs must be willing to develop their capabilities to ensure an acceptable price–performance ratio. But as Dosi, Nelson and Winter (2000 a, b) postulate, the concept of capabilities goes beyond a simple appraisal of innovative performance. Capabilities, in fact, concern the extent of a particular firm's ability to innovate new products by coordinating its activities and processes. In this respect, the extant literature does not provide systematic evidence with empirical studies.

The objective of this current review is to identify what capabilities in particular are required to create appropriate innovations for mass market customers in EEs.

2.2 Traditional view of capabilities and its significance for innovation

After periods of great experimentation, a new dominant design is established (Clark, 1985, Marples, 1961) that is embodied in a new but stable product architecture (Clark, 1985). A dominant design incorporates a range of basic choices about the architecture and is not usually revisited frequently. Progress thereafter takes shape within the framework of a stable architecture, followed by a series of incremental innovations that meet the requirements of demanding customers who want continuous improvements.

To build new knowledge, a firm must shift its orientation from one of refinement within a stable architecture to one of an active search for new solutions within a constantly changing context. Such a change in context may involve markets outside the mainstream, which have so far been left out of the market equation altogether. This requires a shift from dominant design (which renders obsolete a firm's existing knowledge based on architectures) and calls for a different set of capabilities contingent on a particular task or purpose, while other capabilities may be useful for other purposes. The resource-based view (RBV) stresses exploiting the resources and organizational capabilities of a firm as the fundamental determinants of performance (Barney, 1986, Wernerfelt, 1984, Wernerfelt, 1995). Incumbents often appear to follow a resource-based strategy of accruing valuable strategic resources, but fail to exhibit appropriate capabilities to innovate. Hence, most scholars have stressed that established routines and embedded capabilities make it exceedingly difficult to allocate resources for initiatives that serve new customers at lower profit margins. Incumbent firms are, in essence, captured by their dominant constituencies, cognitive models and more profitable customers (Christensen et al., 2001, Slater and Mohr, 2006) . Conversely, exploring a new market requires making significant changes to embedded capabilities with respect to building deep understanding of customers who are largely peripheral to the current business. A number of innovations, such as architectural, disruptive and radical innovations, are often introduced by new entrants due to their capacity to amend capabilities reassessing dominant beliefs.

For example, Henderson and Clark (1990) show that architectural innovations that concern new ways to coordinate engineering tasks, or that reconfigure existing technology in new ways, are often introduced by new entrants instead of by industry incumbents. For large MNCs, failure to develop new products through reconfiguring an established system in novel ways often stems from a dissonance between their established routines and the advancement of capabilities to integrate tasks in novel ways. Focusing on dominant designs, MNCs rely on regular operating procedures to design and develop radical new products, backed by several rounds of incremental innovations. They do not recognize the potential of architectural innovations. Knowledge already entrenched in organizational channels and processes become difficult to change. However, new entrants are not handicapped by a legacy of embedded processes or routines. The inability of incumbents to create new markets through architectural innovations was one of the significant factors that facilitated Boeing’s leadership in the jet aircraft industry over more established firms (Henderson and Clark, 1990).

Therefore, the critical question is: What capabilities are required to cater to price-sensitive markets in EEs and how can these be developed? Scholars have defined capabilities as analogues of organizational mechanisms, including a firm’s ability to coordinate specialized units (Lawrence and Lorsch, 1967), information filters for communication channels (Arrow, 1974) and search routines, procedures (Nelson and Winter, 1982) as key determinants of firm performance. A firm has a specific ‘capability’ implying that the firm has the capacity to perform a particular activity in a reliable and satisfactory manner (Helfat and Winter, 2011, Teece, 2014) . The RBV only elaborates on accumulating strategic resources, but falls short of scrutinizing reasons for firms varying in their capabilities to develop innovations that would create new markets. For example, late entrants who, by definition, do not possess valuable resources often succeed. Therefore, merely amassing resources may not provide the requisite capabilities (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997).

2.3 Dominant vs. disruptive paradigm of capabilities: The significance of capability evolution for new market creation

Understanding capabilities has to begin with an appreciation of the underlying processes deployed in performing a task. Firms differ in the way they coordinate their activities/processes, which ultimately has a significant impact on their innovative performance (Teece and Pisano, 1994, Teece et al., 1997, Dosi et al., 2000b). Capabilities are a key dimension of firm heterogeneity (Nelson and Sidney, 1982) and in some cases, of the kind of idiosyncrasy or inimitability that confers competitive advantage (Teece, 2014). The relationship between firm processes and capabilities explain why different kinds of innovations, such as architectural, disruptive and radical innovations, are often introduced by new entrants rather than by the established companies.

Many studies (Adner, 2002, Christensen, 1997, Christensen and Raynor, 2003, Danneels, 2004, Henderson, 2006) have examined why established firms find it particularly difficult to respond to innovations that disrupt the dominant paradigm. Established firms that are deeply entrenched in their existing value networks and current experiences find it very difficult to reconfigure their capabilities so they can seek the promise of disruptive innovations. For example, Christensen (1997) demonstrated that established firms in the hard disk drive industry were aggressive, innovative and customer-sensitive in their approach to sustaining innovations. However, these incumbents were unable to enter new markets or understand the promises of technology that could disrupt and redefine performance trajectories, as they were held captive by their existing customers, thereby enabling new entrants to topple them.

The paradoxical behavior of Polaroid's difficulty in adapting to technological changes in digital imaging has been cited by Tripsas and Gavetti (2000) as the reason for the company's reluctance to foster new capabilities. Likewise, in the semiconductor industry, a new technology named 'Silicon Planar Process' that was introduced by Fairchild opened the door for the efficient mass production of reliable and cheaper transistors. This innovation soon rendered germanium-based transistors obsolete and a number of early pioneers, such as Transitron, Germanium Products, Raytheon and Hughes, were left with an inventory of obsolete products and more importantly, outmoded capabilities (Tripsas and Gavetti, 2000).

Tushman and Smith (2002) suggest that resource-rich firms often fail to develop innovations that could create new markets. Société Suisse pour l'Industrie Horlogère SSIH (the Swiss watch consortium) and Oticon (the Danish hearing aid company) are good examples of this. Although these two companies had the technology and resources to innovate, it was the smaller and more aggressive companies that initiated new technology in watches and hearing aids. The sudden demise of SSIH and the huge losses of Oticon were rooted in the two companies' inability to renew their capabilities through proactively initiating streams of innovation.

However, there are exceptions to this rule. For example, General Electric (GE) invented a hand-held electrocardiogram (ECG) machine, the 'Mac 400', after seriously considering the needs of poor customers in rural China and India and developing capabilities to ensure an acceptable price–performance ratio (Wooldridge, 2010). The product is simple, convenient to use and sells for only $800, instead of $2,000 for a conventional ECG machine and has thereby reduced the cost of an ECG test to just $1 per patient. GE's cheap and functional ultrasound device is now also being used in the US and other developed countries. Similarly, Hindustan Unilever Ltd invented a disruptive new detergent product 'Wheel'. The product was formulated to substantially reduce the ratio of oil to water, responding to the fact that poor customers in India often wash their clothes in rivers and other public water places (Prahalad and Hart, 2000). Tata Consultancy Services (TCS) of India designed a box that can be retrofitted to connect a television to the Internet via a mobile phone. It has also devised a remote control that allows people to browse the Internet even if they have never used a keyboard. Thus, by using existing technologies in innovative ways, TCS can connect millions of people to the Internet (Wooldridge, 2010).

The new literature on innovation highlights how a number of Chinese manufacturers acquired capabilities that are critical for the success of EE innovation in the local context (Hang et al., 2010). Galanz, a Chinese electronics manufacturer, developed small, energy-efficient, cheap microwave ovens that were designed for middle-class Chinese customers. This microwave oven later disrupted both the developed and the developing markets, dominating more than 40% of the global market share in microwave ovens. Another Chinese manufacturer, Haier, developed a small washing machine (Mini Magical Child) that used less electricity and water, operated with high efficiency and low noise, and was more affordable for price-sensitive Chinese customers than conventional washing machines. Based on the success of this, Haier developed the XQBM, a small, high-efficiency washer that was based on the Mini Magical Child but offered additional features, including 12 different wash modes. The XQBM has sold about 2 million units and has been exported to 68 countries in Europe, America, Asia and Africa. Yadea, a Chinese electric motorbike manufacturer, developed affordable, environmentally friendly electric motorcycles, bicycles and scooters for Chinese customers. These 'good enough', affordable and well-designed electric motorcycles later disrupted the markets of Europe, America and South-east Asia (Hang et al., 2010).

From the above mentioned innovation examples it can be observed that although disruptive innovations serve smaller niche market segment initially, over time they have the potential to serve mass market segment by improving specifications, functionalities and features. In this respect, it is instructive to highlight the differences in the theoretical concepts of mass market innovation and its distinctiveness with niche market innovation.

Niche market innovation	**Mass market innovation**
• Niche markets refer to the subset of the conventional market into smaller segments and then devising specific products for these smaller segments or niches (Linneman and Stanton, 1992).	• Mass markets refer to the 4 billion people at the bottom of the pyramid demanding robust products with basic functions at ultra-low prices which match their low income level and undeveloped harsh living conditions (Dawar and Chattopadhyay, 2002, Prahalad and Lieberthal, 1998).
• Niche markets encompass limited reach of customers.	• Mass markets encompass greater reach of customers.
• In niche market innovation, the customer has separate needs, and a firm's efforts are to satisfy those needs at higher profit margins as compared to mass market (Kotler, 2003).	• In mass market innovation, a firm's efforts are to simultaneously improve the quality of the product attributes and reducing product cost to make it acceptable to the average customer in lower profit margins (Markides, 2006).
• Niche markets innovation often progress into mass market innovations (Kotler, 2003).	• When market saturation starts and product reaches at maturity, the demand for further innovation occurs and former mass markets are inclined to come back to niche markets (Shani and Chalasani, 1992).

Frugal innovations could also be regarded as a subset of mass-market innovations, since frugal innovations are referred to as affordable, value products that meet the needs of resource–constrained mass customers in the EEs (Bound and Thornton, 2012, Sehgal et al., 2010, Zeschky et al., 2011). The Economist (Wooldridge, 2010) defined a frugal innovation to be cheap, robust, easy-to-use and developed with minimal amounts of raw materials. For decades, multinationals adopted a strategy of the global localization-in other words, trying to modify the products developed for rich countries to suit emerging market conditions. The problem with this traditional strategy is that these products can only serve the most affluent customers at the top of the market pyramid in EEs. Later, a number of western companies like GE realized that in order to be able to drive growth in the EEs, companies need to be able to offer products at much lower price points for the mass customers in EEs (Govindarajan and Trimble, 2012). Through frugality, it is possible to innovate specifically for those markets.

The term 'frugal engineering' for emerging markets was first coined by the CEO of Renault-Carlos Ghosn (Knowledge@Wharton, 2009). An overlapping concept of frugal innovation is the so-called "Gandhian engineering" (Banerjee, 2013), which refers to the efforts to convey deep frugality and a willingness to challenge conventional wisdom apply to engineering, product innovation and new product development. According to Ray and Ray (2010), a model of resource constrained innovation is appropriate for an organization with meager resources as also for resource rich firms through deliberate constraints on resources. Since then, frugal innovations possessing a no-frills structure have been developed by a number of emerging market firms and western MNCs to satisfy the needs of mass customers under the constraints of developing countries (Rao, 2013). Some of the prominent examples of frugal innovations include: Tata Nano (world's most affordable small car) by Tata Motors-India, Tata Swach (low cost, simple and portable water purifier) by Tata Chemicals- India, Mac 400, 800 (low cost and portable handheld ECG machines), by GE-US, low cost and portable ultrasound machines by GE-US, Godrej Chotukool (Simple, low cost and portable refrigerator) by Godrej India, simple, low cost and portable healthcare products by Mindray-China and sophisticated, low cost lithium-ion batteries by BYD- China (Chattopadhyay et al., 2012, Immelt et al., 2009, Ray and Ray, 2011).

For the design of Tata Nano, the strategy of frugal innovation emphasized frugality in the R&D processes, utilization of fewer resources, low cost components, significant reengineering of components and part count reductions (Palepu et al., 2011). For Godrej's ChotuKool and Tata Swach, the key strategy of frugal innovation was also to use as little material as possible to provide the basic functions of a refrigerator and water purifier (Bound and Thornton, 2012). Both products targeted mass customers in India who were constrained by the lack of access to electricity, refrigerators and water purifiers. Similarly, for the two types of medical devices developed by GE, the key strategy of frugality was to use as little resource as possible to innovate simple, portable and low cost ECG and ultrasound machines that have the most basic functions to serve the mass population in the highest traditions of rural India and China (Immelt et al., 2009). BYD's case was slightly different, as the frugal design was not in the final product, but in the production line. By replacing the overly sophisticated automated production line with a simpler process, BYD capitalized on the limited resources and managed to produce cheaper batteries in greater volume (Chattopadhyay et al., 2012, Dawar and Chattopadhyay, 2002). To summarize, observing from the examples, the strategy of frugality in product innovations entails design principles that advocates minimal use of resources for efficient functioning of products. The economizing of resources also involves the reusing of components and simpler designs that result in products without extra accessories. These no frills nature of frugal products help maintain lower costs, convenience in use and also a positive impact on sustainability because of lesser resource consumption (Rao, 2013).

The above mentioned examples illustrate that the ability to calibrate innovations for new markets depends on finding a set of capabilities needed to support the requirements of the new markets. In many cases, it is clear that specific institutional idiosyncrasies drive the innovation process. This contradicts the supply-side view that firm resources drive the innovation process. Doing the hard work of learning is indispensable, as capabilities that a firm possesses in one context might not work as well in a different market and demand context. Thus, the question is: What precisely are the capabilities required in a firm, especially in the context of mass markets in EEs?

Firms develop capabilities in idiosyncratic ways that are inevitably rooted in their firm's specific processes, routines and structures. Unlike resources, capabilities cannot be replicated easily. In general, the concept of capability refers to a firm's capacity to deploy resources, such as the knowledge and skills of its human capital, to perform desired output activities, such as innovating new products and services (Dosi et al., 2000b). 'Capabilities' have been envisioned in various ways by a number of authors, including 'capabilities' by Amit and Schoemaker (1993), 'combinative capabilities' by Kogut and Zander (1992), 'integrative capabilities' by Lawrence and Lorsch (1967) and 'architectural competence' by Henderson and Cockburn (1994).

Moreover, expanding the implication of capabilities to the changing market dynamism (see Teece, 2014; Teece and Pisano 1994, Teece et al., 1997, Eisenhardt and Martin, 2000 on related discussions), scholars have proposed that through 'dynamic capabilities', firms develop strategies to recombine and integrate competencies and resources to endure in rapidly changing circumstances. A dynamic capability is one that enables a firm to alter, extend or modify the way it currently makes its living. Dynamic capabilities involve adaptation and change because they build, integrate or reconfigure other resources and capabilities (Helfat and Peteraf, 2003). In a dynamic market environment, which can be characterized by a number of forces such as change in technological development, customer preferences, competition patterns, and so on, a firm that has dynamic capabilities is capable of recognizing, utilizing and advancing the technical, managerial and functional capabilities and expertise that are available locally or externally to the firm (Teece et al., 1997, Eisenhardt and Martin, 2000).

Thus, the concept of capabilities can be categorized in different ways. However, the overall theme postulates that by exploiting internal and external firm-specific resources such as technology, expertise (know-how), skills and knowledge, and deploying combinations of competences and resources that are difficult to imitate, capability facilitates the achievement of innovations, as illustrated in Figure 2.1.

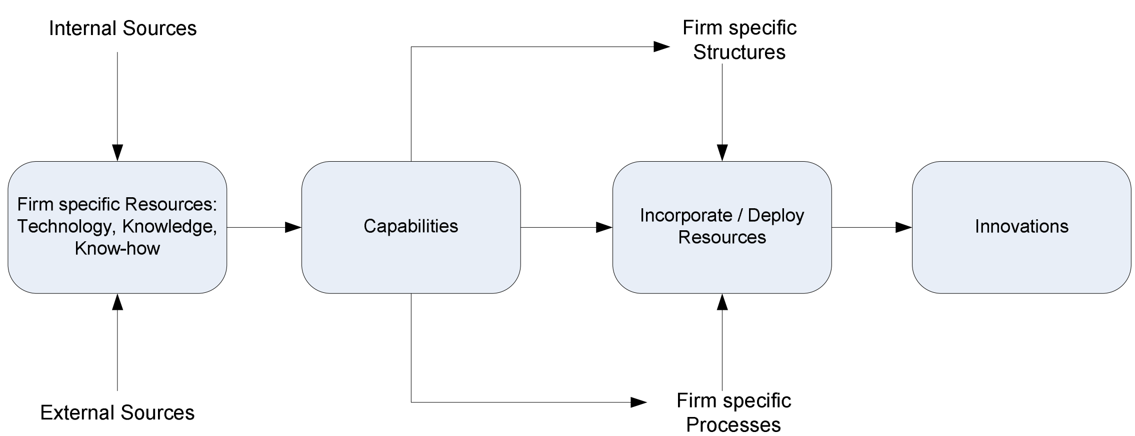


Figure 2.1: A conceptualization of capabilities

The literature also distinguishes between operational capabilities, innovative capabilities and dynamic capabilities. Operational capabilities (Winter, 2003) enable a firm to perform an activity on an on-going basis, using the same techniques on the same scale, to support existing products and services for the same customer population (Teece, 2014). These capabilities are 'ordinary' and are characterized as low level, usually involving repetitive activities such as manufacturing a specific product utilizing an established set of routines/processes (Banerjee, 2013, Lall, 1992, Nelson and Winter, 1982). In other words, the capabilities required to make use of existing resources, such as existing manpower, are operational capabilities. Conversely, innovative capabilities are high-level capabilities that facilitate developing new technologies or products.

2.4 Developing capabilities for specific demand contexts

As noted in the literature, exploiting new business opportunities requires firms to adapt/adjust their capabilities to reflect anticipated changes in the market and non-market institutional contexts (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). A firm gains an advantage if it has sufficient resources such as capital, superior information and workforce. However, without the required capability to orchestrate resources, these resources are of little value. The existing literature does not sufficiently explore this issue, or the best approach for orchestrating resources for mass markets. The literature also does not explore the issues of keeping a deliberate restraint on resources or leveraging existing and resources to cater to the underserved millions. These issues give rise to the question: For whom is the innovation intended — for high- or low-income markets?

Companies intending to design products and manage costs for mass markets need to consider that income constraints are often the fundamental limitation that severely constrains the ability to pay and therefore create major challenges. Customers can be willing but not able to pay (Seelos and Mair, 2007). This is in contrast to developed markets, where companies are usually concerned about the willingness of customers to pay for products and services. The general tendency for MNCs is to overestimate the purchasing power of the poor and set prices too high (Karnani, 2007) for products embodying superior features and specifications. Most customers are therefore poorly served by low-quality vendors or are actively exploited by intermediaries (London and Hart, 2008).

Recent studies (Ray and Ray 2010, 2011) show that a strategy to create appropriate innovations to meet the stringent price-performance criteria of mass markets requires frugal use of, and a deliberate constraint on, resources. Ray and Ray's studies focused on key aspects of design, technology and firm-specific choices that are likely to be critical for mass market innovation in EEs. However, little attention was devoted to identifying the capabilities that would be necessary for pursuing such innovations.

This study aims to address this major gap in the academic literature. Drawing upon on the key aspects of design, technology and firm-specific choices identified by Ray and Ray, this study proposes a set of three capabilities that are likely to be important in catering to low-income mass markets: capabilities to recombine; capabilities to form linkages; and capabilities to modularize (Sharmelly and Ray, 2013, Sharmelly et al., 2013). Combinative capabilities are important because they enable firms to frugally recombine existing core technologies and thus achieve the required performance targets at much lower costs than if they developed expensive new technologies. Linkage formation capability is important because serving low-income customers requires a focal firm to economize on resources by attracting partners to collaborate in, and share the costs of, product innovation associated with high risks, daunting challenges, very thin profit margins and untested markets. The capability to modularize is important because of the presence of multi-tiered market segments in EEs with continuously evolving niches of customer preferences and income parameters (Sharmelly and Ray, 2013, Sharmelly et al., 2013).

This set of capabilities is not proposed as one predetermined, authoritative or absolutely complete set. The usefulness of different capabilities varies according to the particular task or purpose. Moreover, a set of capabilities can be prioritized according to the task at hand. For example, reverse engineering generic drugs to achieve cost reductions requires process reengineering capabilities, while making new drug discoveries requires capabilities to innovate and overturn existing technological paradigms.

2.4.1 Combinative capabilities for architectural innovation

Innovations for mass markets often entail creating an altered performance package through changes in product architecture, without a change in underlying technologies (Ray and Ray, 2010). Combinative capabilities are defined as the firm’s capacity to combine/redeploy existing component knowledge into new architectural knowledge, leading to architectural innovations (Kogut and Zander, 1992; Hitt et al., 2000b). This eliminates the requirement for additional investment in exploration, thereby preventing the quest for new knowledge or technologies becoming excessively resource-intensive (Kogut and Zander, 1992, Hitt et al., 2000b). Architectural innovation essentially involves the creation of new architecture reconfiguring an established system, linking existing components in new ways e.g. resizing, changing design factors and material composition of components (Henderson and Clark, 1990). Firms intending to innovate for mass markets require component knowledge (i.e. knowledge about each of the components) and architectural knowledge (i.e. knowledge about the ways components in a complete system are configured/integrated together) (Henderson and Cockburn, 1994, Henderson and Clark, 1990).

Combinative capabilities emerge from three organizational dimensions: system capabilities, coordination capabilities and socialization capabilities. These enable firms to integrate component knowledge that is either located internally or from external sources into architectural knowledge (De Boer et al., 1999). System capabilities facilitate the establishment of formal procedures and routines for exchanging the functional knowledge that is embedded in a group of engineers. These include communication among groups, policies, directions and formal systems that recombine functional knowledge into explicit new architectural knowledge. Coordination capabilities integrate architectural knowledge through managerial instruments such as interaction, participation, training, job rotation and the institutionalization of relations among members of various groups (De Leeuw and Volberda, 1996). Socialization capabilities enable the integration of knowledge components through a firm's cultural institutions, such as shared beliefs, values, norms and agreed goals, that uphold the firm's mission (De Boer et al., 1999).

The value of combinative capabilities is in creating organizational routines to maximize the knowledge resources of its members more intensively, without necessarily creating new capacity, which adds to costs. Frequent and vigorous interchanges of ideas and demonstrations of physical artifacts attune an innovation with the practical realities of the market and the demand profile of discerning low-income customers. It also leverages existing resources more extensively to perform an alternative task of producing different permutations and combinations of the product for multiple-niche or mass markets.

It is noteworthy that development of capabilities through internal and external combinations of knowledge, assets and technologies has yet to receive sufficient academic attention. The capability to innovate depends not only on the amount spent on research and development (R&D) but also on how that is spent (including whether the R&D is conducted in-house or outsourced), and on how well the R&D is managed (Teece, 2014). The capability to innovate also depends on how an organization can leverage external knowledge resources, for these days, a good deal of previously proprietary knowledge is in the public domain, available from consultants, schools of engineering and the public literature. Hence the question for organizations to answer is what would be the ideal combination of in-house and external knowledge when pursuing a stated objective.

2.4.2 Capability to form linkages

To economize on resources and reduce uncertainty relating to the development of new technologies for serving low-income customers, innovation for mass markets requires 'social embeddedness'. In an informal economy (an unusually large segment of the economies of developing countries), relationships are grounded primarily on social, not legal contracts (De Soto, 2000). Government organizations, with their strong social orientation, and civil society tend to have the most expertise in serving these markets (Aturupane et al., 1994, Sen, 1999). By including input from civil society, local community groups and public sector firms are better able to understand and leverage existing social strengths in these environments (London and Hart, 2004).

This can be achieved by leveraging existing building blocks of local resources and capabilities through collaborative linkages (Seelos and Mair, 2007). Collaborative partnerships enable firms to access various functional and technological competences, knowledge and resources that do not exist within their own boundaries (Gulati and Sytch, 2007, Hitt et al., 2000b, Schilling and Steensma, 2001). Partnerships also facilitate innovation by lowering costs and uncertainties relating to the development of new technologies or new markets, sharing the risk of a particular venture and thus enhancing flexibility (De Man and Duysters, 2005, Gulati, 1998, Hitt et al., 2000a, Quinn, 2000, Schilling and Steensma, 2001). Ground-breaking sources of information and suggestions can often be obtained from the collaborative partners of the focal firm, ultimately being transformed into the ideas of innovative products and services (Dyer and Nobeoka, 2000, Eisenhardt and Martin, 2000, Dyer and Singh, 1998).

A firm's linkage capabilities refer to its ability to forge and manage collaborative partnerships (Dyer and Singh, 1998, Gulati, 1995, Gulati, 1999, Gulati and Wang, 2003). Linkage formation capabilities emerge from the focal firm's partnering experiences from participating in various previous alliances, which then increase the potential of a firm to participate in new partnerships (Dyer and Singh, 1998, Gulati, 1995, Gulati, 1999, Gulati and Wang, 2003). Firms have a significant tendency to form recurrent and long-term alliances with former partners, based on familiarity and trust, to reduce uncertainties in their relationships. Prior experience with partners also facilitates the commitment of partners' strategic resources to be available (Gulati and Wang, 2003, Lavie and Rosenkopf, 2006, Li and Rowley, 2002). Alliance formation capabilities enable firms to not only influence their existing alliances, but also to discover other possible future alliances that eventually enable them to capitalize on their functional expertise, critical competencies, resource base and reputation (Dyer and Singh, 1998, Gulati, 1995, Gulati, 1999, Gulati and Wang, 2003).

When partner firms exchange information through a transparent and honest approach, trust is built within the alliance network (Faems et al., 2008). Trust increases with increased familiarity and interaction (Gulati, 1995). Trust-based relationships eventually reinforce cooperation and performance in the partner firms (Ring and Van de Ven, 1992) and this enables a focal firm to access proprietary knowledge from alliance partners. Moreover, alliances based on trust, loyalty and reciprocity improve the transmission of knowledge and innovative performance (Dyer and Nobeoka, 2000, Phelps, 2010) and generate enhanced relational value (Schilling and Phelps, 2007).

2.4.3 Capability to modularize

If a firm can apply and extend existing knowledge and technologies for multiple markets, it can economize on its resources and earn greater revenues (Burgelman and Sayles, 1988). The ability to exploit existing building blocks of knowledge in different ways becomes very useful when large parts of the underserved market segments require different product specifications. Capability to modularize of a firm refers to its ability to access a diverse range of modules designed independently in different firms, thereby accumulating the component developers' resources and capabilities (Sanchez, 1995, Sanchez, 1996, Sanchez and Mahoney, 1996).

The capability to modularize allows the innovator to calibrate new offerings precisely corresponding to the demand profile of each market segment. It allows the flexibility to cater to both the low-performance requirements of mass markets and the more demanding upper-tier mainstream markets. In this way, modularity cross-subsidizes the losses from products for low-end segments with profits from products for upper-end markets. This is an important determinant for mass market innovation.

The capability to modularize is similar to the concept of exploitation, which signifies a firm's ability to leverage its existing technologies and resources to customize products, based on new needs and preferences (Raisch et al., 2009). This is different from the concept of exploration, which signifies the search for new knowledge, technologies and solutions (Raisch et al., 2009). Modularization of product architectures helps firms to customize product features when the performance of existing product technologies does not exactly meet the requirements of either less or more demanding customers (Christensen et al., 2002). Modularity allows firms to configure new modules and introduce varied features and functionalities. It allows engineers to create families of parts that share common characteristics, thereby reducing development costs for future generations of products, enabling substantial flexibility and promoting continuity (Baldwin and Clark, 1997). In the presence of multi-tiered market segments in EEs, with their continuously evolving niches of customer preferences and income parameters, modularity provides flexibility for the innovators. Products can be customized for the low performance requirements of customers who need the product to last a long time. At the same time, the provision for upgrading a basic model into a more sophisticated one for upper-tier mainstream markets can be retained.

Capabilities that facilitate the implementation of modularity in product innovation rest on two main principals. Firstly, creative leaders, who can envision a future generation of products and conceive of a diversity of product applications and configurations, are required. In the case of mass market innovation, visionary leaders need to articulate and communicate the way these simpler and cheaper products for low-end market segments could be upgraded gradually to meet the demands of the more profitable mainstream market segments (Tellis, 2006). Secondly, to benefit from the flexibilities provided by modularity, the innovating firm needs to have an open orientation that enables it to link and adapt its existing capabilities with those of other companies, in line with rapidly changing technologies (Baldwin and Clark, 1997).

2.5 Discussion

The foregoing discussion highlights the importance of understanding the unique context of mass markets in EEs as the starting point for designing and diffusing appropriate technologies. The low purchasing power of customers in EEs implies that firms attempting to serve mass markets need to be driven by a frugal approach and a deliberate restraint on resources. Firms from developed countries are used to tailoring new product development for the most demanding customers, developing resource-intensive routines and practices. Thus, a large amount of resource becomes a core-rigidity for these firms. Griffin (1997) noted that new product processes typically used as best practices by firms are likely to be complex and include many steps implying dependence on resources. Firms may need to unlearn the way they traditionally choose and allocate resources.

Further, a firm's capabilities in one context might not work as well in a different market and demand context (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). Firms attempting to serve mass markets need to balance the need to meet the social objective of bringing low-cost products to the masses with the need to attain profitability in the long run. Therefore, the significance of combinative capabilities to frugally recombine existing core technologies, attract alliance partners to collaborate in product innovation to economize resources, and develop strong capabilities to modularize and cross-subsidize losses in lower-tier markets with profits from upper tiers, keep costs of the innovation low.

Previous studies have noted the product innovation examples (often introduced by disruptive technologies) of GE, Hindustan Unilever, Galanz, Haier and Yadea as demonstrating an appropriate innovation strategy for low-income mass markets that require simpler and cheaper products. A number of other firms, from both EEs and developed countries, are innovating products ranging from affordable customer electronics to healthcare equipments. Examples of these are Unilever (China), Huawei (China), Godrej and Boyce Manufacturing (India), Bharthi Airtel (India), Whirlpool (US), Procter & Gamble (US), Philips (Netherlands) and Siemens (Germany) (Chattopadhyay et al., 2012, Dawar and Chattopadhyay, 2002, Ebert et al., 2010, Wooldridge, 2010). These companies are able to create new products for mass customers primarily because they possess capabilities critical for the specific contexts within which they operate.

As noted in the literature, the concept of linkages in the LLL is very similar to linkage formation capabilities. As proposed by Mathews in LLL model, (Mathews, 1999, Mathews, 2002b, Mathews, 2005, Mathews, 2006a, Mathews, 2006b, Mathews and Cho, 1999), linkages enable firms to leverage a number of strategic key resources, such as technology, market-specific information and knowledge, that would otherwise lie well beyond the reach of the firm. This repeated application of linking and leveraging resources enables firms to learn performing business operations more effectively, which leads to new innovations.

Linking experiences in various previous alliances enhances a firm's alliance formation capabilities to leverage technology, knowledge and expertise from alliance partners to lower costs and share the risks and uncertainties relating to the development of new innovations (Dyer and Singh, 1998, Gulati, 1995, Gulati, 1999, Gulati and Wang, 2003). Alliance formation capabilities enable firms to not only influence their existing alliances, but also to discover possible future alliances that eventually enable them to capitalize on the leveraged resources for innovations (Dyer and Singh, 1998, Gulati, 1995, Gulati, 1999, Gulati and Wang, 2003). Government policies and supportive institutional framework can act as exogenous factors to channel the linkage, leverage and learning (LLL) processes and thereby, support the development of alliance formation capabilities, influencing the growth of local and foreign alliances (Bruton and Ahlstrom, 2003, Bruton et al., 2010, Mathews, 2006a, Mathews, 2006b).

However, while firms can leverage resources such as technology and knowledge externally from alliance partners or internally through indigenous R&D experiments, unless they have combinative capabilities to integrate knowledge or technology into applications, they cannot achieve a competitive advantage. A firm's combinative capabilities enable the company to combine existing knowledge to modify product architecture. Combinative capabilities eliminate the need for exploration and further investment in new knowledge or technologies and prevent the innovation from becoming excessively resource-intensive (Kogut and Zander, 1992, Hitt et al., 2000b). Firms that have limited resources for innovation, especially those from EEs, tend to rely on their combinative capabilities to exploit existing resources within and outside the boundaries of the firm (Mathews, 2002b).

As observed by Henderson and Clark (1990), highly regarded firms that innovate within the context of stable architectural knowledge, well-developed information and communication channels, and problem-solving strategies for their most profitable mainstream customers are less able to deploy combinative capabilities to achieve an altered price performance for non-mainstream mass markets. Less entrenched firms are not handicapped by embedded architectural knowledge and often find it easier to abandon the old architectural knowledge and build new systems, utilizing their combinative capabilities to develop products for mass markets. Architectural, disruptive and radical innovations are often introduced by new entrants rather than established firms, due to their capacity to amend their dominant beliefs.

Research has found that modularity is critical to competing in product customization for the non-mainstream customer segment, as well as enhancing product attributes for mainstream customers (Adner, 2002, Christensen, 1997, Christensen et al., 2002). Modularity allows firms to configure innovative new modules, expanding the array of possible product varieties and enabling the creation of parts that share common characteristics. This implies that through reducing the development costs for future generations of products, modularity promotes continuity (Baldwin and Clark, 1997). By providing the flexibility for firms to customize products for both the low-performance requirements of mass market customers and the more demanding upper-tier customers, modularity facilitates access to a diverse range of modules that are designed independently in different firms, thereby accumulating the module developers' resources and capabilities (Sanchez, 1995, Sanchez, 1996, Sanchez and Mahoney, 1996).

This current study aims to contribute to the innovation literature by presenting a novel and contemporary insight into the capabilities that are required to create appropriate innovations for mass market customers in EEs. To date, this subject has been under-researched, with the extant literature primarily dwelling on the way established MNCs disseminate existing product innovations in EEs. This study's findings on capabilities will be a valuable reference for scholars and researchers in this field. The findings will also have significant implications for managers of aspiring companies intending to serve mass markets and could break new ground in advancing a plausible theory of capabilities for mass market innovation.

2.6 Summary and conclusions

The discussion in this chapter has highlighted the challenges to the traditional view of innovation that are based on assumptions of affluence and abundance of resources. As EEs play an increasing role in the global economy, the parameters of innovation are changing as billions of first-time customers from the EEs are joining the middle classes and can afford only cost-effective and functional offerings. For many Western companies, responding to the challenge of EE innovation, utilizing fewer resources, designing products with little capital and lowering manufacturing costs, is proving to be very difficult.

The literature suggests that a small number of pioneers are learning to do more with less resource. However, issues such as exactly what capabilities these pioneers developed and how they managed to build appropriate product innovations, in spite of the large income disparities and other practical realities of EEs, has not been explored, nor the question of what other aspiring firms from developed economies can learn regarding capabilities.

In this review, some of the capabilities required by firms aspiring to develop innovations for mass markets, and the way a few pioneers developed these capabilities, has been outlined, based on the literature and empirical evidence. Particularly for managers seeking to establish firms in emerging markets, a set of capabilities have to be prioritized according to the task at hand. To visionary entrepreneurs, some of this knowledge comes intuitively, but for most, gathering knowledge about the way capabilities, resources and technologies should be managed to create value for underserved markets is more a process of trial and error.

Managers seeking to develop low-cost innovations for mass markets need to consider three important issues. Firstly, although EE innovations initially satisfy only the basic minimum requirements of the mass market customers, they also have the potential to improve the performance of products for mainstream markets through modularization. This current study proposes that prospective firms should gain a deeper understanding of those EE innovations that can penetrate the mainstream from the low end of markets. Secondly, this research demonstrates the need to leverage existing technologies to create new combinations of features and specifications to serve the affordability criteria. For well-established incumbents, investments in local R&D, both through collaborations and in-house activity, can significantly enhance the appropriateness of products for low-end segments of the market. Thirdly, leveraging existing building blocks of local resources and capabilities through collaborative partnerships enables firms to access various technological competences and resources that do not exist within their own boundaries. Building collaborative partnerships with networks of local entrepreneurs could also assist MNCs to gain access to local supply chains for inputs and raw materials, co-developing new low-cost products.

Although the RBV literature emphasizes the critical role of capabilities for innovation, it does not offer a structured guideline that suitably illustrates the factors that enable the development of innovations for mass markets in EEs. By moving beyond the supply-side bias of the RBV, this review has drawn insights from the paradigm of capabilities, which outlines how the demand side (i.e. the unique contexts) can drive the innovation process and the principal capabilities that are critical for low-cost innovations for mass market customers. This is especially important given that due to lack of education, information and economic, cultural and social deprivation, poor people are not in a position to decide what kind of technology is appropriate for them or what will lift them out of their deprived states. Here, a greater institutional role is required to fill those gaps.

Chapter 3: Insights on Capability Development through Multidimensional Industry Research

3.1 Introduction

India, the world's largest democracy and high-growth EE, is regarded as an important market for global automotive companies. The automobile industry is one of the strategic sectors of the Indian economy and India is emerging as one of the world's fastest-growing passenger car markets, second largest two-wheeler manufacturer and the fifth largest commercial vehicle manufacturer in the world. One estimate suggests that the Indian automobile industry has contributed 7% of India's Gross Domestic Product (GDP) (SIAM, 2014). Factors that have encouraged the global automobile majors to leverage India's cost-competitive manufacturing practices are steady economic growth, favorable demographic profile, low vehicle penetration level, customer demand, growing population, abundant availability of skilled talent and a maturing automotive component segment (ICRA, 2011, KPMG, 2010, SIAM, 2013). While multinational automakers are relying on India for business growth, the country also remains a preferred outsourcing hub for automotive multinationals, increasingly as a source of developing higher value innovative products, technologies and supply chains. If the current strong growth trend persists through 2020, India could become one of the top five vehicle-producing countries in the world, a huge improvement on being the seventh largest at the time of this study (ICRA, 2011, KPMG, 2010, SIAM, 2013).

Since its beginnings in the early 1950s, the Indian automotive industry has produced a wide range of automobiles and auto components, catering to both local and foreign markets. According to scholars such as Amann and Cantwell (2012), Sagar and Chandra (2004), D'costa (1995, 2004), Mukherjee and Sastry (1996, 2002), Ranawat and Tiwari (2009), Saripalle (2006, 2012) and Narayanan (1998, 2001, 2008), its success has been due to a combination of the robust growth of India's economy, customer demands and government policies (the influence of the latter evidently being substantial). However, little of the academic literature has investigated an extensive continuum of the government policies and their impact on the capability evolution of the Indian automotive industry. While the existing literature maps the growth trajectory of the automotive industry, it does not give a picture of the sequential progression from low-level to high-level technological capabilities along with industry structure through diverse policy regimes.

It is therefore appropriate for this study to closely examine the way capabilities in the Indian automobile industry have evolved and identifying and understanding the government policies that have influenced the industry's development. This extensive, multidimensional inquiry aims to provide detailed insights on the evolution of technological capabilities, exploring multiple aspects at both industry and firm level. This scrutiny will illuminate more precisely the influence of various government interventions in each of the development phases of the industry, the span of capability accumulation, the gradual progression to higher-level capabilities and the resultant impact on the industry structure relating to alliances and modular relations between automakers and suppliers.

This review begins by outlining the background of the global automotive industry and an overview of the Indian automotive industry. The next section discusses the evolution of

India's automotive industry under the influence of various government policies and the impact of them on growing technological capability accretion and industry structure. Detailed analysis and discussion identifying the evidence of progressive improvements in technological capability with the evolution of the industry structure are documented. This is followed by describing the major players and trends in the passenger car industry. The chapter concludes with a summary of the significant factors regarding capability development in the Indian automotive industry.

3.2 Background of global automotive industry and the Indian context

3.2.1 Global overview of the automotive industry

Over the last century, the motor car has shaped the global economy and has become an indispensable part of people's lives. In the auto industry, the 'economic center of gravity' and sources of profits have shifted from the developed world to EEs such as Brazil, Russia, India, China and South Korea (KPMG, 2010, McKinsey, 2013). These emerging markets are poised to significantly outpace growth in developed markets such as North America, Europe and Japan, with the share of global sales in EEs rising 65% in 2012. By the year 2020, it is predicted that emerging markets will account for approximately two-thirds of the total automotive profit (KPMG, 2010, McKinsey, 2013).

According to a US-based public policy research organization, Brooking Institution, the Asian share of the global middle-class customer segment will double from 30% to 64% by 2030, whereas that of the US and Europe will decrease to 22% (Economic Times, 2013). At the time of writing, the contribution of Asia to global auto production had increased from 20% to 50% in one decade, with India predicted to soon become the second largest car producer in

Asia, after China. Auto MNCs have been shifting their production bases from high-cost developed countries such as the US, Japan and Western Europe to low-cost emerging countries such as China and India, to minimize their costs and maximize their revenue. Analysts estimate that producing cars in India today is 15–20% cheaper than in the US. There is also a clear shift in global consumers' preference for smaller, compact and fuel-efficient vehicles. More than 60% of this market is located in EEs, where strong growth of up to 6% per year is estimated until 2020 (Economic Times, 2013).

3.2.2 Overview of the Indian automotive industry

Since India's economic liberalization in the early 1990s, the automotive industry (i.e. automobile plus auto components) has experienced impressive growth. Industry statistics indicates that during the period 2013–14, the industry produced more than 21.4 million units of vehicles, as shown in Table 3.1 (SIAM, 2015).

Table 3.1: Production trends in the Indian automotive industry

Source: Based on SIAM (2015) data

Automotive Production Trends						
Category	**2008–2009**	**2009–2010**	**2010–2011**	**2011–2012**	**2012–2013**	**2013–2014**
Passenger vehicles	1,838,593	2,357,411	2,982,772	3,146,069	3,231,058	3,072,651
Commercial vehicles	416,870	567,556	760,735	929,136	832,649	698,864
Three-wheelers	497,020	619,194	799,553	879,289	839,748	830,120
Two-wheelers	8,419,792	10,512,903	13,349,349	15,427,532	15,744,156	16,879,891
Total	1,11,72,275	1,40,57,064	1,78,92,409	2,03,82,026	2,06,47,611	2,14,81,526

Table 3.2 shows that the revenue of the automotive industry was USD 67,607 million during the period 2013–2014 (SIAM, 2015).

Table 3.2: Revenue of the automotive industry

Source: SIAM (2015) data

Revenue of the Automotive Industry						
Year	2007–2008	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013
Revenue in USD million	36,612	33,250	43,296	58,583	66,264	67,607

This growth has been due to factors such as the Indian government identifying the auto industry as an important sector of the economy, favorable investment conditions and rising demand because of the exceptional growth of the Indian economy (Times of India, 2009). The following three key shifts in government policies facilitated the industry's development: auto industry liberalization, as part of wider economic liberalization in 1991; a phased manufacturing program introduced in 1980s; and a new auto policy in 2002 (Kumaraswamy et al., 2012). Further, favorable investment conditions and changes to the landscape of competition in the global automotive industry attracted almost all of the major auto manufacturers into India. Thus, India has become one of the most attractive automotive locations, providing market and low-cost labor benefits for multinational auto manufacturers (Times of India, 2009). Indian customers have benefited considerably from this, gaining access to a broad range of vehicles at affordable prices. Therefore, it is pertinent to observe how capabilities in the Indian automotive industry evolved and influenced the industry's development.

3.3 Evolution of capabilities in the Indian automotive industry through diverse regimes

Technological capabilities in the Indian automotive industry have evolved through the development of three different policy regimes: the protection and licensing regime (1950–1984), deregulation (1980–1990) and the liberalization regime (1993 onwards).

3.3.1 The protection and licensing regime: 1950-1984

3.3.1.1 Policy framework

In 1948, the Industrial Policy Resolution (IPR) classified the automotive industry as an industry of strategic importance (IBEF, 2009, Mani, 2011, Narayana, 1989). To avoid fragmentation of the Indian automotive industry, the automotive firms were obliged under the IPR to obtain licenses from the government for the purpose of entry, capacity expansion, diversification, imports of machinery, raw materials and foreign collaborations. This resulted in a protected and uncompetitive market, with few incentives to undertake innovation (Chugan, 1995). Consequently, inferior vehicles with obsolete designs were produced during this period. The capacities of the automotive firms were significantly lower than their licensed capacities. As the Indian government viewed passenger cars as luxury items, leading domestic auto manufacturers focused on commercial vehicles. The government controlled the import of capital equipment and raw materials, as well as industrial outputs, and automobile components incurred high taxes. These factors kept the Indian automobile industry in a period of technological stagnation (Ranawat and Tiwari, 2009), as the lack of competitive pressure and tight controls meant manufacturers had no motivation to improve their production quality and they had limited access to technology from foreign manufacturers (Amann and Cantwell, 2012).

In accordance with the objectives stated by the 1948 IPR, the policy for the automotive industry that was pursued in 1949 increased the tariff on the import of completely built vehicles (CBUs) rather than assembling only completely knocked down (CKD) vehicles, and allowed only a few foreign firms to operate a local manufacturing program (Sagar and Chandra, 2004). The Industries Development and Regulation act (IDRA) was introduced in 1951 as a licensing system for the development of the automotive industry. Successive amendments for capacity and product licensing continued to apply in the automotive industry until the early 1990s. Following the recommendation of the Tariff commission, from 1953 the Indian government enforced the requirement of progressive manufacturing on the automotive assemblers, to indigenize the production of vehicles in India (Singh, 2004). This resulted in the exit of foreign assemblers and facilitated the limited collaborations among domestic assemblers with foreign players for manufacturing vehicles locally. At this stage, foreign collaborations were allowed only after meticulous consideration and were subject to control by governmental decrees. The indigenization content was progressively increased from 50% in the 1950s to 80% in the 1960s (Singh, 2004).

3.3.1.2 Market structure

During the protection and licensing regime, which is also known as the ‘License Raj’ era, the auto industry was burdened by government procedures, price controls, high entry barriers for foreign companies and punitive tariffs against imports. Only two manufacturers were operating: Hindustan Motors Ltd (HML) and Premier Automobiles Ltd (PAL) (D’costa, 1995). HML and PAL were licensed to make only 50,000 cars between them. Moreover, the two manufacturers were not granted permission to upgrade their existing models through collaborating with foreign automakers (D'Costa, 1995).

3.3.1.3 Development of capabilities

The 1953 policy decision to indigenize the production of vehicles had a considerable impact on the development of India's automotive industry. The existing automobile manufacturers undertook in-house manufacture of components, as the auto component industry was not well established at that time. This 'learning by doing' facilitated the upgrading of the industry's manufacturing capabilities (Parhi, 2008).

With the revision of the IPR in 1956, the automotive industry gained some autonomy (Narayana, 1989). HML and PAL, who were restricted to the commercial vehicle segment entered into the production of cars. Additionally, the manufacturing program of several other firms, such as Ashok Motors, Standard Motor Products, Tata Engineering and Locomotive Company (TELCO) and Mahindra and Mahindra (M&M) were approved for the manufacturing of two-wheelers, commercial vehicles, utility vehicles and passenger cars (Narayana, 1989). However, priority was given to the production of commercial vehicles and two-wheelers.

Until the 1960s, the Indian government exercised strict controls on foreign collaborations, to discourage the acquisition of technology through foreign equity participation. The resulting decrease of the number of foreign collaborations was restored with the relaxation of policies in the 1980s. However, this prior control actually helped the auto industry to build limited design capabilities. For example, domestic firms such as TELCO and Bajaj Auto were incentivized to introduce indigenously designed vehicles. Consequently, Bajaj Auto designed a 50cc motorcycle and launched it on the market (Chugan, 1995).

To summarize, during the protection and licensing regime the focus was on indigenization, protection and regulation of the Indian automotive industry. As a result, until the 1980s, Indian customers could choose between only three passenger car models: ‘Ambassador’ by HML, which was based on the 1950s Morris Oxford; ‘Padmini’ by PAL; and the ‘Standard Herald’ by Standard Motor Products (D'Costa, 1995). In the 1970s, the combined annual production of the two main manufacturers (HML and PAL) met about half of the demand for passenger cars. Most importantly, under this regulatory regime the existing automotive manufacturers had little incentive to significantly upgrade their technological capabilities, a crucial factor for expanding international competitiveness.

3.3.2 Deregulation/limited liberalization period: 1980–1990

3.3.2.1 Policy framework

From 1970, the Indian government adopted a number of policies that promoted industry competition and modernization. In the early 1980s, the deregulation of the Indian auto industry allowed local Indian manufacturers to enter the passenger car segment and collaborate with foreign automakers (Venkataramani, 1990). During this period, a number of joint ventures were established between Japanese and Indian auto-manufacturing firms for technology transfer and equity participation. For introducing new fuel-efficient vehicle models, domestic firms established several technology collaborations with Western and Japanese manufacturers. A number of Japanese auto component firms also followed their Japanese manufacturers into India and collaborated with the Indian local suppliers, which led to improvements in the capabilities of the auto component segment (Mukherjee and Sastry, 1996).

Despite being classified as a luxury, the passenger car industry was recognized as one of the core industries of economic development and should be supported by the government (Narayanan, 1998). In 1981, ‘Broad Banding’ of licenses was announced by the Indian government, allowing automakers to manufacture a diversified range of vehicles instead of only one product category (Mukherjee and Sastry, 2002). This Broad Banding of product categories was considered critical for the modernization of the Indian automotive industry. Previously, an automaker was required to acquire a license for each vehicle type it was planning to manufacture. With the introduction of the ‘Broad Banding’ policy manufacturers were able to produce a range of vehicles and achieve economies of scale, thereby making the best use of their installed capacities. Manufacturers were also exempted from the Monopolies and Restrictive Trade Practices Act (MRTP), which had constrained the car makers from expanding or setting up new plants (Mukherjee and Sastry, 2002).

From 1986, to encourage existing firms to advance their technological capabilities, the Indian government introduced a more liberal import policy. Fiscal incentives were provided to the passenger car manufacturers for imports of the capital equipment, technology and raw materials that were required for the modernization of the automotive industry (Sagar and Chandra, 2004).

3.3.2.2 Market structure

The modernization of the industry, which included policy decisions regarding new entries, foreign equity collaborations and imports of technology, had a significant impact on the development of India’s automotive industry. The number of vehicle models available to

Indian customers increased, along with improvements in product technology and quality. For example, Maruti Udyog Limited (MUL) was established in 1981 to modernize the Indian automobile industry and manufacture indigenously developed passenger cars for the Indian population (IBEF, 2009, SIAM, 2013). In collaboration with Suzuki (Japan), the first Indian-made vehicle launched in 1984 from MUL was the 'Maruti 800', which included modern technologies and fuel efficiency, and was 21% cheaper than existing domestic cars. MUL captured more than 83% of market share by 1997 and started producing middle-sized passenger cars. The Indian passenger car market was dominated by Maruti, with a 62% market share, up until the 1990s (D'Costa, 2004).

Under the Broad Banding license policy, TELCO entered the light commercial vehicle market, launching the 'Tata 407' in 1985. Two further models were introduced in 1987: 'Tata 608' and 'Tata 709' (Venugopal, 2001). The company also introduced a pickup named the 'Tata Mobile' in 1988, for carrying both goods and passengers, and two new models of commercial vehicles, the 'Tata Sierra' and the 'Tata Estate'. Due to the liberalized import regime, in 1992 TELCO obtained expertise from Anstalt für Verbrennungskraftmaschinen List (AVL) Austria for the development of a fuel-injected petrol engine. The company also imported the expertise and equipment for the design and body styling of 'Tata Sierra' (Venugopal, 2001).

Other Indian automakers also began to upgrade their own offerings. For example, PAL entered into a technical agreement with Nissan (Japan) for their A-12 engine. HML collaborated with Isuzu (Japan) for the design of gasoline, diesel engines and power train assemblies and also collaborated with Vauxhall (UK) for designing and tooling technology.

Standard Motors offered a passenger car, collaborating with Austin Rover (UK) (Saripalle, 2006).

3.3.2.3 Development of capabilities

The limited liberalization that occurred during this deregulation period had a considerable impact on the development of India's automotive industry. The modernization attempts adopted by the Indian government not only intensified competition in the industry, but also upgraded the technological capability base of automaker firms and suppliers (Okada, 2004). Various relaxations to the regulations pertaining to capacity licensing, foreign collaborations, technology imports, liberal MRTP implementations and Broad Banding facilitated significant changes within the automotive industry. The influx of foreign collaborations in the auto industry, the ingress of diverse product designs and insistence on higher-quality components coupled with timely delivery also facilitated the technological capability advancement of the local supplier base. During this period, encouraged by the local content requirement policy of the government, joint ventures between traditional Japanese suppliers and domestic firms begin to grow, igniting the development of local supplier networks (Okada, 2004).

Further, due to the increased collaborations with foreign partners, a number of Indian automakers such as PAL, TELCO and M&M formed joint ventures with international MNCs such as General Motors, Ford, Mercedes and Peugeot. This facilitated the imports of technology and a progression towards high-end technology and fuel-efficient passenger vehicles, thus diversifying from the commercial vehicles and utility vehicles segment. As a result, Indian customers who had hitherto been restricted to a few passenger car models were given more choice (D'Costa, 2004).

In summary, the most important policy decision in the deregulation period was the relaxation regarding foreign collaborations. The overarching objective behind this change can be explained as the instigation of competition, with the spate of technology agreements and foreign investments that revealed a significant change in the structure of the industry, especially the passenger car segment.

3.3.3 Liberalization and globalization regime (1991 onwards): development of innovation capabilities

3.3.3.1 Policy framework

Economic liberalization in India in 1991 had far-reaching consequences for the development of the Indian automotive industry. The New Economic Policy adopted in 1991 proposed wide-ranging economic reforms to liberalize and open up the Indian economy (Industry&Services, 2015, Narayanan, 2001). The government initiated structural reforms such as deregulation of the industrial sector, reforms of the financial sector and taxation, and took a more liberal stance towards foreign trade and investment. Accordingly, the New Industrial Policy introduced by the Indian government in July 1991 marked the beginning of the liberalization and consequent globalization phase of the Indian automotive industry (Chettri, 2002). This resulted in dynamic transformation of the automobile industry, through growing exposure to global competition and an increased inflow of foreign direct investment (FDI) (Shinde and Dubey, 2011). The important policy decisions were de-licensing, capacity expansion, removal of the automobile import quota, and relaxing the taxes on the import of capital goods and technology.

Moreover, under the de-licensing policy of entry and diversification, coupled with a revised foreign investment policy of FDI up to 51%, the industry experienced a huge inflow of FDI. This made the Indian automobile industry fiercely competitive in terms of quality and price, as almost all key foreign automakers entered the Indian auto sector (Narayanan and Vashisht, 2008, Piplai, 2001, Rajesh and Dileep, 2013). At this stage, multinational auto manufacturers were permitted to enter the Indian auto industry and establish majority-owned or even wholly owned ventures. Between 1992 and 1997, Ford, Toyota, Honda, Daewoo, Daimler and Peugeot entered the Indian auto market through joint ventures with domestic firms (Sumantran et al., 1993).

With the key policy decision of abandoning the Phased Manufacturing Programme, which required auto manufacturers to achieve an indigenization level of 95%, foreign auto manufacturers also started to explore the potential of India as an export base for automobile production. This enabled the transformation of the formerly monopolistic passenger car segment into one of the most competitive industry sectors (Panda, 2002).

With the vision of making the Indian automotive industry globally competitive, the Ministry of Industry adopted the ‘Auto Policy’ in 2002 to promote further modernization and indigenous design and development in the industry (Singh, 2004). The policy targeted making India the global manufacturing hub for small passenger cars. Further, the policy allowed up to 100% of foreign equity investment for the manufacture of automobiles and auto components. To help domestic players attain global standards of automobile production, achieving enhanced capabilities and performance, the policy promoted further R&D incentives such as tax deduction of more than 125% for the R&D activities of the manufacturers (Ranawat and Tiwari, 2009, Industry&Services, 2015).

3.3.3.2 Market structure

The above policy changes significantly altered the development trajectory of the Indian automotive industry. All vehicle segments and auto component segments were de-licensed in July 1991 (IBEF, 2009, Parhi, 2006). The de-licensing of the passenger car segment in May 1993 encouraged automotive firms to expand and diversify their business operations with technology acquisition and performance upgrades. The revised foreign investment policy also encouraged a number of multinational automobile companies to enter the Indian market, forming joint ventures with domestic companies. These included the joint ventures of Mercedes-Benz with TELCO in 1994, Ford with M&M in 1996, Fiat with Tata Motors in 1997, Toyota with Kirlosker group in 1997 and General Motors with HML in 1994 (IBEF, 2009, Parhi, 2006).

Once the Indian government opened up FDI in the Indian auto sector, the auto component sector experienced a large inflow of FDI from their key foreign suppliers such as Delphi, Denso and Lucas–TVS. A number of foreign automakers (e.g. Ford, Toyota and Mercedes-Benz) encouraged their suppliers to create manufacturing facilities in India, forming joint ventures with Indian suppliers (Okada, 2004). This growing presence of global suppliers in India created a huge impetus for Indian suppliers to upgrade their production capabilities and quality level to survive as first-tier original equipment manufacturer (OEM) suppliers and also to meet different product specifications and standards. By the mid-1990s, TELCO and M&M formed joint ventures with global suppliers to produce key components. In this way, through lowering trade barriers and opening up the growth potential of the domestic market, the previously oligopolistic passenger car segment was transformed into one of the most competitive industry sectors (Narayanan and Vashisht, 2008). Intensive competition in the automotive industry encouraged local Indian companies to undertake entrepreneurial endeavors, to innovate cost-effective, technologically sophisticated and reliable modes of transport for the growing pool of middle-class Indian customers.

3.3.3.3 Development of capabilities

From a technology perspective, liberalization policies facilitated indigenized R&D efforts to assimilate foreign technology by the local players. For example, Tata Motors established an engineering research center (ERC) for conducting R&D in the areas of design, testing, styling and vehicle performance (Saripalle, 2012). Tata also established a number of strategic partnerships to import technological expertise and facilitate the pooling of resources and capabilities. For example, Tata imported technology for developing fuel-injected gasoline engines from AVL (Austria), welding process technologies from HLS (Germany), body-styling technology from IDEA (Italy) and engine-testing technology from Le Moteure Moderne (France). As a result, in 1999 the first Indian-made car, 'Tata Indica', was launched by Tata Motors, reflecting its accumulation of advanced technological capability in passenger car design and manufacturing (Saripalle, 2012). Similarly, M&M changed from from being a tractor and jeep maker to a passenger automaker and India's first indigenously developed affordable sports utility vehicle, 'Scorpio', was launched in 2002 (Humphrey et al., 2000a, Madhavan, 2014).

Liberalized policies also encouraged indigenized design and development activities by supplier companies and gave rise to close networked relationships between suppliers and OEMs. Humphrey (Humphrey, 2000b) found that the Indian auto component sector designs and manufactures a wide range of auto components, such as engine and transmission parts, electrical drives, suspension and systems and body components. The increasing capabilities of Indian component suppliers include high-level knowledge in auto component design and engineering, specifications and automation, flexibility in small-batch production, and growing IT capability for research, design, development and simulation. For example, while Sundaram and Rico Auto established laboratories for the R&D of reverse engineering of software, and designing and testing of automobile components, Sona Kayo established a design center to conduct R&D for engineering design of parts. These accumulated capabilities enabled supplier firms to take up turnkey projects for the OEMs with greater efficiency, producing cost-effective, quality auto components (Humphrey, 2000b). As a result, a number of global MNCs have shifted their automobile design centers to India, which is an excellent base for prototyping, testing, validating and manufacturing auto components. This allowed the Indian auto component firms to integrate into the global supply chain as first-tier OEM suppliers (Ranawat and Tiwari, 2009, Saripalle, 2012).

To summarize, the key policy decisions in the liberalization phase, as well as liberal trade measures and a huge increase in the number of foreign auto manufacturers promoted competition. Eventually, indigenized R&D efforts by Indian manufacturers to assimilate foreign technology and strategic partnerships to leverage advanced technical knowledge on passenger car design and manufacturing increased the level of technological capability in the Indian automotive industry. Indian customers benefited the most from this competition, which forced auto manufacturers to undertake entrepreneurial endeavors to produce cost-effective, reliable, technologically competent automotive vehicles.

3.4 Analysis and discussion

This section discusses the impact of various government policies on the development of India's automotive industry, tracing the capability advancement in India's automotive industry according to the influences of government interventions.

The evidence suggests that the Indian automotive industry has evolved in three distinct phases, as shown in Table 3.3.

Table 3.3: Evolution trajectory of the Indian automotive industry

Evolution of the Indian Automotive Industry		
Protection	**Deregulation**	**Liberalization**
- Industry characterized by government formalities, price controls, high entry barriers for foreign companies, punitive tariffs against imports and lack of competitive pressures. - Passenger cars viewed as luxury items. - Industry dominated by HML and PAL.	- Deregulation of the industry, limited FDI, more liberal import policy. - Establishment of technology collaborations among domestic and foreign auto manufacturers. - Domestic auto manufacturers entered the passenger car segment under Broad Banding of licenses. Entry of Maruti in the passenger car segment and launch of a number of light commercial vehicles by TELCO.	- Liberal trade measures, de-licensing, capacity expansion, tax relaxations for capital goods and technology import in the auto industry. - 100% foreign equity investment and increased R&D incentives for the auto manufacturers. - Formation of joint ventures between auto multinationals and domestic companies e.g. Ford–M&M, Fiat–Tata Motors, and General Motors–HML.

As Table 3.3 shows, in the first phase of the protection and licensing regime (1950–1984), government policies were related to regulation, protection and indigenization of the industry, which facilitated the development of an indigenous automotive industry. In the second phase of deregulation (1980–1990), the most important policy decision was the relaxation of regulations regarding foreign collaborations and technology acquisitions. This instigated foreign competition in the industry, which transformed its dynamics. Finally, in the liberalization phase (1993 onwards), liberal trade measures in regard to foreign investment facilitated the globalization and entrepreneurial endeavors of the auto sector.

The literature characterizes the Indian auto industry’s operational capabilities as low level, usually involving repetitive activities, such as manufacturing a specific product, utilizing an established set of routines (Banerjee, 2003, Nelson and Winter, 1982). An analysis of the Indian auto industry shows that protectionist policies in the early stages of development played an important role in the acquisition of basic production capabilities (i.e. operational capabilities) (Awate et al., 2012, Lall, 1992). In the absence of a supportive supplier industry, the focus on the local manufacture of auto components by the existing auto manufacturers demonstrates the attainment of manufacturing capabilities. Although the policy decision of 1953 (Progressive Manufacturing for Indigenization) facilitated the upgrading of manufacturing capabilities, strict controls on collaborative partnerships with foreign firms meant the existing auto manufacturers had little incentive to improve their capabilities, due to absence of competitive pressures. The ‘License Raj’, which severely restricted the number of firms competing in the industry to a duopoly, did little to compel Indian firms to upgrade beyond operational- or production-level capabilities This clearly indicates the limitation of government policies in influencing the capability advancement of an industry in an internationally competitive environment.

At a higher level of capability progression, it can be observed that in the limited deregulation phase with the liberal import regime and local content requirement policy adopted by the government, the development of a local supplier base was fostered with the establishment of a number of joint ventures between domestic firms and traditional Japanese suppliers (D'Costa, 1995, Okada, 2004, Ranawat and Tiwari, 2009). Leading auto manufacturers had to rely on domestic component suppliers and increased concerns about quality from local automakers such as TELCO and MUL forced local suppliers to improve their capabilities and component quality. According to Lall (1992), in the technological capabilities approach, the linkage formation capabilities of focal firms are crucial for the development of supporting supplier industries for reproducing components and materials and to increase technological outputs. At a still higher level, adaptive capabilities facilitate technological self-reliance, enabling a firm to re-engineer production. Indeed, the establishment of local supplier network and accumulation of improved supplier capabilities for manufacturing a wide range of critical auto components in the limited liberalization phase clearly indicates the attainment of duplicative/adaptive capabilities progressing from lower-level operational capabilities.

Finally, in the liberalization and globalization phase, state-of-the-art foreign technology integration and indigenized R&D endeavors were facilitated by the liberalization policies. Consequently, the first Indian-made car, ‘Tata Indica’, was introduced by Tata Motors in 1999 and India’s first indigenously developed affordable sports utility vehicle, ‘Mahindra Scorpio’, was introduced by M&M in 2002, indicating the accrual of advanced technological capability in passenger vehicle design and manufacturing. Clearly, this shows the progression to indigenous design, development and innovation capabilities. As Lall (1992) propounds, at the advanced level, innovative capabilities facilitate the development of new technologies/products.

The evolution of the industry also shows that in the licensing period, the motivation to form alliance relationships was much lower, let alone to develop a tiered supplier network, as the government exercised stringent controls on foreign collaborations for the attainment of technology and the existing manufacturers had to undertake in-house manufacturing of auto components. As observed in the regulatory phase of the industry, the existing auto makers HML, PAL and Standard Motor Products were following a low-volume/high-price strategy, due to a lack of domestic and international competition in a protected market. The combined annual production of the manufacturers met about half of the demand for passenger cars and the overall performance of the industry with regard to consumer choices and quality of vehicles was unsatisfactory.

In the deregulation phase, the capability to upgrade the supplier base reflects the value of linkage formation capabilities and close networked relationships between the auto manufacturers and suppliers. This was facilitated by the diffusion of knowledge, skills and information between auto manufacturers and suppliers (Okada, 2004). The incentive to form collaborative partnerships was significantly higher, as a number of joint ventures and technology collaborations were established between foreign and local auto manufacturers, as well as suppliers for technology transfer and equity participation. For example, the first Indian-made car, 'Maruti 800', was developed as collaboration between MUL and Suzuki (Japan). Similarly, other Indian automakers such as TELCO, PAL, HML and Standard Motors also entered into collaborative relationships with a number of foreign auto manufacturers, such as Nissan (Japan), Isuzu (Japan) and Austin Rover (UK).

The inducements to form alliance partnerships and close networked relationships between suppliers and auto manufacturers continued during the globalization phase. This not only encouraged local automakers to conduct R&D in vehicle design, testing, styling and performance, but also enabled the Indian auto suppliers to integrate into the global supply chains.

As observed in the literature, linkage formation capabilities facilitate innovation by economizing on resources and thereby lowering costs, risks and uncertainties (De Man and Duysters, 2005, Gulati, 1998, Hitt et al., 2000a, Quinn, 2000, Schilling and Steensma, 2001). Specifically, in technology-intensive industries, leveraging existing building blocks of local resources and capabilities through alliances allow firms to access various functional and technological competences without incurring additional costs (Gulati and Sytch, 2007, Hitt et al., 2000b, Schilling and Steensma, 2001).

Collaborative partnerships with suppliers also aids in speed and flexibility for customizing product features to meet the evolving needs of customers, thus enhancing a firms' ability to act in response to market dynamism technologies (Baldwin and Clark, 1997). This strategy has long been borne out by Japanese automakers with the use of a tiered supplier system (Ray and Ray, 2011). Rather than designing and manufacturing components and assembly in-house, suppliers are involved for the concurrent design and manufacturing of components at a very early stage of the product development. For lowering costs and accelerating the product's arrival in the market, suppliers are required to locate close to automakers, which enables sharing of knowledge and problem-solving of ideas (Clark and Fujimoto, 1991, Dyer and Singh, 1998). Thus, it can be inferred that with the significant rise of competition in the industry in the later phases of the licensing regime, it was essential for automakers to control costs and accelerate the product design cycle by utilizing alliance relationships and supplier networks.

In the earlier period, as pointed out by Ranawat and Tiwari (2009), most of the R&D efforts of automotive firms in India aimed to merely adapt the proprietary designs to Indian market conditions. Later, the liberalized policies, increased competitive pressures and growing demand of Indian customers for affordable, fuel-efficient vehicles (especially small cars) encouraged auto firms to undertake incessant R&D efforts for in-house product design and development, since investment in radical new concepts or leading-edge technologies was no longer a viable option. Indian firms also needed to conduct R&D to absorb the new technologies that were being imported into India after the liberalization. 'Tata Indica', launched by Tata Motors in 1999 and other successful models such as Tata Indigo, Mahindra Scorpio, Tata Ace, Tata Nano, Bajaj Pulsar, TVS Scooty, were all accomplishments of indigenous R&D efforts. These product innovations largely focused on achieving the required performance targets at much lower cost, rather than by developing expensive new technologies. According to (Ray and Ray, 2010, Ray and Ray, 2011), this strategy is effective in serving less-developed, non-mainstream mass markets to create the altered price-performance package.

Hence, the relationship between key policies of the Indian government in three different phases, and the progression of capabilities along with the consequential impact on the industry structure, can be mapped through the model shown in Figure 3.1, which conceptualizes the evolution of capabilities in the Indian automotive industry.

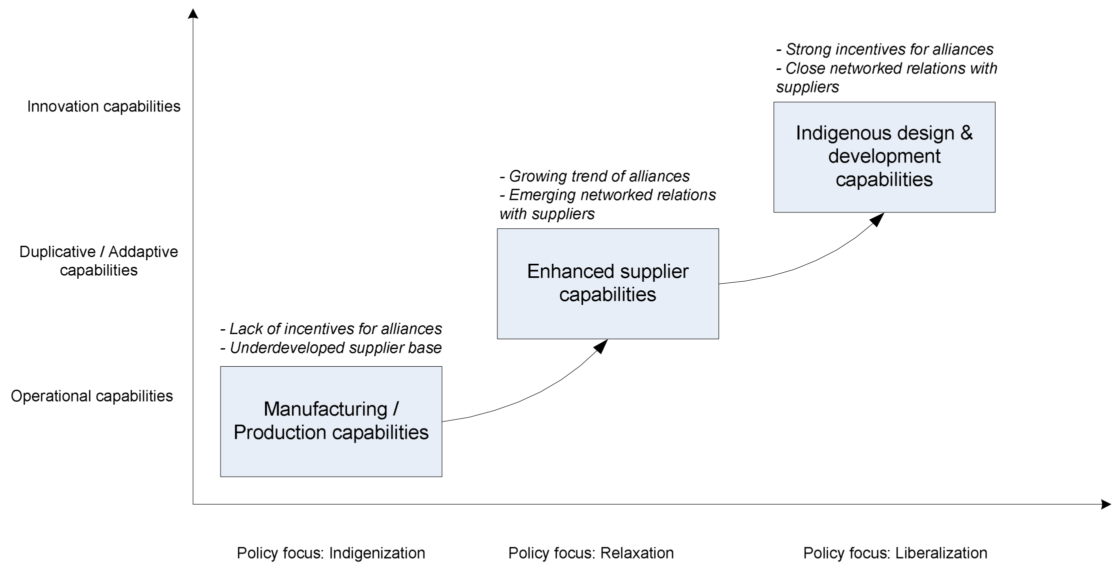


Figure 3.1: Evolution of capabilities in the Indian automotive industry (Source: Author)

Figure 3.1 shows that in the first phase of protection and licensing regime protectionist policies facilitated the accrual of manufacturing/production capabilities (i.e. operational capabilities). Next, in the limited deregulation phase the accumulation of enhanced supplier capabilities enabled the attainment of duplicative/adaptive capabilities. Finally, in the liberalization and globalization phase indigenous design and development capabilities (i.e. innovation capabilities) were accrued due to the liberalization policy focus.

3.5 Current industry configuration: Major players and trends

With the increase in numbers of domestic and foreign automotive firms, competition in India’s auto industry has become more intense. The liberalization of the industry that facilitated the expansion in India’s foreign investment and trade policies, along with India’s favorable macroeconomic trends, have contributed to this development (Rajesh and Dileep 2013, Piplai, 2001).

The most important segments of the Indian automotive industry are the two-wheelers (motorcycles and scooters) and passenger vehicles, accounting for more than 94% of total volumes (see Figure 3.2). The remaining share is commercial vehicles (multi-utility vehicles, MUVs) and three-wheelers (SIAM, 2015).

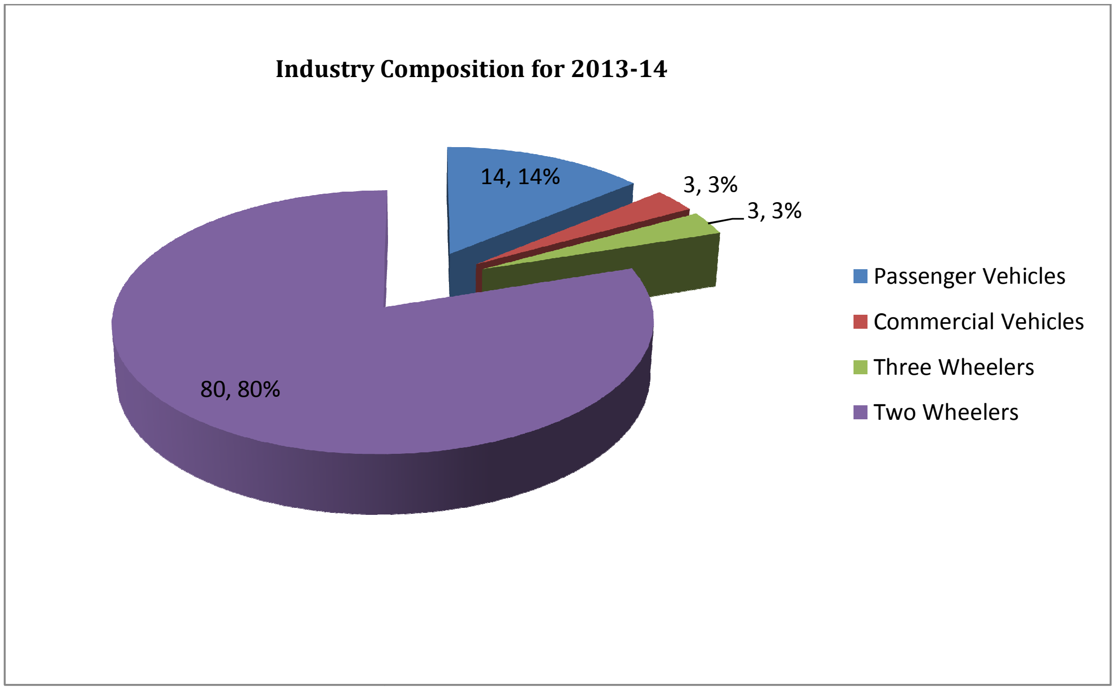


Figure 3.2: Composition of the Indian automotive industry

Source: SIAM (2015) data

Due to the high demand of affordable vehicles, small, compact cars account for more than 80% of total volumes within the passenger car segment (ICRA, 2011, SIAM, 2013). The Indian automobile industry has also gained worldwide recognition for its automobile exports, which reached 3.10 million units in 2013–14 (SIAM, 2015, ThomasWhite, 2010), as shown in Table 3.4.

Table 3.4: Export trends in the Indian automotive industry

Source: SIAM (2015) data

Automotive Exports Trends from 2008–2014						
Passenger vehicles	335,729	446,145	444,326	508,783	559,414	593,507
Commercial vehicles	42,625	45,009	74,043	92,258	80,027	77,056
Three-wheelers	148,066	173,214	269,968	361,753	303,088	353,392
Two-wheelers	1,004,174	1,140,058	1,531,619	1,975,111	1,956,378	2,083,938
Total	1,530,594	1,804,426	2,319,956	2,937,905	2,898,907	3,107,893

Table 3.5 shows that the export revenue of the automotive industry was USD 8 billion during the period 2013–14, contributing 7.1% of India's GDP (SIAM, 2014).

Table 3.5: Export revenue in the Indian automotive industry

Source: SIAM (2014) data

Automotive Export Revenue		
Year	2003–2004	2013–2014
Export revenue in USD billion	1	8
Share of GDP	4.5%	7.1%

Figure 3.3 shows that Maruti Suzuki and Hyundai Motors were the major players of the industry (Economy Watch 2010, Times of India, 2015), along with Tata Motors. In the passenger car segment, these three companies had more than 85% of the total annual sales (SIAM, 2014).

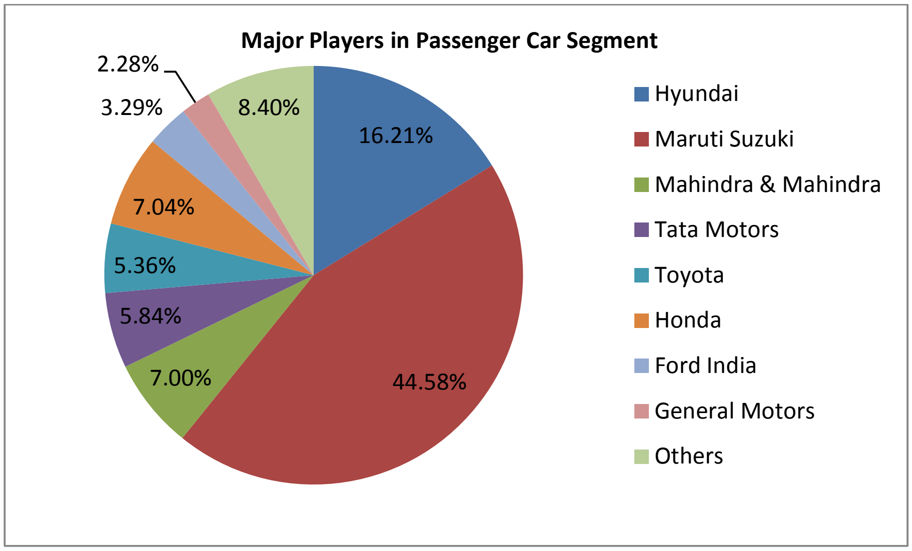


Figure 3.3: Major players in passenger car segment in terms of market share

Source: SIAM (2014)

The auto component sector is one of the fastest-growing segments of the Indian automobile industry. This highly competitive sector generated USD 39.7 billion (see Figure 3.4) during 2008–2013 (ACMA, 2014) and is projected to become the fourth largest auto component producer in the world by the year 2020.

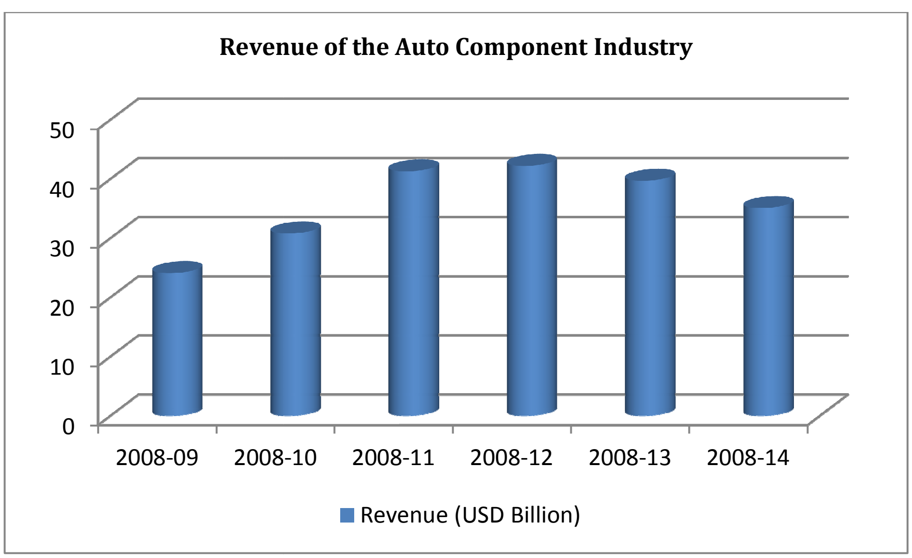


Figure 3.4: Steadily growing revenue trend of the Indian auto component sector

Source: ACMA (2014)

Increasing demand for passenger vehicles, availability of skilled manpower and low labor costs facilitated the growth of the auto component sector (ACMA, 2014, IBEF, 2014). Additionally, favorable policy initiatives such as 100% foreign equity investment and R&D incentives for the manufacturers introduced in the liberalization phase of the industry spurred the intensification of the auto component sector (Narayanan and Vashisht, 2008, Singh, 2004). The technological capabilities of the Indian component supplier base is one of the main reason for established multinational automaker companies to position themselves as competitive small car makers in the Indian market. The growing capabilities of the Indian component suppliers included high-level knowledge in technical drawings, specifications and automation, flexibility in small-batch production, and design, development and simulation. Over the years, the sector developed its capability of manufacturing all auto components required to manufacture vehicles, which is evident from the high levels of localization achieved in Indian-made vehicles such as the Tata Indigo, Tata Nano, Tata Indica, Bajaj Pulsar and Mahindra Scorpio. As shown in Figure 3.5, the auto component sector manufactures the entire range of automotive components. These include engine parts, which contribute 31% to the total component production, followed by driving and transmission parts, which contribute nearly 19% of the total component production (ACMA, 2014, IBEF, 2014). The other components produced are suspension, braking parts and electrical parts.

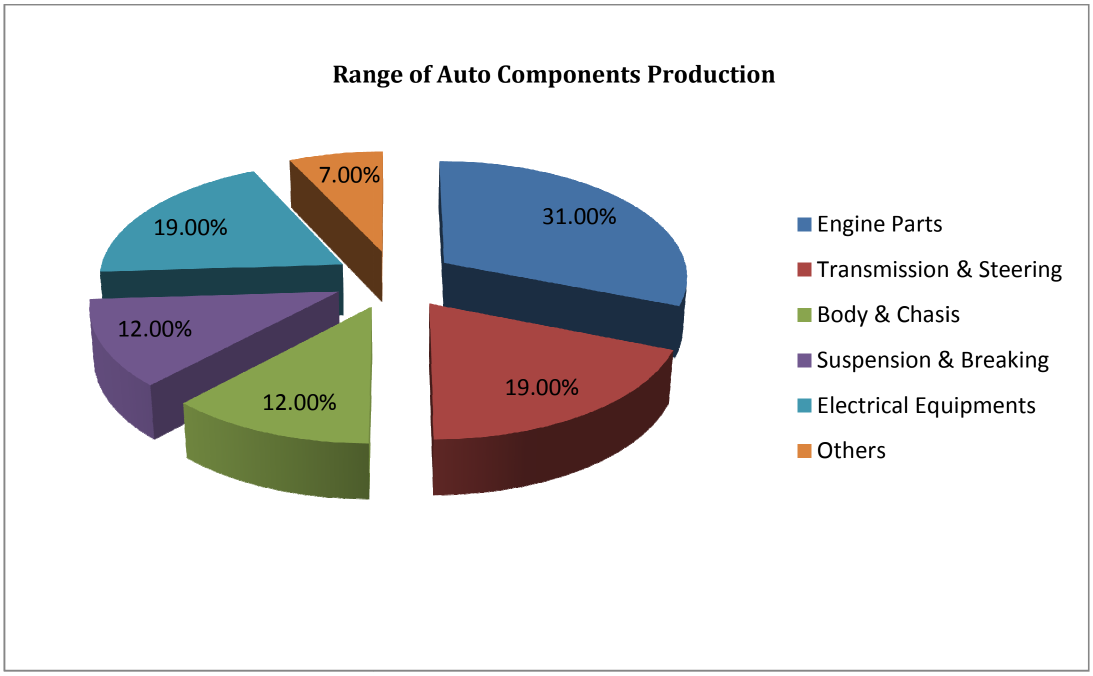


Figure 3.5: Range of auto components production

Source: ACMA (2014) and IBEF (2014) data

As shown in Table 3.6, during 2013–2014 the export revenue of the auto component sector reached USD 10.20 billion, up from 5.10 billion in 2008–2009.

Table 3.6: Growing export revenue trend of the auto component industry

Source: ACMA (2014) and IBEF (2014)

Export Revenue of the Auto Component Industry						
Year	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014
Revenue in USD billion	5.10	4.20	6.60	8.80	9.70	10.20

3.6 Summary and conclusions

This review has revealed valuable information about the Indian automotive industry and sequential evolution of capabilities through different policy eras. It found that the development of Indian auto industry occurred under three major policy regimes. The foci in these different phases were indigenization of the industry, relaxation of regulations and globalization of the industry. It also found that at the commencement stage, protectionist policies played an important role in the attainment of operational capabilities. However, at a later stage, liberalization policies catalyzed the growth of innovation capabilities. Lastly, the stimulus to form linkage partnerships, in-house R&D efforts and modularized relationships among suppliers and auto manufacturers also supported the advancement in capabilities.

The next chapters contain case studies of both Indian and foreign auto manufacturers, as well as quantitative analysis and statistical generalizations from the observations in the case studies.

Chapter 4: Development of Capabilities in the Indian Automotive Industry: Cross-Case Validation Studies

4.1 Introduction

Of late, there has been a dramatic shift of world economic power towards less-developed countries, in particular, EEs. The growing influence of EEs is shifting the global competitive landscape, as these new economies are a great source of opportunity, inspiration and innovation. However, much is yet to be explored in the academic literature about the opportunities and challenges face organizations, which intend to engage with these markets. In recent times, India has emerged as one of the world's fastest-growing passenger car markets and remains a preferred location for auto MNCs to develop frugally engineered products for the masses (ICRA, 2011, KPMG, 2010, SIAM, 2013). However, the existing literature, both theoretical and empirical, does not provide adequate insight as to what should be the approach to developing innovations to meet the unique price–performance criteria of mass market customers. Indeed, the extant literature has yet to map the intricate processes involved in creating suitable innovations for mass markets in EEs.

Even much less has been theorized or systematically explored in the academic literature about the specific capabilities required by firms to create appropriate innovations for the masses. In some quarters, there is a general belief that EEs focus only on absorbing innovative ideas from the developed-country multinationals, where pre-existing product technologies are diffused into mass markets (Anderson and Billou, 2007, Seelos and Mair, 2007). Although a couple of studies have tracked the trajectory of product innovations in mass markets (Ray and Ray, 2010, Ray and Ray, 2011), the precise capabilities required to support the innovations remains unaddressed. Therefore, a valuable insight can be gained from taking a closer look at how firms can develop appropriate innovations for the mass markets in regard to capabilities.

The aim of this study is to fill this gap in the literature. The objective of this chapter is to explore what capabilities are required by firms and how the capabilities might be developed to create innovations for the masses in less-developed countries, most notably emerging economies. Using replication logic, this study observes the phenomenon of capability development processes for mass market innovation. More specifically, by using comprehensive empirical case studies of two emerging market firms (EMFs) and two auto MNCs, coupled with a cross-case analysis, the study examines and validates the detailed processes of capability development for mass market innovations.

The chapter starts with the theoretical background of the study. Following this, the methodology entailing cross-case validation studies is outlined. In-depth case studies of the two EMFs and two MNCs are then presented. This is followed by a cross-case analysis and discussion to determine the similarities and differences of the required capabilities and how they were created to come up with appropriate mass market innovations. Finally, the chapter concludes with summarizing the major findings obtained from the cross-case validation studies along with three propositions in respect of mass market innovation.

4.2 Theoretical background

The dominant view of technological capabilities originates in the resource-based view (RBV) (Adner, 2002) which proposes it is the munificence of resources and organizational slack that leads to innovation. It then follows that if a firm possesses resources to innovate to solve major world problems such as dwindling energy reserves and climate change, it would be the appropriate strategy for the firm to pursue. However, inherent in RBV is a supply-side bias that makes the theory of dominant designs an exclusive approach. With the growing salience of EEs in the global economy, the parameters of innovation are changing as billions of first-time customers with meager purchasing power from the EEs are joining the middle class who can afford only the cost-effective and functional offerings. Indeed, for consumers in less-developed countries, access to cost-competitive goods are more of an immediate priority in contrast to the developed world, where consumers and organizations have moved beyond basic needs towards expectations of solving more intractable problems confronting the human race. Hence, the demand-side perspective is of greater salience when calculating what strategy to pursue in EEs. For many Western firms, therefore, responding to the challenge of EE innovation by utilizing fewer resources, designing products with little capital and lowering manufacturing costs, is a nightmare, as it entails a fundamental revision of the firm's raison d'être. More so, because it requires a shift from dominant design which renders obsolete an organization's existing knowledge base on architectures, and calls for a different set of capabilities contingent on a narrow task or purpose, while other capabilities may be useful for other purposes.

The emerging view of capabilities is subversive. In the demand-side view (Adner 2002), capabilities must take into account the heterogeneity in demand, since capabilities that a firm possesses in one context might not quite work in a different market and demand context (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). It begins with a consideration of the importance of adapting capabilities to the needs of the environment. Isomorphism to institutional realities dictates that firms develop capabilities to serve mass customers who would have otherwise been off the demand and supply equation.

Firms intending to design products and manage costs for mass markets need to consider that income constraints are often the fundamental limitation that severely constrains the ability to pay for, and therefore create, major innovations. Customers are willing, but often not able to pay (Seelos and Mair, 2007). For mass customers in the EEs, over-specifications are of little value as they do not add to the basic functionality of the product. Yet the literature is not clear what type of capabilities are critical to innovation in EEs (Anderson and Billou, 2006, Arnold and Quelch, 1998, Hang et al., 2010, London and Hart, 2004). In general, the impression conveyed by these studies is that firms aiming to operate in EEs must be willing to develop their capabilities to ensure an acceptable price–performance ratio.

Firms differ in the way they co-ordinate their activities and processes which ultimately have a significant impact on their innovative performance (Teece and Pisano, 1994, Teece et al., 1997, Dosi et al., 2000b). To exploit new business opportunities, firms require adaption of their capabilities to reflect anticipated changes in the market and non-market institutional contexts (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997).While resources such as capital, superior information and workforce are vital, without the required capability to orchestrate resources they are of little value. Indeed, it has been observed in the literature that many EMFs initially began with severe resource constraints and yet they somehow mustered capabilities to bring about epochal innovations to their home markets (see Ray and Ray 2010). Therefore, a germane question is to ask what capabilities are then required for firms to create appropriate innovations for the masses in EEs. This is a subject that has remained under-researched, since the extant literature dwells primarily on how established MNCs disseminate existing product innovations in EEs.

In this study we propose a set of capabilities that are likely to be important to cater to low income mass markets. We propose that three capabilities may be highly significant; namely, capability to recombine, capability to form linkages/alliances and capability to modularize (Sharmelly and Ray, 2013, Sharmelly et al., 2013). Combinative capabilities are critical for mass market innovations because they enable firms to frugally recombine existing core technologies and thus achieve the required performance targets at much lower costs than if they developed expensive new technologies. Linkage/alliance formation capability is critical, because serving less-well-to-do customers requires the focal firm to economize on resources by attracting partners to collaborate in, and share the costs of, product innovation associated with high risks, daunting challenges, very thin profit margins, and untested markets. Finally, capability to modularize is critical, due to the prescience of multi-tiered market segments in EEs with continuously evolving niches of consumer preferences and income parameters (Sharmelly, Ray and Ray, 2013; Sharmelly and Ray, 2013). It is not suggested that these capabilities are canonical and an absolutely complete set; these capabilities simply appear as significant when the literature and empirical evidence is taken into account. Particularly for managers seeking to innovate for mass customers in EEs, a set of capabilities has to be prioritized according to the task at hand.

4.3 Methodology

In this research, case study design was used to gain in–depth insight of the context and also to obtain rich data (Dyer and Wilkins, 1991, Yin, 1984). The case study method enabled in–depth exploration of the complex real life activities/processes of selected firms to probe the area of capability development. Studying the underlying processes deployed in performing a task by an emerging market firm is critical in identifying capabilities. As postulated by

Hartley (2004), Eisenhardt (1989) and Yin (1993), the findings obtained from the case study method have the potential to be more rigorous, reliable and empirically valid if multiple case studies are used, which can allow increased generalization across different case study findings. This research study involved a multiple-case design to produce convincing empirical evidence. To address the central research question, four case studies of selected firms creating appropriate mass market innovations were used in the research to capture the capability development processes for innovation.

Sample firms for this research study were obtained from the Indian automobile industry, which has become one of the largest passenger car exporters in the world and is one of the key sectors for the economic development of India (ICRA, 2011, SIAM, 2013). Both the choice of sample firms—local Indian firms and multinational firms working in the Indian automobile industry—and the unit of analysis was guided by how effectively firms are addressing the unique challenges of innovation for mass markets highlighted by academic journals, books, trade journals and business press. The study therefore included four firms, namely, Tata Motors Ltd, Mahindra and Mahindra (M&M), Ford India and Hyundai Motor India Ltd (HMIL).

This research study used qualitative semi–structured interviews to understand the process of capability development for mass market innovations. The interview participants were selected based on the individual judgement permitted on the grounds that participants possess deep knowledge and understanding of the capability development process and its importance for creating appropriate mass market innovations. A total number of 11 semi–structured face-to-face interviews were conducted in India between June and July 2012, with key informants assigned by the participating firms (Table 4.1).

Table 4.1: Interviewees from different firms

Organization	Person interviewed	Designation
Tata Motors	Ravi Kant	Managing Director
	Ashok Joshi	Head, Tata Technologies
Mahindra & Mahindra (M&M)	Rajiv Mehta	Head, Product Planning
	Nitin K. Tikle	Senior General Manager
	Rajesh Pandey	Deputy General Manager
	Srinivas Ramanujam	Deputy General Manager
Hyundai Motor India Limited (HMIL)	Puneet Anand	Deputy General Manager
	K. Rajesh	Manager
	A. Alwarsamy	General Manager
Ford India	Michael Boneham	President & Managing Director
	Sandip Sanyal	Executive Director

In addition to primary data from interviews, and for data triangulation referring to the employment of multiple sources of information for a better understanding (Gibbs et al., 2007), information was also mined from five other categories. These include academic journals, books, specialist automotive journals, engineering and technical trade journals and selected business press, including *Business Week, The Economist, Business Today, Business World, Times of India* – all reputed for quality of journalism. Data was also collected from internal documents of firms, includingannual reports, firm announcements, organizational charts, consultants' reports and supplier-related information. Such documentary evidence acted as a method to cross-validate information obtained from interviews and to triangulate evidence (Eisenhardt 1989). In this way, the corroboration of multiple information sources increased the validity and reliability of this research study (Denzin, 1978).

As Baxter and Jack (2008) recommend, the use of multiple cases in qualitative research allows for within–case analysis coupled with a cross– case analysis to generalize patterns across cases. Moreover, examining evidence from multiple cases can enable new concepts and novel findings to emerge which can be beyond the anticipation of a researcher, and the final research findings can also become stronger and better grounded (Ritchie and Spencer, 2002). In accordance with the view of Eisenhardt (1989) and Yin (1981, 1993), searching for cross–case patterns in this research study included two tactics. First, the four cases were compared according to the selected categories, which in this case included the capabilities identified; namely, combinative capabilities, alliance formation capabilities and capability to modularise. Second, the cross–case analysis also compared the pairs of EMFs and MNCs to look for the subtle similarities and differences (in a divergent way) to facilitate a deep probing of the meaning of the differences.

Finally, to further enhance the internal validity, strengthen theoretical scope and sharpen the generalisation of the research findings, the results of this research study were linked and compared to the existing literature. According to Ahrens and Chapman (2006), this process is particularly important for theory – building research as the research findings are often derived from a limited number of cases. Therefore, comparison with literature discussing similar findings in related/different context strengthens the confidence and enriches the conceptual level of a research study.

4.4 Case Studies of EMFs

4.4.1 Tata Motors

4.4.1.1 Background

Tata Motors Limited is a part of the Tata Group which was founded in 1868 and expanded to build the country's first steel mill and hydroelectric plant in colonial times, to eventually become a diversified conglomerate by the early twentieth century (Khanna and Palepu, 2006). Being intimately familiar with the unique needs and the environment, Tata Group historically served various market tiers of India's economic pyramid, including those at the base, with commodities such as salt, textiles, oil and so forth. In 1969, Tata Motors started selling trucks and buses under its own brand name – "Tata". Until the end of 1980s, India's automotive industry was technologically obsolete with little incentive to innovate because of an industrial licensing scheme – infamously known as the "License Raj" which had prevented firms like Tata from entering the passenger car segment of the industry. The License Raj had resulted in increased import tariffs, difficulty in getting licenses and approvals for foreign technology. After being granted approval in the mid-1990s, Tata Motors entered the low cost passenger car business developing the Indica and Indigo models (Anon, 2006). In 2008, Tata Motors launched an ultra-low-priced passenger car, the "Nano" at a price of approximately US$2,000 – an unprecedented event in recent automobile history (Ray and Ray, 2011).

4.4.1.2 Visionary leadership

Tata Nano was designed and manufactured as the world's ultralow-cost car for mass market customers. This innovation was essentially the result of Ratan Tata's visionary leadership to serve mass customers, recognizing their unique socio-economic characteristics and demand context (Bennet, 2008). In 1991, when Ratan Tata was introduced as chairman of Tata group, he emphasized setting a culture of shared vision for the entire organization. The core purpose of establishing this culture was to instil a vision for the entire group and encourage every member of the organization to innovate products through a keen understanding of the required price-performance criteria of mass customers (Bennet, 2008) .

With an out-of-the-box thinking strategy, young Ratan Tata took on the challenge of making passenger cars. By 1998, Tata Motors was able to launch India's first indigenously designed, developed, and produced car, the “Indica” (Anon, 2006), thus marking Tata Motors’ footprint in the low cost passenger car business. Despite being derided as "Ratan's folly", the Indica became a resounding success and now it is the third-biggest selling car brand in India (Kripalani, 2004a), selling for just US$5,100.

Yet, the Indica remained beyond the reach of India’s masses except for the urban middle class customers who represented a small proportion of India’s vast market potential (Anon, 2006). Thus, to serve mass markets at a price more affordable than the Indica, and which would be approximately half the cost of the Maruti 800—the cheapest car available in the Indian market at US$5,000—Tata started the planet's most challenging project: to develop a super-cheap people’s car, a project he believed could revolutionize the auto industry. His aim was to set a new benchmark for low-cost vehicles, luring in mass customers with a more affordable entry point (Bennet, 2008).

The target market was the millions of Indians who currently used motorcycles, rickshaws and scooters to progress to a people’s car, which would be one of the cheapest cars ever built. Such a launch would not only have a wide-reaching impact on India's growing car market, but also all over the semi-developed world (Bennet, 2008). Revealing his vision (Pandit, 2005) Ratan Tata said:

“The mandate has gone out to our people that we now really need to look seriously at the needs of the larger part of the Indian income pyramid, where most customers can be found….but there is also a social or dreamy side to it. Today in India, you often see four

people on a scooter: a man driving, his little kid in front, and his wife on the back holding a baby between them. It's a dangerous form of transportation, and it leads to accidents and hospitalizations and deaths. If we can make something available on four wheels—all-weather and safe—then I think we will have done something for that mass of young Indians."

Most industry experts were, however, unconvinced and many said Tata's goal of manufacturing a low cost car that would cost only US$2,500 was impossible. Being risk-taking and inspired by sheer entrepreneurial spirit, Ratan Tata depicted his vision (Pandit, 2005) for the potential product innovation in a confident way:

"In India, we want to explore the large mass market that is emerging—not by following, but by breaking new ground in product development and seeing how we can do something that hasn't been done before."

Concerning the development of Nano, Head of Tata Technologies, Ashok Joshi emphasized Ratan Tata's vision in the following way:

"*For emerging markets, the basic theme is value for money. In the automotive sector customers have different expectations. Tata Nano has been developed for a certain group of people. Before Nano came to Indian market there was no car for the low-end customers. As a result they were buying two-wheelers. That was not a safe mode of transport for a family of 4-5 people. This was identified as a white space for innovation as no automaker has done anything in that segment, and this was identified as a main market to emerge. The whole project was led by the vision of Ratan Tata, and he took a keen interest in monitoring the progress from the beginning. He inspired the team, came up with various suggestions. We had a good team structure, project charter, structured process and strong leadership from* *him. After his vision came, Tata Motors did a market survey to understand how this vision can be translated into reality. We were very much open for new ideas because we had to meet the low cost target as well as meet customer aspirations. So we needed engineering excellence in our team."*

Taking enormous risks, Ratan Tata envisioned four critical aspects in the innovation: a) a diminutive vehicle; b) produced in very large volumes, with all the high-volume parts manufactured in one plant; c) intensive use of plastics on the body; and d) a very low-cost assembly operation, with some use of modern-day adhesives instead of welding (Pandit, 2005). A committed team of 500 young and highly qualified engineers worked in a dedicated team to develop India's ultra-low-cost car. Chief engineer in charge of Nano project, Girish Wagh, described it thus (Palepu et al., 2011):

"The Chairman would himself come out, drive and give us feedback – this is not good enough, we need to improve acceleration or comfort. Since he was directly involved and most of the engineers were getting a chance to interact with him and demonstrate their work, it led to a very high level of motivation. For the next iteration, people would work with more energy and enthusiasm, with a belief that something will get accepted. Gradually, this set the DNA of the team. What motivated us was that we were working for a dream for the Chairman. There were many naysayers who were saying 'this is not possible'. That used to fire up the Chairman. It also used to fire up many of us".

Inspired by the challenge, component manufacturers were more than enthused and committed to take up the low cost innovation challenge for this project. Selection of suppliers was therefore made, not only on the basis of their expertise but also on their shared vision despite the high risk associated with the project. Ravi Kant, the CEO of Tata Motors, explained that it was easy to pick the suppliers (Snyder, 2008):

"Some get the target challenge, some say it's impossible".

German supplier, Bosch, was the major foreign supplier for Tata, and the CEO, Bernd Bohr, embraced the low cost challenge and said (Snyder, 2008):

"Yes, we'll do it".

About 80% of component design and manufacturing was outsourced, mainly to low cost Indian suppliers, for example, Sona Kayo Steering, Lumax Industries, Rico Auto Industries, Shivani Locks. With the successful launch of compact passenger cars Indica and Indigo, Tata Motors' credibility for delivering risky innovative car projects was established (Gopalan and Mitra, 2008). Therefore, when approached again to join on the Nano project, the component developers and suppliers enthusiastically accepted the nearly impossible target (Gopalan and Mitra, 2008).

4.4.1.3 Architectural innovation to achieve the desired price-performance package

To obtain the altered price-performance package, in the Nano project there was the requirement of generating novel architectural knowledge, which involved the integration of existing components in new ways, thereby providing the basis for architectural innovation. For doing so, engineers at Tata Motors analyzed all possibilities for reducing cost, starting from product design to manufacturing techniques (Bennet, 2008). Knowledge of car components was gathered through analyzing each component, for example. curve in the sheet metal, control knob from the essential functionality, cost and performance requirements

(Gopalan and Mitra, 2008). To come up with new architectural knowledge, engineers considered new combinations of existing core technologies; explored alternative materials; managed substantial re-engineering and resizing of components; used low cost components meeting regulatory requirements; reduced part count and reconfigured the existing linkages between major components. In this way, Tata Motors developed novel ideas for combining components in an innovative way for the Nano to achieve altered functionality, which is typically associated with architectural innovations. Furthermore, resizing components and altered linkages between them within the new product architecture not only contributed to cost savings but also met the required performance criteria of compactness and fuel efficiency (Gopalan and Mitra, 2008).

In designing the Nano, most of the classic economy car designs rules and conventions were jettisoned. The 3.1-meter-long Nano does not use a transverse front engine and front-wheel drive. Rather, the engine was placed below the rear passenger seat delivering cost, operational efficiency and saving space (Voelcker, 2008). In this regard, Ashok Joshi described it:

"We have the engine at the rear which saved space. This is an important factor because low-end customers usually don't have enough car space/own garage to park a car. Moreover, power train, engine transmission, suspension, and brakes – these are all known technologies and have been used in other Tata car models. But in Nano, these technologies have been applied in a cost-effective way to optimize cost and performance. Furthermore, in the dashboard steering and information panel of Nano, significant innovation has been done."

Without a propeller shaft, the rear engine of Nano drives the wheels directly, having a dramatic impact on safety, utility and costs. Moreover, with the engine fitting straight between the rear axles, there is minimal loss of power through the gearbox to the wheels (Anon, 2009a). The rear engine also allowed for re-engineering of the steering column due to the lighter weight in the front of the car. Surinder Kapur, MD of component maker Sona-Kayo Steering, described the innovative approach (Palepu et al., 2011, Ray and Ray, 2011):

"When we figured out that the car would be rear-wheel drive, we knew that the steering column could be engineered differently since the front wheels would not have the weight of the engine. So we kept the steering column hollow."

This innovation saved not only material costs but also reduced the weight of the Nano. The small 65R12 tyres and wheels of the Nano used less material. Chief engineer, Girish Wagh, described the architectural innovation of the Nano, which incorporated existing car elements in novel approaches (Gopalan and Mitra, 2008):

“Tata Motors looked at various ways to cut costs across the spectrum. For instance, a normal wheel mounting has four pins while we have three. We have also reduced the thickness of the bumpers. Moreover, the car has only one wiper instead of the conventional two”.

Additionally, instead of welded bodies, lightweight steel in the car body was used wherever possible, meeting stringent safety norms (Hagel and Brown, 2008). The seating system had 10% fewer components; handles of the car door had 70% fewer parts than the cheapest European cars. The tires had no tubes. Instrument panels on the dashboard were similar to motorcycles. The rear suspension was also similar to motorcycles, in order to help balance a higher center of gravity and a rear-mounted engine (Palepu et al., 2011). Overall, low cost components that met regulatory requirements were used wherever possible, and all these design innovations generated 40 new patents for Tata Motors (Voelcker, 2008). In his own words, Deepak Jain of Lumax Industries (Gopalan and Mitra, 2008) stated:

"A long-life bulb that might last 10 years adds a lot to the cost, so we fitted a standard-life bulb that met regulatory and warranty issues but kept costs low".

The initial prototype design and engine development was undertaken by Tata Motors at its Engineering Research Center (ERC), Pune, India (Gopalan and Mitra, 2008). Combining knowledge of existing components and their linkages facilitated the creation of new architectural knowledge. Tata Motors combined its in-house body design expertise and engineering capabilities with those of its innovative partners to integrate knowledge possessed by the component makers. Tata, together with its parts makers, created a new blueprint for designing a low cost car through brainstorming on how to design, build and source vehicles. Around 80% of component design and manufacturing was outsourced, mainly to Indian suppliers (Kripalani, 2004a), many of whom had a track record of manufacturing to global standards (Bowonder, 2004).

Along with the competencies of Tata Motors, the capabilities of major foreign partner Bosch Automotive were exploited. Such capabilities entailed re-engineering, redesigning and adapting technologies. Ninan Philip, Deputy General Manager of Bosch Motor Industries in Bangalore, India, stated in this regard (Snyder, 2008):

"Bosch won several major contracts by redesigning major technologies into new products that are smaller, lighter and less complex".

To reduce weight, for instance, Bosch adapted a motorcycle starter motor by not only removing 700 of the 1,000 functions of its European-market engine control module, but also by shrinking the electronic chip and its housing (Snyder, 2008). The German supplier also redesigned throttle-position sensors to reduce size and weight. The sensor was reduced to half its usual size, because Bosch substituted a more sensitive material in the pressure plate (Snyder, 2008)**.** Bosch's 35-amp generator for the Nano of 12 pounds, was smaller than the normal 40-amp, 13-pound model. The use of alternative lighter materials, together with redesigning for minimizing component size, further contributed to lowering the weight of the Nano (Snyder, 2008). According to Girish Wagh, with the 1,278 pounds for the base model, the car needed less equipment to operate. Additional cost and weight-saving features included the Nano's 624cc engine, which works on two cylinders instead of four (Snyder, 2008) and had a single balance shaft instead of one per cylinder to reduce vibration (Voelcker, 2008). Its two-cylinder engine produced only 24 kilowatts (32 horsepower)—roughly the same as a midrange motorcycle in the United States (Voelcker, 2008). Thus, using technology only where needed, the innovation effort was described by Surinder Kapur, Managing Director of Sona Kayo Steering, as (Gopalan and Mitra, 2008):

"*A great example of frugal, cost effective and relevant engineering"*.

Having regular communication among various cross-functional teams enabled by the formal project management policies, the design teams went through several revisions before the car design and architecture could be selected for the prototype, which would essentially meet the unique price-performance criteria of the mass customers. In this regard, Girish Wagh recalls that (Gopalan and Mitra, 2008).

"The team had to go through several iterations before the style could be frozen. The entire body was designed twice, while the engine was designed thrice. If that sounds surprising, the floor was designed 10 times and the seats too, an equal number of times".

Furthermore, the car's dashboard had two concepts, and car exterior had three detailed concepts running simultaneously. Facilitated by the strong interaction among members of various groups and their spontaneous participation in analyzing different options, the concepts that would fulfil the demand and low cost conditions of the mass customers were selected. This was stated by Nikhil A. Jadhav, Industrial Designer of Tata Technologies (Gopalan and Mitra, 2008):

"There were two dashboard design concepts and we thought the second one added more utility. The car had three exterior design concepts to begin with. We picked the one that we thought looked the best and from that we made a full scale model".

Moreover, regarding strong integration among team members, Ashok Joshi said:

"We had strong integration among our team members. Depending on the complexity of the project we formulated a number of cross functional teams. All teams used to sit in the same building, which was critical for internal communication. In terms of maintaining the integration, we had daily project progress meetings, weekly project reviews, frequent briefing on project progress to review how we were progressing to achieve the cost-performance target in addition to other topics. For Nano, there were frequent reviews done by senior leaders including Ratan Tata. Moreover, we were all bound by Tata Code of Conduct which ensured certain behavioural aspects. In the weekly meetings everyone used to be reminded

that this is our goal which helped us to identify where we need the senior management help. So it was a tw- way communication".

Although members of the Nano project team came from a diverse range of experience and backgrounds, they all helped in creating novel architectural knowledge for the low cost innovation. This was made possible due to the embedding of common values and vision founded on strongly agreed-on goals. Putting in 12-14 hours a day, six days a week, the chief engineer Girish Wagh and his team of 500 young and committed engineers embarked on taking their Chairman's dream of developing an ultra-low-cost car (Gopalan and Mitra, 2008).

4.4.1.4 Partnering with suppliers for low cost innovation

Tata Motors put in place an early vendor integration program forming alliances with a number of component makers to mine innovative ideas for a low cost car design by leveraging, exchanging and sharing knowledge within the alliance network. In this way, the recombination and creation of new knowledge occurred more efficiently, which helped Tata Motors to break through the low cost innovation barrier (Snyder, 2008). Head of Sourcing of Tata Motors, Balasubramaniam, in this regard observed:

"We had a lot of design inputs from vendors that either facilitated manufacturing or brought the cost down."

Tata Motors harnessed the power of eager and unusually zealous suppliers for the low cost innovation. The clean sheet, cost cutting of dozens of suppliers was pooled to create the Nano. Acknowledging this, Girish Wagh mentioned:

"We had about 100 suppliers on the project that made as big a contribution as our own development team."

Prior relationships with the Indian suppliers from the Indica and Indigo project influenced Tata Motors to form recurring alliances for manufacturing Nano. The experience of working with the same Indian suppliers during the 1990s enabled the firm to comfortably participate in a number of collaborative partnerships for the Nano project. Confirming this, Ashok Joshi mentioned:

"We formed alliances with a pool of Indian and foreign suppliers who shared the same vision as us to make this innovation happen. What we did is, we called our current suppliers and also called suppliers with whom we didn't work before. Then we shared our vision and the plan of what we wanted to do, and asked them to join us to make this innovation happen from the perspective of performance and cost. We are proud to say that everyone was very willing".

Thus, the learning experience from prior alliances greatly influenced Tata Motors to engage in partnerships not only with the Indian suppliers, but also with several Western firms in the Nano project.

Some tier-one suppliers went beyond their traditional role of manufacturing to pre-specified designs to the designing of components. In this regard, Ashok Joshi observed:

"Brake system was supplied by Bosch and Brake India. The suppliers had to come up with the innovation to keep the cost at the targeted level. Suppliers for the air-conditioning system were Behr India (German subsidiary) and Subros (from Delhi). Both brake and air-conditioning systems were designed and manufactured by the suppliers. The benefits of going

to the suppliers and giving them freedom to design were that we could use their knowledge base, could draw upon their development methodologies. Since innovative processes were available to vendors, they could run them and come up with best possible solution. So the choice was much wider. We could explore more new ideas and come up with best possible solutions to achieve increased reliability, reduced cost, higher performance".

Indeed, Lumax Industries, that designed the head and tail-light fixtures, and the Sona-Kayo Group, that designed the steering column of the Nano, both believed that their collaboration at a very early stage was a major reason why costs were reduced through innovative component design and improving manufacturing process (Gopalan and Mitra, 2008). Deepak Jain, Executive Chairman of Lumax Industries, highlighted how the expertise of this firm's engineers was vital for the low cost innovation (Gopalan and Mitra, 2008):

"The opportunity to work on this car also gave our engineers a chance to showcase their skills, because most other car products are designed abroad and we just have to manufacture components to a specific blueprint. In this project we designed light fixtures that met all regulatory needs, fitted in the car and were low-cost".

Similarly, Kiran Deshmukh, Deputy Managing Director of another key supplier, Sona-Kayo Steering Systems, observed:

"We are trying to create a mindset for innovation…innovation in design is a must; we are creating tools and developing skills so that people are able to think out of the box."

Dr Bernd Bohr, Chairman of Bosch Automotive Group, which was one of the major foreign suppliers for Nano project and highly known for engineering excellence, described his experience (Palepu et al., 2011):

"Tata did not come to us with large rulebooks or specifications. They simply told us what the weight of the car would be, that it would have a two-cylinder engine, and would need to achieve Euro 4 emission regulation. In addition, it needs to drive, of course. And that was the major difference from other auto projects or customers".

The exchange of specialized knowledge and functional expertise among Tata Motors and its partners was based on trust; based on collaborative relationships as the members firms' exchanged information in a transparent approach to create an environment for innovation. Having trust-based prior relationships with the Indian suppliers from the Indica and Indigo project influenced Tata Motors to form recurring alliance for manufacturing Nano. In explaining this, the Managing Director of Tata Motors, Ravi Kant, observed:

"Innovation is not something, which can be taught. I think it is the whole environment, which you create…,.You need to be very open, you need to be very transparent; you need to be sharing things. So in a collaborative effort, a very different kind of attitude and way of working is required."

Moreover, regarding trust-based relationships, Ashok Joshi corroborated:

"Openness to share information and trying alternative solutions was crucial for Nano development which was enabled by trust. For example, at the beginning, how to develop air-conditioning system keeping the cost down was a black box problem to us. The suppliers shared details of their previously developed air-conditioning systems since they are specialized in it. The openness and trust showed by the suppliers were vital at that point in time. This helped us to identify the problem and helped us to achieve the desired cost target".

The collaborative partnerships benefited Tata in establishing an innovative car design through cross-fertilization of ideas and capitalizing on a broad variety of critical skills. Partnerships also benefited component suppliers in reducing costs from rework, and concurrently designing components (Gopalan and Mitra, 2008). For example, Rico, an Indian engine-block and cylinder-head caster, advised Tata even before the project team decided whether the base engine of Nano would be two or three cylinders. Vikas Saxena, Rico's Assistant General Manager for business development and project management, in this regard said:
"The range was from 550cc to 750cc and when the answer was 624cc; it was a very close decision on how many cylinders to use" (Synder, 2008).

4.4.1.5 Modularity in product architecture

With the architectural knowledge on modules and their interactions to generate specified functionalities, designers of Tata Nano knew how to upgrade the base model to a new, better equipped Nano. Provisions of inter-changeability in the architecture enabled incorporation of more sophisticated modules for the upper-middle-class people of the Indian market, as observed by Ratan Tata (Snyder, 2008):

"You can have a version that sells for two or three times the price of the base car. I don't see this, over time, being any less profitable than an ordinary car. The car will be equipped with bigger engines, including diesel, and more advanced features such as power windows, air-conditioning and so on".

Additionally, Tata Motors expected to start exporting the advanced Nano first to other emerging markets in Africa, Latin America, Southeast Asia and eventually to Europe and other developed markets (Gopalan and Mitra, 2008). Confirming this, Ashok Joshi announced:

"Modularity was one of the essential elements to keep the low cost of Nano. Otherwise, cost of manufacturing variants gets phenomenally high. With modularity, the volume is distributed over a larger base and cost comes down. Not only modular architecture was utilized for designing Nano; in Tata Motors the process of fitting a specific part/component is also the same across variants to reduce capital cost. Cars typically consists of about 20 major systems, for example, brakes, power trains, transmission system. So it is possible that each one of the engineers out of 20 working on an individual system may not have full knowledge on the whole car. However, teams in Tata motors for Nano were formed in such a way that the team leader had full knowledge on the whole car , system interfacing and the team members knew who were the other persons working on the systems which is close to their individual systems".

Tata Motors also proposed an alternative low cost distribution model to speed up the distribution process, even to the more remote locations of India (Anon, 2009b). A modular design would enable the Nano to be made and distributed not only from Tata Motor's main plant in Pune, but also by franchisees spread out across the country. These local entrepreneurs would assemble complete knock down (CKD) kits in their low cost satellite mini-factories located closer to the customers, as well as sell and service these vehicles. Thus, instead of shipping finished cars to dealers, Tata Motors would ship kits of mostly assembled modules to satellite mini factories that would complete final assembly (Snyder, 2008). The logic is to make manufacturing as simple as possible and translate the savings into the car's low price (Gopalan and Mitra, 2008). As described by Ratan Tata (Pandit, 2005):

"We're looking at small satellite units, with very low breakeven points, where some of the cars could be assembled, sold, and serviced. We would encourage local entrepreneurs to invest in these units, and we would train these entrepreneurs to assemble the fully knocked-down or semi-knocked-down components that we would send to them, and they would also sell the assembled vehicles and arrange for servicing."

4.4.2 Mahindra & Mahindra Limited (M&M)

4.4.2.1 Background

Mahindra & Mahindra Limited (M&M) - a subsidiary of Mahindra Group is an Indian multinational automaker. Based on consolidated revenue, it is one of the largest automobile manufacturers by production in India (Mathur, 2011). Between 1950 and 1984 during India's so-called protection and licensing regime known as license raj, the automotive firms were obliged to obtain licences from the government for the purpose of entry, capacity expansion, diversification, imports of machineries, raw materials and foreign collaborations (IBEF, 2009; Narayana, 1989; Mani, 2011; Chugan, 1995). Licences were only given to a selected few auto manufacturers only after the requirements of government agencies were satisfied. Moreover, the number of vehicle units that an auto manufacturer could produce was also restricted through a series of controls and government permits. By the 1980s, the auto industry had slow growth rates and all these factors kept the Indian auto industry in a period of technological stagnation. In response to all the restrictions, M&M felt it had to diversify in order to be successful (Mahindra, 2014). Accordingly, M&M entered new segments and diversified into different business sectors such as automotive, agribusiness, energy, real estate, logistics and hospitality.

The history of Mahindra and Mahindra began in 1954 with M&M becoming a manufacturing partner of the Willys Overland Corporation, US (Thomke and Luthra, 2009). Willys is best known for its design and production of military and civilian jeeps. With the initiative of two brothers K.C. Mahindra and J.C. Mahindra the jeeps were licensed to be manufactured in India as Mahindra brothers perceived the value of Willy jeeps suitable for India's emergent road infrastructure. Later on, M&M formed collaborative partnerships with a number of global automobile manufacturers such as Renault, Ford, Peugeot, Mitsubilishi/Samcor, Ugine Kuhlmann and International Harvester Company (Thomke and Luthra, 2009).

Keshub Mahindra joined the board of the firm in 1948 and was elected chairman in 1963. He was a role model for business leaders and a true Statesman (Thomke and Luthra, 2009). He built Mahindra as a firm that is known for its ethics and social responsibility and had shown how one remains steadfast in turbulence and navigates in crisis without sacrificing ethics and values. With the leadership of Keshub Mahindra, in 1990 the real reform was initiated in M&M to become competitive in India (Mahindra, 2014). M&M afterwards undertook a radical re-engineering of its shopfloor, restructured its corporate core and refocused its strategy around a smaller group of businesses. Keshub Mahindra made deliberate decisions on the sale of its oil drilling and machine businesses, and to concentrate on vehicle production. The aim of the change program was also to welcome investment from foreign firms, many of them extremely large, well-capitalized, technologically advanced and globally renowned (Mahindra, 2014).

A decade after the liberalization of the Indian economy, M&M went through a process of restructuring from a functional organization to a multi-business group of firms in 2003 (Thomke and Luthra, 2009, Stewart and Raman, 2008). As a result of the restructuring and the 48 years of his chairmanship, six different sectors such as automotive, automotive components, farm equipment, IT and software, financial services and infrastructure development were established. In the passenger automobile segment M&M is the market leader in the utility vehicle category, with market share of 45%. Some of the notable passenger vehicles from M&M are Scorpio, Bolero, XUV 500 Thar and Xylo. M&M also has a major stake in the Indian tractor business with market share of 40%. (Thomke and Luthra, 2009, Stewart and Raman, 2008).

The firm utilizes product portfolio strategy to position vehicles in the market according to the price point and utilities provided. For example, Bolero has been positioned as the affordable, rugged and entry-level vehicle which is also a dominant market leader in the sports utility vehicle (SUV) segment in India. Xylo has been promoted as an entry level SUV which can replace sedans (Baggonkar, 2010). On the other hand, Scorpio has been positioned as a premium and mature SUV. In addition to making ground-breaking utility vehicles like the Scorpio and Bolero, Mahindra offers sedans like Verito (previously known as Logan), pickups and commercial vehicles that are reliable, environmentally friendly, and fuel-efficient (John, 2011).

4.4.2.2 Visionary leadership

Anand Mahindra (J.C. Mahindra's grandson) - a Harvard Business School graduate - joined Mahindra Ugine Steel Company (MUSCO) as an executive assistant in 1981. A person with the innate capability of out-of-the-box thinking, Anand Mahindra began by revolutionizing on four spheres: envisioning, creating a structure, enabling and energizing. Mahindra realized the significance of developing a vision for the future which will enable the firm to turn around (Stewart and Raman, 2008). However, he knew that a mere vision of the future will have no impact until and unless an appropriate organization structure was established with the required resources and authority. In his own words:

"These mechanisms help me compose the music so that many soloists can play in my orchestra. The players know what's not negotiable: the pace, the tempo, and the traditions. I have to write the music and then stick to my role of conducting the orchestra rather than trying to play the music myself" (Stewart and Raman, 2008).

After taking the role of de facto Chairman and Managing Director of the US$6.6 billion M&M group, Anand Mahindra set up aspirations for the firm (Thomke and Luthra, 2009). He emphasized that innovation in all spheres of product development and process management would enable M&M to become the topmost player in the Indian automobile market. Anand Mahindra termed these aspirations as "mantras" (Sanskrit word referring to prayer) that are capable of creating transformation in the firm. Stressing the need for deep customer insights to innovate for the mass customers and encouraging an agile, open innovation culture, Anand Mahindra revealed his vision as:

"We came up with five elements that would foster innovation in the Group. One, innovation has to start with insights about a customer. Without identifying a need, you can't come up with new products or processes. Two, great products have great designs. Three, you have to encourage experimentation. You must hire people who don't listen to you, which I always seem to do! You have to create a sandbox where people can play—and fail, often and early. The organization must celebrate failure. Four, unlike Xerox PARC's inventions, innovation must add value to the firm's bottom line. Five, you need to have a sales plan. No innovation sells itself; firms have to find ways of packaging and marketing it. So you need insight,

design, experimentation, added value, and sales plans for innovation, and—I love acronyms—the first letters of those elements spell IDEAS. That captures the essence of what M&M will do to create a culture of innovation" (Thomke and Luthra, 2009).

Based on the innovation centric focus, Mahindra described his target for the Mahindra Group as:

"My aspiration is that M&M becomes one of the most customer-centric organizations in the world. If we focus on understanding our customers, we will be able to develop customer-centric innovations. By that, I don't mean we should only ask customers for product ideas. Magic happens when firms observe customers in that way, and develop new products or services" (Stewart and Raman, 2008).

As an avid risk taker, ready to embrace tough challenge, Mahindra initiated the development of a new car concept despite financial constraints (Thomke and Luthra, 2009). The "Scorpio", which is a world class sports utility vehicle (SUV) is India's first indigenously developed affordable SUV, launched by Mahindra in 2002. Foreseeing the opportunity in the field of frugal engineering for emerging markets, Mahindra embarked on the mission to innovate a high quality SUV at very low cost in order to address the customers with low purchasing capacity. The mandate was "design to cost" and thereby the development cost of Scorpio was only US$120 million which is only one fifth of other automobile manufacturers' expenditure. The challenge could have jeopardized Mahindra's career. Instead, with Scorpio, M&M demonstrated excellence in affordable innovation for the emerging markets (Thakkar, 2012, Thomke and Luthra, 2009).

Mahindra describes his achievement:

"As you know, M&M developed an SUV, the Scorpio, and customers love the vehicle. But we need to make more such products. If M&M is going to compete with the world's best firms, it has to become an innovation factory—which is why I returned innovation to the top of our current priorities" (Stewart and Raman, 2008).

Anand Mahindra set an exemplary example creating an encouraging environment for an innovation culture and motivating employees to come up with breakthrough innovation ideas (Thomke and Luthra, 2009). For example, as head of the R&D for the entire M&M group, he supported an engineer named Sandesh Dahanukar who came up with the idea of developing a tubular chassis for a number of vehicles. Sandesh observed the fact that conventional chassis were not suitable for automotive vehicles since the chassis were prone to frequent breakdown due to the massive pressure of the vehicles. He thus came up with the idea of an affordable tubular chassis to support load bearing (Thomke and Luthra, 2009). Anand described Sandesh as a "maverick" engineer who thinks out of the box and does not always go by the routine processes and protocols (Thomke and Luthra, 2009).

To expedite the prototype development of the tubular chassis, Anand Mahindra arranged a budget of 600,000 INR (US$9,643), and arranged for Sandesh to work on the project without being affected by the corporate bureaucracy. With direct assistance from Anand, this effort paid off and in a few years, a fully functional tubular chassis was crafted, saving more than 300 million INR for M&M (Thomke and Luthra, 2009). Outlining the significance of promoting such an environment for innovative ideas, Mahindra expressed:

"I later wondered whether someone with an engineering background would have allowed Dahanukar to do this. I had experienced enough of the benefits of liberal arts thinking to

respect renaissance thinkers...Mavericks like Dahanukar often defied rules, processes, and corporate bureaucracy and had trouble fitting into the social fabric of a large organization. Without management support, they would constantly think about quitting their jobs or would be on the verge of being fired. The role of top management is to allow the two models to coexist and create a supportive environment for both. Designing that environment is perhaps the greatest challenge" (Thomke and Luthra, 2009).

Another M&M engineer, named K.J. Davasia, who possessed deep knowledge about the Indian tractor market observed that Indian farmers not only use tractors for farming, but also for personal and commercial transportation for spawning extra household income. Based on his observation, Davasia came up with the idea of the affordable "Sactor", which is a combination of tractor and hybrid transporter for the low income Indian farmers (Thomke and Luthra, 2009). Davasia, who is now the president of M&M's farm equipment sector (FES), approached R.N. Nayak who was leading the R&D for the FES. With less than one million INR budget (US$16,130), a concept prototype was developed, using the frugal engineering approach. Anand Mahindra encouraged the team, expressing his eagerness for the project as Davasia described:

"Anand always looks for unique things and is keen to see creative projects."

Consequently, necessary resources were allocated by Anand for this project and in 2003 the "Sactor" project underwent initial testing phases.

4.4.2.3 Advancing architectural innovation to satisfy unique price-performance criteria

For the price conscious Indian customers, M&M strove to innovate at an affordable cost while maximizing the value proposition. Rajiv Mehta, head of product planning, described the situation thus:

"India is typically a value conscious market. So you have to focus on the value that a customer is getting from time of vehicle purchasing till selling that. So we try here at M&M to maximize the value for customers. Scorpio and XUV500 is a perfect example where we have maximized the value proposition in a price range which is more affordable than other automakers".

The motto of M&M is to innovate and upgrade through cost optimization instead of cost cutting in order to capitalize on the value contributions. In this regard, the M&M product development team spent substantial time observing customers and gaining significant insights on customer requirements. Based on observation, it was found that in India, due to long hours waiting in traffic jams, fuel burns unnecessarily and results in extra cost for the customer. This was identified as a specific area where M&M could deliver greater value through cost savings. The "Start-Stop mechanism" is an example of using existing technologies and reconfiguring components in new ways. The firm realized that though customers would want to switch the engine off at signals, they often overlook actually doing it because they are apprehensive of being left behind when the signal changes. So, together with Pune-based Indian supplier named KPIT Cummins, M&M developed the "Revolo Hydro Kit" that switched off the engine if it was idling for more than a set period of time (Krishna and Sarkar, 2012). This kit is a simple plug-in battery pack which is connected to the electric engine and makes sure that the motor and engine work concurrently. Based on regenerative braking, the kit is activated and the sensor helps to transit from fuel to electric automatically, saving fuel consumption. A press of the clutch automatically restarted the engine. Deputy General Manager, Srinivas Ramanujam, described it as:

"This simple mechanism ensured that the consumer was not left behind in traffic and yet got better fuel economy".

Furthermore, to satisfy the unique price-performance criteria, M&M engineers persistently experimented with new combinations of existing technologies, proceeded with re-engineering or reducing components and managed reconfiguration of vehicle parts interrelations that are characteristically linked with architectural innovations. President of automotive sectors, Pawan Goenka, affirms:

"To bring down the overall cost of manufacturing, we have to make use of cost-effective alternative products while not compromizing on quality and safety. Work on newer substances which can be used to replace traditional materials for developing vehicles is carried on" (Pathak, 2012).

For example, in order to trim down the cost of manufacturing vehicles, M&M exploited plastic fenders, replacing conventional steel (John, 2011). M&M also utilized aluminum, amuch safer and stronger option than steel to reduce the weight of vehicles, leading to lower consumption of fuel. Studies on aluminum revealed that if a vehicle's weight is compressed by 100 kg using aluminum parts substituting for traditional steel, the vehicle would save 2,000 liters of fuel in its life cycle. In addition, M&M makes vehicles more environment friendly, since with aluminum, the emission of greenhouse gases is reduced by 9 grams for every kilometer the vehicle runs (Mathur, 2011).

M&M engineers also conducted numerous experiments to come up with novel arrangements of existing components such as front seats. As a result, the front seat in the Mahindra Xylo can be turned into a flatbed, delivering a higher degree of comfort for people who spend a lot of time on the road. Additionally, the Mahindra Xylo also comes with foldable trays that open up from the rear of the front seats, making a quick bite or drink "on the go" very convenient. Rajiv Mehta explained:

"We thought of how to maximize what my customers can do with seats? You know we have a matrix called 'rational, functional and emotional'. Rational benefit is to ensure that the customer can sit, functional benefit lies in the comfort of the seat. These benefits are almost the same as what every automaker provides. Emotional benefit is where we tried to maximize our offerings and then we came up with the idea of flatbed and foldable trays".

Through a number of formal processes, coupled with strong relationships among team members, cross-functional teams at M&M shared their knowledge and expertise for project developments. As an example, for the Scorpio project, a team of 120 engineers with an average age of 27 was spread across 19 diverse functional teams (Thakkar, 2012). The goal for the Scorpio project was to develop an affordable SUV and at the same time equip the vehicle with all contemporary amenities. Consequently, Scorpio was provisioned with bigger space, state-of-the-art technology and a modern design. Without the communal effort of team members, the development of Scorpio with the required value proposition would not have been made possible. Affirming this integrative approach for any project, Rajiv Mehta commented:

"We form cross-functional teams having people from R&D, engineering, manufacturing, marketing and sales to combine their knowledge and proficiency. We arrange regular meetings and development programs for the teams to enhance their competence level. We find it extremely important to evaluate teams based on their group effort to keep any project development on track. Understanding that our people are the main driving force of our firm, work performances are extensively associated with various award and recognition systems".

4.4.2.4 Advancing partnerships with suppliers

Starting from 1947, when M&M introduced the first utility vehicle in India, until today, Mahindra vehicles are produced as collaboration between the firm and a small set of strategic suppliers. In this regard, collaborative partnerships were formed with both local and global partners who were engaged from the very early stage in the product design, trial productions, and manufacturing. Where any new automotive design/ production technology was not available through a local Indian supplier, M&M tied up with global suppliers for the technology. For example, M&M formed alliance relations with Bosch and Lear. These international suppliers set up their manufacturing base in India to take the advantage of localization, which was a very important aspect for Mahindra for cost innovation. Moreover, on top of localization, supplier's knowledge, experience and technology had also been adopted into a wide range of M&M vehicles. Mr Rajiv Mehta, Head of Product Planning, described it thus:

"For Mahindra, the main advantage of such alliance relations lies in the value creation. It is simply not possible for us to have expertise in all areas of vehicle manufacturing. For example, suppliers designing sitting systems, or air conditioning systems for the vehicle, are in the best position to carry out innovation in those specific areas because they have expertise and experience doing so. Therefore, rather than giving suppliers the predefined specifications, we encourage them to innovate. This ultimately ensures M&M to get a better valued product for the customer".

Learning and partnering experiences with the same supplier base enabled Mahindra to develop affordable, fuel-efficient and reliable SUVs like the Scorpio, Bolero and Xylo, in addition to cars, pickups and commercial vehicles. For example, Bosch manufactured fuel components of engine, injectors, hydraulic pumps, engine control units (ECU) for a range of Mahindra vehicles. Lear provided complete sitting system. The mobile platform of Scorpio was built by Delphi. Steering columns, and air-conditioning systems of the vehicles were obtained from Indian suppliers such as Motherson Sumi, Varroc Group, Rane.

Mahindra encouraged suppliers to come up with their own innovations through design changes, with value engineering keeping the cost pressure in focus. This provided the suppliers a great opportunity to learn. For example, an electronic braking system was developed by Wabco India to detect the distance between a car and the vehicle ahead, in real time, to reduce fuel utilization (Krishna and Sarkar, 2012). In this connection, Kitin K Tikle, Senior General Manager, described it:

"So it is a chain of innovation with our alliance relations. Innovation not only happening in Mahindra; Mahindra is also driving innovation for the suppliers to carry on".

Trust was perceived as one of the very important elements of such collaborative partnership by M&M, because without trust the joint efforts would not be productive to the expected level. So such innovation for mass market projects involved trust-based relations with the same set of suppliers in a very collaborative environment facilitated by regular communications. Accentuating the importance of trust, Mr Nitin K Tikle said:

"For example, if the suppliers have very innovative ideas on something which is at conceptual level, and they want us to implement through investment and engineering process, our door is always open for them to discuss that. If the idea is feasible, we take it to the engineering level. So this kind of collaboration and open communication we have."

In this way, sustaining such partnerships and accessing technological competencies across collaborative partners allowed Mahindra to embark on developing low cost and rugged automotive vehicles; it also encouraged the suppliers to undertake their own innovations.

4.4.2.5 Modularity in vehicle design

According to the Senior General Manager, Nitin K. Tikle, and Deputy General Manager, Rajesh Pandey, for any low cost design of a mass market project, modularity was essential in achieving ultra-low cost levels while keeping the option to move to higher configurations. M&M thus had a modular architecture in vehicles due to its significant effect on minimizing time and development cost. Nitin K Tikle explained:

"*Modularity is one of the important factors for two reasons. First, modularity saves us lot of time and cost because if the designs are modular then you don't need to design the whole system all over again if anything goes wrong. Moreover, if you are breaking any system into* *a number of modules, then the total development cost is getting distributed. For example, the door module; I can pick the same module and adopt it for next car model."*

M&M also maintained a network of a small but key group of module developers who were specialized in developing specific vehicle modules. For example, Indian supplier Aditya designed power window modules; German supplier Bosch developed central locking, fuel injection, etc. It was easy to carry over these same modules into the next vehicle rather than developing again. These developed modules were utilized for multiple M&M vehicle models such as Bolero, Scorpio and Xylo. Furthermore, the reliability and quality of the modules also increased significantly, since the suppliers had the specialization and capability in doing so.

4.5 Case Studies of MNCs

4.5.1 Hyundai Motor India Ltd (HMIL)

4.5.1.1. Background

For Hyundai Motor India Limited (HMIL), a wholly owned subsidiary of the Korean-based Hyundai Motor Company (HMC) (Lansbury et al., 2006), the Indian market was the second largest after the US market where it had sales of more than 500,000 passenger cars per year. HMIL is the largest passenger car exporter, and second-largest car manufacturer of India. HMIL was established in 1996, and made an investment of more than US$450 million to construct a manufacturing plant in Chennai, India with a capacity of manufacturing 120,000 passenger cars per year. The fully integrated plant was designed to produce the mini passenger car "Santro" and the "Accent" (Wright et al., 2009). The plant was producing

100,000 vehicles per year. By May 2000, HMIL had captured a 14% share of Indian passenger car industry.

In order to cater to the rising demand the firm invested an additional US$1 billion to build the second assembly plant in Chennai, along with an R&D facility, plus a ground and vehicle performance test center in 2001. These facilities enabled the Chennai plant to become a self-sufficient manufacturing and production site for the Indian mass market. In other words, the Chennai plant was the first ever greenfield investment by an established auto maker firm in India. HMC announced it would make the Chennai plant a global hub for manufacturing small cars (Park, 2004).

The first manufactured car from HMIL was the Hyundai Santro which was launched in 1998 and was a huge success in the Indian market. This is why Santro obtained a reputation of an affordable car with best-in-class quality for Indian mass market customers. This model was awarded "Car of the Year" by the reputed Indian newspaper, *Business Standard* (Park, 2004). The firm currently manufactures a number of passenger car models and these are the Hyundai Accent, Executive, Santro Xing, Fluidic Verna, Nextgen i10, Fludic Elantra and Eon. The manufactured cars are being exported to more than 160 countries across the continent of Europe, the Middle East, Latin America and Asia Pacific regions. (Park, 2004).

Targeting the middle class Indian car buyers who intend to purchase cars for first time, HMIL launched "Eon", the smallest car ever developed by the firm. Describing the innovation strategy for Eon, Deputy General Manager Puneet Anand mentioned:

"To the price-conscious Indian customers, affordability is a key criterion in the decision-making process of car purchase. With increasing disposable incomes and economy growth, Indians are very value conscious. Having realized this, affordability and robustness were identified as important aspects for the development requirement. The design parameters of Eon include a fashionable city car with unique styling and functional features – creating synergy of Korean technologies and Indian style."

Moreover, with Eon, the firm plans to penetrate heavily into the rural market of India. In this regard, Manager K. Rajesh commented:

"*We are looking heavily into the compact car segment in India targeting the growing middle class customers, specially the first time buyers and rural market customers*".

4.5.1.2 Visionary leadership

HMC was in trouble worldwide before Chung Mong-Koo became the Chairman and CEO in 1999. The vehicles ranked among the worst in the world as they were associated with the image of defective and poor quality cars. During 1987 to 1988, the firm constructed a manufacturing plant in Bourgmont to produce the "Sonata". Due to the chronic quality issues in 1993 the construction of the plant was stopped, and by 1996 the whole plant was shut down with losses of over 500 billion KRW (US$453 million). This incident is known as the "Bourgmont nightmare". Therefore, during the 1990s no one imagined the possibility that Hyundai Motors would become one of the best automobile firms in the world (Kim, 2011).

In 1999, when Chung took over as chairman and CEO of HMC, with the vision of joining the world's top five automakers by 2005, he aggressively pursued total quality management in order to improve the manufacturing processes and design capabilities that have transformed the firm into one of the world's leading automakers (Rhee, 2003). In his own words (Hyundai, 2004):

"Our new brand strategy is designed to ensure that we reach industry-leading levels not only in terms of sales volume, but also in terms of customer perception and overall brand value; while laying the foundation for Hyundai to become, ultimately, the manufacturer of the world's best quality cars".

Affirming this, Puneet Anand mentioned:

"The biggest strength of Hyundai is its understanding of market demands and customer sentiments. Our company has, in a timely fashion, introduced products in the passenger car segment such as the smallest car, the Eon, ascending to compact cars i10 and i20. The vision and leadership capability of our chairman Chung Mong-Koo lies in accurately forecasting consumer demands for emerging markets and offering class-leading products. Highly packed features coupled with value for money offerings made Hyundai the most successful multinational brand in the passenger car business in India."

Chung recognized that quality of car is a strong driver of growth (Kim et al., 2004, Kim, 2011, Noble, 2010). Based on this philosophy, in 2000 Chung reorganized the firm, combining the operation, sales and after sales service units into a single department to comply with the global automobile quality standard. Due to this integrated quality department, communication among cross-functional units became much easier, sharing of information among various teams was much faster and the time required to get direct feedback from the Chairman decreased substantially (Kim, 2011). In the words of Chung Mong-Koo (Kim, 2011):

"To reach our goal and fulfil our dreams, we have to improve the quality and enforce cost competitiveness."

Moreover, Chung also doubled the budget of research and development for improving processes for faultless manufacturing. With vigorous leadership from him, a tenfold expansion of the quality control department was made, and Chung took the bold step of offering extended warranties for Hyundai cars. This played an important role in restoring the customer confidence in Hyundai vehicles (Noble, 2010). His decisiveness, charismatic leadership style and philosophy regarding quality enabled the carmaker to achieve revolutionary performance in Hyundai vehicles. Consequently, Hyundai was ranked as 6^{th} automaker of the world in terms of their sales volume in 2004. Furthermore, during the global financial crisis of 2008, when renowned other automakers such as General Motors, and Toyota faced tremendous difficulties, Hyundai was the only automaker to expand its sales volume worldwide by 7% (Kim, 2011).

Realizing the greatest growth potential of India, which is an emerging economy, Chung envisaged making Hyundai India as the firm's global hub for small car production; not only for emerging markets, but also for rest of the world. Hence, with this vision, Chung announced the investment in a second manufacturing plant in India in 2005. The second plant's capacity was decided to be 400,000 units a year from the existing capacity of 250,000 units. Chung described the strategy (Hyundai, 2004):

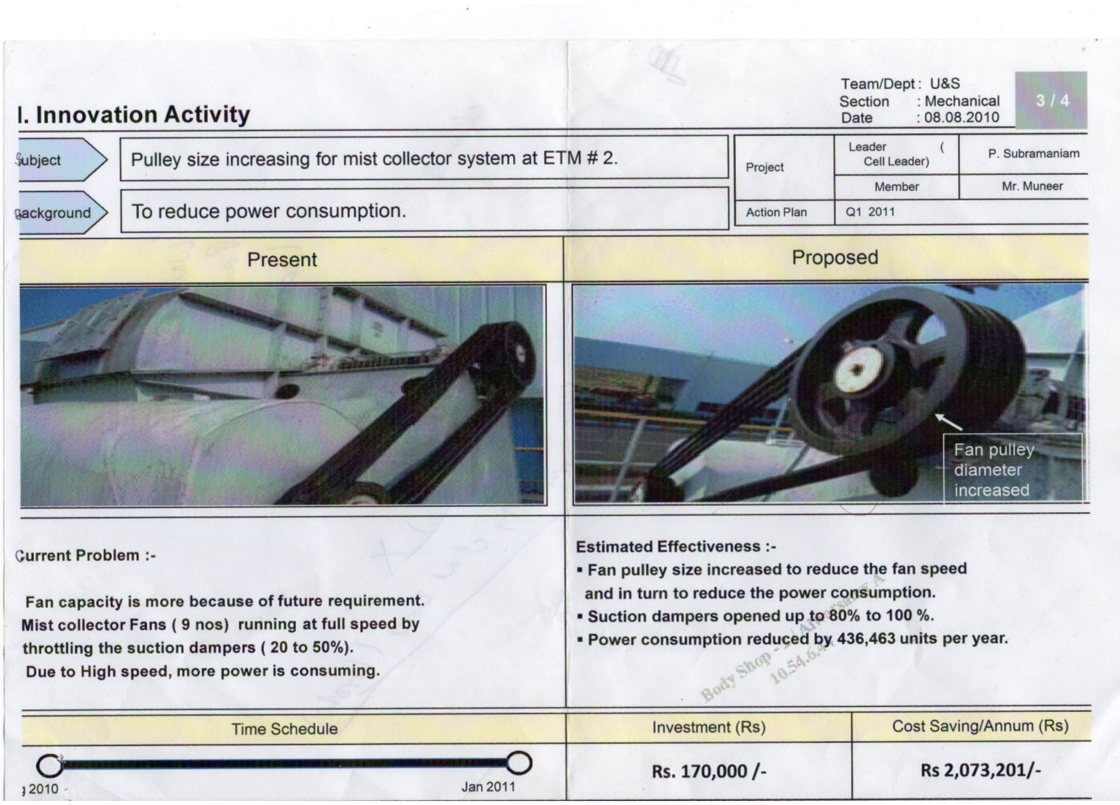
"India, Brazil, Russia and China demonstrate the greatest growth potential and are the markets of the future. The investment in the second plant in India will be about 500 million. This plant will be developed adjacent to the existing one at Chennai. Another US$100 to 150 million is expected to come in by way of investments by vendors. This will make Hyundai's investment the largest multinational automobile investment in the country".

4.5.1.3 Frugal engineering by HMIL

According to General Manager A. Alwarsamy, HMIL reviewed its vehicle design and manufacturing operations not in terms of functions, divisions, or products, but in terms of key processes. The firm employed innovative technologies and organizational resources to achieve major cost reduction and improvements in quality and flexibility.

"*We eliminate all sorts of costly aspects from our product development processes so that not only we can pass the savings on to our customers, but also can design and develop vehicles from less materials, with more performance and in less time. At HMIL our main focus is on frugal engineering – that means, maximizing value and efficiency through eliminating non-essential waste. We believe frugal engineering is an essential approach for developing affordable vehicles not only for Indian market but also for other emerging markets.* "

Providing examples in this regard, A. Alwarsamy mentioned that HMIL re-engineered a number of core processes replacing expensive machinery with simple and self-invented procedures, reusing common raw materials and reducing process rejections for a better resource usage, achieving drastic manufacturing cost reduction and reducing excessive resource consumption. For instance, previously the fan capacity of the Chennai plant was unnecessarily high. More specifically, the fans were running at full speed by throttling the suction dampers from only 20% to 50%. Due to the high speed, the plant was consuming more power than required. To improve the effectiveness, the firm invented a simple procedure to reduce the fan speed. The pulley diameter of the fan was increased to reduce the speed, and in turn to reduce the power consumption (Figure 4.1). By doing this, suction dampers opened up to 80% and eventually, power consumption for the plant was decreased by 436,463 units per year. Moreover, this simple procedure saved more than INR2,073,201 (US$33,000) for HMIL.



I. Innovation Activity

Team/Dept : U&S
Section : Mechanical
Date : 08.08.2010

3 / 4

Subject	Pulley size increasing for mist collector system at ETM # 2.	Project	Leader (Cell Leader)	P. Subramaniam
			Member	Mr. Muneer
Background	To reduce power consumption.	Action Plan	Q1 2011	

Present	Proposed
	Fan pulley diameter increased

Current Problem :-

Fan capacity is more because of future requirement.
Mist collector Fans (9 nos) running at full speed by throttling the suction dampers (20 to 50%).
Due to High speed, more power is consuming.

Estimated Effectiveness :-

- **Fan pulley size increased to reduce the fan speed and in turn to reduce the power consumption.**
- **Suction dampers opened up to 80% to 100 %.**
- **Power consumption reduced by 436,463 units per year.**

Time Schedule	Investment (Rs)	Cost Saving/Annum (Rs)
2010 – Jan 2011	**Rs. 170,000 /-**	**Rs 2,073,201/-**

Figure 4.1- Innovation activity at HMIL

Sources: Interviews and HMIL plant visit in India

In order to increase the indigenization level, HMIL had an integrated manufacturing setup at the Chennai plant, which consisted of: state-of-the-art paint shop; final assembly line and production facilities; engine and transmission lines; aluminum foundry; plastic extrusion plant and R&D centre. As a result of this, HMIL achieved indigenization level of over 85% (Park, 2004). The firm used aluminum to make cylinder blocks which are used for engines. Previously, in casting four-cylinder blocks, the process rejection rate of aluminum was very high. Moreover, in the paint shop of the Chennai plant primers/paints were wasted unnecessarily. To attain better resource usage and drastic manufacturing cost reduction, HMIL implemented some simple changes in the production line. In the words of A. Alwarsamy:

"We formed a team to examine how to extend the life-cycle time of aluminum block casting to reduce process rejection rate. The team came up with a simple solution to reprocess the rejected aluminum cylinder blocks and supply the blocks back as aluminum ingots for production. This helped us to decrease the process rejection rate to 30%. Moreover, in the paint shop we used to apply different primers for every base coat color of the top shed. For example, for red top shed of a vehicle, red primer was used. This was not efficient because significant amount of primers used to get wasted in the batch process of production. This was causing heavy inventory cost of multiple color primers. A unique process management system helped us to deliver the most extensive color range, which was independent of minimum batch requirements. By replacing this overly sophisticated production line with common primer of five color shades, we increased the process efficiency to a great extent and saved INR 30,000,000 (US$49,000) per year".

To improve the price-performance criteria required for the mass market, the inputs of various functional teams, and communications among them, contributed significantly. The communication among cross-functional teams such as R&D, design, manufacturing, marketing and finance, was facilitated by having well-built relations among the group members. A. Alwarsamy illustrated this:

"Hyundai has lately altered itself into a new way of thinking with a new corporate philosophy –'new thinking, new possibilities'. Here at Hyundai innovation is driven by five core values. These are customer satisfaction, communication among our people, collaboration, challenging ourselves and designing value–for-money vehicles. Management therefore perceives communication among cross-functional project teams as a very important factor. To enable communication we conduct regular meetings and team building workshops with our teams. We also arrange competition for teams. A team coming up with process innovation which saves substantial cost for the company gets monetary reward. For example, 0.25% of total cost saved through process innovation goes to the winning team. This kind of initiative not only motivates our people to challenge themselves, but also allows close relationship building among the employees".

Moreover, being encouraged by the renewed corporate philosophy and strongly agreed-upon goals, all members of the firm starting from technician to team leader delivered their best effort to design vehicles deploying their technical abilities and teamwork.

4.5.1.4 Forming collaborations with suppliers

HMIL put in place an early vendor integration program forming alliances with more than 100 key component-makers to mine innovative ideas by leveraging, exchanging and sharing knowledge, design engineering information and production technology existing within the alliance network. In this way, the recombination and creation of new knowledge occurred more efficiently and helped HMIL to innovate affordable cars for the masses of India. In this regard A. Alwarsamy mentioned:

"We have collaborations with more than 100 companies (both local Indian and foreign) who manufactures critical vehicle components, modules and integrated systems for us. We also source components from more than 45 Korean vendors who have established their operations in India".

Based on a strong collaborative linkage among the component makers, HMIL formed industrial clusters in Chennai, Bangalore, Mumbai and Delhi. The core vendors were located within the radius of 50km of the Chennai plant. This conscious building of vendor base was the part of high localized content strategy and the main reason of achieving economies of scale. In this regard, A. Alwarsamy observed:

"*We source components from more than 45 Korean vendors who have established their operations in India, either investing through joint ventures with local Indian companies or through greenfield investment in the Indian auto sector. This has enabled technology transfer between the Indian and Korean companies. Alliancing with all these companies has allowed us to share risk and cost of R&D, new technology import and vehicle production.*"

Significant components of a vehicle such as braking system and anti-lock braking system (ABS) were manufactured by Mando Brake Systems, an Indian supplier. Steering systems of Hyundai cars were sourced from Mando Brake Systems, along with Hyundai Mobis, a Korean supplier. Hyundai Mobis also supplied rear dead axle, sub-frames and sheet metal components for Hyundai cars. Some other critical modules of a car, such as power trains, clutches, transmission systems and engines were manufactured by Valeo Friction Materials, which was a joint venture between the France-based Valeo group and Indian Anand group. Furthermore, casting components of engine and transmission systems were designed by Hinduja Ltd.

HMIL sourced numerous other non-critical parts from a range of various suppliers. For instance, lead acid batteries were sourced from "Exide", door and window mirrors from "Schefenacker Motherson", headlamps, tail lamps and side trafficators from "Lumax Samlip" and seatbelts from "Autoliv IFB".

The firm acquired learning and partnering experience working with mostly the same set of suppliers, starting in 1996 with the development of Hyundai Santro and then subsequently different other models; for example, Hyundai Accent, Elantra, Sonata, i10, i20 and Hyundai Eon. Outlining the benefits of such collaborative partnerships A. Alwarsamy revealed:

"It would not have been possible for us to design and manufacture cars for the Indian masses without accessing our suppliers' technical skills, knowledge and resources. Alliancing with our suppliers and leveraging their expertise has enabled us to develop practical solutions for addressing some of the sturdy challenges we faced for innovating vehicles for Indian customers".

Thus, forming alliances with the same set of local and foreign suppliers influenced the firm to leverage functional expertise, specialized knowledge and critical competencies from the vendor base. The collaborative partnership among the firm and the component suppliers was based on trust, which eventually facilitated the exchange of strategic resources among the partners. Moreover, trust-based prior relationships with a pool of suppliers influenced the firm to form recurrent alliances with them for subsequent projects. HMIL shares best business practices with the suppliers through arranging regular meetings where all parties discuss problems and come up with mutually acceptable solutions.

Regarding the development of the Hyundai Eon, A. Alwarsamy emphasized the trust based alliance relationship as:

"Eon was developed in collaboration with the Hyderabad R&D center of India and Namyang R&D center of Korea. Not only the collaboration was among cross-country engineers, but also it was among a pool of Indian and foreign suppliers – especially Korean suppliers. The car was developed with best-in-class quality, technology and great style from India. Both of our development teams and set of suppliers displayed remarkable efforts to design the lightweight, low cost car for the Indian mass market customers."

And again,

"We formed collaborative partnerships with the same set of critical component suppliers for the Eon project, starting from our business here in India since 1996 through developing the Hyundai Santro. We did not build our products around them, but the suppliers manufactured components according to our requirement. We perceived trust as an important factor in the relationship between us and the suppliers. The relationship with our vendor base is the main

ingredient of forming long time partnerships. It's not the way that we use the supply components only and suppliers make money and go away. It is more of a continuous learning effect by the company and the suppliers. As an example, we provide education program support and technical information support for design engineering to enhance the product development capability of our suppliers."

As a result of strengthening the supplier base for core components—a part of the proactive localization strategy of HMIL—currently more than 90% of total components are locally supplied. Moreover, HMIL started to export 50,000 engines and transmissions each year from mid-2004 to HMC's plants in Korea and other countries (Wright et al., 2009).

4.5.1.5 Modularity in Hyundai vehicles

According to General Manager, A. Alwarsamy, and Manager, K. Rajesh, modular design of Hyundai vehicles was essential to ensure the flexibility in car design, development, assembly and maintenance. Modular architecture was required to provide more sophisticated car functionalities and enduring value to the price-sensitive Indian customers by reducing development cost. In Hyundai vehicles, modularity enabled capitalizing on the module developers' functional expertise and knowledge. Observing this, K. Rajesh commented:

"*Modular architecture is an absolute requirement for designing Hyundai vehicles. This is because modularity gives us the provision to outsource key modules from different suppliers. Therefore, we adopt modular architecture and this does not only save our development time, but also allows us to access the high quality modules developed by proven suppliers. Modularity is thereby essential to maintain the high quality of Hyundai vehicles.* "

Outlining an example of modularity, K. Rajesh explained that Hyundai "Santro Xing" had been exported to different countries of the world in the form of SKDs (semi knock down kits) and CBUs (complete built units). The body panel, engine and transmission components of the modular car, Santro Xing , known as "Visto" in the Korean market, were entirely imported from India and then assembled in the Ulsan plant of Korea. Moreover, in regard to modularity, A. Alwarsamy explained that the power trains of Hyundai vehicles were configured in modular architecture to facilitate the combination of different motors, batteries and transmissions with a common hardware interface. More specifically, in the modular architecture of power trains, different motors and transmissions can be combined in various ways without altering the rest of the car. This allowed the automaker to roll out different categories of power trains for a number of car varieties to meet the evolving customer needs.

4.5.2 Ford India

4.5.2.1 Background

Ford India Private Limited, a wholly owned subsidiary of the American Ford Motor firm was established in 1995 and started production in 1996 (Madhavan, 2012; Sarkar, 2010). The firm's headquarter is located at Chennai, India. Presently Ford is the sixth largest automaker in the Indian market. Current models of Ford India consists of the sedan and hatchback form of Ford Fiesta, the sedan Ford Fiesta Classic, the midsize SUV-Ford Endeavour, the SUV-Ford Ecosport and the small car Ford Figo (Sarkar, 2010). Due to the lack of value-for-money positioning, success in the Indian market came late for Ford India. Although Ford was considered an interesting niche player in Indian market, it aspired to build cars for the volume segments. Adopting a strategy of local engineering, higher level of localization, value engineering and ensuring low cost of ownership, Ford innovated its game-changer model

Ford Figo. Targeting more than 65% of India's new vehicle buyers, Ford Figo helped drive growth in the Indian market (Sarkar, 2010). Former President and Managing Director of Ford India, Michael Boneham, in this regard commented:

"Ford Figo is targeting the middle class customers of India because middle class is growing due to increased level of GDP. So, far more people are moving to the average GDP per-capita of US$4,500-6,000. People are moving from a two-wheel vehicle to four-wheelers. This increased GDP per-capita level gave us confidence as the middle class customer segment will continue to grow. Not surprisingly, 65% of our Figo customers are first time car buyers moving from two-wheel vehicles, and who have never driven a four-wheeler before. We planned to give them a great experience and for us it was all about making our brand accessible and giving valued product features. Positioning Figo as value for money was a big factor for its success".

With the encouraging customer response, eight more models were being planned for launch in the Indian market by 2015, focusing more on diesel variants (Madhavan, 2012, Sarkar, 2010).

4.5.2.2 Visionary leadership

It was a crucial time period for the American automobile industry between 2008 and 2009. The industry suffered a major financial crisis. Faced with the problem of reduced cash flow and looming bankruptcy, the two big players, General Motor (GM) and Chrysler had to resort to federal funds for survival. In the midst of extreme uncertainty and industry turmoil, Ford, one of the major players of the US auto industry survived due to the charismatic leadership of the 64-year-old President and CEO, Alan Mulally (Hoffman, 2013; Madhavan, 2009). Mulally joined Ford on September 2006 from Boeing commercial airplanes. Quite obviously, scepticism ran high on whether Mulally would be able to rescue Ford from its drowning. Proving all the speculations wrong, Mulally's vision had taken Ford back to its roots and had returned Ford as the most profitable global automaker (Hoffman, 2013, Madhavan, 2009).

With the vision of positioning Ford for faster business growth, Mulally oversaw the sheer importance of emerging markets such as India and China in Ford's strategy. In India, Ford began operation in 1996, investing US$450 million. However, Ford did not achieve the anticipated success in the Indian market. Michael Boneham explained:

"Traditionally, we used to bring in vehicles already designed, developed, manufactured for Europe and the US market, then bringing them here in India and doing some small adaptations and so on. That strategy was alright if you want to be a small volume manufacturer. This is because the cost of doing that was high; level of localization was relatively low. As a result, we could not position our products to be competitive in India where you need to be in a price segment between US$5,000 and $6,000 because 70% of all cars are sold here in India in that price range".

Taking on extra-ordinary risk, Alan Mulally influenced the firm's board of directors to invest an additional US$500 million in India, despite the financial crisis of 2008. The target market was India's growing middle class customers whose rising incomes led them to aspire to upgrading from a two-wheeler to a four-wheeler vehicle. Mulally therefore embarked on the challenge to build the first ever compact car from Ford Figo, with the plan to make India into Ford's small car hub. Alan Mulally articulated his vision as below:

"The future of the automobile is going to be small cars worldwide with higher quality and more features. It is not going to be small and cheap, but small and high quality. If you look at the entire world, 60 percent of all vehicles globally will be relatively of smaller size, about 25 percent will be medium size and 15 percent will be large cars. As I said, if the whole world is going to be 60 percent small cars, the solution for India —making a wonderful high quality small car and making it efficiently—will be the foundation for rest of the world. For small cars, India is the center of the universe" (Madhavan, 2009).

And again:

"Indian customers want the best quality, high fuel efficiency and safety at the most affordable price. These parameters have now become the pillars of design for the entire Ford family"(Madhavan, 2012).

As a result, Ford Figo was developed as the most affordable car that the firm had ever built for the rising Indian middle class customers (Madhavan, 2012, Gupta, 2010). At a starting price of INR 3.8 lacs, building Figo meant a paradigm shift for Ford; the vehicle manufacturer that was not known at all for making small cars.

Eventually, the compact car Figo was a great success in the Indian market and Ford expects India to become its third-largest market, after the US and China, by 2020 (Madhavan, 2012). And with this, Mulally's larger vision is to accomplish the original dream of Henry Ford: transforming automobile from rich man's toy to a convenience for everyone by making the best vehicles at the most affordable price (Gallo, 2012).

Before Alan Mulally took the position of CEO at Ford, the firm was going through a critical time as there was no persuasive vision for going forward. Realizing the importance of a compelling vision, Mulally made sure that his vision was communicated in terms of an apparent and concise work plan to the entire Ford team consisting of employees and suppliers which has helped Ford to its greatest turnaround (Hoffman, 2013). In his own words Mulally described (Hoffman, 2013):

“What I have learned is the power of a compelling vision”.

Mulally believed that the creativity of the engineers would be increased by establishing a collaboration based atmosphere (Gallo, 2012). In addition of being passionate and utterly optimistic, Mulally inspired cross functional teams through personal relationships- depicted by Hoffman (2013) as “the cheerleader in chief”. For example, regardless of the firm hierarchy, Mulally would regularly pay visit into employees office or call them for personal visit. These practices of employee bonding not only enhanced their morals, but also helped the employees to focus on their work plans.

4.5.2.3 Re-engineering global platform by Ford India

For the Indian market, Ford used to bring the vehicles already designed, developed and manufactured for foreign markets, doing some small adaptations. As a result, Ford India could not come up with the vehicles meeting the required price-performance specification of the Indian mass customers. In this regard Michael Boneham explained:

“Nearly 70% of all cars sold in India are small cars. We have been around for long time-learning, and weaving our experiences, on what India is all about. A few years back, we recognized that we needed a competitive price positioning, and started working hard on our value-for-money positioning. The strategy was to achieve higher level of localization, do local engineering and value engineering”(Sarkar, 2010).

For doing so, Ford engineers experimented with employing common components for a range of different car models as well as low cost and lightweight components wherever possible. For instance, Ford India re-engineered a common platform known as “One Ford global product development system” to design a range of base vehicles comprising identical components that were interchangeable for maximum flexibility in design, installation and repairs. Later on, various other add-ons were incorporated to design different vehicle derivatives. Alan Mulally in this regard affirms:

“Our *global platforms are 60-80% same around the world and then we customize those vehicles according to the needs of a customer in a particular region. That’s the advantage we have at Ford” (Padmanabhan and Raj, 2012).*

In the words of Michael Boneham:

“As part of our global platform strategy a range of Ford vehicles such as Fiesta, Fusion, Figo, Ecosport are developed with the same base vehicle deploying common parts. We then produce different derivatives of the base vehicle by changing the top-head of the car-integrating accessories and adding a variety of features. In this way more choice in terms of technology and functions are available to the customers. Exploiting common vehicle components gives us the advantage of achieving economy of scale. Our innovation strategy also goes in terms of significant localization of the vehicle components which is 85% and local manufacturing which is done here in India. In terms of value engineering, our engineers make sure that vehicles from Ford comply with the requirements of Indian mass customers. So, we design accordingly to create value for customers upfront rather than taking a high cost vehicle and trying to get the cost down. With localization, the parts are available much easily and at much lower costs. In addition, we benchmarked the parts replacement with the

best-in-class and did value engineering, not just to address the price positioning but also to bring down the cost of ownership" (Sarkar, 2010).

Furthermore, Ford India undertook numerous experiments using lightweight and many discrete components in their vehicle design. In this way, Ford India tried to maintain the affordability criteria for the Indian mass customers while significantly enhancing the performance and agility of its vehicles. In this connection, Sandip Sanyal explained:

"We have deployed lightweight components wherever possible in the vehicle design. For example, we have used all aluminum body panels. In terms of power train technology, engine and transmission technology, we have used aluminum cylinder head and block to make the vehicle lightweight, rigid and fuel economic. Using such lightweight material has reduced vehicle weight by roughly 15% and has made it possible to go further on a gallon of gasoline, boosting fuel economy. Thus, our focus on innovation strategy is to go beyond the customers' thinking and give them the surprise and delight in terms of products that they really expect".

Cross-functional teams of skilled engineers from a variety of disciplines and backgrounds worked in an integrated manner motivated by Ford's global motto "One Ford". For example, teams with expertise in different dimensions such as design, engineering, manufacturing, product development, marketing, supplier quality assurance worked toward a common goal. Moreover, Ford also engaged the customers and suppliers upfront with the design and development team as a part of the global product development system. Official routines and close interaction among the group members, such as regular review meetings and knowledge exchange, facilitated the design of cost effective components.

Michael Boneham illustrated:

"A range of skilled and motivated teams is the key to Ford's current and future success. Here at Ford India we lay emphasis on the fact that what can be made possible absolutely depends on integrated and close teamwork among employees, partners and suppliers. This has ensured our value-for-money positioning in the Indian market. As an example, for Ford Figo we had some unplanned changes in the instrument panel features at the very last stage due to the evolving customer demand. Our teams were open and flexible to do this. Ford is a great system-driven firm - for everything there is a definite process here."

4.5.2.4 Advancing collaborative partnerships with suppliers

Ford sustained strong collaborative partnerships by proactively developing both global and local supplier bases for automotive vehicle component design and manufacturing, thereby enabling the diffusion of technology, skills and utilizing the technological capabilities of the suppliers. According to Michael Boneham, the suppliers were engaged from the very early stages, participating in the vehicle module manufacturing and trial productions. Innovative efforts of Ford were thus strengthened through recombining and thereby generating new knowledge more competently. These efforts helped Ford to achieve affordable mass market innovation. Again, Michael Boneham stated:

"*We formed a number of partnerships for mass market projects and we worked very closely with our suppliers to get high quality components at the appropriate cost level"*.

As an example, for developing the Ford Figo which is a small and affordable car for the Indian mass market launched in 2010 (Sarkar, 2010), the firm entered into a number of partnerships with the component suppliers. Ford accumulated learning and partnering experience of working with mostly the same suppliers during the 2000s for the development of the Ford Endeavour, Fiesta Classic, and Fiesta. In this regard, Michael Boneham explained that previously Ford used to import the power train of engines from the US. However, it was not an acceptable scenario to get the cost base attractive to the targeted Indian customer segment. Afterwards, Ford formed an alliance with Jai-Hind, which is an Indian automobile product manufacturer specializing in fabricating engine parts. Ford worked closely with Jai-Hind on the block and head casting of engines. Along with its Indian supplier, Ford also worked with global suppliers such as Visteon for air-conditioning systems, Bosch andSiemens for power train, and Johnson Controls for seating system. Thus, the learning experience from prior alliances influenced Ford greatly to engage in partnerships with the supplier base, capitalizing on their proven functional expertise and core competencies.

The collaborative partnerships among Ford and the suppliers were based on trust, which eventually facilitated the transmission of specialized knowledge among the partners. Moreover, trust-based prior relationships from early projects influenced Ford to form recurrent alliances with the same suppliers for subsequent projects. In this connection, Executive Director Sandip Sanyal observed:

"Ford used common suppliers as much as possible across the entire product line. We work together with the best local and global suppliers who are known for their own innovativeness and cost effectiveness. We also create our supply base around our plants so that we don't have to move material long distance and thereby reduce the logistics cost".

The alliance relations not only assisted Ford to come up with mass market vehicles through capitalizing on a broad variety of critical skills, but also benefited suppliers and equipment manufacturers. As Michael Boneham said:

"Working closely with Ford gave a fantastic chance for partners such as Jai-Hind to grow their own business, as they could demonstrate their capacity. We have got a mix of local and global suppliers and it was very effective because of trust".

4.5.2.5 Modularity in vehicle design

Ford's ability to acquire detailed architectural knowledge of the overall vehicle design well in advance ensured that the modules interacted with each other in the complete vehicle system and achieved the desired overall functionality. Michael Boneham, speaking on modularity, observed:

"Indian customers are not only concerned of purchasing price but also immensely focus on vehicle ownership cost such as, fuel economy, service cost, warranty cost and reselling price across the entire product life cycle. So the ownership cost is equally important to purchasing cost. Bearing this in mind, from the innovation perspective we implemented the 'Child Part' strategy, understanding customer requirement. Traditionally the whole air-conditioning system of our vehicle needed to be replaced if anything went wrong. With the help of our engineers adopting the Child Part strategy, we broke the air-conditioning into 15 different parts so that any single erroneous part can be replaced rather than replacing the whole system. So, this is exactly a modular architecture. We have adopted this modular architecture for 36 different critical systems of the car".

Boneham explained that in India lots of road accidents happen, damaging car exteriors. Since the doors of Ford vehicles were modular, it allowed any car owner being hit in the door to simply replace the skin of the door. That is the outer part of the door can come out and the inner part remains untouched. Thus, modularity in the car design contributed considerably to reducing the cost of vehicle ownership and service maintenance for the customers.

4.6 Discussion and cross-Case analysis

Based on the evidence in the case studies, it is now possible to identify what capabilities are required by firms and how such capabilities may be developed during the process of innovation for the masses. In doing so, the study establishes not only what capabilities are salient for mass market innovations, but also the various factors favouring the capability development process.

The portrayal of four firms in the previous section describes the approach of firms developing innovations for mass customers. Based on the evidence presented, a cross-case analysis has been performed to analyze the similarity and differences of the required capabilities and how they are created to come up with appropriate mass market innovations summarized in the tables (4.2 and 4.3) below.

Table 4.2: Capabilities Demonstrated in the cases of EMFs

Capabilities	**Rationale**	**Capabilities Demonstrated in the cases of EMFs**	
		Tata Motors	**Mahindra & Mahindra**
Combinative capabilities	Meeting the unique price–performance criteria of mass markets in an EE	Creating a new architecture through novel combinations of existing core technologies and reconfigurations of major components for ultra-low-cost design. Socialization of a common vision and values promoted by the leadership facilitated cohesiveness to accelerate the achievement of the goal. Setting a framework of formal project management procedures and mechanisms to facilitate co-ordination among diverse cross-functional teams.	Recombining and reconfiguring existing core technologies and components in new ways led to new architecture creation such as the "start-stop" mechanism of Mahindra Scorpio's engine. Fostering an open environment and robust communication system to compile inputs of cross-functional team members. Formalized system of integrating architectural knowledge. Motivation of team efforts, shared sense of purpose and faith in engineers' own in-house technical capability through charismatic leadership.
Alliance formation capabilities	Sharing cost and risk while leveraging specialized knowledge	Winning commitment of vendors by leveraging recurrent relationships from previous alliances. Leveraging reputation of Tata Group for trustworthiness, to obtain specialized knowledge of a large network of partners and inducing them to move beyond their traditional role of "make to design" towards committing resources for co-creation and co-specialization. Transparency and information sharing systems to cement a bond of trust with partners.	Forging recurrent collaborative relationships to win the trust of a network of local component suppliers. Enabling transfer of specialized knowledge and best practices to improve quality and reduce costs – thereby increasing commitment among vendors. Driving innovation at component suppliers' end through design changes and value engineering.
Capability to modularize	Ensuring product upgrade and improvement over time to serve multiple tiers	Visionary leadership setting out how technology for mass markets can be evolved to service more profitable mainstream markets. Forging an open orientation which facilitated embedding of inputs for design through early vendor integration enabled modularity.	Anand Mahindra's vision conceived of a high quality yet affordable SUV for mass markets that could be later upgraded to service the more sophisticated mainstream markets. Open orientation innovation culture to involve module suppliers in the design phase of major car engineering systems.

Table 4.3 Capabilities Demonstrated in the cases of MNCs

Capabilities	**Rationale**	**Capabilities Demonstrated in the cases of MNCs**	
		Hyundai Motor India Ltd.	**Ford India**
Combinative capabilities	Meeting the unique price – performance criteria of mass markets in an EE	HMIL does not explicitly demonstrate new product architecture creation entailing combinative capabilities. HML evidently re-engineered a number of core processes replacing expensive machinery with simple and self-invented procedures, reusing common raw materials and reducing process rejections for better resource usage, manufacturing cost reduction and reduced resource consumption. Three organizational dimensions of combinative capabilities evident from strong communication among cross-functional teams coupled with well-built relations and strongly agreed-on goals.	Similar to HMIL, Ford India does not exhibit new architecture creation entailing combinative capabilities. Use of alternative low cost, lightweight components and component resizing instead of experimenting with new combinations of existing core technologies and reconfiguring linkages among components. Organizational aspects of combinative capabilities evident from close interaction among group members along with common goals, values and formal routines. These were only demonstrated in the boundary of already established and stable product architecture of Ford.
Alliance formation capabilities	Sharing cost and risk while leveraging specialized knowledge	Learning and partnering experience to leverage functional expertise, specialized knowledge and critical competencies from the vendor base Compared to Tata Motors and M&M, less autonomy was provided from HMIL to the suppliers for driving design innovations. Trust-based collaborative partnerships facilitated the transmission of strategic resources to focus more on localization.	Forming recurrent alliances with the same suppliers to capitalize on the broad areas of vendor skills for innovating high quality vehicles at the appropriate cost level. Similar to HMIL, the auto maker relied on its intra-firm and global linkages to ensure strategic industry positioning, quality and differentiation of its various subsidiary products. Trust-based relationship facilitated linkage formations primarily for purchasing materials and reducing the cost of local manufacturing.
Capability to modularize	Ensuring product upgrade and improvement over time to serve multiple tiers	Enabling to leverage module developers' functional expertise and knowledge to ensure the flexibility in manufacturing, assembly and maintenance. Compared to Tata Motors and M&M, firm is less open to involve module suppliers in the design phase. The motivation of visionary leadership primarily stems from manufacturing cost reduction and achieving business growth targeting India's growing middle class	Re-engineering global product development system to design a range of base vehicles comprising identical components to produce different derivatives with varied functionalities. Impetus of visionary leadership rests on reducing manufacturing cost and achieving economies of scale. Suppliers were mostly manufacturing to pre-specified designs.

		customers.	

4.6.1 Linkage formation capabilities

Serving less-well-to-do customers calls for a strategy of collaborative alliances to economize on resources, reduces cost and uncertainty (Seelos and Mair, 2007), and enables firms to access various functional and technological competences that do not exist within their own boundaries (Gulati and Sytch, 2007, Hitt et al., 2000b, Schilling and Steensma, 2001). An ultra-low-cost innovation requires a network approach that shares costs and risks with alliance partners, while leveraging specialized knowledge and other network resources (Dyer and Singh, 1998, Gulati and Wang, 2003, Gulati, 1999). Tables 4.2 and 4.3 highlight the salience of linkage formation capabilities in innovation for mass market customers in EEs. Tata Motors' competence in forging and managing multiple alliances and networks explains its success of building the Tata Nano for mass markets in India. Tata Motors not only possessed alliance capabilities, but also deliberately directed resources towards cultivating exceptional alliance capabilities. It devoted its assets to co-ordinate a large network of alliance partners to share costs and risks, while leveraging specialized knowledge and other network resources for the development of Nano. For designing the base model of Nano, Tata Motors collaborated with manufacturers as well as critical car component designers. It combined its in-house body design expertise and capabilities with those of its innovative partners for re-engineering, redesigning and adapting technologies to create new architectural knowledge. Leveraging the Tata group's reputation for trustworthiness, the firm motivated alliance partners to break away from the convention of involving suppliers only in manufacture of parts to pre-specified designs and motivated them to become partners in innovation by taking on the more challenging role of designing components. Some suppliers, such as Lumax Industries, Sona Kayo group and Rico went beyond their traditional role of manufacturing to pre-specified designs, to the designing of components such as steering column, engine-block and head/tail light fixtures (Gopalan and Mitra, 2008). The learning experience accumulated from prior alliances during the Indica and Indigo projects back in 1990s greatly enhanced the alliance capabilities of Tata Motors. The alliance experience was used to leverage recurrent relations with the same Indian vendors as well as a basis to negotiate with new Indian and foreign vendors, reducing costs substantially.

In a similar way, for the other Indian auto manufacturer, M&M, linkage formation capability was developed from the learning and partnering experience gathered since 1947 when the firm introduced the first utility vehicle in India. M&M formed linkages with a set of strategic partners who were engaged from the very early stage of car component design, component manufacturing and trial productions. M&M not only collaborated with Indian suppliers, but also with a number of global suppliers who set up their manufacturing base in India. Similar to Tata Motors, M&M also motivated the suppliers to come up with their own innovations through design changes and value engineering to control the cost of innovations and offer a better valued product; highly significant for mass market customers.

For the two multinational auto manufacturers, namely HMIL and Ford, the motivation to form collaborative linkages are also evident. HMIL amassed alliance formation capabilities through learning and partnering experience of working with mostly the same set of suppliers, starting in 1996 with the development of the Hyundai Santro and then subsequently other models like Hyundai Accent, Elantra, i10, i20 and Hyundai Eon. Alliance formation capabilities enabled the firm to participate in a number of collaborative partnerships with more than 100 local and foreign key component makers manufacturing critical vehicle components, modules and integrated systems for HMIL. It is evident from the interviewees' observations that forming linkages have influenced HMIL to leverage functional expertise, specialized knowledge and critical competencies from the vendor base without which it would not have been possible for the firm to tackle the challenges of innovation for the Indian mass customers.

Likewise, Ford accrued linkage capabilities by partnering with the same set of suppliers for the development of the Ford Endeavour, Fiesta, Fiesta Classic and Ford Figo, since 1996. Both local Indian and global suppliers were engaged from the very early stages of vehicle module manufacturing and enabled the firm to capitalize on the broad areas of vendor skills to innovate high quality product at the appropriate cost level. A point of difference among the local Indian and multinational auto manufacturers lay in the fact that the inclination and capability to motivate suppliers to come up with their own innovations is more evident from the cases of the Indian manufacturers, Tata Motors and M&M. Rather than giving suppliers the predefined specifications, participants from these two firms explicitly outlined the significance of driving innovation from the supplier end to explore more new ideas and achieve high performance at a reduced cost. The reason why the two EMFs provided more autonomy to the suppliers for driving design innovation can be understood from the literature investigating different forms of local inter-firm linkages by MNCs and the differences between MNC affiliates and EMFs in their attainment of linkages.

In general, it is known from the existing literature that MNC subsidiaries create relatively few and superficial linkages with local suppliers of a foreign economy. In contrast, EMFs usually develop deep local backward and forward linkages in the local environment (Ray and Venaik, 2001). Tending to be more import-dependent and less locally and vertically integrated, MNC subsidiaries form local linkages only to purchase raw or semi-finished inputs from local suppliers and undertake local manufacturing in order to reduce cost of production (Ray and Rahman, 2006). The reasons for MNC subsidiaries influencing the propensity to develop few and superficial linkages with local suppliers are manifold. For ensuring proper quality and differentiation of the MNC subsidiaries products, which would provide ownership advantage over its local rivals, MNC subsidiaries depend more on its global resources like the parent or other affiliates for the import of proprietary capital equipment (Lall and Mohammad, 1983). More specifically, MNC subsidiaries tend to concentrate more of their R&D work at headquarters for the supply of core technologies (Lall, 1980). Also, to avoid development of new know-how about local market conditions and to maintain technology homogeneity among their subsidiaries, MNC subsidiaries are less likely to form local linkages compared to local firms, This approach enables it to avoid transaction costs of local supplier search and the risk of losing trade secrets to unaffiliated parties (Caves, 1971, Caves, 1996, Buckley and Casson, 1976). To maintain their strategic positioning in the industry, foreign enterprises tend to rely more on their intra-firm and global linkages than local linkages (Ray and Venaik, 2001). Therefore, MNC subsidiaries are significantly less willing to undertake a full array of value-chain activities in a foreign economy, except when the subsidiary products are differentiated from the rest of an MNC's global operation. Also, the transaction costs of reinventing the wheel in-terms of identifying and forming linkages with local suppliers will tend to discourage local sourcing of core technologies (Ray and Venaik, 2001). Thus, in alignment with the scholarly viewpoints, HMIL and Ford India have formed local linkages primarily for purchasing materials and to reduce the cost of local manufacturing rather than driving design innovations. Lack of propensity to, and experience in, forming linkages in local markets therefore generates lower linkage capabilities and this becomes a limitation to catering to low income mass markets. Ford and HMIL are at present only catering to upper-middle class customers in India. Therefore, capabilities to manage their value chains are primed according to the needs of those markets.

By contrast, learning from prior alliance experience boosted Tata's capability to foster trust in its alliance partners which enhanced knowledge creation and sharing among Tata and collaborative firms (Gopalan and Mitra, 2008). As Tata Motors and the collaborative firms exchanged information in a transparent and honest approach, trust was built in the alliance network (Gopalan and Mitra, 2008). In this way, trust-based alliance relationships facilitated the exchange of core knowledge among the firms and enhanced the innovative performance of Tata. Similarly, linkages based on trust facilitated the transmission of innovative ideas and technological capabilities among M&M and the vendors, enabling the development of low cost and rugged automotive vehicles. Trust is also perceived as a significant factor in the relationship between the multinational auto manufacturers and the suppliers which has helped the firms to design affordable cars for the Indian mass customers. For example, collaborative partnership based on trust facilitated the transmission of strategic resources among HMIL and the vendors also influenced the firm to form recurrent alliances. Likewise, trust-based relationships influenced Ford to form recurrent alliances with the same suppliers for a number of subsequent projects.

4.6.2 Combinative capabilities

The cases of Tata motors and M&M highlight the salience of combinative capabilities to achieve an altered price-performance package for the mass markets. Creative combination of existing core technologies and reconfiguration of major components are hallmarks of combinative capabilities to create new product architectures.

A frugal approach to innovation compelled Tata Motors to embark on designing a completely an ultra-low-cost product rather than performing minor adaptations of existing products. Tata Motors created new product architectures to experiment with recombination of existing core technologies, alternative materials, resizing components, reducing part count, and reconfiguring the linkages between major components; a classic example of a firm deploying combinative capabilities to achieve an altered price– performance package for mass markets. Emphasizing frugal engineering, the "start-stop mechanism" of Mahindra Scorpio's engine is a classic example of new architecture creation recombining components without changing the core technology. This innovation satisfied the unique price and performance requirements of mass market customers in terms of providing better fuel economy.

Combinative capabilities enable firms to integrate architectural knowledge for new product development and they emerge from system, co-ordination and socialization capabilities of a firm (De Boer et al., 1999). Strongly agreed-on goals, common values and a shared belief to recombine discrete knowledge of engineers from cross-functional teams is an example of socialization capabilities. For developing the Tata Nano and Mahindra Scorpio, strong integration of, and regular communication among, diverse cross-functional teams facilitated by formal project management policies unified architectural knowledge; an example of system and co-ordination capabilities.

By contrast, Ford India and HMIL do not explicitly demonstrate engaging in architectural innovation. Ford India only used alternative low cost and lightweight components and component resizing instead of experimenting with new combinations of existing core technologies and reconfiguring linkages among components. Likewise, in focusing on frugal engineering, HMIL maximized value, efficiency and eliminated non-essential waste through re-engineering a number of core processes, reusing common raw materials and reducing process rejections. These generated significant manufacturing cost reduction and cut resource consumption.

The inability of Ford India and HMIL to understand the value of architectural innovation is somewhat puzzling given their established position in the global market and their depth of experience in the global automobile industry. According to Henderson and Clark (1990), architectural innovation poses problems for well-reputed firms as these firms are actively engaged in incremental innovations operating within the context of stable architectural knowledge. Given the evolutionary character of product development and their focus on already established designs, well established firms focus on continuous improvements in their existing product performance within stable product architecture. Moreover, due to the well-developed information and communication channels, and problem-solving strategies, learning about a change in the architecture therefore requires explicit management attention to invest time and resources to learn about the new architecture and apply new architectural knowledge effectively (Henderson and Clark, 1990). However, well-reputed firms are handicapped in their attempt to actively search for new solutions as they specialize in their standard operating procedures to design and develop new products and innovations. Architectural innovation, in contrast, requires frequent experimentations in design to create new knowledge. As a result, many well established firms encounter difficulties in coming up with architectural innovations (Argyris and Schön, 1999). This is especially true for foreign subsidiaries of an MNC. Often, growth-triggering innovation emerges in foreign subsidiaries of an MNC being located close to customers of a particular local market, and understanding their requirement better (Birkinshaw and Hood, 2001). However, innovative ideas emerging from foreign subsidiaries are often not considered by the parent firm due to the tightened internal systems including established formal and informal commutation channels between headquarters and subsidiaries, and less authority delegated to a subsidiary. As a result of this, innovative ideas cannot flow freely from the foreign periphery to the corporate center (Birkinshaw and Hood, 2001). Less-entrenched firms, on the other hand, that are not handicapped by the embedded architectural knowledge, often find it easier to build organizational flexibility to abandon the old architectural knowledge and build new ones, being more open-minded to new ideas. Accordingly, they search actively for opportunities to introduce changes in product architecture (Henderson and Clark, 1990).

Nonetheless, HMIL and Ford India demonstrate three organizational dimensions of combinative capabilities – system, co-ordination and socialization capabilities (De Boer et al., 1999) which is evident from the formal routines and close interaction among group members, coupled with strongly agreed-on goals. However, the engineers were demonstrating these capabilities only in the boundary of already established and stable product architectures of Ford and HMIL.

4.6.3 Capability to modularize

For Tata Motors, prior knowledge of modular architectures facilitated upgrading base models to more advanced versions in the later phases. With the Nano, Ratan Tata envisioned the prospect of catering to both Indian mass customers and upper middle class customers, and he shared this vision with the engineering team. This led to provisions being created through a modular architecture to incorporate more sophisticated modules. Tata Motors was able to use the knowledge on the relevant car modules and their interactions to harness a pool of autonomous module developers to generate the desired functionalities. Designers of the Tata Nano strategically invested in amassing learning of a modular vehicle well in advance for upgrading the base model to more advanced version in the later phases. By having an open orientation to draw ideas from a pool of various autonomous module developers, Tata Motors was able to access a diverse range of modules designed independently in different firms which is in line with the propositions found in the literature (Sanchez, 1995, Sanchez, 1996, Sanchez and Collins, 2001, Sanchez and Mahoney, 1996). Based on having the architectural knowledge on the relevant car modules and their interactions to generate specified functionalities, Tata Motors was able to generate an alternative low cost distribution model to speed up the distribution process which really helped to maintain the affordability criteria.

In a similar way, being able to access and accumulate the module developers' specialization and capabilities, M&M was able to achieve low cost levels and keep the provision to move to higher configurations. With the visionary leadership of Anand Mahindra, M&M envisaged the prospect of catering to both Indian middle class customers and high-end customers of India and the global market. He shared this vision with the engineers, creating an environment for innovation culture. Therefore, based on an open architectural design M&M was able to innovate a whole family of Mahindra Scorpio-starting from the base model Mahindra Scorpio LX for serving the lower performance requirements of mass markets, to more upgraded versions, for example, Scorpio SLE, VLX AT and VLX 4WD, and premium models for more demanding mainstream customers . Likewise, for HMIL, the capability to modularize was enabled by the capacity to leverage module developers' functional expertise and knowledge. This allowed HMIL to not only achieve flexibility in car design and development, and reduce cost for the price sensitive mass customers, but also to provide more sophisticated car functionalities to meet the evolving customer needs. Moreover, this also allowed HMIL to facilitate the export of the Hyundai “Santro Xing” to different countries of the world, in the form of SKDs and CBUs.

For Ford India, a detailed architectural knowledge of the overall car design comprising relevant car modules and their interactions in the complete vehicle system, helped it to re-engineer its global platform system. Through re-engineering the “One Ford global product development system”, a range of Ford vehicles such as Fiesta, Fusion and Figo were designed applying cosmetic changes, changing external car accessories and a variety of features. The car components were also interchangeable for maximum flexibility in design, installation and repairs. This allowed Ford India to produce different derivatives of a base vehicle offering more varieties of technology and functionalities appropriately suited in the context of multi–tiered markets in EEs.

A point of difference between the four firms lay in the fact that for Tata Motors and M&M, the visionary leadership of Ratan Tata and Anand Mahindra led to provisions being created through a modular architecture to serve both mass customers and upper middle class Indian customers. These two EMFs also faced the challenge of balancing the need to meet the social objective of bringing low-cost products to the masses with the need to attain profitability in the long run. As a result, both Tata Nano and Mahindra Scorpio projects were led by the vision of Ratan Tata and Anand Mahindra. They not only took a keen interest in monitoring the progress from the beginning, but also inspired the team, paying regular visits and coming up with various suggestions. This is different for the multinational auto manufacturers HMIL and Ford India, since the motivation of Chung Mong-Koo and Alan Mulally primarily stemmed from manufacturing cost reduction and achieving faster business growth, targeting India’s growing middle class customers. Both Tata Motors and M&M were more open to involving module suppliers in the design phase of major engineering systems. This was more challenging and crucial, as designing modules demanded much greater commitment on the part of suppliers to build new capabilities, entailing many risks and uncertainties. Thus, according to Ashok Joshi, only those suppliers that shared the firm's vision and committed resources to designing modules for Nano were included in the network of module developers. This is in contrast to HMIL and Ford India, as these foreign automakers were less open to involving module suppliers in the design phase. Suppliers were mostly manufacturing to pre-specified designs according to the firm requirements.

From the four case studies it can be summarized that linkage capabilities, combinative capabilities and capability to modularize are essential in innovation for mass markets in EEs. It is not suggested that these capabilities are canonical and an absolutely complete set. From the case evidence of the four auto firms, these capabilities simply emerged as significant in the process of creating innovations for the masses. Particularly, for managers seeking to innovate for mass customers in EEs, a set of capabilities have to be prioritized according to the task at hand. The relationship between the required capabilities and appropriate mass market innovations is demonstrated in Figure 4.2 below.

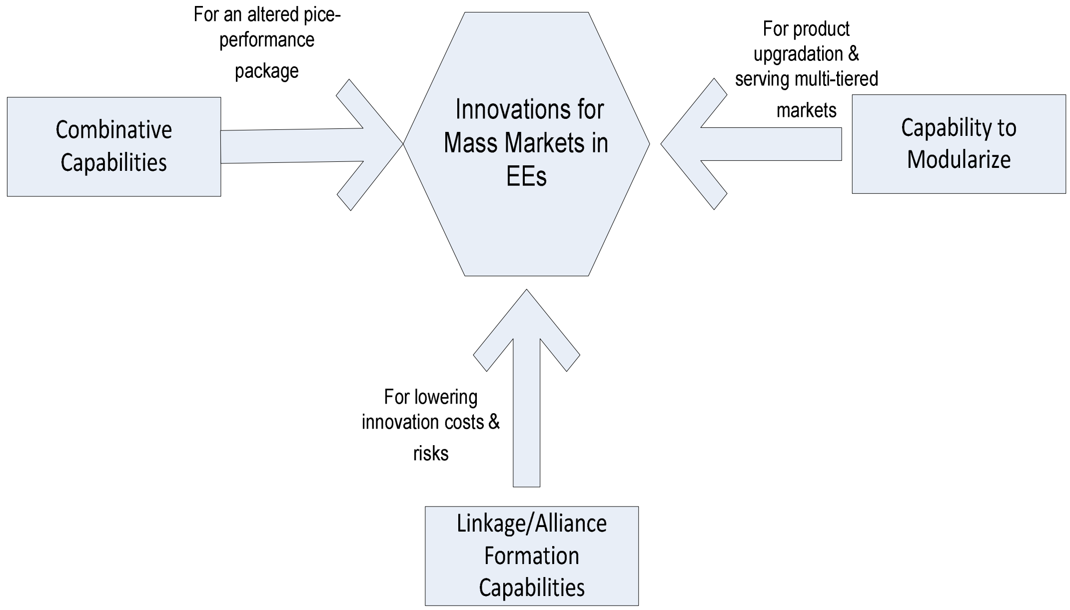


Figure 4.2: Capabilities for mass market innovations in EEs

Having analyzed the required capabilities for mass market innovation and the development process of the selected firms, the study will now look at the broader perspective of capability development. According to the resource-based view (RBV), firms possessing necessary capabilities are capable of adapting, redeploying and incorporating internal/external technical, managerial and functional resources, skills and knowledge to come up with flexible product innovations (Eisenhardt and Martin, 2000, Leonard-Barton, 1992, Teece and Pisano, 1994, Teece et al., 1997, Kogut and Zander, 1992, Amit and Schoemaker, 1993). However, unlike large MNCs, many EMFs which are late entrants to global competition, lack resources, and are constrained by a number of difficulties such as being isolated from technology development centers and lack of access to the advanced high technologies (Mathews, 2002b, Mathews, 2005, Mathews, 2006a, Mathews, 2006b).

The linkage, leverage and learning model (LLL) proposed by Mathews explains EMFs' pathway to achieve capabilities (Mathews, 2002b, Mathews, 2005, Mathews, 2006a, Mathews, 2006b, Mathews and Cho, 1999). In order to catch up with advanced MNCs, and become an innovator from an imitator, EMFs focus on accessing resources outside of their own boundaries, forming linkages with external firms through collaborative partnerships, joint ventures, licensing and contracting relationships. EMFs are succeeding in the global business environment by moving to advanced technological level through the means of linking with partners and leveraging resources from them (Mathews, 2002b, Mathews, 2005, Mathews, 2006a, Mathews, 2006b, Mathews and Cho, 1999). Moreover, EMFs also link up with various networks and institutions such as become integrated in the global value chain as suppliers.

In the context of developing countries, linkages are even more critical, as drawing from the linkages EMFs from developing countries can leverage strategic key resources e.g. technology, knowledge and skills that would otherwise lie well beyond the reach of an EMF (Mathews, 2002b, Mathews, 2005, Mathews, 2006a, Mathews, 2006b, Mathews and Cho, 1999). Finally, the repeated applications of linkage and leverage processes enable EMFs to overcome their initial disadvantages and accelerate their organizational learning. In this process, EMFs learn by combining elements from the established linkages with their own stock of knowledge and become technologically advanced. Eventually, EMFs can either acquire new capability or enhance their existing ones to perform operations more effectively, which leads to new innovations (Mathews, 2002b, Mathews, 2005, Mathews, 2006a, Mathews, 2006b, Mathews and Cho, 1999).

For example, the emergence and rapid catch up of a number of East Asian countries such as first by Japan and later by other Asian Tigers e.g. Korea and Taiwan in high technology and knowledge intensive sectors such as semiconductors, information technology and mobile telephone service has been explained from the perspective of forming linkages, resource leverage and learning process of the latecomer firms (Mathews, 2002a, Mathews, 2006a, Mathews, 2006b, Mathews and Cho, 1999). Although EMFs start with meagre resources and competitive disadvantages, through adopting the strategic orientation of linkage, leverage and learning, these companies have managed to turn these disadvantages into business opportunities and have managed to innovate advancing capabilities. The Korean and Taiwanese semiconductor companies have become the world's third and fourth largest players in the global semiconductor industry by 1996. Korean companies e.g. Samsung, Hyundai, LG and Taiwanese companies such as Taiwan Semiconductor Manufacturing Corporation are some examples of EMFs that have become leading industry players in semiconductor industry forming linkages, leveraging resources and learning processes (Hobday, 1995, Lall, 2000, Mathews, 2002a).

From the cases of Tata Motors and M&M, it is unequivocal that the movement from being an imitator to an innovator of automobiles which have found acceptance in international markets is not automatic. M&M, for example, formed linkage with Willys Jeeps as a manufacturing partner in 1954 to leverage the firm's design and production capabilities for military and civilian jeeps. With the leveraged technical know-how, in 1996 M&M entered the SUV segment to compete globally. Repeated application of the linkage and leverage process resulted in learning and enhanced capability for the Mahindra Scorpio development, which is the India's first indigenously developed affordable SUV.

Although the literature has focused on EMFs enhancing capabilities, surprisingly little has been theorized or systematically explored in the literature about capability development of the established MNCs in the context of EEs for mass market innovations. The prevailing social–economic, institutional and environmental idiosyncrasies in EEs make innovation a daunting challenge for established MNCs. Coupled with altered demand context of mass market customers, such as affordable and functional products with simpler specifications and functionalities (Dawar and Chattopadhyay, 2002, Prabhu and Krishnan, 2005, Prahalad and Lieberthal, 2003), MNCs find it crucially challenging to serve mass market customers meeting their unique demand and price–performance conditions. Therefore, a closer look at how two established MNCs from the global automobile industry developed capabilities for EE innovations provides a valuable insight.

To scrutinize the broader scenario of capability development focusing beyond the firm level, it can be argued that the creation of appropriate innovations for mass market customers was also favored by the role of the Indian government developing a supportive environment through establishing policies. The significant impact of the institutional environment, such as supportive government policies for entrepreneurial development and efforts, has been extensively recognized in the literature (Bruton and Ahlstrom, 2003, Bruton et al., 2010, Bruton et al., 2008). Furthermore, Mathews (2006a, b) has emphasized that supporting institutional frameworks can not only channel the linkage and learning process, but also can have effective impact on the late entrants to overcome their initial disadvantages. In this regard, Lall (1996) echoes similar views that in developing economies selective government intervention is required to co-ordinate investments and ensure efficient resource allocation. Government intervention can not only take the form of policies, but also can be applied in the form of industry protection, tariff imposition and financial incentives to achieve export competence.

The impact of institutional and policy framework on enhanced capability level for firms working in high-tech industry has been articulated comprehensively in the existing literature. For example, through favourable institutional and policy framework the semiconductor industry of Singapore was able to leverage technology, skills and resources from MNCs which eventually enhanced the capabilities of local semiconductor firms who were late entrants in the global semiconductor industry (Mathews, 1999). Supportive government policies stimulated transfer of skills and technologies from MNCs to the local small and medium-sized enterprises (SMEs), encouraged MNCs to strike more linkages and alliances with the local firms and facilitated investment in higher value-adding semiconductor activities, moving beyond simple assembly operations. In a similar way, the emergence and success of Japanese and Korean semiconductor firms was made possible by the design and implementation of relevant policies and favorable institutional factors (Cho et al., 1998). On the other hand, due to the inconsistent set of government policies and lack of government support, the leverage of technology from MNCs to Thai automobile firms occurred with extreme limitations. This resulted in the lack of technological capability upgrading of local Thai auto suppliers (Busser, 2008).

In the context of the Indian automobile industry, the Indian Government's policy of indigenization and the policy of restricting imports of fully assembled automotive vehicles not only compelled the automakers to form linkages and alliances with the local supplier pool to survive in the fiercely competitive Indian market, but also acted as the key factors for the enhancement of capabilities (Amann and Cantwell, 2012, Okada, 2004, Sagar and Chandra, 2004). More specifically, the Indian Government adopted the policy of restricting imports of automotive vehicles to encourage the multinational auto manufacturers to establish manufacturing sites in India, fostering and managing increased linkages with the local supplier base and bringing in their own suppliers. Furthermore, to reduce cost and modify designs to suit local demands, the Indian Government's policy of indigenization provided an impetus for both the local and multinational auto manufacturers to utilize more than 95% of local content for vehicle production and gradually achieve capabilities (Okada, 2004, Sagar and Chandra, 2004).

A reliance on imported business models by the MNCs, with minor adaptations of existing products, may prove insufficient to penetrate into mass markets (London and Hart, 2004). The few MNCs that have entered EEs with minor adaptations of their highly specified products have invariably overshot the requirements of customers therein, with little consideration about their purchasing power (Dawar and Chattopadhyay, 2002; London and Hart, 2004). For the Indian mass market, Ford used to bring the vehicles already designed, developed and manufactured for foreign markets doing small adaptations. Consequently, Ford India could not come up with the vehicles meeting the required price–performance specification of the Indian mass market. To survive in the Indian automobile market, the firm had to adopt the strategy of achieving a high level of localization. As a result, for Ford Figo, which is the first compact car from the firm developed specifically targeting the Indian middle class customers, the utilization of local content has increased to more than 95% to achieve the appropriate cost level. Without forming linkages with a number of local Indian firms and leveraging their proven functional expertise and core competencies, it would not have been possible to come up with vehicles for the Indian mass market at high quality and affordable price.

As observed, MNCs' subsidiaries create relatively few local linkages in a foreign economy compared to local firms (Lall, 1980, Lall and Mohammad, 1983) to maintain the global market positioning and the global integration system, ensure product quality and differentiation, reduce the cost of searching, and avoid the risk of losing trade secrets. In this context, the role of a host-country government can be to act as an exogenous factor to influence and enhance the development of favorable local and foreign linkages by an MNC subsidiary (Ray and Venaik, 2001). It follows, therefore, that although linkage capability has been significant for EMFs and MNCs to facilitate new learning, there is substantial difference in the depth of formed linkages with local suppliers among the EMFs and MNCs. This is evident from the viewpoint of engaging local suppliers in design innovation more extensively by the EMFs compared to the MNCs. For the two MNCs, the motivation to co-invent technical systems and components with suppliers is low. However, aligning with the proposition of Ray and Venaik (2001), it has been observed that favorable government policies and institutional environment enabled the MNCs' subsidiaries to establish local linkages at an increased rate.

Supportive government policies from the liberalization phase of the Indian auto sector also facilitated the Indian auto manufacturers (EMFs) to emphasize increased indigenization levels due to the greater competition level in the industry. For example, striking increased linkages with local partners who were engaged from product design, trial productions, manufacturing of vehicles and leveraging technological skills from them, enabled M&M and Tata Motors to innovate the Mahindra "Scorpio", India's first indigenously developed affordable SUV, and the Tata "Nano"-the world's most affordable passenger car.

4.7 Conclusion

This study observed the patterns of capability development for mass market innovations in the context of EEs. We saw that success in mass markets stems from a deliberate strategy to meet the unique demand criteria prevailing among its customers. This is distinct from the supply-side standpoint of the RBV, which proposes munificence of resources, and organizational slack is sufficient for innovation, be it for new to the world innovation or for innovation for new markets. For many Western firms, responding to the challenge of undertaking a shift from the dominant design thinking that renders obsolete a firm's existing resources, and calls for a different set of capabilities contingent on a narrow task, is almost a daunting task. Most incumbents are unwilling to undertake such a shift in strategic thinking, despite the evidence on the ground. Based on the evidence, it is now possible to specify the following propositions:

Proposition 1: Linkage capabilities are likely to be significant in facilitating innovations for mass markets in EEs.

Proposition 2: Combinative capabilities are likely to be significant in facilitating innovations for mass markets in EEs.

Proposition 3: Capability to modularize is likely to be significant in facilitating innovations for mass markets in EEs.

To examine these propositions, the research project is to develop a set of appropriate hypotheses and thereafter test the hypotheses in an empirical framework. This leads the research to its final stage of empirical analysis in the following chapter.

Chapter 5: A Multivariate Analysis of Capabilities for Mass Market Innovation in Emerging Economies

5.1 Introduction

This chapter examines the capabilities that enable firms to innovate for mass markets in EEs. The analysis draws from the key findings from the case studies in Chapter 4 and integrates them with the literature on capabilities for innovation, to develop a set of hypotheses that predicts how the leveraging of innovation capabilities can translate into successfully catering for the mass market in EEs. Quantitative methodology is used to test these propositions, which aim to identify whether these are precisely the capabilities that make mass market strategies successful.

Despite the increasing importance of EEs, there is little systematic and empirical evidence in the existing literature regarding the capabilities that are required by firms to innovate for the mass market in these countries. Until now it has been widely assumed that innovations in developed countries can be adopted easily in the developing world, with markets in the EEs needing to focus only on absorbing innovative ideas from the developed country multinationals. Revolutionary new products embodied in technological breakthroughs are perceived to be good enough to eventually trickle down to the masses in EEs (Arnold and Quelch, 1998, Dawar and Chattopadhyay, 2002, London and Hart, 2004, Prahalad and Lieberthal, 2003, Wooldridge, 2010). Barring a few notable exceptions (e.g. Chattopadhyay et al., 2012), innovations specific to EEs are hardly mentioned in the literature, nor any examples of EMFs designing frugally engineered products for the masses and a number of MNCs following suit. Since the 1990s, examples of innovations in the automotive industry in India, such as Mahindra's affordable 'Scorpio', Tata's ultra-low-cost 'Nano' (Chattopadhyay et al., 2012, Kumar, 2013), and from global auto MNCs, such as Hyundai's 'Eon', Toyota's 'Etios' and Honda's 'Amaze' (Malini, 2013), have changed our understanding of mass market innovation, making this a worthwhile subject of investigation.

MNCs from the developed world have traditionally considered EEs as new outlets for their existing products embodying highly sophisticated technologies and have focused mainly on making incremental improvements and investing into their existing technologies (Prabhu and Krishnan, 2005, Prahalad and Lieberthal, 2003). The product technologies and specifications offered have continued to surpass the requirements of mass market customers, or have been simply too expensive for them (Anderson and Billou, 2006, Anderson and Billou, 2007, Anderson and Markides, 2006).

While academic attention has been recently drawn to the phenomenon of EMFs, there has been little or no research on identifying the precise capabilities that are required to create appropriate innovations for mass market customers in EEs. This current study contributes to an understanding of the principal capabilities that are critical for mass market innovations. The hypotheses predict that linkage, combinative and modularization capabilities can create an altered price-performance package, reducing costs and improving functionalities over time to serve multiple tiers of customers.

The theoretical background for the study is presented first, followed by a discussion of the research hypotheses. In the next section, a description of the dependent and independent variables is presented, followed by an explanation of the statistical method used in the study. After reporting and discussing the results, the chapter concludes with a summary of the major quantitative findings in line with the cross case validation studies.

5.2 Theoretical background

The dominant view of technology strategy, which stems from a RBV of firms (Adner 2002), emphasizes accumulation of resources as the main determinant of success. However, this supply-side bias makes the dominant view an exclusive approach. In the demand-side view (Adner, 2002), firms must take into account the heterogeneity in demand and the capabilities required to integrate resources with proper routines and structures (Dosi et al., 2000a, Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). It begins with a consideration of the importance of adapting capabilities with the needs of the environment. Isomorphism to institutional realities forces firms to develop management capabilities to serve consumers who would have otherwise been missing from the demand-and-supply equation.

Mass markets in EEs are clearly large and untapped. Capabilities to cater to such markets need to be reflected in the successful reduction of costs and adaptation of products for an eco-system where price-performance consideration is the fundamental starting point of innovation. The unique social, cultural and institutional characteristics of EEs imply that traditional products and management processes do not work in this context and that firms need to strive for new levels of efficiency by radically rethinking the whole supply chain (Prahalad and Lieberthal, 2003). For mass market customers in EEs, over-specifications are of little value and as a consequence, products embodying such features do not succeed. To date, the literature has not provided insights into the type of capabilities that are critical to innovation in EEs (Anderson and Billou, 2006, Arnold and Quelch, 1998, Hang et al., 2010, London and Hart, 2004). These studies indicated that firms aiming to operate in EEs must be willing to develop their capabilities to ensure an acceptable price–performance ratio.

Understanding capabilities begins with an appreciation of the underlying processes deployed in performing a task. Firms differ in the way they coordinate their activities/processes and this ultimately has a significant impact on their innovative performance (Teece and Pisano, 1994, Teece et al., 1997, Dosi et al., 2000b). Capabilities are a key dimension of firm heterogeneity (Nelson and Sidney, 1982) and in some cases, of the kind of idiosyncrasy or inimitability that confers competitive advantage (Teece 2014). As noted in the literature, firms that intend to exploit new business opportunities need to adapt/adjust their capabilities to reflect anticipated changes in the market and non-market institutional contexts (Teece and Pisano, 1994, Teece, 2014, Teece et al., 1997). Firms gain advantage if they have the capability to orchestrate resources such as capital, superior information and workforce, to fit the needs of the environment.

Companies intending to design products and manage costs for mass markets need to consider that income constraints are often the fundamental limitation that severely constrains the ability to pay and therefore create major challenges. Customers are willing but often not able to pay (Seelos and Mair, 2007). This is in marked contrast to developed markets, where companies are more concerned about the *willingness* of consumers to pay for products and services. The general tendency for MNCs is to overestimate the purchasing power of low-income markets and set prices too high (Karnani, 2007) for products embodying superior features and specifications. Most EE customers are therefore poorly served by low-quality vendors or are actively exploited by intermediaries (London and Hart, 2004).

Recent studies (e.g. Ray and Ray 2010, 2011) show that an innovation strategy to create appropriate innovations to meet the stringent price-performance criteria of mass markets requires frugal use of, and a deliberate constraint on, resources. These earlier studies focused on key aspects of design, technology and organizational choices that are likely to be critical for resource-constrained innovation for mass market customers. However, little attention was devoted to identifying the capabilities that would be necessary for pursuing such innovations.

This study proposes three capabilities that are likely to be important in catering for low-income mass markets: capabilities to recombine, capabilities to form linkages/alliances, and capabilities to modularize (Sharmelly and Ray, 2013, Sharmelly et al., 2013). Combinative capabilities are critical for mass market innovations because they enable firms to frugally recombine existing core technologies and thus achieve the required performance targets at much lower costs than if they develop expensive new technologies. Linkage/alliance capability is critical because serving low-income customers requires a focal firm to economize on resources by attracting partners to collaborate in, and share the costs of, product innovation associated with high risks, daunting challenges, very thin profit margins and untested markets. Capabilities to modularize are critical, due to the presence of multi-tiered market segments in EEs with continuously evolving niches of consumer preferences and income parameters (Sharmelly and Ray 2013, Sharmelly et al., 2013).

This study does not propose that this set of capabilities is predetermined or absolutely complete. A particular set of capabilities is usually suitable for a particular task or purpose and other capabilities may be useful for other purposes. Moreover, a set of capabilities can be prioritized according to the task at hand. For example, reverse engineering generic drugs for cost reduction requires process reengineering capabilities, which are different from the capabilities necessary for new drug discoveries, which require capabilities to overturn existing technological paradigms. For the purposes of mass market innovation, organizations that are capable of more effectively leveraging resources are likely to succeed.

5.3 Hypotheses

5.3.1 Combinative capabilities and mass market innovations

As mentioned earlier, too serve mass market customers in EEs, firms need to configure their resource bases and product development processes to deliver an altered price–performance package. Excessive investments in new technologies can be avoided by reconfiguring an established system without changing the core technology and components, through resizing and material compositions that lead to altered functionalities and specifications in a system (Henderson and Clark, 1990). The development of capabilities through internal and external combinations of knowledge, assets and technologies has yet to receive sufficient attention in the literature. However, Ray and Ray (2010) describe the activities of the latecomer firm C-DoT (Centre for Development of Telematics, a telecom manufacturer in India), which managed to produce a range of affordable telecom switches suitable for the rural masses of India, under severe resource constraints, through the reconfiguration of existing core technologies and components

A firm's combinative capabilities enable it to synthesize and apply existing component knowledge acquired from internal R&D experiments or external learning such as alliances or joint ventures to create new product architectures. While combinative capabilities reduce (but do not pre-empt) the need for further investment in new knowledge or technologies, they prevent the innovation from becoming excessively resource-intensive (Kogut and Zander, 1992, Hitt et al., 2000b). Firms that have limited resources for innovation, especially those from EEs, tend to rely on their combinative capabilities for innovating products for their mass markets. For example, innovators from Korea and Taiwan captured the opportunities in the semiconductor industry in this way (Mathews, 2002b, Mathews and Cho, 1999).

Combinative capabilities are effective because they create organizational routines to maximize the knowledge resources of its members more intensively, without necessarily creating new capacity that adds to costs. Frequent and vigorous interchanges of ideas and demonstrations of physical artifacts align innovations with the practical realities of the market and the demand profile of discerning low-income customers. It also leverages existing resources to perform an alternative task of producing different permutations and combinations of the product for multiple-niche or mass markets.

The capability to innovate depends not only on the amount spent on R&D but also on how that is spent, whether the innovation is conducted in-house or outsourced, and on how well it is managed (Teece, 2014). Much expertise that was once proprietary is now explicit and in the public domain, available from consultants, schools of engineering and the public literature (Teece, 2014). Hence, success in mass markets entails leveraging both internal and external combinations of knowledge, with a view to maximizing diffusion. This leads to the following hypothesis:

H1: In the context of mass markets in EEs, a firm's combinative capabilities are positively associated with its innovative performance.

5.3.2 Linkage/alliance formation capability and mass market innovations

The literature has traditionally suggested that achieving an acceptable price performance trade-off for customers in EEs requires firms to draw from the local context (Hang et al., 2010). Firms that aspire to develop product innovations for mass market customers should build local capability through social embeddedness, creating collaborative partnerships with local firms (Chesbrough, 2003, London and Hart, 2004, Seelos and Mair, 2007, Simanis and Hart, 2008). For example, C-DoT of India developed digital telecom switches by forming alliances with a large pool of local vendors for telecom component manufacturing and this helped C-DoT to share the costs and risks through leveraging specialized knowledge with the vendors (Ray and Ray, 2010).

Innovator firms can access resources via formal inter-firm linkages such as strategic alliances, joint ventures, collaborative partnerships, outsourcing and other contractual arrangements for exploration, new product development and knowledge creation. Such formal inter-firm linkages, also referred to broadly as alliances, are driven primarily by the logic of strategic resource needs and opportunities for innovation (Eisenhardt and Schoonhoven, 1996). Formal inter-firm linkages or alliances become particularly critical in determining the success of innovative projects in knowledge-intensive industries, which draw on a multi-disciplinary knowledge base that is both complex and tacit in nature (Powell, 1998).

As well as facilitating access to technical and knowledge resources, alliances can lead to a significant reduction in lead times, enabling innovating firms to bring out new products and services cheaper and faster than their competitors. Partnerships also facilitate innovation by lowering the costs and uncertainties related to the development of new technologies or new markets, sharing the risk of a particular venture and thus enhancing their flexibility (De Man and Duysters, 2005, Gulati, 1998, Hitt et al., 2000a, Quinn, 2000, Schilling and Steensma, 2001). Collaborative partnering experiences facilitate the utilization of functional expertise, critical competencies, resource bases and most importantly, the reputation of alliance partners (Dyer and Singh, 1998, Gulati, 1995, Gulati, 1999, Gulati and Wang, 2003). Ground-breaking sources of information and suggestions can be obtained from the collaborative partners of the focal firm and can be transformed into innovative products and services (Dyer and Nobeoka, 2000, Eisenhardt and Martin, 2000, Dyer and Singh, 1998). In the context of mass markets in EEs, building partnerships with local firms through local technology development and leveraging existing blocks of local resources and capabilities is essential for a potential firm's successful innovation (London and Hart, 2004).

For firms that are either resource constrained or deliberately attempting to minimize resource deployment to lower the cost of innovation, formal linkages with global innovators is key (Mathews, 2002). Firms leverage the technological and financial resources necessary for learning and building innovation capabilities from the formal linkages established with global innovator firms from advanced nations. For example, latecomer firms in knowledge-intensive industries in East Asia and other EEs are known to have deepened and specialized their own knowledge base and expanded their own range of product offerings globally by leveraging their global partner's technologies and expertise, through serving in formal contractual relationships and joint ventures. Such formal linkages have enabled these latecomers to enter lucrative global markets for technologies that were initially beyond their reach (Kim et al., 2004, Mathews, 1999, Mathews, 2006b).

Linkage capabilities therefore not only leverage building blocks of knowledge from markets but also economize on costs and reduce uncertainties about how the innovation is perceived by the market. In turn, this reduction of costs and increase in the value of the innovation maximizes its diffusion. Therefore, the following hypothesis is proposed:

H2: In the context of mass markets in EEs, a firm's linkage formation capability is positively associated with its innovation performance.

5.3.3 Capability to modularize and mass market innovations

An ability to leverage existing building blocks of knowledge in different ways becomes very useful when a firm intends to meet the needs of the underserved segments of the market, which require different product specifications. A capability to modularize allows the innovator to calibrate their offerings to correspond precisely with the demand profile of each market segment. It allows the flexibility to cater to both the low-performance requirements of mass markets as well as the more demanding upper-tier mainstream markets (Christensen et al., 2002). Thus, modularity not only contributes to the disruptive potential of the innovation but also cross-subsidizes the losses from products for the low-end segments of the market with profits from the upper-end market, which is a most important determinant for frugal innovation. Capability to modularize is similar to the concept of *exploitation* (Raisch et al., 2009), which signifies a firm's ability to leverage its existing technologies and resources to customize products based on new needs and preferences. This is different from the concept of *exploration*, which signifies the search for new knowledge, technologies and solutions (Raisch et al., 2009). Modularization of product architectures helps firms to customize product features when performance in existing product technologies do not exactly meet the customer specifications of either less or more demanding customers (Christensen et al., 2002). The ability to customize features to the specific needs of lower-tier customers is one of the major sources of competitive advantage and profit margins for the innovators (Adner, 2002, Christensen, 1997, Christensen et al., 2002). Product customization for both customer segments requires a constant interchange between the focal firm and the target segments (Christensen et al., 2002).

Modularity allows firms to configure innovative new modules, expanding the array of possible product varieties and enables the creation of parts that share common characteristics. This implies that by reducing development costs for future generations of products, modularity promotes continuity in rapid product innovations (Baldwin and Clark, 1997). Modularity in product architecture, in turn, enables substantial flexibility and speed in customization of features which enables firms to meet the evolving needs of customers and act in response to market dynamism (Baldwin and Clark, 1997, Sanchez, 1995). In this regard, the focal firm needs to have the capability to assess a diverse range of modules designed independently in different supplier organizations and thereby accumulate the component developers' resources and capabilities (Sanchez, 1995, Sanchez, 1996, Sanchez and Mahoney, 1996). This also presupposes capabilities to precisely identify unmet and idiosyncratic needs through constant dialogue and interchange with customers. Therefore, the following hypothesis is proposed:

H3: In the context of mass markets in EEs, a firm's capability to modularize is positively associated with its innovative performance.

5.4 Constructs and measures

This chapter has outlined the capabilities that are needed by firms aspiring to develop innovations for mass markets and the way a few pioneers have developed such capabilities. To operationalize these capabilities, a firm needs to investigate the precise value propositions they offer to markets (Helfat and Peteraf 2003, Teece, 2014). In this study, an econometric analysis is proposed to identify the measures that define these capabilities and what they achieve in terms of successful innovation diffusion in mass markets.

5.4.1 The dependent variable

Many researchers have argued that firm size facilitates innovation (Aiken and Hage, 1971, Kimberly and Evanisko, 1981). Large firms have more complex and diverse facilities such as financial slack, marketing skills, research capabilities, product development experience that aid the adoption of a large number of innovations (Nord and Tucker, 1987). In the context of mass market innovations, large firms also all remain in a better position to tolerate the potential loss due to unsuccessful innovations (Damanpour, 1992)

Large firms that cater to mass markets can not only have more market presence in terms of higher sales and revenue, but also have greater incentives to innovate to maintain their market share. Large firms tend to have the relative innovative advantage in industries which are capital intensive (e.g. automotive industry), concentrated and produce a differentiated good (Acs and Audretsch, 1988). Large sized firms also have a systematic tendency to produce innovations that are intrinsically of higher quality than smaller firms (Blundell et al., 1999). The view of large firms having an advantage in innovation is based on a number of arguments, namely:

- Due to higher cash flows from which to finance their investment in R&D, large-sized firms tend to commercialize more innovations through exploitation and also have a higher valuation on the stock market (Rogers, 2004). In each of these cases the assumption is that external capital markets may be unwilling to finance innovation due to high level of risk or inability to understand technical details.
- Large firms also have marketing advantages that are beneficial in promoting diffusion or sales of an innovation (Blundell et al., 1999, Dahlquist and Robertsson, 2001).
- A larger volume of sales implies that the fixed costs of innovation can be spread over a larger sales base (Cohen and Klepper, 1996).
- Large firms may have access to a wider range of knowledge and human capital skills then small firms, allowing higher rates of innovation (Rogers, 2004).
- Larger firms also have an advantage over smaller firms in R&D competition. Consider two firms that produce the same product and pursue the same number of approaches to innovation. For simplicity, suppose that all R&D expenditures result in innovations which lower average cost of production. If the two firms spend the same amount on R&D to achieve unit cost reduction, the larger firm, however, would apply the unique cost reduction over a larger level of output (Cohen and Klepper, 1992, Cohen and Klepper, 1996). This enables the larger firm to earn greater profits from its R&D (Nelson et al., 1967).
- The greater return of earning from any given level of R&D due to a firm's greater size, provides it with an incentive to perform a greater level of R&D than its smaller rival, reinforcing its advantage over smaller firms (Cohen and Klepper, 1992).
- Thereby, larger firms will achieve a more rapid rate of technical advance on the approaches to innovation that are pursued (Acs and Audretsch, 1988).

Thus, according to the extant literature, the size of a large firm is often associated with greater incentives and capabilities to innovate. In this regard, market capitalization is a well-accepted measure of the market power of a firm (Acs and Audretsch, 1987, Blundell et al., 1999, Dahlquist and Robertsson, 2001, Pavitt et al., 1987, Rogers, 2004) Hence, to serve the purpose of a good dependent variable, in this empirical study the proxy used for analyzing firms' innovative performance is the size of the firms operating in the Indian automobile industry, measured by market capitalization.

5.4.2 Independent variables

Table 5.1: Independent variables

Constructs	Rationale	Measuring Variables
Combinative capability	For combining/redeploying knowledge to create new technology or knowledge base	• Intangible assets dep/sales • Indigenous royalties, technical expertise/sales • R&D expenses/sales • Foreign spending expertise/sales • Foreign spending royalties/sales
Linkage/alliance formation capability	To form collaborative linkages with partners to economize on resources, share costs and risks associated with mass market innovation	• Purchase finished goods/sales • Outsourced manufacturing jobs/sales • Indigenous rawmat/total rawmat • Imported rawmat/total rawmat • Imported finished goods/sales • Imported capital goods/sales
Capability to modularize	Continuous interchange with customers to ensure product adaptation, upgrading and customization over time, to serve multiple tiers of customers	• Managerial remuneration/sales • Travel expenses/sales • Distribution expenses/sales • Communication/sales

Combinative capability is indicated by the level of expenses incurred by a firm to combine and recombine knowledge and reconfigure core technologies. This construct has the following measures:

- Intangible assets (depreciation): Codified knowledge that is accumulated in the firm's patents, blueprints, databases, manuals, standard operating procedures (SOPs) and scientific publications represent its stock of intangible assets (Nelson and Sidney, 1982). Expenses incurred by firms in establishing, maintaining and updating these forms of intangible assets can be therefore used as a proxy for the firms efforts in combining existing and new codified knowledge to innovate. In this study, the rate at which a firm depreciates intangible assets as a proportion of sales (Intang_Ass_dep) was used to measure its combinative capabilities.
- R&D: This is the expenses incurred by a company conducting formal research and development efforts, including experimentation to create new technologies and knowledge (Cohen and Levinthal, 1990, Lall and Urata, 2003, Nelson and Winter, 1982). This can include exploration, as well as recombining existing knowledge to create new technology and a knowledge base through exploitation. In this study, the measure for combining tacit and codified knowledge was recurring R&D expenditure as a proportion of sales.
- Foreign expertise ('know-how'): This is measured by the capital expenses incurred by a company on technology procurement and transfers from foreign entities, which can enable the recombination of existing tacit knowledge or the redeployment of technologies to generate new innovations. In this study, this is measured as a percentage of sales.
- Foreign spending royalties: This represents fees paid to foreign entities for patents and codified knowledge. Expenses incurred by firms in establishing, maintaining and

updating these forms of intangible assets can be used as a proxy for a firm's efforts in combing existing and new knowledge. This facilitates the recombination of knowledge to develop new innovations. In this study, royalties on technical know-how was measured by the level of expenses paid by a company to local institutions for obtaining technological know-how.

Linkage/alliance formation capability is denoted by the effectiveness on the diffusion of the innovation (in terms of sales or market valuation) of the focal firm's expenditure on resources to establish collaborative partnerships with others. This construct has the following measures:

- Purchase of finished goods: This signals linkages with local firms for the procurement of finished goods that are input materials for production or for resale in the domestic market.
- Outsourced manufacturing job: This specifies linkages with local/foreign firms by means of expenditure on contracting out manufacturing jobs.
- Indigenous raw materials: These represent linkages with local firms for the procurement of basic materials from which finished products are manufactured.
- Imported raw materials: These represent linkages with foreign firms for the procurement of basic materials from which finished products are manufactured.
- Imported finished goods: These represent linkages with foreign firms via expenses on finished goods that are input materials for production or for resale.
- Imported capital goods: These represent linkages with foreign firms for the procurement of capital goods such as plant and machinery.

Capability to modularize is shown by how efficiently a firm uses resources to cater to both the low performance requirements of mass markets as well as grow into the more demanding upper-tier mainstream markets. Visionary leaders and managers who envision a future array of products can mobilize capabilities to make a wide array of products to serve multiple tiers of markets. Continuous interchange with customers ensures product adaptation, upgrading and customization over time, to serve multiple tiers of customers. Therefore, managerial remuneration and expenditure on interaction with customers and suppliers can impact on modularization capabilities and hence, diffusion of the innovation. This construct has the following measures:

- Managerial remuneration: To facilitate the implementation of modularity in product innovation, firms need to have creative leaders who can envision a future generation of products and conceive of a diversity of product applications and configurations (Tellis, 2006). In this study, this is measured by the wages of managers/leaders.
- Travel expenses: These represent the firm’s efforts to facilitate interaction with local customers and gain insights on customer needs and market information. This enhances the capability of a firm to customize products for multiple tiers of customers. Travel expenses are also incurred when firms negotiate with suppliers on specifications, terms of trade, and delivery of products, all of which enhance efficiency and reduce costs. In this study, this is measured by expenditure related to local travelling.
- Distribution expense: The rationale for this measure is that a more intensive distribution system indicates a more customized approach to selling to different tiers of markets. In this study, this is represented by incidental expenses on distribution of goods and services sold to different markets.
- Communication expenses: This indicates the degree of coordination across the distribution channels to cater to different tier of customers. In this study, this is represented by expenditure related to communication strategies.

5.4.3 Control variables

The control variables chosen for this analysis were:

- Age: Measured in terms of years of operation since first established, the age of a firm could have an impact on its size. Hence, it was prudent to include this factor because it could uniquely identify the effect of the explanatory variables.
- Sales: Measured as a logarithmic value of total revenue, sales and the size of the asset base are frequently related. Hence, it was prudent to include this factor.

5.5 Statistical methods

The data used in this statistical analysis was obtained from the ‘Prowess’ database of the Centre for Monitoring the Indian Economy (CMIE), which is the most comprehensive and reliable source of data on the Indian economy. This database provides the availability of cross-sectional data on a firm-by-firm basis for domestic and foreign affiliates, as opposed to industry averages. This allows a much more sophisticated analysis. For this study, the Indian transport industry cluster was chosen, comprising passenger cars, commercial vehicles, heavy vehicles, sports utility vehicles, two- and three-wheelers and auto ancillaries.

For the given objective, a range of estimation models could be used. Although it is the most commonly used model and is highly useful, a simple pooled OLS (ordinary least squares) model can lead to biased and inconsistent parameters if time-invariant covariates are omitted. If omitted time-invariant variables are correlated with the policy incentive variable, a FE (fixed effect) model will provide a consistent and unbiased estimate of the parameters while simultaneously controlling for unobserved unit heterogeneity. Conversely, if these omitted time-invariant variables are uncorrelated with the explanatory variable, a RE (random effect) model would provide a more efficient estimate than an FE model. An advantage of RE is that time-invariant variables can be included and the entity's error term is not correlated with the predictors, which allows for time-invariant variables to play a role as explanatory variables. In RE models, the individual characteristics that may or may not influence the predictor variables need to be specified. However, if some variables are not available, this can lead to omitted variable bias in the model.

RE allows generalizing the inferences beyond the sample used in the model. The validity of these assumptions is examined by the Hausman Test. In the case of the presence of auto-correlation and heteroscedasticity, the generalized least squares (GLS) method, which corrects for these two factors, was used.

The final econometric model estimated is shown in Equation 1:

$$Size_{i,t} = \beta_0 + \beta 1 x_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \qquad \text{(Equation 1)}$$

In this study, 2000–2012 panel data from the Indian automobile industry was used with a sample size of 66 companies, which yielded 673 observations. The size log of firms was used as the dependent variable representing firms' innovative performance. For ensuring comparability of variables across the period 2000–2012, all data was standardized by firm size, as measured by sales. Equation 2 was estimated by pooling the data for all years (pooled OLS) (see column 1, Table 5.3).

As discussed earlier, the OLS results were biased because of omitted variables, requiring the use of panel data techniques. Therefore, both FE and RE models were run. First, an F-test was conducted to see whether individual FE existed. Since the F-value was greater than the tabulated value, the null hypothesis (i.e. the model is pooled OLS) was rejected and FE and RE were required. Columns 2 and 3 of Table 5.3 give the FE and RE estimates.

Therefore, the final econometric model estimated was as shown in Equation 2:

$$Size_{ij} = \beta 0 + \beta 1Intangible_{ij} + \beta 2royalty_{ij} + \beta 3R\&D_{ij} + \beta 4For\_roy_{ij} + \beta 5Pur\_fin_{ij} + \beta 6\ Out\_mfg_{ij} + \beta 7Indig\_raw\_mat_{ij} + \beta 8Imp\_raw_{ij} + \beta 9Imp\_fin\_goods_{ij} + \beta 10Imp\_cap\_goods_{ij} + \beta 11Mangerial\_remun_{ij} + \beta 12Distrib_{ij} + \beta 13Travel_{ij} + \beta 14Comm_{ij} + \gamma 15\ Age_{ij} + \gamma 16\ Sales_{ij} + \varepsilon_{i,t} \quad \text{(Equation 2)}$$

5.6 Results and discussion

Table 5.2 gives the mean and standard deviation values.

Table 5.2: Mean and standard deviation values

Variables	Mean	Std. Deviation
Sizelog	1.6365	.71437
Age	34.87	15.099
Saleslog	1.6606	.85002
intangible_ast_dep /sales*100	.0576	.24257
royalties_tech_know_how /sales*100	.2586	.53145
rnd_exp /sales*100	.2586	.53183
forex_spending_royalty/sales*100	.3398	.72774
purchase_fg /sales*100	1.2509	2.86366
outsourced_mfg_jobs /sales*100	1.8380	2.60786
indig_rawmat_pc_total_rawmat	80.6762	23.59642
import_rawmat /sales*100	5.9851	7.38485
import_fg/sales*100	.0888	.42554
import_cap_goods/sales*100	1.0711	1.87658
managerial_remuneration/sales*100	.5702	3.17235
distribution_exp /sales*100	1.6203	1.42472
travel_exp /sales*100	1.3343	9.03694
communications /sales*100	.4357	3.75125

Table 5.3: Results of FE and RE models

Variables	FE (1)	RE (2)	Pooled OLS (3)
Age	0 (omitted)	0.0034**(0.0)	0.076***(0.001)
Sales	0.70***(0.017)	0.726***(0.014)	0.958***(0.012)
Intangible asset depreciation	0.71***(0.020)	0.074**(0.023)	0.029**(0.035)
Royalties & technical know-how	-0.017 (0.017)	-0.017 (0.018)	-0.012(0.022)
R&D expenses	0.068*** (0.012)	0.075***(0.013)	0.057***(0.017)
Foreign royalty	0.010 (0.009)	0.011(0.010)	0.016(0.016)
Purchase of finished goods	-0.0004* (0.0026)	-0.004(0.002)	-0.002(0.003)
Outsourced manufacturing	0.004 (0.003)	0.003(0.003)	0.057***(0.003)
Indigenous raw materials	0.0012*** (0.00)	0.001*(0.00)	0.057***(0.000)
Imported raw materials	0.001(0.001)	-0.001(0.00)	-0.090***(0.001)
Imported finished goods	-0.015(0.021)	-0.019(0.021)	-0.002(0.021)
Imported capital goods	0.0009 (0.002)	0.001(0.003)	0.021*(0.005)
Managerial remuneration	0.023***(0.010)	0.009(0.011)	-0.217**(0.015)
Distribution	-0.0045(0.06)	-0.006(0.006)	-0.048***(0.006)
Travel	0.003(0.004)	0.006(0.004)	0.157*(0.007)
Communication	-0.010*(0.005)	-0.001(0.006)	0.208***(0.009)
Constant	0.331(0.004)	0.230(0.064)	0.336***(0.046)
Observations	673	673	673
R-squared	0.77	0.89	0.91
F-test/Wald chi-square	137.37	3044.25	424.33
Hausman Test		599.12	

From the results of the Hausman Test, it is clear that FE was more appropriate. Therefore, the FE results are discussed here.

5.6.1 Results related to Hypothesis 1

Hypothesis 1 predicted that a firm's combinative capability would have a positive impact on size of the firm. The results in Table xx shows that intangible assets (β=0.71, p<0.000), had a significant and positive relationship on the size of the firm. This means a unit expenditure in depreciation of intangible assets caused a 7% increase in firm market size. The same result applied for R&D (β=0.068, p<0.000), which was tested for its impact on the size of the firm.

R&D expense represents investment in the company's efforts to create new technology and knowledge base. This is especially applicable in the context of EEs, since serving mass markets often entails creating an altered price–performance package through recombining knowledge and reconfiguring core technologies and components of a system in new ways to reduce costs. Since a firm's combinative capabilities enable it to combine/redeploy knowledge to create new technology, the significance of R&D expense and intangible assets appeared to suggest that obtaining knowledge via its own R&D were essential elements of combinative capabilities. This confirmed that an increase in combinative capabilities had a positive impact on a firm's innovative performance, as measured by firm size.

However, the results showed that the measures foreign spending on royalties and royalties on technical know-how had no impact on the diffusion of innovation, as measured by market size. The insignificance of foreign royalties and technical know-how implied that a mass market innovator was less dependent on foreign expertise but more dependent on internal efforts to recombine existing knowledge. However, the insignificance of foreign royalties did not warrant rejection of the combinative capabilities hypothesis, but perhaps was indicative of the fact that access to critical knowledge and technological resources can be obtained from local sources.

5.6.2 Results related to Hypothesis 2

Hypothesis 2 predicted that linkage/alliance formation capability would have a positive impact on mass market innovation performance, as measured by firm size. The results in Table 5.3 indicate that indigenous raw materials ($\beta=0.0012$, $p<0.000$) had a significant and positive influence on the firm's market size. Therefore, innovative performance of firms operating in the Indian automobile industry was influenced by collaborative linkages to economize on resources and sharing costs and risks with alliance partners, which are critical to mass market innovations. Other measures (e.g. imported raw materials, purchase of finished goods and imports of finished goods) had no impact on firm's market size in the FE regression. However, the insignificance of these measures did not necessarily refute the linkage/alliance formation capability hypothesis, but conceivably indicated that rather than outsource/import inputs such as architectural designs, applications and technology through license agreements, both local Indian and multinational automotive firms were focusing on developing capacities to manufacture finished goods within the firm environment establishing fully integrated facilities. This seems to suggest that firms did not intend to carry the risk of losing trade secrets to unaffiliated parties associated with licensing/subcontracting related to 'arm's-length' transfers of designs and specifications (Kumar, 1991).

Moreover, in line with hypothesis 2, the lack of significance of import of capital goods implied that the import of proprietary expertise embodied in technology and capital equipment were not critical to the innovative performance of firms. This signifies the fact that for the supply of core technologies, automotive firms were concentrating most of their R&D endeavors within India, without being dependent on foreign entities. Almost all auto manufacturers, whether local Indian firms or foreign MNCs, were raising R&D investments in India with the intention of gaining efficiencies and scale by establishing an R&D base in the local environment, to minimize costs and maximize revenue (Economic Times, 2013). Interestingly, this result was also aligned with the observations from the case studies in the previous chapter. Examples include the establishment of self-sufficient manufacturing and production sites, along with R&D facilities, by the foreign automaker HMIL (Park, 2004) and

Tata Motor’s establishment of an ERC to undertake R&D activities in the areas of engineering and product development (Saripalle 2012, Ranawat and Tiwari, 2009).

5.6.3 Results related to Hypothesis 3

Hypothesis 3 predicted that capability to modularize would have a positive impact on mass markets innovation, as measured by size. The results revealed that managerial remuneration ($\beta=0.023$, $p<0.000$) had a positive and significant impact on the modularization capabilities of a firm in terms of the size. Case evidence in the previous chapter showed that visionary leadership at Tata Motors and M&M were critical to successfully implementing modularity to meet the social objective of bringing low-cost products to the mass market and attain profitability in the long run. However, the other measures (distribution expense, local and foreign travel expense and communication) had no impact on the innovative performance of a firm, as measured by firm size.

This lack of significance does not automatically refute the hypothesis, nor does it negate the results. It could have indicated that local and multinational automobile companies mostly directed their sales to a single segment, the growing middle-class and upper-middle-class customers in urban/metropolitan areas, rather than seeking out the tier 1 and tier 4 customers from other areas, who were not convinced to buy these offerings. This emphasizes the need for a more customized approach regarding distribution channels and communication strategies, to improve the quality of coordination across the distribution network. It also implies that firms need to obtain better insights on customer needs through travelling. For example, Ford is now focused on developing close relationships with customers across India and expanding the dealer network in tier 4 locations (TheHindu, 2012); Tata Motors expects to attract an increasing number of Indian customers by establishing extensive dealership networks, enhanced communication strategies and advertisement campaigns (New Indian Express, 2014).

5.7 Conclusion

To summarize, the results of this quantitative study have confirmed the predictions that combinative, linkage and modularization capabilities are fundamental factors in a firm's innovative performance in the context of mass markets. More specifically, developing appropriate products that meet the unique affordability and specification criteria of mass markets in EEs requires simplification of the product technologies that have been created for mainstream markets. It is the combinative capabilities of a firm that enables the creation of the desired price–performance package, applying existing knowledge and thereby eradicating the need for further investment in new knowledge or technologies (see Hitt, Ireland and Lee 2000, Kogut and Zander 1992, Ray and Ray 2010, 2011, for a theoretical discussion).

Firms also need to hone their local capability through social inventiveness, as in possessing linkage formation capabilities, to access critical resources, technologies and knowledge, thus lowering their costs and sharing the risks of product innovations (De Man and Duysters, 2005, Gulati, 1998, Hitt et al., 2000a, Quinn, 2000, Schilling and Steensma, 2001). Above all, the qualitative case studies of four automakers (Tata Motors, Mahindra & Mahindra, Hyundai Motor India Limited and Ford India) and results of this quantitative study have highlighted the importance of the capability to modularize.

Chapter 6: Conclusion

To summarise the major findings, this concluding chapter returns to the research question "What capabilities are required to create appropriate innovations for mass markets in EEs?" In line with the research question, the objectives were a) to determine what capabilities emerge as significant in the process of creating innovations for the masses, and, b) to determine how are the capabilities developed by individual firms studied. Drawing on the theoretical constructs of dominant vs. disruptive paradigms of technology strategy and the importance of tailoring capabilities for specific demand contexts, this thesis explores the phenomenon of capability development processes for mass market innovations in EEs. The research utilizes a mixed method approach combining qualitative and quantitative methodology to address the central research attention. Multiple case studies of selected firms from an emerging economy industry coupled with a cross case analysis served to capture the processes of capability development. The qualitative part examined the case studies of Tata Motors, Mahindra and Mahindra (M&M), Ford India and Hyundai Motor India Ltd (HMIL). The quantitative part entailed a multivariate analysis using panel data from the Indian automotive industry to statistically validate the qualitative findings across industry population.

This concluding chapter is organized into the following sections. Section 6.1 provides a summary of the major research findings in respect of capabilities for mass market innovation. Section 6.2 outlines major contributions of the research study. Section 6.3 presents theoretical and practical implications of this research for academic researchers, managers of firms and policy makers of EEs. Section 6.4 summarises the research limitations and section 6.5 outlines the future directions of research.

6.1 Summary of research findings

The three empirical chapters of this research study include: a) A multidimensional enquiry of the Indian automotive industry to provide detailed insights on the evolution of capabilities exploring multiple aspects at industry and firm level b) Multiple case studies of automotive firms and cross case analysis to observe the phenomenon of capability development processes for mass market innovations and c) Multivariate analysis employing panel data from the Indian automotive industry to statistically validate the qualitative findings across industry population.

The extensive multidimensional enquiry of the Indian automotive industry in chapter 3 presents exhaustive insights on an emerging economy (Indian) auto sector and maps the sequential evolution of capabilities through diverse policy regimes. It observed that the development of Indian auto industry has advanced in the course of three major policy regimes. The distinctive foci in different phases were indigenisation of the industry, relaxations of regulations and globalization of the industry. It noted that at the stage of its establishment, protectionist policies played an import role in the attainment of operational capabilities. As defined in the literature, operational capabilities are characterised as low level capabilities which usually involve repetitive activities, such as manufacturing a specific product, utilizing an established set of routines (Banerjee, 2003, Nelson and Winter, 1982). The analysis of Indian auto industry shows that protectionist policies in the early stages of development played an important role in the acquisition of basic production capabilities (i.e. operational capabilities) (Awate et al., 2012, Lall, 1992). In the absence of a supportive supplier industry, the focus on the local manufacture of auto components by the existing auto manufacturers demonstrates the attainment of production capabilities.

However, in the liberalization and globalization phase, liberalization policies catalysed the accrual of high level/innovative capabilities. The first Indian made car 'Tata Indica' which was introduced by Tata Motors in 1999 and India's first indigenously developed affordable sports utility vehicle 'Mahindra Scorpio' in 2002 by M&M indicates the accrual of advanced technological capability in passenger vehicle design and manufacturing. As observed by Lall (1992), this refers to the progression to indigenous design, development and innovation capabilities that facilitate the development of new technologies or products. The advancement in capabilities went hand in hand with the formation of linkage partnerships, in-house R&D efforts and modularized relationships among suppliers and auto manufacturers.

The relationship between key policies of the Indian government in three different phases, and the progression of capabilities along with consequential impact on the industry structure, was mapped through the model below, which conceptualizes the evolution of capabilities in the Indian automotive industry.

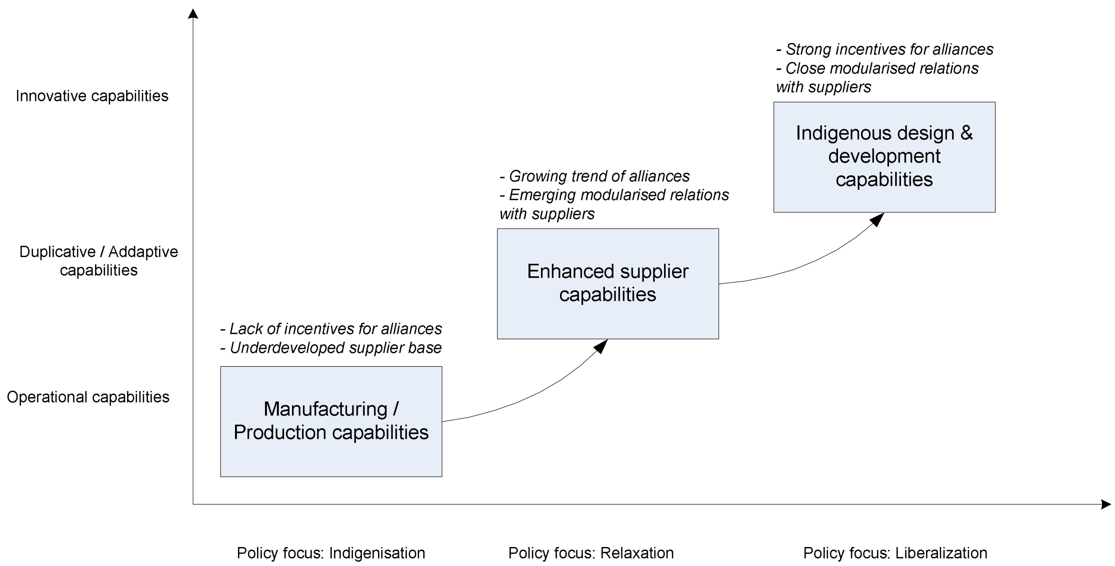


Figure 6.1: Evolution of capabilities in Indian automotive industry (Source: Author)

The purpose of chapter 4 was to explore the capability development processes through empirical case studies of two Indian auto firms (Tata Motors, M&M), and two auto MNCs (Ford India, HMIL). What emerged as prescient was linkage formation capabilities in creating affordable innovation for the masses since serving less well to do customers called for a strategy of collaborative alliances to economize on resources, reduce cost, uncertainty and enable firms to access various functional and technological competences that do not exist within their own boundaries (Gulati and Sytch, 2007, Hitt et al., 2000b, Schilling and Steensma, 2001). In the case of four auto firms, emergent linkage formation capabilities were developed from the learning and partnering experience of working with mostly the same set of suppliers who were engaged from the very early stage of car component design, manufacturing and trial productions. This helped the car manufacturers to offer cost-effective and better value products for mass market customers.

Moreover, the study observes the significance of combinative capabilities for the cases of Tata Motors and M&M to achieve an altered price–performance package for mass markets. As defined in the literature, combinative capabilities allow redeploying the existing component knowledge into new architectural knowledge leading to architectural innovations for a firm. This eliminates the requirement for additional investment in new knowledge or technologies and thereby prevents the innovation from becoming excessively resource intensive (Kogut and Zander, 1992, Hitt et al., 2000b). A point of difference among the four companies is that Ford India and HMIL did not explicitly demonstrate their engagement in designing architectural innovation. Ford India only used low cost and lightweight components and component resizing instead of experimenting new combinations of existing core technologies and reconfiguring linkages among components. Similarly, focusing on frugal engineering HMIL maximised value, efficiency and eliminated non-essential waste through reengineering a number of core processes, reusing common raw materials and reducing process rejections. These enabled HMIL to reduce cost and resource consumption.

Lastly, the study traced the development of capability to modularize in Tata Motors, M&M, Ford India and HMIL. Modularity allows firms to configure new modules and introduce varied features, functionalities and allows engineers to create families of parts that share common characteristics – thereby, reducing development cost for future generation of products and promoting continuity (Baldwin and Clark, 1997). In the prescience of multi-tiered market segments in EES, modularity provides flexibility for the innovators to cater the lower performance requirements of the mass customers and enables to grow into the upper tier mainstream markets. Capability to modularize enabled the car manufacturers to achieve low cost level for the price sensitive mass customers, flexibility in car design, development and provided the provision to move to higher configurations to meet the evolving customer needs. A point of difference between the four companies lay in the fact that for Tata Motors and M&M, the visionary leadership of Ratan Tata and Anand Mahindra set out how technology for mass markets can evolve to serve more profitable mainstream markets. Focusing on an open orientation innovation culture, Tata Motors and M&M involved module suppliers in the design phase of major car engineering systems. This is in contrast with Ford India and HMIL as these automakers were less open to involve module suppliers in the design phase. Suppliers were mostly manufacturing to pre-specified designs and the impetus of visionary leadership focused only on reducing manufacturing cost. Hence, summarising from the cross case validation studies and analysis, the below framework conceptualises the required capabilities for mass market innovations.

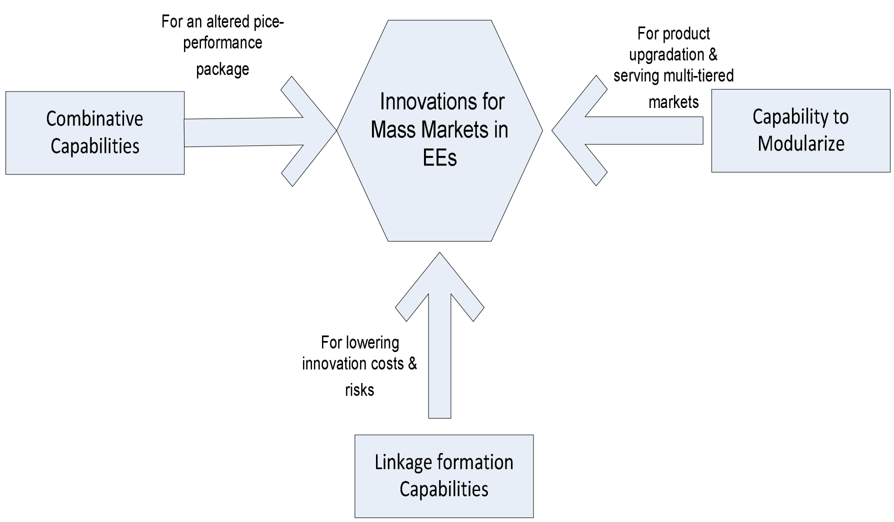


Figure 6.2 Capabilities for mass market innovations in EEs

In chapter 5 an empirical examination in a multivariate framework was conducted using 12 years of panel data from the Indian automotive industry to scrutinize the precise factors that assist firms to create appropriate innovations for mass markets in EEs. The chapter empirically tested propositions emerging from the cases to statistically validate the qualitative findings across an industry population. The hypotheses harboured were linkage formation capabilities, combinative capabilities and modularization capabilities of a firm are positively associated with its innovative performance. Econometric testing was conducted using size log of the local firms and MNCs operating in the Indian automobile industry as the dependent variable for analysing innovative performance of firms. In line with the hypotheses, the results indicated that linkage formation capabilities (indigenous raw materials) had a significant and positive influence on the firm's market size. This authenticated that innovative performance of firms operating in the Indian automotive industry was influenced by collaborative linkages to economize on resources and sharing costs and risks with alliance partners, which are critical to mass market innovations.

What is more, the results indicated that combinative capabilities (R&D expense, intangible assets) to recombine technology and knowledge resources in new ways for creating an altered price–performance package for the masses have a significant and positive relationship on the innovativeness of the firm. This confirmed that an increase in combinative capabilities has a positive impact on firm's innovative performance.

Furthermore, in line with the hypotheses, the results prove that innovative performance of firms is associated with capability to modularize as specified by managerial remuneration, which has a positive and significant impact on the firm's market size. This is in sequence with case evidence in chapter 4, which showed that visionary leadership at Tata Motors and M&M were critical to successfully implementing modularity to meet the social objective of bringing low-cost products to the mass market and attain profitability in the long run.

From a methodological standpoint, this study is unique in its approach to combine qualitative and quantitative methodology to uncover the capabilities required for mass market innovations.

6.3 Contributions of the study

The findings of this study present a novel and contemporary insight on what capabilities are required by firms to create appropriate innovations for the masses and how the capabilities are developed. This subject has remained under investigated till date. The scientific and evidence-based findings of this study obtained through multiple case studies, a cross case validation combined with econometric analysis makes new contribution to knowledge on this theme. The study's findings about capabilities to facilitate mass market innovations are therefore expected to serve as a valuable reference to academic researchers, business managers and policymakers in the area of emerging market innovation.

As observed in Chapter 2, the emerging view of technology strategy emphasises firms attempting to serve mass markets need to be motivated by a demand driven approach. Large variations in the demand context of EEs imply firm capabilities honed in a developed country may not work successfully for mass market customers in the former. Customers in EEs demand simple, functional and affordable products due to income constraints (Seelos and Mair, 2007, Anderson and Billou, 2006, London and Hart, 2004). By drawing on the idea that capabilities need to be tailored for a specific demand context, the present research study provides a novel insight into how firms could model capabilities that would address the unique patterns of demand in EEs. In particular, the value of this study lies in the comprehensive insights it provides to observe, categorise, and model the phenomenon of capability development processes required for mass market innovation. Furthermore, by statistical validation of key findings through econometric analysis on a large sample of firms, this study demonstrates the generalizability of results.

This study also makes important contributions towards theory development. At a theoretical level, scholars have urged the importance to investigate an extensive continuum of the government policies and their impact on the capability evolution of the Indian automotive industry (Humphrey et al., 2000a, Mani, 2011). Scholars in innovation management have also emphasized the need to add new theoretical insights on the interaction between capabilities and emerging market innovations (Ray and Ray, 2010, 2011). This research study responds to this call for theory development. The unique contribution of this study lies in mapping the process of capability advancement in the Indian automotive industry through different policy eras by means of a conceptual framework. Furthermore, by drawing on emerging concepts from the case study research, the present study formulates a set of testable propositions. The set of specified propositions developed represent elements of the new conceptual framework to observe the patterns of capability development for emerging market innovations.

Apart from its contributions to theory development, the study also makes significant contributions to research methodology for examining the capabilities that enable firms aspiring to develop innovations for mass markets. The limited research in this area fails to provide a valid model that can be generalized across an industry population. To address this methodological weakness in previous research, this research study employs comprehensive empirical case studies of two EMFs and two auto MNCs to examine and validated the detailed processes of capability development. Moreover, methodologically, this is also one of the few studies that utilized a mixed methodology to understand the specific capabilities required to innovate in EEs. The present study not only develops a set of propositions to contribute to theory development based on the comprehensive insights obtained through empirical case studies, but also confirms the validity and generalizability of these propositions through quantitative techniques employing panel data from the Indian automotive industry. In this way, this research study demonstrates the usefulness of a mixed method in research on capabilities required for emerging market innovations.

The findings of this research study delineate some significant theoretical perspectives for academic researchers and practical implications for business managers of prospective firms

For **academic researchers** studying innovation in EEs, this study contributes to the emerging body of knowledge by demonstrating how capabilities may accumulate through learning. Indeed, how efficiently processes are deployed, and methods of interchange among personnel followed is determined by EMFs' extant capabilities – a function of learning. This extant base of capabilities can be enriched as the EMF learns to solve new problems in-house and in collaboration with suppliers – leading to emergent capabilities. Learning therefore becomes the mainspring of capabilities which arise through experience (Lall, 1992). Thus, EMFs that start out with a solid base of capabilities gained through learning about their home environment over a period of time will remain ahead in competition.

This research makes a useful contribution through an in–depth, empirical examination of the Indian automotive industry and uncovering the significance of linkage formation capabilities to access critical resources, share cost and risk while leveraging specialised knowledge. The study also identified and examined the precise role of combinative capabilities to create an altered price–performance package for the masses and modularization capabilities to improve functionalities over time to serve multiple tiers of customers in EEs. The proposed framework of required capabilities is useful in addressing an unexplored area in literature for emerging market innovations. In this way, this research study represents a novel contribution to the innovation literature on mass markets in EEs.

This study has significant implications for **managers** of firms seeking to embark on a mission to innovate for mass markets. First, the study proposes that potential firms should gain a meticulous understanding of demand criteria and innovation requirements of mass customers in EEs, which is also suggested in the literature (Danneels, 2004, Slater and Mohr, 2006). By looking beyond their most profitable customers and technological domains, established multinational companies from developed countries need to proactively allocate resources to augment capabilities for accomplishing sustainable form of competitive advantage. Second, the research demonstrates the need to leverage existing blocks of resources and technologies to create new combinations of features to serve the mass customers in an affordable way. For well-established incumbents, investments in local R&D through both collaborations and in-house activity can significantly enhance appropriateness of products for low-end segments. Third, the study emphasize the salience of linkage formation capabilities in developing innovations leveraging resources and sharing of costs and risks (Seelos and Mair, 2007). Multinationals can co-develop and diffuse low cost products establishing linkages with local enterprises to tap into local supply chains for procuring local inputs at reduced costs and utilize the low cost processes in addition to learning routines (London and Hart, 2004).

In addition to the managerial implications discussed above, the research findings also have significant implications for **policy makers** in India and other EEs. The competitiveness of the automotive sector will largely depend upon the capabilities of the industry to innovate and upgrade. The industry will definitely be benefited if it has strong domestic competition, capable local suppliers and demanding local customers (Porter, 1990). Global automakers will establish their production hubs in countries that are high in productivity, capacity utilization and where essential competitive advantage can be created and sustained. Given that skilled human capital with advanced knowledge and technological capability is required to innovate core automotive products, policy makers need to increase investment in tertiary education, vocational education, training and skills development programs. Moreover, policymakers must continue to promote R&D incentives such as tax deduction for the R&D activities of the auto manufacturers and support cutting-edge research in public research institutions. This will enable emerging market automotive firms to develop innovative new technologies. Such policy measures will encourage global auto manufacturers to utilize EEs as a production base for world market. Also, formulating favourable FDI policies to continue attracting foreign auto MNCs is critical to establish linkages between emerging market auto firms and foreign MNCs to facilitate technology transfer, forge linkages for collaborative R&D and upgrade technological capabilities. Illustrating the role of policymakers in the case of Thailand's automotive industry, Busser (2008) has shown that due to the lack of favourable policies from Thai government, the technology transfer from Japanese auto MNCs to Thai supplier companies was limited. Furthermore, the lack of strong support from the Thai government restricted the capability of local suppliers to undertake R&D activities of auto component design and hence, lower level of technological capability upgrading took place within Thai automotive industry.

6.3 Research Limitations

Like most empirical research studies, certain limitations constrain the generalizability of this study. First, the study was limited to a single industry – being the automotive industry, which accounts for the primary, yet unavoidable limitations of this study. Being a single industry study, the evident question is to what extent its findings can be generalized across other industries. Second, being a single country study, the question is to what extent its findings can be generalised across other EEs. The institutional environment, policy framework and the role of government differ from country to country; hence, it is not always possible to confirm whether what worked in the context of a specific country will work in another. In this regard, examining automotive industry of other emerging economies such as China, Brazil, Russia and multiple other technology intensive industry studies involving more emerging economies is required for a further comprehensive investigation. These limitations imply directions for further research.

6.4 Future Research Directions

Future studies on innovation strategies in EEs in response to the required capabilities could be extended to focus on several other EEs, in addition to India. Future research could also investigate case studies of various firms from industries other than automotive sector from India and other EEs. Studies on multiple EEs and several firms from diverse industries could refine and enrich our understanding on the specific capabilities required for innovation in EEs. Further research could also potentially rank the importance of capabilities through contrasting, characterizing and potentially grouping more EMFs in different industry sectors. Such taxonomy could be useful for comparing the capabilities required by firms to create affordable mass market innovations in different regions. Moreover, building on the evidence presented in this research, future studies including a larger sample base of firms in the econometric analysis are likely to be useful in developing a more comprehensive understanding of factors that enable firms to create appropriate innovations for EEs.

Findings of this research study highlight the significance of three organizational dimensions of capability to recombine: system capabilities, coordination capabilities and socialization capabilities to create appropriate innovations for EEs. Therefore, the role and dynamic interaction of system, coordination socialization capabilities in building critical combinative capabilities could also be explored in a more in-depth way in future research. This will shed light on the applicability of combinative capabilities as an effective approach for synthesizing and applying existing component knowledge through internal R&D experiments and external learning such as alliances to create new product architectures without investing in new knowledge or technologies.

In sum, this research study represents an important step towards building a comprehensive understanding of what capabilities in particular are required to create appropriate innovations for mass market customers in EEs and opens up many possibilities for future research. Mass markets in EEs are considered to be the largest untapped markets on earth and EEs hold vast opportunities for innovators who are willing to take a ‘great leap’ into large untapped mass markets in these countries (Hart and Christensen, 2002). The growing influence of EEs forcing business leaders to think hard about new growth equations to adapt to the realities of a very different global marketplace in the quest for competitive advantage. This research study has examined the intricate processes involved in shaping and managing innovation for the masses in EEs with regard to capabilities. The results of both case study research and quantitative analysis demonstrate the significance of linkage formation capabilities for lowering innovation costs and risks. The study also revealed the importance of combinative capabilities for an altered price–performance package. Lastly, the study highlighted the significance of capability to modularize to achieve low cost level and serve of multi–tiered market segments in EEs. In this way, this research study has contributed to the emerging body of literature aiming to understand what capabilities are required to create appropriate innovations for mass markets. By focusing on two EMFs and two auto MNCs from the Indian automotive industry, the study fills a critical gap in the innovation literature, which dwells primarily on how MNCs disseminate existing product innovations in EEs. The proposed conceptual framework can be secured as a reference point by potential firms to innovate targeting the mass market customers. The study is therefore useful in providing actionable knowledge that may guide practitioners nurture to the require capabilities.

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APPENDIX 1

THE UNIVERSITY OF NEW SOUTH WALES

UNSW Business School

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Dr. Pradeep Kanta Ray	Ph: +61293855848	Fax: +61293136775	Email: pray@unsw.edu.au
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Kind Attention: Mr. Ratan N.Tata, Chairman, Tata Motors Limited.

Dear Mr. Tata,

The letter is to formally invite your organization to participate in an interview based research project concerning mass market innovation for emerging economies in automobile sector of India. In particular, we request an interview with the Head of Tata Technologies-Mr.Ashok Joshi. It would be highly appreciated if you could please facilitate this interview to be conducted with Mr. Ashok Joshi.

The project is titled: *Innovation for Mass Markets in Emerging Economies.* The objective of this research is to discover how affordable and low cost innovations are initiated and managed by the innovating firms for mass market customers. Moreover, the study aspires to explore the precise capabilities required by firms to create innovations for mass markets.

This research is being undertaken by Rifat Sharmelly to satisfy the requirements of Doctor of Philosophy (PhD) research degree at the University of New South Wales, under my supervision in School of Management, UNSW School of Business.

The interview is designed to cover the following areas:

- Discover key criteria and specific elements of innovations for mass markets.
- How innovations are initiated and managed in an emerging economy context.
- Resources and capabilities required by firm for delivering affordable innovations for mass markets.

Interviews are expected to be conducted in India from June 12- July 10, 2012. If your organization chooses to participate, the researcher will interview the participants nominated by you. It is anticipated that each interview will take no more than 50 minutes. Interviews will be recorded. A questionnaire will be provided to participants well in advance before the interviews are conducted.

Information provided by participants will remain confidential. The data collected will be for academic purposes only. Study findings will be made available to participants upon request, either completely or partially, upon completion of the PhD thesis. Importantly, participation in this study is entirely voluntary.

Detailed information will of course be provided prior to the interview and/or at your request. I will be grateful if you could please provide your response by email to Rifat Sharmelly. If you would like to speak to myself or Rifat directly, please do not hesitate to do so.

Yours truly,

Dr. Pradeep Kanta Ray

Senior Lecturer

School of Management
UNSW Business School
The University of New South Wales

APPENDIX 2

INTERVIEW SCHEDULE

1. What kind of innovation strategy does your company adopt for emerging markets?
2. To address the affordability and acceptability criteria for the customers at the low end of markets, what innovation strategy does your company adopt? Please provide examples in this regard.

3. Please describe in detail how innovation for niche customer segments is managed.
4. In designing car for niche customer segments, what factors in terms of product technologies and functionalities are stressed? Please provide examples in this regard.
5. While designing cars for low end customer segments, do you also plan to attract mainstream customers? In what ways? Please provide examples in this regard.
6. In your opinion, what kind of leadership capability and vision is required by your company to go for low cost passenger car business?
7. Do you emphasize establishing an environment of shared belief in the organization?
8. Can you describe what kind of collaborative partnerships/ alliance relationships you have entered with component manufacturers/suppliers (both local and foreign) for any mass market innovation project? Please name a few component manufacturers.
9. In your opinion, what are the major benefits from such collaborative partnerships?
10. Were there any recurring partnerships with the same suppliers? Please give some examples.
11. How do you think the learning experience from alliance partnerships influenced to engage in such relationships?
12. Do you think trust was an important element of such alliance relation and repeated ties? Can you provide some examples in this regard?
13. Is modularity one of the essential aspects of low cost car designing for mass markets? Why?
14. To enable modularity, do the engineers have knowledge on the full car design beforehand?
15. Do you maintain a network of module developers? Please provide examples of such module developers. In your opinion, what are the major benefits of having a network of module developers?
16. To create low cost passenger car what kind of design philosophy is adopted? Is the strategy of creating low cost car is different from the strategy of

multinational companies (MNCs)? Please provide some examples in this regard.

17. To obtain unique price-performance criteria, how do you experiment with new combination of existing technologies and reconfiguration of components?
18. Was the design expertise of partners/suppliers utilized for any low cost car project in addition to your internal expertise? Please give some examples.
19. Is there integration among cross functional team members? In what ways this integration is maintained? Please provide some examples in this regard (Such as, regular communication among cross functional groups/ formal project management polices/ strongly agreed goals, values etc.