Evolution of dynamic capability in emerging market firms from the Indian IT industry for rapid globalization

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Evolution of Dynamic Capability in Emerging Market Firms from the Indian IT industry for Rapid Globalization

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Abstract

This study examines how emerging market firms (EMFs) develop capabilities to leapfrog in the knowledge intensive global information technology (IT) industry. Academic literatures have thus far focused on globalization of large multinational companies (MNCs) from developed countries, mainly from the OECD. While firms from the OECD are well endowed in resources, firms from developing countries are generally resource poor and their establishment, development and international expansion have taken place within an institutional environment that is different from those found in western economies. Hence how resource poor EMFs learn to transform comparative advantages into dynamic firm-specific capabilities deserves attention. The study explores how Indian IT firms "moved up the value ladder," moving out of the "low road" where the barriers to entry are low and competition is based mainly on price and squeezing wages, to the "high road" where competition is based on differentiation. A combination of qualitative and quantitative methodology is used. The qualitative part focused on inductive case study research, moving along observation, categorization and association, finally giving rise to constructs and models. The quantitative part entailed deductive econometric studies on 703 companies using panel data method, testing hypothesis to identify which factors contribute to globalization of EMFs. The findings reveal that globalization of EMFs is an evolutionary process and in each phase of evolution, the EMFs progressively learn from their linkages with MNCs and leverage them to globalise rapidly. Through linkages with MNCs, EMFs gained access to markets, technology, and reputation. The research identified the distinctive capabilities acquired by the EMFs in each phase of their capability lifecycle. Linkages with and learning from international and domestic innovation networks transformed EMFs' business model and upgraded their capabilities. The study shows that dynamic capability in the form of powerful intellectual property enabled EMFs to evolve from service provider to a partner status. Findings of this study present a novel and contemporary insight on how EMFs evolve to develop dynamic capability, which enables them to leapfrog in a fast changing technology space. The results challenge the view that the Indian software industry presents the classic problem of locking-in a low road of the innovation trajectory.

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List of Abbreviations

ASIC	Application-specific integrated circuits
AMD	Advanced Micro Devices (AMD)
BPO	Business Process Outsourcing
CLC	Capability life cycle
CMIE	Centre for Monitoring Indian Economy
DC	Developed Countries
DF	Domestic Firms
EMF	Emerging Market Firms
EPT	Equipment, Process and Technology
FDI	Foreign Direct Investments
FF	Foreign Firms
FMNC	Foreign Multinational Corporations
GDM	Global delivery model
GIN	Global Innovation Network
GPN	Global Production Network
ICT	Information and Communication Technology
IDC	International Data Corporation
ISI	Import substitution industrializing
IT	Information Technology
KPO	Knowledge Process Outsourcing
LCD	Liquid Crystal Display

LDC	Less Developed Countries
LF	Local Firms
LLL	Linking-Learning-Leveraging
MNC	Multinational Corporations
NIIT	National Institute of Information Technology
OBM	Own Brand Manufacture
OECD	Organization for Economic Co-operation and Development
ODM	Own design manufacturing
OEM	Original Equipment Manufacturer
OLS	Ordinary least squares or linear least squares (regression)
R&D	Research and Development
RBV	Resource based view
SEP	Special export zones
S&T	Science and Technology
SOP	Standard operating procedure
STP	Software Technology Parks
TCS	Tata Consultancy Services
UGC	University Grant Commission
VSLI	Very-large-scale integration (chip design)

Chapter 1

Introduction

1.1 Background

The closing decades of the last century witnessed the phenomenal rise of emerging market firms (EMFs) in the knowledge based IT industry, most prominently from India and China. These EMFs leapfrogged their way into the global economy and established a formidable presence in world markets. There has been much interest of late about the ever growing salience of these EMFs, in particular how they grew to become giant corporations in a span of thirty years.

The recent success of Indian EMFs in the IT sector merits more in-depth inquiry into the sources of their international competitiveness. Since competitiveness is gained through the unique capabilities of firms, it is logical to map the precise underpinnings of the capabilities of EMFs from the IT industry that helped them grow rapidly and globalize. The genesis of the capabilities developed by the EMFs and how they leveraged these to their advantage is a valuable area of knowledge that would explain the causal relationship between accelerated globalization and capabilities of EMFs. Therefore this research idea was conceived to be a valuable and meaningful area of study.

The literature on international competitiveness to date has tended to focus mostly on manufacturing firms from the triad countries. Generally, these firms are well endowed in resources and have developed within more or less similar institutional environments. However, firms from developing countries are generally resource poor and their establishment, development and international expansion have taken place within an environment different from those found in western economies. As EMFs are mostly and increasingly from developing countries, opportunities exist for a more in-depth inquiry into, and analysis of, the sources of their international competitiveness. To reiterate, what is untold in the literature is how EMFs learn to transform comparative advantages into dynamic firm-specific capabilities by assembling teams of talented engineers, tangible and intangible resources, both internally and externally, to deliver a technical outsourced service to exacting standards and customers worldwide.

This thesis demonstrates how the linking-learning- leveraging (LLL) model is used by EMFs as a tool to progressively acquire dynamic capability over three evolutionary phases in the Indian IT industry. This phenomenon is demonstrated through a combination of empirical proofs using case studies and econometric analyses as it tracks how resource poor EMFs move from operational capabilities (codified knowledge base) to dynamic capabilities (tacit knowledge base). Therefore two frameworks namely “dynamic capability” and “LLL model” were invoked to explain the evolution of capabilities in EMFs. Many scholars have criticised Teece’s dynamic capability framework as being inadequate in explaining how capabilities arise in the first place. Therefore the framework of Mathew’s LLL model is used to explain clearly the routes and means used by the resource poor EMFs to acquire dynamic capabilities to complete globally.

1.2 Research Question and Objectives

The research question in this study is *how do EMFs develop capabilities to leapfrog in knowledge intensive industries eventually to take a leadership position in global markets?* In line with the research question the objectives are:

a) to examine what capabilities must EMFs develop that enable them to globalize rapidly.
b) to explore what internal and external factors favour the leapfrogging process of EMFs.

1.3 Research Methodology and Data Sources

A combination of qualitative and quantitative methodology is used in this research. Christensen and Carlile (2006) suggest that the building of theory occurs in two major stages – the descriptive stage and the prescriptive stage. According to Christensen and Carlile (2006) most researchers exploring a new field start their work in the descriptive stage of theory building. They utilize three steps to do this: observation, categorization, and association (Christensen and Carlile, 2006). The observation of the recent and nascent phenomenon and finding an explanation of its cause and effects in the first instance is best served by descriptive research. The single case study of a focused EMF (Infosys) is used to describe the evidence. Once the observation, categorization and observation was complete, the study used cross case study facts (from HCL, Sasken and Cranes) to match patterns and validate the inferences from the single case study. Thereafter a framework was established based on the attributes of the phenomena under study. Finally, through quantitative models, data analysis was done in a multivariate framework from a data set of 703 companies which tested hypotheses to statistically validate the qualitative findings of the case studies. The details of qualitative and quantitative methodology are provided next.

The qualitative part maps the sequence of the capability development and globalization process adopted by the EMFs and analyses the reasons for such a phenomenon. The focus is to identify how EMFs developed and leveraged capabilities to leapfrog in knowledge intensive industries eventually to take a leadership position in global markets? The objective is to identify whether the EMF's alternative model of capability development and globalization would pass the scientific scrutiny of being significantly different from the existing known models. The objective is also to determine whether any such model meets the expectation of the scientific community in terms of an acceptable conceptual framework that is both relevant (reliable x valid) and consistent, and which would produce similar results if used and replicated in similar circumstances. To quote from Christensen and Carlile (2006):

> "In the first step researchers observe phenomena and carefully describe and measure what they see. Observation, documentation and measurement of the phenomena in words (or numbers) is important at this stage because if subsequent researchers cannot agree upon the descriptions of phenomena, then improving theory will prove difficult" (Christensen and Carlile, 2006).

In this case the phenomena include organizations, information, processes, physical artefacts and the like. In the second stage the phenomena are classified and categorised – based on the characteristics of the phenomena which helps in simplifying and understanding the possibly consequential relationships between the phenomena and the outcomes – in this case a framework. The third step explores the association between the characteristics of the category and the outcomes seen – recognizing and making explicit what differences in the magnitude of those attributes correlate most strongly with the patterns in the outcomes of interest. In this case, a technique that was useful is regression analysis to define correlations which are preliminary exercises to construct models (Christensen and Carlile, 2006).

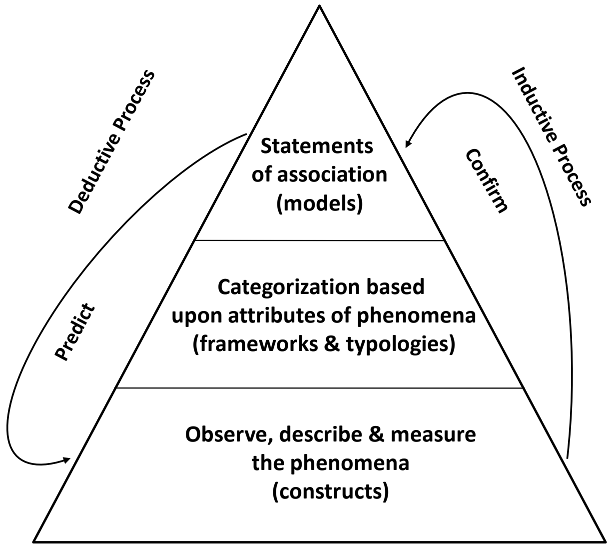

Figure 1.1: The process of Building Theory

Source: Adapted from Christensen and Carlile (2006)

In descriptive theory building researchers follow the inductive portion, moving along these three steps – observation, categorization and association, and in so doing give rise to constructs, frameworks and models. Christensen and Carlile (2006) suggest that researchers can then improve these theories by cycling from the top down to the bottom of this pyramid in the deductive portion of the cycle – seeking to "test" the hypotheses that had been inductively formulated (Christensen and Carlile, 2006).

Therefore this research is focused on explanations of a contemporary phenomenon within its real life context (Darke *et al.*, 1998), before trying to discover the variables that constitute a formula of an alternate model of capability development. Hence the most appropriate methodology is the case study approach with supportive empirical and quantitative findings. Context being part of the study, too many variables and complexity were thought to make standard experiment and survey designs (McClintock *et al.*, 1979) impossible to address. The next objective was to choose an appropriate type of case study research, i.e. either descriptions of phenomena or development of theory or testing theory (Darke *et al*., 1998).

In case studies, events are observed, recorded and analyzed from real organizations. In fact, real life situations are reflected as data facts that had already gone through a whole lot of alterations, modifications, and adjustments. Hence, case facts represent the finished form of a stabilized experiment and reduce the need for further multi-point quantitative and survey research for validation. Campbell (1975) echoes similar views that the method can be applied even if there is a single case because the pattern must fit multiple implications derived from an explanation or theory. It was therefore concluded that a single case study focus coupled with cross-case facts for comparison and pattern matching would be a valid and appropriate method to address the research inquiry (the capability development and globalization pattern of EMFs).

The study focused on a research strategy that would be able to integrate alternate sources of data and use a chain of evidence to explain the findings (Yin, 1981). The case study research elements had a combination of qualitative and quantitative evidence. Evidence came from published fieldwork (interviews) of earlier researchers, knowledge sharing by industry experts, archival records, business reports, journal articles, published reports of corporations and personal observations. Since the boundaries between phenomenon and context were not clearly evident, the approach was to collect data[1] from relevant information sources, which provided an opportunity for the researcher to witness and experience the relevant events by observation (Yin, 1981).

The unit of research was firms from the emerging markets (India) and those engaged in the business of knowledge based service delivery. Such specificity of study object ensured low variance (skewness) in the population parameters. Although the rigour of parametric tests could not be incorporated in a case study approach, the basic principles of natural science research methods were incorporated to ensure that the process reflects robustness.

Non-probability-sampling methods were used to select the study objects (EMFs like Infosys), which is a valid method when the existing knowledge on the population is sufficient (and handful as in this case). In the research strategy the population parameters were defined to constitute the industry segments engaged in the area of knowledge based service delivery and sample statistics were planned to be drawn from the lead player Infosys (a pioneering EMF).

Once the primary study object (Infosys in this case) was finalised, the 'snowball sampling technique' automatically led the researchers to the next entity (EMFs like HCL, Sasken and Cranes), based on similar population characteristics. Cross case evidence was then used from these EMFs which operated in the same or similar domain and occasionally data were used from global players like IBM, Accenture and EDS for global comparisons. Investigation of specific booster cases was also taken from EMFs like NIIT. This design gave a 360-degree perspective and therefore most common data (evidence) analysis errors were minimized at the design stage.

Such a comparative research design framework also helped in cross-validation and increased reliability. However the key was to ensure construct equivalence before selecting the objects of study. The equivalence premise was that in real life cases, significant diversity would exist in micro dimensions of the variables in the context, in spite of the phenomenon remaining the same. Hence, it was important to focus on the macro conditionality to establish equivalence. In other words, the researcher was not overly concerned about similarities of two conditions to draw parallel but accepted the generality of the terms of engagement, purpose and similarity of mission to establish equivalence. Since the real life case facts represents several complex dimensions of corporate functioning, for selecting equivalents, the researcher used the appropriateness and type of relationship between cross cases. In design terms, the research outputs and the explanations were expected to be valid if a monotonic relationship existed between the cross cases thus selected.

Thereafter the study used the cross-case evidence to focus on the presence of similar systematic relationships between these cases, the direction of such relationships and the strength of association to infer and explain the phenomena of capability development and globalization of EMFs. The inferences were accepted if they met the criteria of relevancy (i.e. reliability x validity).

Within-case data was segregated and segmented as important period data that helped to observe continuity and consistency. Cross-case data were designed to provide industry benchmarks and datum to evaluate evidence and its applicability in a wider cross section of similar industry.

The data tabulations were done in the note-taking format in bucketed segments that appropriately addressed the core research issues and consciously avoided narrative aspects of interviews, logs, and activity summaries (Yin, 1981). Evidence was organised around specific propositions or activities with flexibility to be modified as the research progressed. Topic by topic integration of evidence (Gross *et al.*, 1971) was done by collating data from different sources but on the same topic, in specific pre-defined segments that match the research query areas (Jick, 1979; Yin, 1980). The "meaningful events" (Yin, 1981) were tabulated culling out from the huge volume of case facts and data collected. This helped to remain focused and develop the chain of evidence (Yin, 1979, p. xii) that best explained a phenomenon. As one shifted to within-case analysis to cross-case analysis, this chain of evidence finally bound the outputs of all the methods used and established the evidences sequentially and continually to the scientific outcome and conclusions. For building explanations, the technique consisted of an accurate rendition of the facts, considering alternative explanation of these facts and then finding the most appropriate explanation congruent with the facts (Yin, 1981). Lessons from cross-case study were compared to observe a common explanation that emerged (Derthick, 1972). As the search for an explanation is a kind of pattern matching process (Campbell, 1975), the systematic matching of evidence that caused the rapid globalization led by capability developments across several EMFs gave rise to the final research conclusions. The process is documented schematically in the Figure 1.2 below.

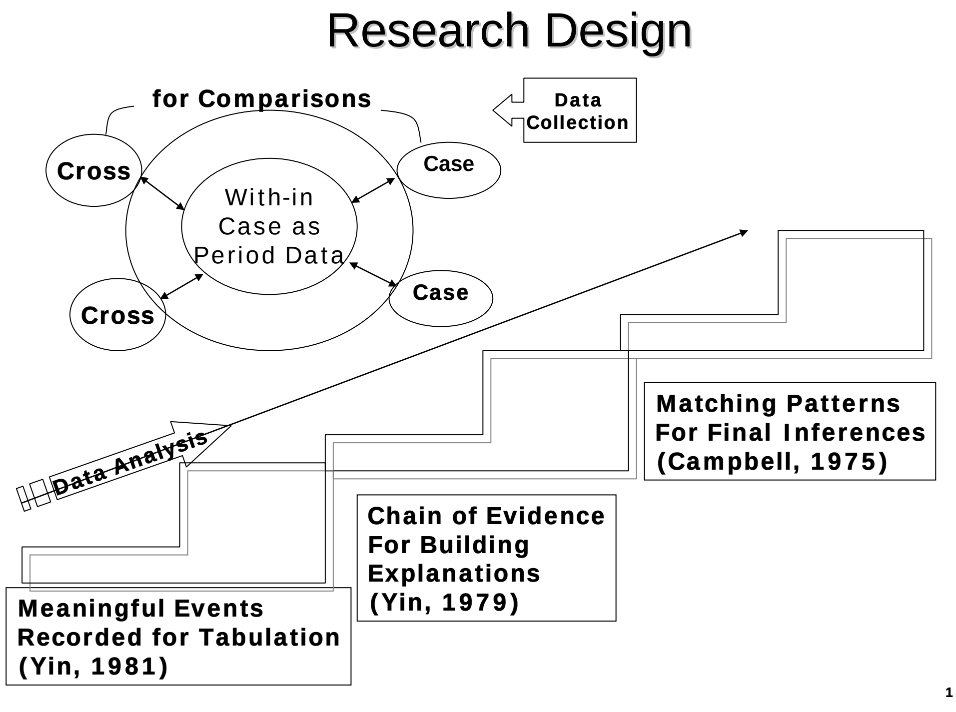

Figure 1.2: Research Design

The inquiry is assumed to be value-free (Darke *et al.*, 1998) and hence at all times the researcher remained detached, neutral and objective. The outcome of the research is presented with the descriptive observations of the phenomenon and the explanations.

Investigations of this nature with a substantial sample size can assist generalization of research findings. Rubin and Babbie (1993) propose that: "Quantitative research methods emphasise the production of precise and generalizable statistical findings". They believe that there is certain objectivity about reality, which is quantifiable. "The data which are collected by positivists tend to be numerical and are open to interpretation by use of statistics: thus the data are said to be quantitative. When we want to verify whether a cause produces an effect, we are likely to use quantitative methods" (p. 30).

To serve the purpose of this research and test the hypotheses, panel data method was used employing the random effects (RE) model. The analysis is performed in a comparatively static context in which the models are shown as equations pertaining to different periods. This is a far superior method than that of OLS regressions, where a major assumption is that the xi values are uncorrelated with the error terms. However this is not plausible or possible to confirm because we only have estimates of the error terms and if correlation exists, then these estimates will be incorrect. In general this problem is brought about by omitted variable bias. There is another variable which is correlated with both x and y so that after fitting the model above there is still a relationship with this other variable and the residuals. Omitted variable bias is the most common illustration of what economists refer to as endogeneity. Endogenous variables are variables determined by other variables in the system, i.e., x causes y and y causes x. To ensure the elimination of bias in the study, care was taken to incorporate suitable dummy variables as controls as well as using the Wu-Hausman test.

In panel data or longitudinal data, the behaviour of entities is observed across time. Panel data allows for control of variables one cannot measure things like difference in business practices across companies; or variables that change over time but not across entities (i.e. national policies, federal regulations etc.). In other words, it accounts for individual heterogeneity.

The rationale behind random effects model is that, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model: According to Greene (2008)

> "…the crucial distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model..." [2008, p.183]

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 for time-invariant variables to play a role as explanatory variables. In random-effects 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 allows generalizing the inferences beyond the sample used in the model.

1.4 Structure of this Thesis

The chapters in this thesis are structured in the following sequence. Following this introduction, Chapter 2 is concerned with literature review. This is followed by Chapter 3 which focuses on a comprehensive multidimensional review of the Indian IT industry. Chapter 4 is concerned with the evolution of capabilities of a leading Indian IT major Infosys which is followed by Chapter 5 which focuses on case studies of three firms. Chapter 6 is a multivariate analysis of 703 Indian IT firms and Chapter 7 concluded the thesis. A brief synopsis of the chapters is provided next.

In Chapter 2 the literature review is devoted to studying what are the different institutional and firm-specific factors that determine the evolution of capabilities in organizations in generic terms, and in particular late-moving firms including EMFs. It reviews the literature on how EMFs leapfrog into international markets of developed economies, under rapidly changing competitive and regulatory environments. What is of interest here is the genesis of transformation that enables these firms to compete with multinationals in developed markets with advanced value-added products and services. The literature review is cast in a micro-economic framework towards the analysis of firm-level dynamics. The review systematically explores the literature on what pathways may be available for emerging market firms (EMFs) to leverage key internal and external resources towards the development of dynamic capabilities in a high tech industry.

Chapter 3 provides insights on dynamic capability development through multidimensional industry research at industry and firm level. The chapter mainly focuses on the capability development routes and interfaces of the IT industry and IT firms with observations of the critical evolutionary milestones and the transformations of the global and firm level business models that impact capability transformations. Lastly it documents the current steps taken by leading firms that enable them to leapfrog into driving technological advancements.

Chapter 4 comprises the case study of a leading IT major Infosys in its real life context, to document some meaningful events and their explanations. Through the lens of dynamic capability development, it examines how an emerging market firm can leapfrog in knowledge intensive industries in various stages and phases. It maps the sequence of strategies through a focused case study of Infosys (a pioneering EMF) to document the evolution of the dynamic capabilities to establish the causal relationship between rapid growth and capability development.

Chapter 5 dwells on cross case validation using three EMFs, namely HCL, Sasken and Cranes to arrive at the propositions of the study. Case facts from these cross case study matched patterns of the EMFs model of dynamic capability development at various periods of their capability life cycle. These include the progressive evolutionary development of their growth and distinctive foci in different periods.

Chapter 6 is a multivariate analysis using quantitative data from 703 companies in the IT industry. This chapter examines which factors enable EMFs to transform basic level operational capabilities into advanced level dynamic capabilities to challenge incumbents on their own turf. The results provide evidence to challenge the views of Arora *et al*. (2001) and D'Costa (2004) that the Indian software industry presents the classic problem of locking-in a low road of innovation trajectory. The specific contribution to knowledge is established here with empirical evidence with the identification of a "reverse loop" in the learning curve and is explained in details in this chapter.

The concluding Chapter 7 summaries the findings that answer the research question. These include mapping of the precise capabilities that enabled the EMFs to leapfrog in the knowledge intensive IT industry and globalize rapidly. More specifically, it identifies various dimensions of capabilities that were developed by the EMFs and leveraged to globalize rapidly. It also establishes a causal relationship of capability development with the externalities and environment to document the evolutionary patterns and finds out how the EMFs utilized the capabilities to leapfrog.

[1] Data and interviews found in secondary sources - annual reports, media reports, consultant reports at Infosys, HCL, Sasken, Cranes, IBM, EDS and Accenture in India. Information was arranged and analyzed to match patterns with the primary data. The chain of evidences was used for validation, conclusions and the final observation of the phenomena and the explanations.

Chapter 2

Literature Review

2.1 Introduction

There has been much interest of late in the empirical literature about the ever growing salience of emerging market firms (EMFs), most prominently from India and China, and as to where their advantages stem from. The EMFs are not a new phenomenon; indeed they have the same legacy as latecomer firms from East Asian nations, which powered their passage into global competition through novel ways of learning and absorbing knowledge through leverage (more on this later). However EMFs have gained more prominence recently. It may be argued that the recent waves of globalization, liberalization and deregulation worldwide have had much to do with this.

Placing our study in the context of the post-liberalization era in India, this chapter reviews the literature to seek answers about how EMFs can leapfrog into the international markets of developed economies, under rapidly changing competitive and regulatory environments. What is of interest here is the genesis of transformation that enable these firms to compete on the multinationals' turf in developed markets with advanced value-added products and services. The review is devoted to studying what are the different institutional and firm-specific factors that determine the evolution of capabilities of organizations in generic terms, and in particular late-moving firms including EMFs. The study is cast in a micro-economic framework towards the analysis of firm-level dynamics.

The literature on EMFs from the Indian subcontinent is varied and instructive. Therefore a review of the same is in order here, however this is not an exhaustive study. Athreya's account depicts how Indian firms learnt to convert the programming skills of engineers recruited from the outside into firm specific skills – learning how to assemble teams of software engineers and delivering value added services for a diverse range of clients anywhere around the world. While an abundant pool of programmers formed the basis of competitive advantage in the initial stages, it was improved productivity due to dynamic capabilities that enabled them to sustain their competitive advantage in changing market circumstances later. Athreya draws on the notion of dynamic capabilities as the basis of their competitive advantage. However as the author points out, little has been framed in the literature about the process of this transformation or to map the trajectory of this evolutionary process – evolving from basic levels of capabilities towards developing dynamic capabilities. While the author does provide a very comprehensive account of how this transformation occurred in a broad industry framework, the work falls short of illuminating the micro economic details of the transformation of individual firms.

2.2 Challenges and Opportunities Facing EMFs

In generalised terms, how do firms evolve from late entrants to mature competitors with veritable competitive advantage? This issue becomes more interesting when these EMFs are located in developing countries. Developing countries suffer from certain institutional weaknesses which render the process of this transformation even more difficult. Inadequate institutional support for market based transactions, and weak inter-firm linkages characterise these economies (Choi, *et al*., 1999; Gaur and Delios, 2006; Gaur and Kumar, 2009). Emerging economies are also relatively higher-risk countries subject to uncertain structural changes (Nachum, 2004; Gaur and Kumar, 2009).

Consequently, emerging economy firms tend to be much smaller, even in the large emerging nations such as India and China (Ray, 2004). Moreover, resources are not easily available, nor are they configured to serve industry. The extent of markets to which firms could cater is limited. Their home markets are small compared to developed economies. Even the second biggest emerging economy, India, has a demand comparable to only Portugal or Greece for sophisticated products and services (Gaur and Kumar, 2009). The lack of both quantity and sophistication of demand conditions presents a seemingly insuperable problem of how and for whom the value added services are to be developed.

How EMFs improve their competitive positions despite such unfavourable exogenous factors is therefore an interesting question. Khanna and Palepu (2004) suggest that emerging economy firms, which are especially capable of serving markets with underdeveloped infrastructures and institutional voids, tend to move into other emerging markets that have similar institutional environments. Operating under business groups, EMFs find niches for their products in poorer countries (Khanna and Palepu, 2004). Some of these successful EMFs are family controlled, others professionally managed publicly traded companies such as Tatas or Infosys etc (see Khanna and Palepu, 2000). Elsewhere, Ramamurti (2004) argues that today's MNCs started out under resource constrained environments in their home territories and innovated appropriate products suited to local environments with labour intensive means of production and local inputs. Craig and Douglas (1997) proposed that EMFs shift from low cost low wage/resource driven commodity approaches to component or private-label manufacturing for established multinationals – often by mounting the global value chain (more on this later). The authors discuss how EMFs can leverage their home advantage of having low cost physical and human resources to develop strong competitive positions in world markets. The recent offshoring and outsourcing phenomena have provided the ideal breeding ground for such partial involvement.

The works of Dawar and Frost (1999) and that of Bartlett and Ghoshal (1992) map the appropriate strategic responses of EMFs to greater openness and liberalization of the world economy. These authors argue that instead of focusing on narrow strategies, EMEs tend to focus on a broad range of strategies for different ecological niches of customer preferences, both locally and globally. The authors raise issues on the strategic posturing by local firms and how local firms advantageously position themselves in the right industry space. Dawar and Frost (1999) argue while "defenders" focus on leveraging local assets for innovation directed to local markets where MNCs are weak, "dodgers" tend to leverage cost-oriented, commodity approaches, such as component or private-label manufacturing, for established multinationals (Craig and Douglas, 1997; Dawar and Frost, 1999). On the other hand, "contenders" focus on upgrading to expand into markets similar to their home base (Dawar and Frost, 1999). Bartlett and Ghoshal (1992) suggest essentially two strategies by which EMFs carve out global positions. As the late-mover experience suggests, they either"benchmark and sidestep" or"confront and challenge" big MNCs. While the former implies learning to compete with MNCs in their home territory and then using the experience to compete overseas, the latter implies riskier strategies of introducing new business models that challenge established rules of competition – i.e. stake out a new competitive space (Porter, 1990). However useful these studies might be, they only dwell on a broad range of strategic options open to an EMF, but not on what it must do to upgrade its capabilities.

2.3 The Neoclassical Mainsprings of Competitive Advantage

There is a large body of literature in economics which shows how openness of an economy is a source of growth through technological and informational externalities (spillovers) (Grossman and Helpman, 1991; Gruber *et al*., 1967; Helpman, 1992; Romer, 1990). The benefits of externalities associated with openness are supposedly important for developing economies because a major part of technological change and generation of new ideas takes place in developed economies with huge investments in research and development (Patibandla and Petersen, 2002). Openness facilitates technological diffusion owing to the public goods nature of new ideas and technologies. MNCs are observed to be important transmitters of new technologies because their operations have demonstration effects on local firms, and are a source of technological and informational externalities (Aitken and Harrison, 1999; Branstetter, 2000; Grossman and Helpman, 1991; Kokko, 1994).

Spillovers are a part of the economic growth process, which implies inter-temporal changes in the economic factors (Patibandla and Petersen, 2002). For example, spillovers increase skills of workers and with responsive intermediate input and final product market conditions this is likely to increase productivity and incomes. This, in turn, signals strong incentives for local manpower to acquire industry specific skills, thereby increasing the pool of local skilled manpower. Furthermore, spillovers cause growth of the local industry, which in turn may change for the better local market institutions. This process may provide further incentives for FDI inflow and change in the nature of operations of MNCs in the host economy. However, this whole cycle is predicated upon the nature of policies pursued by a nation, particularly whether these are vertically coordinated or sporadic instances of intervention (Lall and Teubal, 1998).

According to neoclassical economists, the most efficient way to acquire technological capabilities is to undertake high investments in physical and human capital (Lucas, 1988; Krugman, 1994; Romer, 1990). Technological knowledge, which is largely embodied in physical capital, i.e. machinery and codified documents, is exogenously available, and can be accessed by all firms under free trade if they make sufficient investments to acquire these. Rises in total factor productivity (TFP) would be the result of steady investments in physical and human capital under openness to trade, adopted at best practice levels (see Lall, 1992 for a critique). Accumulation theorists have thus argued that local firms can leverage inflows of foreign technology to improve their technological base in the catching up process (Pack and Saggi, 2001).

Accumulation theorists' stress that technological gaps can only arise due to restrictions on free trade, or inward-looking economic policies, which inhibit technology flows from developed countries (DCs) to less developed countries (LDCs). In comparison to those that intervene in trade, LDCs that pursue liberal trade policies industrialize faster and more efficiently (Krueger, 1990; Balassa, 1988). To support their standpoint, neoclassical theorists argue that import substitution industrializing (ISI) economies such as India have performed less well than their East Asian counterparts precisely because East Asia had open trade policies, and welcomed technology flows and FDI – hence ISI was inefficient. By contrast, the technological success of East Asia came as the result of private enterprises responding to incentives offered by trade liberalization, based on the comparative advantage and abundance of certain factors of production such as low labour costs (Little, 1982). The neoclassical view is that East Asian success was due to limited government intervention, and permitting the realization of static comparative advantage: the lack of competitiveness in countries like India was to be located in trade distortions which restricted the flow of technologies and prevented specialization to occur (see Perkins, 1994).

The implication of the neoclassical analysis is that enterprise competitiveness (or its lack thereof) can simply be explained by whether the economy in which an enterprise operates is open to flows of resources and technology from exogenous sources or not. Hence in this view, exogenous factors assist in upgrading of capabilities of firms at the micro-level. However the neoclassical assertion that technology is available off-the shelf to all comers, late or early, and that technology mastery is automatic and costless, is an over-simplified view of the complexities involved in the catching up process (Freeman, 2004). Even if the technology is available "off- the-shelf" the buyer has to do much more "homework" (Lall, 1993). When technology is bought as a package, the recipient is often not fully informed about what it buys. Particularly for local firms (LFs), the process of gaining technological competence is not instantaneous or automatic, even if the technology is well diffused elsewhere (Lall, 1998). Technology transfers from MNCs are not like transferring a physical product, but include many tacit elements; simple transfers of blueprints, SOPs, patents and designs does not ensure technology will be effectively absorbed (Morrison *et al*., 2008). Moreover even though several specialized services can be brought in from (domestic or foreign) contractors, consultants or other firms, a basic core of functions in each major category like efficiency, quality, or cost improvement have to be internalized by the firm to ensure successful commercial operation (Lall, 1992; see also Cohen and Levinthal, 1990). Insofar as these core functions have to be mastered, there are factors that work to the disadvantage of late-movers, discussed next.

2.4 Early Movers Versus Late-Mover Advantage

Unlike incumbents, many latemoving firms from emerging economies do not start from a position of advantage: they have to acquire these firm-specific advantages (see Hymer, 1960; Dunning, 1988) in order to overcome their disadvantages (Gaur and Kumar, 2009; Child and Rodrigues, 2005). Building a resource base, such as technological and marketing resources, is a path-dependent process, requiring extensive time and effort (Dierickx and Cool, 1989) Starting from a resource-meagre position, it is not easy for emerging economy firms to build or even acquire resources on their own. The problem has been conceptualised in a strategic framework by Cho *et al*. (1998) as the early mover versus late mover issue. On the basis of in-depth case analysis of three Japanese and three Korean semiconductor firms the authors categorize successful latecomer strategies. The authors first examine what precisely are the early mover advantages of incumbents, revealing that these could be grouped into three areas: market, competition, and the early-moving firm itself. The *market* (or *consumers)* provides opportunities for firms that come earlier than others. Early movers build image as they launch new products and gain reputation in the market, which often leads to consumer familiarity and loyalty (Ries and Trout, 1986, 1998, 2000; Trout and Ries, 1986) and creates switching costs (Schmalensee, 1982, 1988). Early movers also pre-empt late entrants of the limited opportunities available in diverse aspects of the market such as inputs, real estate, suppliers and skilled employees (Lieberman and Montgomery, 1990, 1998) focusing on exploiting the competitive vacuum in the market. Finally, *the early-moving firm* can have a further source of advantage through *learning by doing.* By similar logic, sources of late-mover advantages can also be reduced to three areas: market, technology and the late-moving firm itself. First, as the *market* (or *consumers)* evolves it opens up opportunities for late entrants in meeting the changing market landscape and puts the early movers that do not respond to the changes to a disadvantage. C*hanges in technologies* can also offer a valuable window of opportunity for latecomers, particularly when the new technologies equip late entrants to set new industry standards and innovate new business models. Latecomer advantages may also take the form of *free-rider effects* stemming from their late entry, with early movers having incurred most of the pioneering costs. Informational and technological spillovers also reduce R&D costs for the purpose of imitation (Mansfield, 1988). In the case of Japanese and Korean firms, Cho *et al*. (1998) explain that their strategy of catch-up with early movers included invoking human embodied technology transfers, technological leapfrogging, and resource leveraging.

While this analysis is prescient in conceptualising what external factors cause a shift in competitive advantage from early to late movers, it is less so in illuminating in minute detail the internal process by which the late moving firm gains the resources, skills and capabilities and transforms itself from a position of disadvantage to advantage. In order to analyse how this transformation may occur it is necessary to examine the resource based view of the firm, drawing from the evolutionary literature.

2.5 The Resource Based View of the Firm

According to Teece (1998), competitive advantage is a function of what resources one has and how these resources can be deployed, reconfigured and redeployed in a changing market. Teece (1998) defines dynamic capabilities as the 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. In the RBV it is argued the advantages of large firms stems 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). In order for an organization to exhibit dynamic capabilities, it must sense the opportunity and the need for change, calibrate responsive actions and investments, and move to implement a new regime with skill and efficiency. Sense-making can be assisted by sense-making tools, like scenario planning, as well as the insights of brilliant outsiders. The object of the exercise has never been to predict the future, but to understand the fundamental drivers of change and to quickly chart action plans once key uncertainties are resolved. When the organization has figured out what is going on, and calibrated the opportunity, it must choose among the available "action plans". These are not infinite in number, but may be restricted to one or two or maybe a handful of viable alternatives that are satisfactory. Actions are likely to be similar to those used in the past. These so called "actions" draw on organizational "routines" that enable managers to alter their resource base, i.e. to acquire new resources, integrate them together, and recombine them. These include learning routines whereby managers and others build new thinking within the firm (Teece *et al.*, 1997; Eisenhardt and Martin, 2000; Helfat, 1997; Henderson and Cockburn, 1996; Rosenkopf and Nerkar, 2001) and improve capabilities to compete in the market.

Herein, capabilities can be either"operational" or"dynamic", (Helfat and Peteraf, 2003). An operational capability is defined as "a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type". In this definition, the term routine refers to a"repetitive pattern of activity" (Nelson and Winter, 1982, p. 97). Thus, operational capability generally involves repetitively performing an activity, such as manufacturing a particular product, or coding tasks in software and IT, using a collection of routines to execute and coordinate the variety of tasks required to perform the activity. The capabilities to make use of existing resources, such as existing manpower, are simple (operational) capabilities (Banerjee, 2003).

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, consumer preferences, competition patterns, etc, a firm possessing dynamic capabilities is capable of recognizing, utilizing and advancing its technical, managerial and functional capabilities and expertises that are available locally or externally to the firm (Teece *et al*., 1997, Eisenhardt and Martin, 2000). In science-based regimes, the possible recombination of capabilities through acquisitions (Eisenhardt and Martin, 2000) eventually inculcates dynamic capabilities in smaller firms or late entrants. A dynamic theory of capabilities postulates that a firm responds to the potential or actual changes in the environment (Teece *et al*., 1997; Banerjee, 2000) and aligns its resources as well as its alliances in line with the new business strategy.

Both resources and capabilities evolve and change over time. Taking an evolutionary approach, Helfat and Peteraf (2003) describe trajectories of capabilities (see Helfat and Peteraf, 2003; Helfat, 1997) through the capability life cycle (CLC), which envisions that a newcomer firm's capabilities evolve through various stages – founding, development and maturity. The founding stage lays the foundation for subsequent development of capabilities by acquiring the necessary resources and bringing in human and social capital; the developmental stage entails building capabilities in which the organization may decide whether to build from scratch or imitate a capability from another organization depending on the risk associated – which entails organizational learning and inevitably results in path dependencies. In the mature stage capability building ceases but can be branched and extended to be renewed, redeployed or recombined (Helfat and Peteraf, 2003). Hence the upward trajectory of large firms can be explained by the evolutionary approach taken by Helfat and Peteraf who argue that as new entrants these very firms also once lacked the capabilities that characterise large firms.

The question now is what is the precise nature of organizational effort that a firm, especially a late-mover, needs to expend from its inception to maturity to achieve dynamic capabilities? The CLC approach does not elaborate on this problem and hence fails to conduct an in-depth audit of how capabilities are created in the first place. For this the evolutionary approach of Nelson and Winter (1982) is instructive.

2.6 The Evolutionary Approach to Firm-Level Capabilities

As opposed to the conventional neoclassical notion of a "one off leap" from inefficient to efficient firms, the evolutionary approach emphasizes cumulative, path dependent, trial-and-error processes in technological catch-up. Barriers to learning are overcome only gradually. Nelson and Winter (2002) stress that firm-level technological change needs to be understood as a continuous process to absorb or create technical knowledge. This is determined partly by external inputs and partly by past accumulation of skills and knowledge.

According to Nelson and Winter (1982, 2002), it is it legitimate to think of firms in a perpetual state of change – groping, innovating or evolving towards more profitable ways of doing things or towards some target they envision. For a new entrant in particular, it is dubious to assume that it can display a wide range of high competencies from its very inception, since the achievement of high competence depends on whether or not the firm has undertaken sustained effort to learn from experience (Nelson and Winter, 2002, p. 28). Indeed, in today's world, individuals and organization are able to perform highly complex tasks, many of which could not be performed a few decades ago, precisely because they have evolved through experience. Competence is achieved when skills and routines are learned and perfected through practice. Just like an ice cream start-up owner gradually learns what varieties to stock by learning from customer demand, in the same way any organization gradually learns from experience and builds routines. Thus, the evolutionary view of the competence puzzle focuses on the role of learning and practice and specifically on experience that train the actors. This approach treats organizational and individual competence in similar terms; the authors treat *organizational routine* as the organizational analogue of individual skill. When rich and relevant information is available to guide action, organizations often find routinized ways of exploiting it (Nelson and Winter, 2002, p. 29). Routines enhance efficiency and prevent deviation from set patterns.

The evolutionary view holds that individual skills, organizational routines, advanced technologies and modern institutions come into being through trial-and-error cumulative learning, partly by individuals, partly by organizations, partly by society as a whole (Nelson and Winter, 2002, p. 31). Over time, competition winnows out many of the actors, with the ones that survive having routines that cope best with the environment. "Other evolutionary models treat the actors as operating with a particular set of routines 'in the short run', but as having mechanisms that enable them to improve routines or to learn about significantly better ones as time elapses and they gain experience" (Nelson and Winter, 2002, p. 40). Hence it would follow that new firms, particularly late-entrants and EMFs, evolve through a gradual process of learning by doing and finding ways to improve routines and learn better routines with time. However, the question then is whether EMFs that lack a supportive institutional context can learn on their own or whether there is need for state intervention and other mechanisms to support this learning.

2.7 How EMFs Gain Capabilities – a Process Approach

The micro level analysis of firms and technological capabilities in emerging economies and developing countries has drawn inspiration from the "evolutionary theories" developed by Nelson and Winter (1982), and explained in Nelson (2008) and Dosi (1988). Dosi *et al*. (1988) argue that evolutionary theories can explain the "existence of ***asymmetries*** among firms, say between incumbents and late entrants, in terms of their quality of output (Dosi, 1988, p. 1155) and perhaps also capabilities. Different innovative capabilities, that is, different degrees of technology accumulation and different efficiencies in the innovative search process" (p. 1156) explain this asymmetry.

Advancing the capabilities approach, Lall (1992) explains that firm level capabilities must be understood as a continuous process to absorb or create knowledge, partly through acquiring external inputs and partly by past accumulation of skills and knowledge (Lall, 1992, p. 166). Organizational learning has been described as the ways in which organizations build, supplement and organise knowledge and routines around their activities (Sadler-Smith and Badger, 1998). Organizational learning is experiential, i.e. it is through experience that knowledge about action–outcome relationships is developed and encoded in routines. Further, it is embedded in organizational memory and changes the collective behaviour of its employees. Organizational knowledge is the resource generated through accumulation of organizational learning (Mehra and Dhawan, 2003).

In the technological capabilities approach, Lall (1992) propounds that transfers of resources and technology from foreign suppliers followed by demonstration can be an important first step in acquiring capabilities for late-moving firms. Often the process entails the seller setting up the plant, giving the recipient hardware, raw materials and doing the start–up and trial production runs in a turnkey arrangement. The recipient receives codified set of instructions (SOP) but has to undertake a steep learning effort to understand the underlying tacit elements embodied in the technology in order to master the production process. Gradually through a trial-and-error process and building of routines, the recipient learns how to become efficient in the given technology. This is what is known as the *operational* level of technological capabilities. At a higher level, *duplicative capabilities* enable the recipient to fully replicate the plant, machinery, components and raw materials on its own, without foreign assistance – known elsewhere, especially in developing countries, as the process of indigenization. By this time the recipient has mastered both the codified and tacit elements of technology and internalised the knowledge acquired externally. At a still higher level, *adaptive capabilities* empower the latecomer firm to adapt the product to different niches of customer preferences, by changing specifications, features or even the underlying technologies themselves. Finally, the innovative level of capabilities allows building the next generation technologies and changing the current paradigmatic assumptions and achieving a new state of the art status (see Lall, 1985).

In a related but distinctive way, Hobday highlights stages in the evolution of East Asian firms in the electronics industry in microeconomic terms. In contrast with the research and development (R&D) and design-led strategies typical of leaders and followers, latecomers began with incremental improvements to manufacturing processes which led on to minor product innovations.

For example the OEM-ODM-OBM model of Hobday (2003, 1995) explains how East Asian firms learned process and product skills and know-how. Within the firms, subcontracting and original equipment manufacturer (OEM) mechanisms acted as a training school for latecomers, enabling them to overcome entry barriers and to assimilate manufacturing and design technology. The needs of export customers drove the pace of learning and acted as a focusing device for technological assimilation, adaptation and innovation. This process gradually led East Asian firms to undertake their own design manufacturing (ODM) by making product and process innovations. Still later, East Asian latecomers powered their way into own brand manufacturing – examples include Samsung, LG, Acer and the like.

In the technological capabilities view, organizational *learning* is the key to achieving higher levels of capabilities. Lall (1992) further underscores that late-entrants also need to develop *linkage capabilities* to receive from, and transmit to, component or raw material suppliers, subcontractors, consultants, service firms, and technology institutions, the vital information, skills and technology. Such linkages affect not only the productive efficiency of the enterprise (allowing it to specialize more fully) but also the diffusion of technology through the economy and the deepening of the industrial structure, both essential to industrial development.

2.8 Learning and Linkages

The linkage, leverage and learning model (see Mathews, 2006a) are strategies of catching up that are available to latecomer firms and EMFs. They enable the firms to make connections with the wider global economy, and draw from these linkages skills, knowledge and technology resources that would otherwise lie well beyond the reach of the EMF (Mathews, 2006a). Mathews' (2002a) LLL model explains how an EMF's *linkages* with foreign firms (buyers of their services) provide the required knowledge resources to be leveraged. Starting from a resource-meagre position, it is not easy for emerging economy firms to build resources on their own. One way to circumvent the problem is to acquire resources from external sources (Gaur and Kumar, 2009). As a result, many emerging economy firms secure access to critical resources in foreign countries, and acquire foreign firms to get a quick foothold in foreign markets (Rodrigues and Child, 2003; Child and Rodrigues, 2004, 2005, 2011; Child *et al*., 2009). The effect of applying strategies of linkage and leverage is that latecomers are enabled to overcome their disadvantages and exploit their few advantages as latecomers to the full. It makes sense for latecomers to utilize all the resources from the advanced world that they can acquire, in return for providing services such as low-cost manufacturing. EMFs can engage in exporting goods and knowledge based services to foreign MNCs. Strategic linkages with MNCs enable access to markets, technology, and reputation (Thomke and Kuemmerle, 2002).

The implication of the LLL model is that a late-moving firm contemplating external resource acquisition can expect to capture advantages when incumbents have laid down infrastructure and market clarification initiatives that can be appropriated by the new entrant at little direct cost (Lieberman and Montgomery, 1998). In the subsequent stages EMFs undertake learning to demonstrate value and win business contracts rapidly. Mathews used this model in the white goods segment. For EMFs lacking resources, the approach is to identify the resources and technology that can be leveraged and then work out how to implement a framework that actually taps these resources as a base for learning and improving their technological innovation capabilities (Matthews, 2001). Multiplying linkages with advanced firms in an interconnected global economy provides the local firm (LF) its first potential competitive advantage (Mathews, 2002a, p. 476). It fashions a strategy of linkages that complements the strategies of incumbents by meeting their needs and offering services, then it opens the door for further advance and industrial upgrading (Mathews, 2002a, p. 476). By diversifying into international markets, emerging market firms can to some extent minimize the impact of market failure in accessing resources and other supplies only from their home country (Gaur and Kumar, 2009).

However, international expansion via accessing resources from incumbents is not without its drawbacks. If exports of EMFs entail value added goods with high levels of intellectual property, these are subject to agency problems. Incumbents may exercise high bargaining power over EMFs. An MNE with a global monopoly position may extract rents and inhibit young firms' innovation. Another downside of using the MNEs is that EMFs may not have full access to and awareness of the flow of ideas.

2.9 Knowledge Intensive Industries and EMFs

On the one hand, the extant literature has framed the EMFs strategy in evolutionary microeconomic terms – highlighting stages in evolution, for example the OEM-ODM-OBM of Hobday (2003, 2005). On the other hand, Perez and Soete (1988a, 1988b), Lee and Lim (2001), Soete (2001), Soete *et al*. (2002), Pérez (2012) observe that the emergence of a new techno-economic paradigm provides a "window of opportunity" for latecomers who have occasion for the first time to compete equally with incumbent firms. This is due to the fact that every firm has a similar start with new technology and the incumbent might like to stay longer with old technologies. A window of opportunity can also open with business cycles, as analyzed in Matthews (2005) for the cases of semiconductor, LCD (Liquid Crystal Display) that can be applied to other industries.

In a science based regime, it is possible for smaller, plausibly late entrant to seize a technological possibility before its older rivals and ultimately catch up (Nelson and Winter, 2002). Developments exogenous to the focal industry can endow late entrants with new competitive weapons (Nelson and Winter, 2002). When smaller and more innovative firms seize a technological opportunity, dominant designs are threatened (Henderson and Clark, 1990). Incumbents who focus too narrowly on prevailing applications of a basic technology may leave niches open in which later entrants can mount a broader threat (Bower and Christensen, 1995; Christensen and Bower, 1996). This indicates how late-entrants might position themselves in high technology industries, otherwise guarded by steep entry barriers. Today, a number of science based industries are experiencing rapid technological advances, where entrepreneurial start-ups whose innovations (both product and process) are based largely on the work of one or a few individuals, offer significant competitive threats to larger firms (Nelson and Winter, 2002). The analysis of science-based regimes involves a number of interesting questions, including the possible recombination of capabilities through acquisitions (Eisenhardt and Martin, 2000), which eventually inculcates dynamic capabilities in smaller firms or late entrants. The early history of biotech – the classic "science-based" case, but also a quintessential “complementary assets” case – is now available as a vivid illustration of how these various themes can play out (Nelson and Winter, 2002).

Downturns and rising costs set a brake on the incumbent, and resources become cheap to reduce the cost of the late entry. Yet another source of opportunity for latecomers can emerge with a change in government regulation or intervention in the industry. Guennif and Ramani (2012) analyze how the change in regulatory system gave opportunities to Indian

EMFs in the pharmaceutical industry. The role of the government was also prominent in several East-Asian cases of catch-up, such as China's telecom equipment industry (Mu and Lee, 2005) and Korean and Taiwanese high-tech industries (Mathews, 2002a).

2.10 Global value chains and EMFs

EMFs can also compete in international markets by seizing opportunities even as globalization of production value chains is transpiring. Globalization of value chains results in the physical fragmentation of value added activities, where the various stages are optimally located across different sites, as firms find it advantageous to source more of their inputs globally. Institutional change through liberalization of information technology, and competition has led global networks to emerge (Ernst and Kim, 2002). Information and communication technology (ICT) has made possible the slicing and dicing of the value chain, where the various stages are optimally located across different sites to reduce costs (Ernst and Kim, 2002). Besides, no firm, not even a dominant market leader, can generate all the different capabilities internally that are necessary to cope with the requirements of global competition (Ernst and Kim, 2002). Competitive success rests on selectively sourcing specialized capabilities *outside* the firm that can range from simple contract assembly to quite sophisticated design capabilities (Ernst and Kim, 2002). Using IT across national boundaries, HP, Dell, Compaq, Motorola, Intel, IBM, Lucent and Nortel were first in pursuing such divestment strategies.

The dispersion of value added activities by MNEs throughout the world enable EMFS to mount the global value or supply chain (Gereffi, 1999; Pietrobelli and Rabellotti, 2007) by specializing in comparatively advantageous activities – such as labour intensive assembly operations.

Fragmentation of value added activities allows countries to develop competitive activities in niches – one component or process – and reach huge markets in ways not possible some years ago. Linkages in the GVC can play a crucial role in accessing technological knowledge and enhance learning and innovation (Gereffi, 1999; Pietrobelli and Rabellotti, 2007).

Thus leaders of global value chains actually play a role in fostering and supporting this process the opportunities for suppliers "to move up the value ladder," moving out of the "low road" to competitiveness where competition is based mainly on price and squeezing wages, and the barriers to entry are low (Pietrobelli and Rabellotti, 2007). For small firms in developing countries, participation in value chains is a crucial means of obtaining information on the type and quality of products and technologies required by global markets, and of gaining access to those markets (P 1262). MNCs can transfer the"missing elements" of technology, skills and capital needed to complement local capabilities if they see a competitive product at the end of the investment (Lall, 2004). MNCs disseminate both explicit and tacit knowledge to local suppliers in low-cost locations, which could catalyze local capability formation (Ernst and Kim, 2002).

2.11 Summary

The literature on international competitiveness to date has tended to focus mostly on manufacturing firms from the triad countries. Generally, these firms are well endowed in resources and have developed within more or less similar institutional environments. However, firms from developing countries are generally resource poor and their establishment, development and international expansion have taken place within an environment different from those found in western economies. As EMFs are mostly and increasingly from developing countries, opportunities exist for a more in-depth inquiry into, and the analysis of, the sources of their international competitiveness. In the foregoing sections, this chapter outlined major streams of the extant literature, the gaps and how these may be filled. To reiterate, what is untold in the literature is how EMFs learn to transform comparative advantages into dynamic firm-specific capabilities by assembling teams of talented engineers, tangible and intangible resources, both internally and externally, to deliver a technical outsourced service to exacting standards and customers worldwide. In a way Mathews' (2002a) model of linkage (to foreign markets through MNCs), leverage (cost innovation) and learning (technology and processes) comes nearest to an explanation of the rapid rise of EMFs in the global economy, however it also falls short in so far as one looks for detailed insights into the resource and knowledge recombination process within EMFs. Moreover the empirical literature is rather sparse in conducting detailed analyses on the upstream processes that are crucial to the creation of competitive advantage in EMFs – in particular a mapping of how they transform basic level capabilities to advanced dynamic capabilities to challenge the incumbents in their own turf. This is what this thesis sets out to accomplish. To reiterate, the objective of the study is to systematically examine the key factors that contribute to the development of dynamic capabilities in EMFs from developing countries. Placing the study in the context of post-liberalization era in the south that facilitated access to global resources and markets, the study dwells intensively on the effects of resources and intermediate-product market internationalization on the development of EMF's dynamic capabilities.

To conclude, this review of the literature has systematically examined what pathways are available for emerging market firms to leverage key internal and external resources towards the development of dynamic of capabilities in a high tech industry.

Chapter 3

Insights on Dynamic Capability Development through Multidimensional Industry Research

3.1 Introduction

The Indian software industry has attracted a disproportionate amount of interest as a global source of software services, despite the fact that its $4 billion software revenue in 1998-99 was only a tiny fraction of the estimated world software market of over $300- 500 billion.[1] It has grown more than 30 per cent annually for 20 years, with 2008-09 exports at close to $60 billion. India exports software services to more than 60 countries, with two-thirds to the United States, including half of all Fortune 500 companies (Breznitz, 2005). The industry has captured a significant portion of the world trade in software services. One estimate suggests that India has 16% of the global market in customized software, and more than 100 of the Fortune 500 companies had outsourced to India (Dataquest, 31 July, 96; pp 43-44). Perhaps the most impressive of all, the industry has grown over 50% per year over the last five or six years, and if current trends persist, software exports may account for a full quarter of Indian exports within the next five years.[2]

The competitiveness of the industry is generally attributed to the low cost of scientific and engineering manpower with English language skills (Hanna, 1994; Heeks, 1996). The industry has been able to achieve export competitiveness without a domestic market base and inefficient input industries and infrastructure of telecommunications (Ghemawat and Patibandla, 1999; Patibandla *et al.*, 2000). According to Carrington and Detragiache (1998), the Indian success story has been a combination of resource endowments (created in part by a policy of substantial investments in higher education), good timing and an exemption from overly interventionist and intrusive government laws. India's success also testifies to the abundant supply of entrepreneurs who recognized and responded to the opportunity that the IT revolution in the West offered. What is more, India, being a relative latecomer even among developing countries of Asia, seems to have found a niche in the information technology revolution as an increasingly favoured location for customized software development. Its success has led to speculation about how long the Indian software industry can sustain its growth. It has also led to the hope that software and information technology can be the engine of growth for poor, labour abundant countries.

It is therefore appropriate to investigate what factors contributed to such unique growth from the dimensions associated with capability development and how capabilities were leveraged to achieve accelerated globalization and growth. This chapter provides insights on the dynamic capability development of the emerging market firms (EMF) by researching multiple dimensions at industry and firm level.

Capability development of EMFs can be understood in the context of several challenges and opportunities that individual firms and the IT industry faced in a longitudinal scale. Some evolutionary mapping of the capability developments have been done by early scholars like Athreye, Kumar, Lall, etc. However very little academic literature is devoted to comprehensively examining an extensive spectrum of dimensions of the industry and firms on how incremental and micro level capabilities have been accrued over time and its resultant impact on success and growth. Therefore while evolutionary mapping of capability provides understanding of the stages and phases of capability development, it falls short in the explanations of the precise locations of capability accruals and how each elements and areas (dimensions) impacts the overall. The evolutionary models also fails to identify an exhaustive list of capability accrual points (locations and dimensions) that explains holistically the capability accrual and its utilization for globalization and growth. Therefore it can be argued that for a comprehensive understanding of where and what capabilities have been accrued at the industry and firm level and how these capabilities helped the industry and firms to leapfrog into accelerated growth, research needs to use a multi-dimensional framework that is extensive and exhaustive, as against an evolutionary model of research. A funnel approach of starting with a wide range of multidimensional factors that contributed to capability development and systematically narrowing down the factors to the most significant and meaningful areas (dimensions) will accurately articulate the type of capability and the quantum of capability accrual in each study's aspects and elements. Therefore this multidimensional approach is specifically significant in explanation of the sum total of the resultant capabilities as all possible areas of capability accumulation have been factored in, thus making the study outcome more holistic and robust from the perspective of using the appropriate framework and explanations of the capability development of EMFs. It also helps to explain more accurately the necessities that drove up scaling of capabilities, multiple sources of capabilities, specific areas of accrual of capabilities and how it supported the accelerated growth and globalization. Therefore in this chapter several industry and firm level dimensions are investigated to identify sources of capabilities which also include evolutionary processes. The investigation also focused on micro dimensional levels and on incremental necessities that drove EMFs' business model initially and later the changing environment that needed changing capability to remain globally competitive. Further the competitive dimension in this framework also includes areas to understand how capabilities got developed due to competitive pressure (like innovative global service delivery models).

It is therefore postulated that a multidimensional investigation will provide an appropriate framework to understand the multiple dimensions associated with capability development and its evolution.

The industry and firm level insights in this multidimensional research are structured as follows: section 3.3 focuses on the capability development routes and interfaces of the IT Industry, section 3.4 deals with firm level observations and insights of the same, section 3.5 deals with observations of the early evolutionary milestones that explains the start up capabilities and the foundation blocks and section 3.6 deals with insights on the transformations of the global and firm level business models that triggered new or transformed capability requirements. Lastly in section 3.7, the current technological advancements and extensions are documented to predict the future trends in capability development by leadership firms that leapfrog them into the future advanced technological spaces. The aim here is to observe and identify the factors and the areas of the capability development that had a significant impact on the growth and internationalization of the EMFs. The intention is also to find any evidence of progressive improvements in capability; any evidence of distinctive phases in an evolutionary process like the life cycle stages that would help establish the foundation of the distinctive periods/phases of capability development for focused attention. The observed factors will need to be further investigated in the subsequent stages of the research to develop the construct of the globalization model through the lens of dynamic capability development.

3.2 Background of Global IT Industry and the Indian Context

To observe the phenomena of this study, which is the capability development through the lens of globalization of EMFs, research needs to be directed to observe the IT industry over its life cycle from inception to maturity stages to get an accurate insight of how capabilities were developed and contributed to rapid globalization.

3.2.1 The Phenomenon

By 1995, the global market for computer services was estimated by IDC[3] as being over $220 billion. Of this, a substantial fraction involved outsourcing of some part of the software development and maintenance process to overseas service providers. Custom software development was estimated to be nearly $16 billion, systems integration at $32 billion, IT consulting at $11 billion, and business service outsourcing at $9 billion (IDC).

A growing fraction of the outsourcing was taking place across national boundaries against a backdrop of shortages of skilled professionals in the developed countries like the US and Europe. A study based on responses to a telephone survey of 532 US corporations with more than 100 employees concluded that there were an estimated 346,000 IT positions vacant in the US, in three core IT occupational categories, namely programmers, systems analysts, computer scientists and engineers. In addition, there were another 240,000 vacancies in areas such as technical writing, training, and sales (ITAA, 1998).[4] Although this study, and the methodology it used, has been criticized, the study proved the underlying hypothesis that the IT labour market had experienced shortages in the developed world at that time. The progress of technology was observed as a leading phenomenon whereas the lack of availability of skilled manpower was seen as a limitation. The arguments centred largely on whether this challenge was a temporary phenomenon or reflected a more critical longer term imbalance. The perception of the potential reality that the problem would be persistent and more acute drove US corporations to look for solutions outside the developed world and that is where the knowledge workers from the developing world like India, China, and East Europe started to be significant in this global workforce solution. Therefore it is observed that EMFs' evolution of capability started with a context which was external circumstances driven as against an internal industry or firm level drive.

The Indian domestic socio-political and economic environment was undergoing a radical change at precisely the same time. A chain of successive coalition governments had not deviated from economic liberalization and remained firmly on a strategic course to connect increasingly with the globe. In the governmental strategy to achieve a balance of trade, the IT sector was identified as an important earner of foreign exchange. Increased employment generation supported the strategy consistently. Thus the knowledge led service industry benefited from the timing factor which was identified again as extraneous and circumstantial. The capability development model thus identifies the external environment as a significant factor for the evolution of capability.

The Indian IT industry grew more than 30 per cent annually throughout the two decades of the 1980s and 1990s. From about $50 million in exports in the late 1980s, the industry grew at around 30 per cent a year to more than $200 million exported by 1993 (table 3.1). In the boom years of the mid- and late 1990s, software exports grew 50–60 per cent annually, reaching $6 billion by 2001. Even during the infamous ‘dot com’ bubble burst, software exports continued to grow by about 25 per cent annually, which significantly outpaced growth in the software industry anywhere in the world. The growth continued and India's software industry clocked a healthy 33 per cent growth rate with 2008 exports close to $60 billion (Nasscom).

Responding quickly to the growing demand, the State encouraged this growth by considerably simplifying the process for obtaining the numerous clearances and permits that any firm in the organized sector in India typically needs. The liberalization phase in India also saw less bureaucracy in job visa and work permits for foreign engagements.

Finally, observing the quick growth and foreign exchange earning potential the State also offered a number of incentives and tax holidays to the knowledge based IT industry. Thus a new era dawned of rapid globalization of the new age technology driven enterprises mostly engaged in overseas knowledge services industry (Gambardella and Ulph, 2003). Observation suggests that the relative ease experienced by entrepreneurs in entering the software industry as against the complexity of any other start up ventures in India is another factor that enhanced capability.

Therefore behind the transformation of the capabilities of the Indian IT industry there were some unique extraneous circumstances that catalyzed the phenomenal growth.

3.3 Industry Level Observations

3.3.1 Overview of the Indian Software Industry

The Indian service sector accounts for 61.8% of India's real GDP, 39% in overall exports and 81% of FDI share (Mani, 2001). Statistics and literature identify that there has been an unconventional and accelerated growth in the Indian software industry in just two decades (Dossani, 2005; D'Costa, 1998; Athreye, 2005). The Nasscom report 2001 indicates that Indian IT companies exported software services worth $8.3 billion in 2001. This is a phenomenal growth as compared to $128 million in 1990-91. Indian software services exports started with the low end of the value chain like data entry and onsite projects in the early 1980s and subsequently moved up the value chain to offshoring, developing niche products, and software consultancy by the 2000s (Patibandla and Petersen, 2002). Around 123 foreign companies from US, Canada, Europe, Asia and Australia had invested in R&D activities in India by 2005 (TIFAC, 2006) which is a significant jump from less than 10 prior to the 1990s. Saxenian (2002) infers that the Indian expatriate network spearheaded the global competition in software service industry.

3.3.2 Global Overview of the software industry

During the 1990s India, Ireland and Israel (3 Is) emerged as significant software exporters **(**Gomory and Baumol, 2000**).** In the same period, Brazil and China also developed an extensive software sector relying largely on the domestic market, and then attempted to move to exports.[5]

Table 3.1: The Software Industry a Global Overview of basic facts

Countries	Sales ($ billion)	Empl (000)	Sales/ Empl (000)	Software Sales/GDP (%)	Software Development Index
Brazil *	7.7	160 **	45.5 **	1.5	0.22
China	13.3	190 **	37.6 **	1.1	0.23
India	12.5	250	50.0	2.5	0.96
Ireland (MNE)	12.3	15.3	803.9	10.1	0.34
Ireland (Domestic)	1.6	12.6	127.0	1.3	0.04
Israel *	4.1	15	273.3	3.7	0.17
US	200	1024	195.3	2.0	0.05
Japan **	85	534	159.2	2.0	0.08
Germany *	39.8	300	132.7	2.2	0.09

Various sources. * = 2001; ** = 2000;

Note: The Software Development Index is the ratio between Software Sales over GDP (in %) and the GDP per capita of the country (in 000 US $) (See also Botelho et al., 2005).

Table 3.1 (Kapur and McHale, 2005) shows that in 2002, the Indian and Chinese industries were of comparable size (respectively $12.5 and $13.3 billion), while the 2001 sales of Brazil and Israel were $7.7 and $4.1 billion. The Irish industry reached $13.9 billion in total sales in 2002, of which $12.3 billion is attributed to multinational companies and $1.6 billion to the indigenous sector (Kline and Rosenberg, 2006).[6]

The software development index indicates that the emerging economies are accelerating their growth in the software industry compared to the developed nations. India is highest (0.96) in the table.

3.3.3 Employment Figures as an Indicator of accumulation of capability

In March 2003 the Indian software industry employed about 250,000 people (Lamoreaux and Sokoloff, 1996).[7] The 2000 figures for China and Brazil are respectively about 160,000 and 190,000. Employment figures are good and reliable indicators of accumulation of capabilities. The above figures clearly demonstrate that capabilities were accumulating in a rapid pace in the Indian software sector as against some critical benchmark countries stated above.

But the most impressive figures about the software industry in these emerging economies are their growth rates, which have ranged as high as 40% per year in the Indian case (Table 3.2, column 2) (Mann, 2003).

Table 3.2: Brazil, China and the 3Is: Software Industry Growth & Export Shares

Countries	Average Growth in the 1990s (%)	Exports as % of sales (2002 or latest available year)
Brazil	20	1 - 2
China	30-35	11
India	40	80
Ireland	20	85
Israel	20	70

Various Sources.

The number of firms engaged in IT activity has also grown. The membership of NASSCOM (software industry association) increased from around 100 in 1990 to 797 in 2000 (Athreye, 2005). Similarly, the number of new Irish software firms increased from less than 300 in 1991 to 760 in 2000 (Sands, 2005). These are good indicators of the cumulative industry capability of a nation state that has a corresponding effect on the potential to link, learn, leverage and internationalize.

It is also worth noting that the total Indian software workforce engaged in exports (estimated to be less than 400,000) is still a small fraction of the more than 3.2 million software professionals in the US alone. The US supplemented their existing 3.2 million knowledge workers with a share from the available 0.4 million from India who in turn helped in technology led automation to reduce the impact of manpower shortage. Therefore data on these cross border employment needs provide valuable insights on the causes and drivers of developments of human capital capability of the EMFs. Advanced need based capabilities were systematically developed by the EMFs due to such skilled migration needs of manpower as well as the need for integration of the EMFs' IT skilled workforce in the global production network.

3.3.4 Origin of Indian Players: Evolutionary Model

The market leaders in the Indian software industry are relatively new players. With a few exceptions, notably Infosys, Wipro, HCL, TCS and Satyam which comprised the early entrants, most firms are single sector firms (specialized in software alone). Also a few early entrants in the industry had close links with computer hardware business and development activity.

In an era of tight Governmental control of imports and cash strapped foreign exchange conditions of a closed economy like India, the emerging market firms had to innovate a synergetic business diversification strategy For example, Heeks (1996, p. 69) notes that Tata Consultancy Services (TCS) was the first firm to agree to export software in return for being able to import hardware, in 1974.

Once the software exports of Indian firms took off, a large number of new firms entered the industry (Chong, 2002). Low entry barriers meant start-up firms could start with a fairly small initial investment, small office space and communication facilities. In other words low levels of capability were required at the initial phases when the entry barriers were low. With the growing need for maintenance services, many firms began sending software programmers to clients on a temporary basis. This is the phase that is often referred to as the manpower supplementation business or "body shopping" phase in the evolutionary model, where capability requirements were at the low level of individual's basic software technology knowledge and skills sufficient to carry out software maintenance tasks at the clients' location.

The entrants were of two types. The first were existing computer hardware firms diversifying into the software industry. These included computer hardware firms such as HCL and Wipro, as well as firms with large in-house data processing and system integration capabilities such as Larsen & Toubro. There were others such as BFL, Sonata, Satyam and Birla Horizons that were, before their metamorphosis as software firms, divisions of large and medium industrial groups.[8]

The second type of entrants were new start-ups such as PCS (Patni Computer Systems Ltd),[9] Datamatics, Infosys and Silverline. Current managers of top software firms worked in these companies earlier in their careers. Indeed, one of the best-known software exporters, Infosys, was founded by a group of seven PCS managers who broke away from PCS. Infosys's first contract was a support and maintenance contract with a client in the apparel industry for whom PCS had finished a large project.

Furthermore, the history of the industry shows that entry strategies varied by firms and not all firms entered the business segment to export software services. For example, some firms entered to develop packaged products (like Windows for Microsoft) as well as products for specific industries (Banking solutions, Tally for accounting) or products such as enterprise resource planning (ERP of Oracle) products. However, by the early to mid-1990s, software service exports increased greatly in importance. The result was a great surge of turnover among the leading software firms in India at that time, as shown by table 3.3 below.

Table 3.3: Top eight Indian software exporters

Rank	1980-81	1985-86	1989-90	1994-95	1997-98
1	TCS	TCS	TCS	TCS	TCS
2	TUL	TUL	TUL	TUL	Wipro
3	Computronics	PCS	COSL	Wipro	Tata Infotech
4	Shaw Wallace	Hindistron	Datamatics	Pentafour	Pentafour
5	Hinditron	Infosys	Texas Instruments (TI)	Infosys	Infosys
6	Indicos Systems	Datamatics	Digital (DEIL)	Silverline	Satyam
7	ORG	DCM DP	PCS	Fujitsu	Tata IBM
8	System	COSL	Mahindra-BT	Digital (DEIL)	CMC Ltd.

Source: Heeks (1996), page 89 for data up to 1994-95, and CMU Software Dataset for 1997-98

Although entry in the industry still appeared to be strong, there were signs that market leaders were beginning to identify niches and areas of specialization, in terms of technologies or functions, as well as vertical domains (industrial sector).

For example Sasken Communication Technologies (SCT) found their niche in the embedded communications solutions that helps businesses across the communications value chain accelerate product development life cycles (SCT corporate brochure). This had helped them win customers like European rail systems and to move into a new phase where the value they bring to the clients is seen as unique and domain expertise is seen as a critical knowledge for their competitive advantage which the clients want to internalize to avoid its falling into competitors' hands. Hence these niche EMFs were getting acquired by their principal users from overseas. For example, two firms, BFL and IIS Infotech, have been acquired by a Dutch bank and a British software service company respectively (Floyd, 2002). The postulation here is that the knowledge acquired in the IT sector was being leveraged by EMFs to also make inroads in the ICT sectors. The insight reveals that knowledge of basic information technology also produced capability in the EMFs to use and leverage them. This explains their rapid internationalization as the EMFs could extend their operations and offer their knowledge based services from a single sector of IT to multiple sectors involving ICT. In other words, capabilities were leveraged horizontally.

However a major consolidation of the Indian software industry still appears to be in the growth phase, because demand for a diverse range of domain expertise is still growing rapidly in an industry, where economies of scale are relatively unimportant and innovation and uniqueness of technology and solutions drive the client's business model. Yet low level coding and software maintenance jobs will remain the backbone for stability of EMFs whereas innovation in niche markets will drive their profitability and growth. Therefore capability leveraging is expected to continue both horizontally and vertically.

3.3.5 Institutional effects on industry dispersion and capability development

Geographical concentration and location advantages in IT industry in India have been cited by various researchers in the literature (Arora *et al*., 2001; Banerjee, 2003). It is important to investigate in detail the industry dispersion and the plausibility of the capability development hypothesis that is associated with certain location or technology hubs of the EMFs' headquarters.

Contrary to popular belief, as Table 3.4 shows, the industry is not concentrated in Bangalore, although Bangalore is certainly a very prominent location for firms in the software industry.

Table 3.4: Revenue distribution: Nasscom member firms by geographic region, 1997

Region	Revenue ($M)	Number
Mumbai & Pune	597.5	107
Bangalore	323.6	84
New Delhi-Noida & Gurgaon	285.8	105
Chennai	130.9	34
Hyderabad	62	21
Others	57.6	64

Source: CMU Software dataset (n= 405)(Gartner, 2002)

Besides Bangalore, locations such as Bombay, Pune, Madras and Hyderabad are important as well. However, with the exception of the region around Delhi, there are no noticeable clusters in the northern or the eastern regions of India. The distribution of engineering colleges, concentrated in the western and southern regions, closely mirrors the distribution of the software industry. Furthermore, Table 3.5 shows that engineering colleges are heavily concentrated in these two regions, which also is another explanation of the geographical distribution of the development centres and home base of the EMFs.

Table 3.5: Number and Capacity of Engineering Colleges in India, Approved up to 1998-99 by region.

Region	Number of Colleges	Sanctioned Capacity (# of students)	% of Sanctioned Capacity at Self-Financed Colleges
Central	50	9470	0.52
East	25	4812	0.26
North (incl. North-West)	140	25449	0.42
West	140	34165	0.74
South (incl. South –West)	308	82597	0.79
Total	**663**	**156493**	**0.69**

Source: Ramarao, 1998.

This provides another insight in the research investigation area, namely capability development through educational establishments. Domestic knowledge institutions helped EMFs to develop the appropriate technological capabilities through the supply of skilled engineering graduates, and regional knowledge institutions helped industry dispersion across the country.

3.3.6 Development of Skills and Human Capital by Private Educational Institutions

Knowledge based service industry is greatly dependent on human knowledge capital and skills. A study of the Indian software industry is incomplete without understanding the skill development, deployment and supplementation.

The competitive dynamics of high-tech industries, which are subject to rapid technological change, have to do with more than the endowment of a large pool of low-cost skilled manpower (Lall, 1996). At present, India's educational institutions annually generate between 75,000 and 80,000 software professionals, of varying technical skills, with proficiency in the English language. About 16,500 engineering graduates are produced by the formal institutions and the rest by the private training institutes (UGC data). This pool of skilled labour is produced by some of the world class research institutions such as the Indian Institute of Science in Bangalore, and a half dozen Indian Institutes of Technology. This has provided a major incentive for MNCs to enter India to tap into this low-cost but high-skilled workforce (Arora and Athreye, 2002; Arora *et al*., 2000; Arora *et al*., 2001; D'Costa, 1998; Patibandla *et al*., 2000).

Accredited engineering capacity in India increased from around 60,000 in 1987-88 to around 340,000 in 2003, and IT capacity increased from around 25,000 to nearly 250,000[10]. It is likely, however, that the actual number of IT admissions increased more slowly and the number of IT graduates increased even more slowly. NASSCOM figures indicate that in India the number of IT graduates increased from 42,800 in 1997 to 71,000 in 2001. By comparison, the number of IT graduates in the US increased more slowly from 37,000 in 1998 to 52,900 in 2000 (IDC 2002).

During this period the IT workforce (which does not directly correspond to IT degree holders) in the US was probably eight to ten fold larger than the IT workforce in India (Lorenz, 2006).

During the '90s, a substantial proportion of additional engineering capacity was created in the private sector. Education which was predominantly a state subject for centuries also underwent transformation at the beginning of the liberalization-privatization-globalization (LPG) era (Dahringer and MuÈhlbacher, 2001). Several private institutions and overseas collaborations made inroads into the educational and mostly vocational service sector, thus capturing the growing needs and demands of the IT professional. A quick glance on the case study of one such private and vocational education enterprise will accurately establish this point.

A private institution named NIIT (National Institute of Information Technology) was set up in 1981 by young Indian entrepreneurs to pioneer the concept of high quality IT education in India. . Apparently NIIT has trained one out of every three software professionals in the country (when low end operators and hardware maintenance services are included).[11] In 1982, NIIT set up education centres in three cities in India namely Mumbai, Delhi, and Madras and followed them up with one in Bangalore in 1983. In the same year NIIT introduced corporate training programs. By 1991 NIIT's footprint reached overseas as they set up their first overseas office in US. In the same year NIIT received its first CBT assignment from IBM. By the year 2000 their software operation started in 18 countries. This EMF was given

Microsoft's"Best Training Company Award" in 2001. Subsequently NIIT acquired three companies in the US in 2002, and launched NIIT SmartServe for Business Process Management thus climbing the value chain. The prestigious CMMi Level 5 certification was acquired by NIIT in 2003 for their software business and to further their globalization efforts they initiated their 'Global Solutions Business' through another entity named NIIT Technologies Limited in 2004. Today this EMF services corporations and individuals in 42 countries across North America, Europe, Asia Pacific and Australia with its wide ranging learning solutions in the software industry. The group offers application development and management, enterprise solutions, including managed services, and business process management, and caters to industry segments like banking and financial services, insurance, transportation, retail and manufacturing. They have also successfully forged alliances with global IT majors like Computer Associates, IBM, Informatica, Metalogic, Microsoft, NetIQ, Oracle, SAP and SEEC, making them a truly global enterprise from an emerging economy in the knowledge based services industry (interview transcripts and company profile).

Therefore human capital and capability development by a non-governmental vocational education enterprise, through training and supplementing skills to global majors, was one of the critical drivers for the software industry capabilities development.

More generally, Figure 3.1, which is based on data from the All India Council on Technical Education (AICTE), shows that nearly 80% of the accredited intake capacity for engineering students at the undergraduate level in 2003 (about 340,000) was in privately financed colleges (those that did not receive grants from the government). This establishes the role of domestic private and non-governmental institutions' roles in skills development and capability creation.

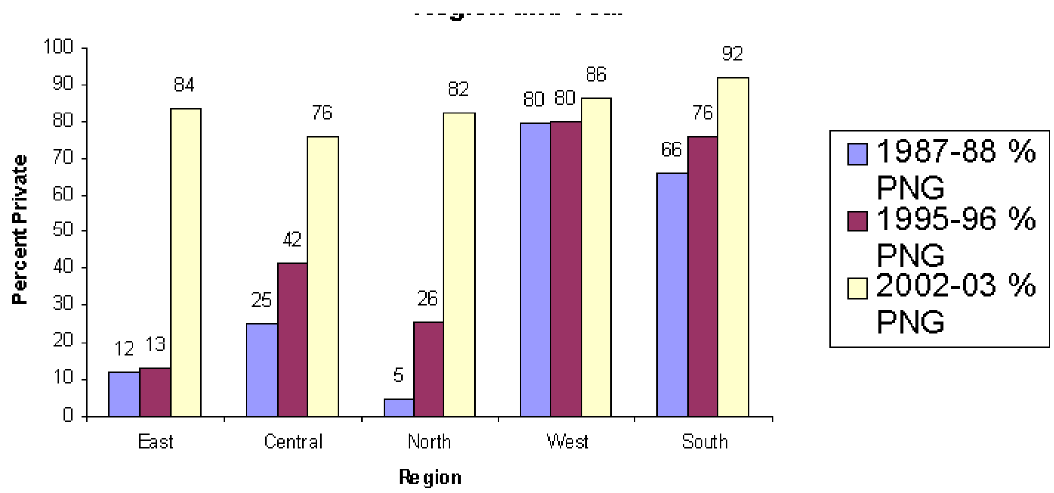

Figure 3.1: Share of Privately Financed Colleges in Indian IT Capacity, by Region and Year

Source: Based on data from the All India Council on Technical Education (AICTE).

Notes: PNG refers to "Private Not Granted", which are privately financed colleges.

The role of privately financed colleges, the vast majority of which were created in the 1990s, is even more emphasized if one looks only at IT related engineering programs. However it is not without controversy. Such a rapid expansion of engineering training capacity has raised valid concerns about the quality of the education and a variety of other social costs.

Nonetheless, such a skills supply response of a nation with vast young and eager human resources indicates the flexibility and adaptability of India that is otherwise less predominant in more developed countries. EMFs have been able to leverage and reserve of valuable and appropriate human resources in India with significant returns in their global deployment due to such flexibility and adaptability in quickly scaling up of skilled manpower supply by the domestic knowledge institutions.

There is a gap in the literature in the area of domestic institutional effects on the continuous and sustainable developments of the dynamic capabilities to supplement the skills gaps. This could have provided more accurate insights on capability development in the areas of human capital developments and skill supplementation efforts by the domestic knowledge institutions.

3.3.7 Leveraging opportunities through foreign linkages and externalities

The following section provides the industry linkages from a historical and evolutionary perspective. These linkages need special deliberation due to their significant contribution towards the export of services by the EMFs. The study of capability development of the EMFs to leverage such external opportunities through linkages could be an important area of investigation to discover the cause of dynamic learning and accelerated growth.

3.3.7.1 Crafting capabilities to seize unique global opportunities

The Indian software industry is perhaps the clearest example of export led growth. The impetus for growth initially took the form of an on-site model, in which the Indian firms (and many US based firms as well) literally rented out software programmers to work at the client's site and under the client's management. India based firms enjoyed a clear cost advantage over their US rivals in the lower end of software services, and did not compete directly with market leaders such as EDS, Computer Science Corporation, Anderson Consulting (now Accenture) and IBM (Palich and Gomez-Mejia, 2009). With booming demand, Indian firms had the opportunity to learn how to manage relatively large projects, as well as gain knowledge of the psyche of the overseas clients, their expectations and work culture. This helped to quickly tackle the learning curve and create greater acceptability of EMFs in overseas market. Euro conversion projects and Y2K projects were well suited to the kind of competences and skills that the Indian software industry had by then developed. It is instructive to note that both Y2K and Euro conversion projects were not opportunities created, but seized by EMFs. The software industry needed an impetus to leap from the inception stage to the growth stage and the external factors like Y2K and Euro conversion seem to have come at the right time (Sheth, 2006). The large amount of manpower that was required to handle Y2K issues was provided by the EMFs. This in turn gave them the critical mass required to create a sustainable organization and have a stable base of core revenue earnings.

Seizing such global opportunities like Euro conversion and Y2K needed commensurate capability and delivery mechanisms that the EMFs custom created and leveraged.

3.3.7.2 Externalities: Evolution of capabilities due to the influence of foreign multinationals on domestic policies

A large number of knowledge based enterprises (EMFs) started often with extremely meagre resources but overcame this limitation by leveraging resources from their client multinational corporations with whom they struck partnerships. For example in 1989, General Electric became early sponsors of the Indian IT industry which was followed by a series of American MNCs to using Indian IT professionals and enterprises as their strategic operations delivery partners. The involvement of powerful American industry leaders also accelerated the Indian government's liberalization reforms in policy matters and helped to quickly lower barriers to international trade. One major policy reform which accelerated capability formations was the recognition of software as an industry by the Government. This allowed the investments in this sector to be eligible for incentives (including export incentives). Thus the investments in IT capability clearly guaranteed meaningful returns to EMFs.

The Government also reduced import tariffs for components and announced a domestic science and technology policy which liberalized access to the latest technologies abroad to compete globally and to capture a share of global software exports. (Pradhan, 2009a). This ensured that capability enhancement through hardware upgrades and investments in infrastructure was now more affordable. This therefore explains another dimension of the causes and results of capability enhancements in the IT sector.

As demand for IT enabled services grew, the Department of Electronics (DoE) initiated targeted infrastructure building in the form of Software Technology Parks (STP) in India in and around 1990 (Dossani, 2005). STPs were conceived with the idea of catering specifically to the needs of foreign multinationals and to eliminate a lot of bureaucratic, legislative and economic barriers. Hence STPs were equipped with state of the art infrastructures matching overseas conditions, which allowed uninterrupted 24 hours dependable power supply (when the neighbouring domestic industrial estates had none), specific and targeted tax exemptions and the allowing of 100% foreign ownership with repatriation clauses. In other words the multinationals influenced the government to create the most suitable and conducive FDI environment in return for their software outsourcing commitment to India.

3.3.7.3 Capability development due to domestic demand

Around 1986 all state-owned banks in India were standardizing banking systems with uniformity across the sector and also integrating systems (Monetary Policy-Reserve Bank of India). Hence there was a need to use the new technology, namely the UNIX platform, over the old MS-DOS (TCS corporate brochure). The software professionals were required to learn or upgrade their knowledge and skills in this area to deliver the project. Soon UNIX became the industry norm. To deliver new projects and to maintain the current UNIX based systems, the demand for software professionals who were knowledgeable and skilled in UNIX increased manifold (Filippov, 2010). This domestic demand translated into knowledge competency and assisted the industry to become a global player. EMFs from India were recognized internationally as experts in UNIX based systems. Thus domestic market demand and technology pressure compelled Indian software professionals develop expertise in UNIX which later gave them an early start in a globally competitive market (Lecraw, 2007).

This is a significant historical fact that has directed the Indian IT industry in the current strategic course. Current literature has not documented such valuable causes of capability enhancement, failing to identify what domestic compulsions the emerging nations and their firms faced and what were the effects of these compulsions and challenges in their dynamic capability development. However this investigative fact provides a meaningful insight on how domestic demand helped capability development.

3.3.7.4 Impact on competency development due to separation of innovation and production locations

In the context of emerging economies taking up mostly the lower levels of software production and maintenance jobs, the implications of the physical separation of more innovative segments of the industry to the US needs to be considered,. It is observed that in many industries the locus of production and the locus of invention are physically separated mostly due to the effective utilization of the corresponding centres of excellences based on comparative advantage. This is particularly true when the body of knowledge underlying the invention process has a strong scientific connotation and locational advantage. Building on earlier work by Lamoreaux and Sokoloff (1996, 1997), Sutthiphisal (2004) studied the location of production and invention in three different industries during the Second Industrial Revolution, namely the textile, shoe, and electric industries. Sutthiphisal (2004) concludes that in general the locus of invention did not shift with the locus of production as the latter moved to other locations. Moreover, he observes that the spatial link between location of production and invention is weaker in the more "science-based" electric industry. Using data from a century later, Mariani and Cesaroni (2001) and then Mariani (2002) studies the location of R&D and production facilities by the Japanese MNCs in Europe. Mariani (2002) concludes that in low and medium R&D industries, R&D labs are more likely to be located close to production facilities, than in more R&D-intensive industries. Extending this logic in the IT industry, if the software industry is highly R&D-intensive, then there could an academic argument against any justification of co-location of software innovation and production centres.

However it is undeniable that the physical separation between the design development and production activities comes with its costs, including costs of transaction, contracting, communication and management. Physical separation of activities may reduce the potential learning opportunities from production (e.g., Arrow, 1962; Enos, 1962) or from the feedbacks and linkages emphasized by Kline and Rosenberg (1986). Nonetheless, the lower cost of labour and the ability to work around the clock are important offsetting features of offshored production location. Besides, the greater project management and delivery abilities of software firms from emerging economies are perhaps the most appreciated benefits that the US clients enjoyed which made them early sponsors of these EMFs. To examine this debate in the context of this specific research area a closer look at the IT project management methodology is called for.

Software engineering projects can be divided into several separate discrete elements (Paul, 2004). At a technical level, it is not mandatory that all individual discrete elements of the project works be performed by professional engineers and engineers alone. There could be several other categories of workers who could add substantial value in the whole delivery process without having an engineering degree. In fact a substantial portion of the routine development activities could well be delivered by a technically trained and vocationally qualified workforce (PMI, 2004). Since the cost of non-engineers could be significantly lower, innovation in the delivery mechanism using lower cost-efficient manpower in the component split is an accepted strategy in software project delivery. EMFs used these strategies early in their entry cycle to have competitive advantages (Varghese, 2006). Moreover due to the virtual nature of the workflow and data transmission it is not necessary that all activities and tasks are performed in any given location, on-site, off-site or near-site. Hence unlike other manufacturing or R&D projects, software services projects could be created, monitored, tested and delivered remotely, thus opening up the possibilities of numerous delivery options (Swami, 2006). These options are normally dictated by the nature of the project and chosen from a commercial and business perspective of the client organization.

Therefore in software projects it is common to observe that the locus of production and the locus of invention are physically separated, mostly due to the effective utilization of the corresponding centres of excellences based on comparative advantage. The comparative advantages are linked to the skills and capabilities associated with each centre of excellence and therefore in the physical separation of project components there are inherent separation of skills and capabilities.

The investigation of EMFs clearly identified that an innovative service delivery model (e.g. global delivery model) is used to achieve competitive advantages where locus of production, innovation, testing and implementation have been innovatively separated by the EMFs. Therefore capabilities of each of these component delivery locations were custom developed, based on the centre of excellence concept.

3.3.8 International migration and mobility (brain-drain): Impact on dynamic capability development

By the late 1980s, India was graduating approximately 150,000 English-speaking engineers and science graduates, with only a limited demand for their services from the internal economy (Iglesias and Veiga, 2002). By this time, India's economic liberalization was also well under way while the information technology revolution in the developed world had begun to take root, and shortages of skilled programmers and IT professionals were beginning to develop. With a history of top talents from Indian graduate schools heading massively towards the US year after year, bright Indians were found working in very substantial numbers in US firms and Silicon Valley projects. Some of them played an important role, although yet to be documented in the academic literature, in matching the buyers in the US with the suppliers in India (Deng, 2004). On one hand this continuous brain drain bled the inventory of top skills and talents for domestic industry, but it also indirectly helped the EMFs to connect with the US corporate, which was critical for winning business through such alma maters. The debate is still continuing on which side the balance tilted and to what extent.

The argument of brain drain is strengthened by statistical evidence that reveals that a good proportion of human capital deployed by the EMFs on-site in US, Europe and Australia did not return to India (Agarwal, 2005). They were either absorbed by the local employers due to their demonstrated technological capability and value addition or they applied for skilled migration and stayed in the host countries. Therefore the recurrent loss of trained and experienced workers continuously put pressure on the domestic industry's ability to retain a highly skilled workforce. For sustained growth they needed to showcase to their international clients both organizational capability and a talent pool of skilled and experienced manpower. Training new team members delayed delivery of the projects, which had to be countered by putting appropriate buffers in the system. This inflated costs of operation, making the industry more vulnerable to global competition.

In summary, though the global dispersion of the skilled manpower formerly concentrated in the home country brought in benefits, it also created challenges for EMFs. Despite the many potential benefits of a diaspora, (Kumar and McLeod, 2001) the outflow of skilled engineers, scientists and doctors does represent a net loss of talent and cumulative capability. The corresponding investments to replenish the gross capability loss then added pressure to the learning and training establishments.

The broad question about the net effects of such international mobility of skilled people on the home country is a complex one and needs more understanding and research. Kapur and McHale (2005) conclude that the benefits from the diaspora outweighed the costs for the three Is (India, Ireland, Israel) for the development of the software industry.

What is not known is the impact of brain drain in the evolution of the EMFs' capability progression from the lower end to the higher end of the supply chain. How these EMFs leveraged these challenges in their favour and continued to grow capabilities dynamically, is dealt with in more detail in the subsequent chapters.

3.4 Industry Analysis

3.4.1 Mapping the Indian IT Industry

This section dwells on the types of firms, their comparative standings in the industry, state support and interventions that helped the firms, activities and investments they made, impact of R&D investment on dynamic capability building and locational advantage of R&D infrastructure setup for accelerated learning. This gives a holistic view and multidimensional mapping of the firm level dynamics for capability development.

Firms are categorized by their origin, operations or holding patterns and through understanding their compositions, linkages, areas of domain expertise or engagement, size, scope, growth and driving engines etc. The State's participation is observed through historical, economic and political policies, and chronological support and interventions on both micro and macro level in an evolutionary model.

Lastly, the quality of human resources is evaluated based on their value adding capability and hence the issues concerning sourcing, growing, retaining and leveraging them. In other words, the section's focus is to understand the features and scope of human capital, its sources and contributions. Firm level interventions for enhancing human assets capability and strategies are deployed for leveraging the human assets capabilities.

3.4.1.1 Type of Firms in Indian IT Industry

The Indian IT Industry can broadly be divided into three categories of firms for comparative study. While there could several ways to categorize the firms, for the purpose of this research the following three categorizations were found to be most appropriate. First are the EMFs which are firms of Indian origin engaged predominantly in global business, like Tata Consultancy Services, Infosys, WIPRO, HCL etc. Secondly the existing foreign MNCs (FMNCs), who are global giants in the knowledge based service delivery domain like IBM, Accenture, EDS, etc, which have their own subsidiaries in the emerging markets but headquarters in developed countries like the US, Europe, and Japan etc. Thirdly the domestic firms (DFs) who operate mostly as standalone enterprise without any major linkages with any foreign companies or their subsidiaries.

While the focus of this study is predominantly concerned with the first two categories (EMFs and foreign MNCs), it will be worthwhile to use DFs as an independent datum for meaningful comparisons. Therefore a quick review of the evolution of the DFs would provide the requisite context.

Given a weak copyright regime which led to rampant software piracy, many of the firms in India did not consider software package development as a strategic option.[12] To address this problem, the government initiated a series of measures.[13] As a result, the piracy rate in the country came down from 89 per cent in 1993 to 60 per cent in 1997 (NASSCOM, 1999). These initiatives, other than reducing software piracy, also induced the creation of DFs that catered to the newly found opportunity of software packaged products. The CMIE data shows hundreds of Indian companies, both large and small, started purely as standalone domestic firms with no foreign connections and engaged in the business of software product development and domestic service maintenance. For most of these DFs, domestic sales accounted for a substantial part of their revenue (Joseph, 2009) as they developed packaged software, which is sold in the domestic market.[14]

3.4.1.2 Relative standing of the segmented firms in the IT Industry

The figures in Table 3.6 show that EMFs and FMNCs have much higher turnover and profitability compared to the DFs. On average, during 2001 to 2010 the profitability of FMNC and EMFs were recorded at 17% and 19% respectively compared to only 9% for DFs. In the same period the average turnover of the EMFs and FMNCs were INR 60 million and 19 million respectively compared to only INR 3 million for the DFs.

Table 3.6: Segment Comparisons: Turnovers and Profitability

	Average Turnover per Firm types (Rs. Mn.)				**Profit to Turnover Ratio (%)**		
Year	FMNC	EMF	DF		FMNC	EMF	DF
2001	4	11	1		26	18	11
2006	13	36	3		17	21	3
2007	18	50	2		17	21	10
2008	20	70	3		14	23	11
2009	25	86	4		12	22	11
2010	31	108	4		13	10	8
2001-2010	***19***	**60**	**3**		**17**	**19**	**9**
Relative Standing	**6.3**	**20.0**	**1.0**		**1.9**	**2.1**	**1.0**

Indexed Comparison of the Segments (Turnover X Profitability) **12.0** **42.0** **1.0**

Source: CMIE data

On a linear scale, the EMFs were around 20 times larger in organizational size than the DFs and more than three times larger than their foreign MNC competitors. The year on year growth of turnover also indicates that while the FMNCs were growing at 86% per annum, the EMFs more than doubled (109%) on an average year on year basis in these nine years compared to only 44% growth by DFs. This shows that the acceleration of growth of EMFs was 27% faster than the FMNCs in India. Since the comparative profitability of the EMFs were also better than the FMNCs, the combined effects of accelerated growth and continuous and consistent better profitability year after year brought an exponential competitive advantage in favour of EMFs.

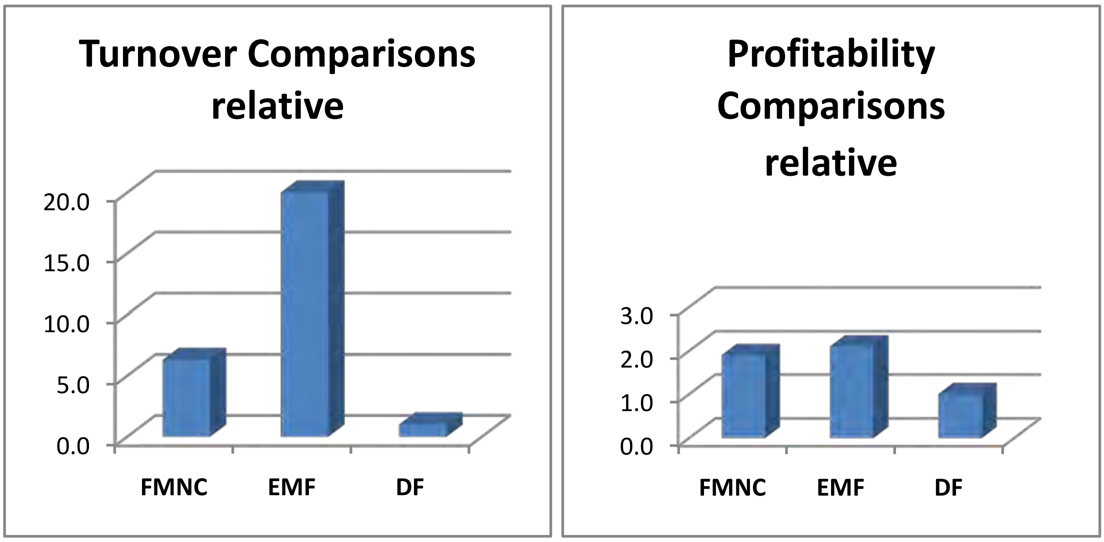

Chart 3.1: Segment Comparisons: Turnovers and Profitability

Chart 3.1 shows the comparative status of these three segments on both the measures.

However the combined effect of profitability and turnover (index) provides an accurate measure of the segments potential standing which is depicted in Chart 3.2.

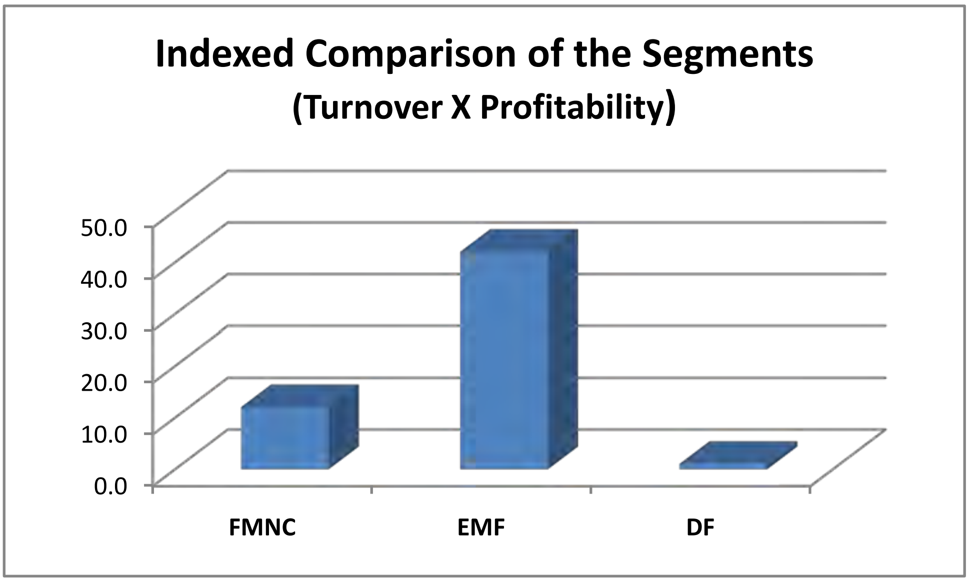

Chart 3.2: Indexed Comparison of segments

The indexed comparison shows that the FMNCs were 12 times better and EMFs were 42 times better than the DFs in the indexed segment standing scale. A bipolar index comparison shows EMFs' standing was 3.5 times better than the FMNCs making them a clear leader in the IT industry segments. However the literature does not explain how the requisite dynamic capabilities that sustained their competitive growth in that decade were acquired and maintained by the EMFs.

3.4.1.3 State Participation in firm level capability development

State participation is observed through historical, economic and political policies as well as interventions in both micro and macro level to get a perspective of how it helped the capability development of the firms.

Literature reports that the Government of India undertook various policy and institutional interventions specifically targeted to enhance the supply of skilled manpower and R&D capability (Kumar and Joseph, 2005). Tax subsidies on R&D investment, fiscal moratoriums and reducing duties, taxes and levies of computer hardware helped the individual firms in their infrastructural investment efforts. Thus government policies increased firm level affordability of investments in capital goods; helped to release funds through the banking sector, increased profitability and helped firms remain competitive. It also supported new start up firms with single window clearances, allocation of land and subsidized electricity that saw a large number of new entrants in the software industry (Nasscom membership data).

Government incentives and industry grants for setting up new manufacturing and service delivery centres also induced highly skilled software technocrats and engineers to return to India from Silicon Valley and to set up manufacturing facilities of the sophisticated chip design, VLSI (Very-large-scale integration) projects, semiconductors and micro processors (IEEE, 2011). As a result the total value of output and export which was less than five per cent in 2005 is estimated to increase to over 10 per cent in 2012 (Planning Commission 1999-00 to 2011-12).

Though there are sufficient data on government's policy initiatives, liberalization and targeted support of the software industry, the academic literature does not capture the specific impact of these individual elements of state intervention to link with specific competency, faculty, aptitude and skill development of the Indian firms to help their progressive development.

Investments in infrastructure have a direct bearing on capability development and hence such developmental linkages associated with state support are critical interventions that explain the impact of the State's participation in firm level capability development.

3.4.1.4 Firms' activities and Investments for enhancing dynamic capabilities

The software industry is termed a knowledge based service industry and hence it is obvious that the backbone of the industry is domain knowledge of the technology spaces. The competitive advantage at the firm level is highly skewed towards its internalization of knowledge which is either proprietary (IP) or tacit. Hence R&D investments and efforts that continuously upgrade such skills and knowledge (capability) are the driving engine for survival and growth of the firms in the IT industry.

A number of researchers have used conventional statistical techniques to measure R&D intensity (measured as R&D expenditure as a proportion of sales) to quantify or associate investments at firm level with innovation. Joseph and Abraham (2005) developed an index named Index of Claimed Technological Competence (ICTC) using firm level information on their areas of specialization (Joseph and Abraham, 2008). The theoretical construct of the ICTC they had developed from the literature on technological opportunity.

The results and the estimates in their study show an upward mobility of firms in their technological competence. Their study explained that in 1998 over 56 per cent of firms had a low index (defined as less than 30%) whereas by 2001 (post Y2K) the percentage of low index firms declined to around 44 per cent. Similarly in the higher index category (defined as greater than 60%) the share of firms increased from 5.3 per cent in 1998 to 8.3 per cent in 2001.[15] Hence it could be concluded that R&D activities and investments in technological competency (capability) is a significant contributor for firms' development and growth.

This was further validated by the fact that as the Indian firms started developing and internalizing distinctly different capabilities that gave them global competitive advantages, the FMNCs increasingly collaborated with the Indian firms, using FDI and equity participation to bridge the gap of their capability (Ernst and Lundvall, 2000).

Lastly, the review observes that with equity participation and having controlling shares, the FMNCs started outsourcing higher end tasks like knowledge process outsourcing to overseas locations (Swami, 2006) thus making the Indian firms able to move up in the values chain from being a middleware supplier to a partner in the global innovation network (GIN).

Therefore it can be argued that the firm level activities, linkages and investments had enhanced the firm level technological competency which in turn had enhanced the firm level dynamic capability, leading to accelerated and unconventional growth of these firms. These data provide understanding of the "organizational capability" development at the firm level in this research.

3.4.1.5 Firm level R&D activities for accumulation of knowledge capability

A survey of FDI in R&D conducted by the Technology Information, Forecasting and Assessment Council (TIFAC, 2006) of the Government of India's Department of Science and Technology, provides data on foreign R&D investments and activities for the period 1998-2004. The report indicates that prior to the 1990s India had less than ten foreign R&D centres. However in the next decade, 1991-2000, this number jumped close to 50, a five times jump in R&D activities by the foreign firms. Comparing data for the next decade (>year 2000) it is observed that the same level of investments and activities in R&D by FMNCs were achieved in less than half the previous time (post Y2K), thus indicating a pattern of acceleration at which R&D activities and the innovation outcomes had been internationalized at the firm level in India post the year 2000.

Table 3.7: Foreign R&D Investments in India (< year 2005)

Country of FMNCs base	Country's Share No. of R&D Centres %	Country's Share R&D Investments %	Country's Share R&D Employment %
Australia	1	0.10	0.19
Canada	4	1.02	2.81
China	3	6.03	2.97
France	6	1.74	4.33
Germany	9	7.12	9.69
Japan	7	0.78	0.92
Korea	3	6.06	2.98
Netherlands	3	1.36	2.94
Sweden	2	0.10	0.25
Switzerland	2	0.59	0.81
UK	8	4.01	6.23
USA	52	70.37	67.40
Total (%)	100	100	100

Source: Derived from TIFAC (2006)

Table 3.7 shows that US based FMNCs accounted for 52 per cent of the total number of R&D centres prior to mid 2000. The US firms' share in actual R&D investment (70%) and R&D employment (67%) indicates that they were the leading adopters of the outsourcing and offshore technological partnering strategy with the EMFs. The US was followed by Germany, looking across all the three indicators in the table. The other European FMNCs from the UK and France are also seen following Germany's footstep in R&D activities and investments. It is worth noting that Asian country firms from China and Korea also had significant activity in R&D employment (~3%) and R&D investments (~6%) in the IT sector of India, followed by Japan. Therefore it can be argued that while firms from the US led the linkage and leverage strategy (almost half of the R&D activities), the rest of the activities in R&D came from representative countries from Europe, Asia and Canada, thus making this phenomenon a truly global trend.

This provides meaningful insight into the FDI participation from diverse global centres and the pace of investments by FMNCs that helped capability development in offshore locations through linkages with local firms. The activities for capability development observed in the infrastructure development of R&D centres for innovation provides insights on the leveraging of these linkages for accelerated learning (knowledge capability development) and developing intellectual property in offshore locations by firm level partnership and collaborations.

3.4.1.6 Locational and cluster effects on capability development

The literature is rich in pointing out that location plays an important role in capability development. In the classical model, the cluster effect is best derived (Porter, 2005) if R&D centres are well located. However whether this is true in the Indian IT industry needs to be validated with facts. Therefore mapping of the IT industry in India and observing any evidence of concentration of activities and R&D locations through the lens of regional capability inventory is critical to establish firm level correlation of capabilities with locations. Table 3.8 provides the information below.

Table 3.8: Locations of activity and R&D centres in India

Ranking	City	Description	Share of R&D Centres %
1	Bangalore	Leading in Information Technology Industries in India.	34
2	Chennai	Second largest exporter of Software next to Bangalore.	12
3	Hyderabad	Another fast developing Southern Hub.	11
4	Pune	A major industrial city and an education centre for knowledge linkage in IT industry.	11
5	NCR	The National Capital Region of India comprising Delhi, Gurgaon, Faridabad, Noida, Greater Noida and Ghaziabad. Witnessing large investments in infrastructure in IT projects.	10
6	Mumbai	Commercial, entertainment, financial capital of India. Witnessed tremendous growth in IT and BPO industry(63% in 2008). EMFs like TCS, Patni, LnT Infotech, I-Flex WNS are headquartered here.	8
7	Kolkata	IT hub of eastern India. All major FMNC and EMFs have large establishments here. State Govt investing in mega IT projects to build new IT parks.	6
8	Mysuru	Upcoming and benefiting from the spillover of Bangalore being the second largest city in the state of Karnataka. Contributed US$275 million to Karnataka's IT exports in 2009–2010. EMFs like Infosys have largest technical training centres and Wipro has established its Global Service Management Center (GSMC) here.	3
9	Mangalore	Major EMFs like Infosys, Wipro, and MphasiS BPO have establishments here. Mega investments underway to create 3 I.T. parks, with Export Promotion Industrial park (EPIP) and Special Economic Zone (SEZ).	3
10	Coimbatore	A well established industrial city and second largest city in the state of Tamil Nadu, now being transformed to suit IT industries.	2
			100

Source: Shares of R&D centres estimated from Nasscom data.

Table 3.8 shows the top ten clusters of IT activities and R&D locations in India. It is observed that the R&D centres are co-located with the major delivery centres in India. The centres of production and centres of innovation are not separated within the country because there are apparently no specific advantages. On the contrary they are co-located due to several synergy benefits and savings (Varghese, 2006). Firstly, skills and talents are well dispersed within India and especially at the bottom and mid segments of the firm level human resource pyramid (capability dispersion). Secondly, regional talents can be acquired and retained at lower wages locally, if they are procured locally and deployed as the workforce in local establishments (capability retention). The cost of migrating the skilled work force increases wage costs as it is associated with relocation allowances mainly from higher housing costs. Young adults (skilled graduates) in India are culturally expected to live in joint families and in parents' homes, even when they join the productive workforce. This is a significant cultural difference from the western world that keeps the needs and hence the wages low at the entry and mid level of skilled workers in India. Thirdly, every state government has special incentive programs in terms of highly competitive tax benefits, land availability, etc, to attract and retain industry in each state (Economic Review 2011). The incentives are negotiable and the larger the investments the better the deals the industry can negotiate with the state governments, employment generation being one of the main reasons for such political patronage. Therefore dispersions of industry activity and organizational capability have helped the IT firms in their corporate governance and economic model. Fourthly, though the educational curriculum (knowledge capability development) is nationally policy driven for consistency, mostly the educational institutions are state run, state funded or privately operated by local entrepreneurs which independently cater to the industry needs in each state[16]. Therefore the supply of skilled local talent (skill capability) is also well dispersed in India and well balanced in the equivalence scale. This ensures there are no pressures of sourcing the lower and mid segment of technologically skills manpower from outside the state. Lastly, since the knowledge based IT industry is manpower intensive, industry tends to mitigate risks associated with industrial relations and human resources issues well by dispersing them geographically and handling regional issues locally. All these and a few more social and economic factors explain the dispersion of IT capability and R&D activities shown in Table 3.8.

Table 3.8 also points out that Bangalore enjoys the early start up advantage. The individual firms derive the best cluster advantages by being situated in this hub that continues its number one position although the share is diminishing in relative percentage terms as other centres like Chennai, Hyderabad, Pune, Mumbai, Delhi and Kolkata are fast developing.

Therefore the geographical dispersion of most renowned IT firms' headquarters is explained due to the fact that the combined operating entity (operations and R&D) is location neutral domestically. This is contrary to the same firms' international operating model where there are no specific advantages of co-locating centres of production and centres of innovation and therefore the service delivery model is fragmented by its individual discrete elements and linked in a virtually unified supply chain. It is therefore inferred that in the domestic IT industry scenario capability development is not due to cluster advantages or any one specific locational advantages (like Bangalore hub) following Michael Porter's model, but is due to being well dispersed geographically across India with dispersed capability creation and retention in states and regions.

However there is a gap in the literature to clearly establish the correlation between investments in R&D activity based on capability assessment of locations. It is not clear from the facts and the literature whether location of the firm and its R&D centres play any significant role in its ability to develop capability or its acceleration.

3.4.1.7 Intersectoral capability development with foreign R&D investments:

Review of firm level foreign investments in R&D in India provides some meaningful clues to the attractiveness of specialization areas and domains by partners from global innovation networks.

Table 3.9: R&D Investment areas by foreign companies

R&D Investment Domains	Company Count	% of Total
Software development	29	24
Hardware development (including chip design)	6	5
Analogue circuit design (semiconductor)	3	2
Operating System development	4	3
Wireless telephony development	5	4
Fiber Optics and network engineering	3	2
Automobile Research	8	7
Chemicals and molecules Research (dyes and chemicals, agro chemicals, pharmaceutical drugs design, etc)	14	11
Others (power, engineering, biotech, medical, avionics etc)	51	41
Total	123	100

Source: TIFAC (2006) data used to calculate

Table 3.9 indicates that software development is by far the most attractive domain for R&D investments by foreign MNCs. Around 29 FMNCs invested in software development R&D activities in India, which represents almost a quarter (24%) of the total foreign firms with R&D FDI. This figure jumps to 41% when all information and communication technology (ICT) related R&D

investments are grouped together with the inclusion of operating systems, mobile telephony, fibre optics, computer networking and analogue semiconductor based circuit designing. A considerable number (50 plus) foreign innovation leaders have invested in R&D activities concerning all these IT areas.

It is clear that the attractiveness of R&D investments from the global innovation network partner firms is in the domain of IT and ICT areas, and within this category software development constitutes half the investments. Therefore it could be inferred that "intersectoral capabilities" are being developed with inward R&D FDIs in India at the firm level with varying degrees.

The table above also points out that both horizontal and vertical "intersectoral capability" is being developed at the firm level. This is evident from R&D investments in a diversity of areas as well as in IT related areas like semiconductors, chip design, automotive research, drug research, biotech, avionics, engineering, power, dyes and chemicals, etc.

These trends and linkages will transform the capability requirements and capability composition substantially as these linkages from global production networks (GPN) are delivering a wide range of diverse learning and dynamic capability at the firm level. Leveraging these additional linkages and learning, the EMFs are expected to move further in the value chain and be part of a global innovation network (GIN).

3.4.1.8 Effect of foreign equity in capability developments in Indian firms

Equity participation provides another firm level dynamic that helps understand the extent of the linkages of domestic firms with foreign firms and the effect of foreign participation in learning and capability development by local firms.

The average Indian promoter's share derived from the CMIE data is found to be 33%.[17] Chart 3.3 shows the distribution of Indian promoter's shares as a percentage of total equity of the domestic firms.

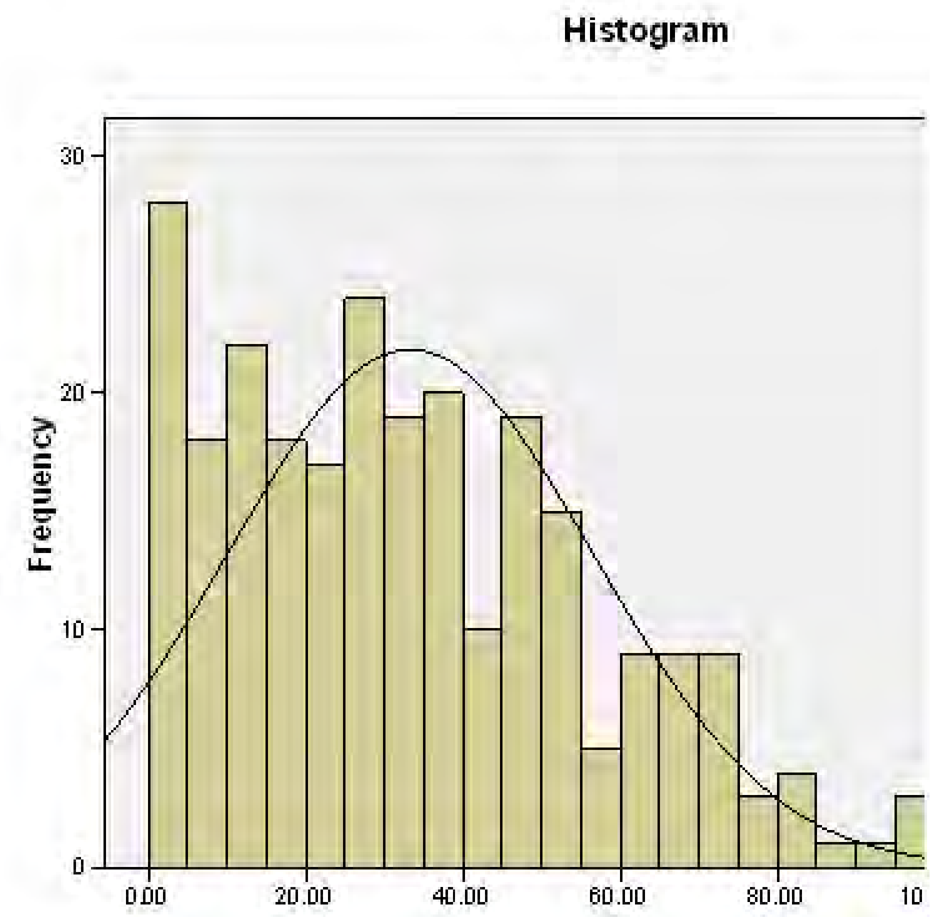

Chart 3.3: Indian Promoter's Shares in % of total Equity

Source: Derived from CMIE data

Amongst the segment where foreign companies participated with equity, the controlling shares (67%) have been held by the foreign partners. This indicates that the foreign partners invested in the local companies strategically to keep their operational control and more importantly the confidentiality of their intellectual property. The dissemination of knowledge has been protected within a close partnership. Thus the foreign firms restricted the capability development of the domestic industry only to their partners.

CMIE data was further analyzed to observe the trends of Indian shareholding over a thirty years' time frame. Chart 3.4 indicates that at the very inception stage the average Indian promoter's shares were 46.03% which progressively got diluted to 28.62% during the 1990-94 period, indicating progressive foreign participation with higher FDI. The foreign equity participation steadily decreased thereafter with Indian promoters consolidating around 34.33% average holding by the years 2000-05.

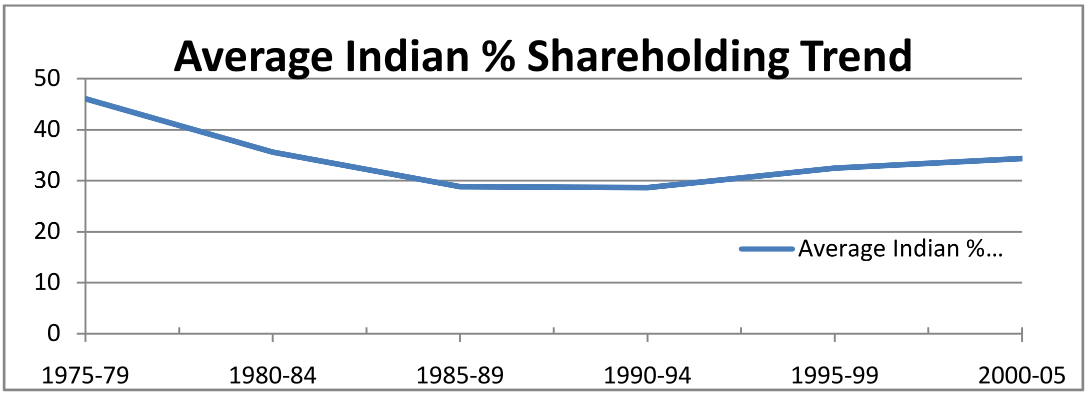

Chart 3.4: Trend of Indian Promoter's Shares over 30 years

Source: Derived from CMIE data

It can be argued therefore that as the domestic firms were getting more successful and the business model was getting clearer (more BPO, KPO and outsourcing), the need to develop capabilities through linking and leveraging foreign collaborators were getting lesser. Indeed foreign equity investments in Indian firms has been another source of learning and leveraging opportunity that has helped develop the dynamic capabilities of EMFs over a period of time.

3.4.1.9 Investments in R&D activities and capability development

In the early 1980s and 1990s EMFs' primary purpose was to earn foreign exchange (Gambardella and Ulph, 2003). Hence they were not particularly focused on alliances with foreign partners via inward FDI at that stage. Also the foreign enterprises saw India as a low cost delivery centre and EMFs as economical operational resources and not assets (Hanna, 1994). Hence FMNCs wanted to retain greater management control and knowledge confidentiality through controlling equity FDI. However the need for earning foreign exchange diminished substantially with accumulated foreign exchange reserve of nearly $300 billion (Dataquest, 1994). Therefore the EMFs' strategic focus shifted from merely earning foreign exchange to more value added domains which required global and intersectoral capabilities for sustainable competitive advantage (Varghese, 2006). Building global capabilities came through focusing investments in product and process innovation and R&D capabilities (Swami, 2006).

The progressive strategic evolution and greater shift towards R&D investment provide valuable insights on the process and stages of firm level resource development and capability enhancement. Consequently it is evident that investments in R&D at the firm level were undertaken to match changing business compulsions and global competitive pressure. Therefore the progressive focus on strategic R&D investments played a significant part in developing dynamic capability and shaping the Indian IT enterprise to its unconventional success.

3.4.1.10 Capability development through R&D outputs and global network

The R&D outputs and reported innovations are a good measure of firm level intellectual asset building and capability development. The European Commission Survey (ESC, 2009)[18] states "Anecdotal evidence suggests that the emerging economies are increasingly becoming a source for knowledge generation and the inception of ideas, forming a so-called new technological frontier' for the development of knowledge". Further examination of this observation provided the ECS with the sectoral choices of the IT industry along with automotive and agro-processing sectors, for detailed study.

The empirical and theoretical points of departure are the insights summarized from this ECS study. The evidence also suggests that the outsourcing of knowledge-intensive R&D activity and the emerging phenomenon of knowledge creation in developing locations is predominant in the IT sector (ECS, 2009). The following section provides the ECS survey primary data on the Indian firms to establish the baseline of knowledge about the extent and the causes of innovation and networking activities that developed the firm level capabilities.

3.4.1.10.1 Firm Level Innovation activity

A comparison of firm level innovation activity is provided in Table 3.10 below.

Table 3.10 indicates a wide dispersion of innovation activity undertaken by Indian firms in the areas of product, process, services, supply chain and support services.

Table 3.10: Firm level Innovations

Innovation Areas	DF %	FMNC %	EMF %	Total %
Product Innovation	50	69	88	62
Service Innovation	56	75	86	**67**
Process Innovation	43	57	78	52
Supply Chain Innovation	44	52	80	52
Support Services Innovation	43	56	84	53
Average by Firm Type	47	62	83	57

Source: Estimates based on European Commission's survey data: Period 2006 -09

Note: DF = Domestic Firms; FMNC= Foreign Multinational Corporations; EMF= Emerging market firms.

Most R&D activates are undertaken in the service sector (67%), followed by product innovation (62%). Almost half of the 324 firms surveyed indicated that they have engaged in at least one innovation activity in last three years (pre 2009) in process, supply chain and support services. The overall innovation figure of above 50% indicates a high level of innovation activity amongst the firms operating from India. This could partially explain the extent of capability developed by Indian firms that helped them dominate the IT sectors on an overall basis.

However a close look at the figures by the type of firms provides even better insight. 83% of the EMFs are actively innovating compared to 62% of FMNCs based in India and 47% of domestic enterprises with no foreign collaborations. In other words the innovation activities amongst EMFs are respectively 34% and 77% higher compared to FMNC and DFs. The main R&D activities of the EMFs are focused around product innovations (88%), closely followed by service innovation (86%). The innovation in the outsourced activity is reflected in the support service innovation (84%) and global service delivery innovation (80%), all showing high incidence figures.

This evidence indicates that a high level of innovation activity (>50%) amongst the firms operating from India helped in accelerated capability development and explains the rapid internationalization of EMFs through the capability enhancement route. What is not explained in the ECS data is the causal diagnostics. The linkages of these innovation activities to the globalization growth and the route of the benefit realization are not explained in this descriptive study.

3.4.1.10.2 Innovation Result Areas

Table 3.11 indicates that FMNCs and EMFs were predominantly engaged in innovation activities which were "new" to the industry. This pattern is consistent across the four innovation categories of product, process, service and support domains. By contrast, the domestic firms (DFs) reported that they were involved in innovation activities that were new to their firm. This provides insight into the type of innovation activity undertaken by different categories of firms. It is apparent that R&D activities were mostly centred around adaptation of new technology in specific domain areas by the FMNCs and EMFs, whereas the DFs (domestic firms) were adding R&D capabilities to their own firms.

Table 3.11: Innovation Result Areas

Innovation Areas	DF %	FMNC %	EMF %	Total %
Product Innovation				
New to the world	12	14	22	14
New to the industry	23	40	**60**	34
New to the firm	19	15	10	16
Service Innovation				
New to the world	10	16	14	13
New to the industry	23	35	**54**	32
New to the firm	25	25	22	24
Process Innovation				
New to the world	4	7	12	6
New to the industry	20	31	**46**	27
New to the firm	20	19	24	20
Supply Chain Innovation				
New to the world	8	5	6	6
New to the industry	17	31	**46**	26
New to the firm	20	16	32	21
Support Services Innovation				
New to the world	7	5	2	5
New to the industry	13	38	**50**	27
New to the firm	26	13	32	23

Source: Estimates based on European Commission's survey data: Period 2006 -09

Note: DF = Domestic firms; FMNC= Foreign multinational corporations; EMF= Emerging market firms.

The indexed comparison of the firm type and its R&D outcomes provides further insight.

Table 3.12: Indexed comparison of Innovation Result Areas by firm type

INDEXED Comparison	**DF**	**FMNC**	**EMF**	**Total %**
New to the world	100	100	100	9
New to the industry	234	372	457	29
New to the firm	268	187	214	21

Table 3.12 indicates that, on an average, around 9% of the firms produced R&D results that were new to the world. Similarly 29% of all the firms produced R&D outcomes that were new to their industry of engagement and 21% of the firms produced innovation results that were new to their firms.

3.4.1.10.3 Source of Technology for capability development

Table 3.13 shows that both DFs (73%) and FMNCs (45%) access knowledge through in-house resources and internal linkages whereas EMFs' major source (42%) of technology and knowledge access is external global enterprises with no ownership or partnership linkages.

Table 3.13: Source of technology for capability development

Source of Technology Access	**DF %**	**FMNC %**	**EMF %**	**Total %**
In-house resources and linkages	**73**	**45**	23	**56**
Own subsidiaries	8	16	21	12
External linkages with non-MNC firms	7	15	8	10
External MNC firms with no linkages	11	21	**42**	19
Research Intuitions and Universities	1	3	6	3
Total % of firms	**100**	**100**	**100**	**100**

Source: Estimates based on European Commission's survey data: Period 2006 -09

Note: DF = Domestic firms; FMNC= Foreign multinational corporations; EMF= Emerging market firms.

This indicates that the EMFs (42%) are relatively more globally networked for their knowledge and technology access as compared to the DFs (11%) and

FMNCs (21%). EMFs (6%) are also relatively better linked with research institutions and universities for knowledge acquisition. Therefore the comparative results of technology sourcing options showed that the main differentiator between EMFs and others (FMNCs and DFs) was their ability to access (purchase) technology from other MNCs to develop their knowledge capabilities. This explains EMFs' consistent competitive advantage that continuously drove their growth and internalization leveraging knowledge capabilities.

3.4.1.10.4 Network and Linkages for knowledge access critical for innovation activity

The power of a global "network" for capability enhancement is established through facts in this section. Table 3.14 provides actual survey results of each type of firm in the IT sector in India and their linkages with several categories of networks to acquire knowledge and thus enhance capabilities.

The data shows that firms have engaged in a multiple linkage strategy (network) to acquire knowledge capability in the IT domain. The most preferred route across all firm types is the direct linkage with customers and contractors. This is followed by the hired services or purchase of knowhow from subject matter experts and consulting experts. Government has been the next best source of knowledge capability, followed by indirect access to competitor's knowledge. Lastly, a sizable (more than one third) number of firms reported to have accessed knowledge from knowledge leaders in academia and research institutions. These linkages establish evidence of the various categories of "networks" the firms use to acquire knowledge capability.

Table 3.14: Network and Linkages for knowledge access

Networks	DF %	FMNC %	EMF %	Total %	Types
Academia/ Research Institutions	27	44	46	36	Knowledge Banks
Competitors	34	57	60	45	Indirect Linkage
Government	35	58	72	49	State Support
Consultants	40	63	68	52	Hired Linkages
Contractors	51	75	72	62	Direct Linkage
Customers	66	87	80	75	Direct Linkage
Average "Network"%	**42**	**64**	**66**	53	

Source: Estimates based on European Commission's survey data: Period 2006 -09

Note: DF = Domestic firms; FMNC= Foreign multinational corporations; EMF= Emerging market firms.

Putting specific firm types under the lens, the data shows EMFs have leveraged their Governmental linkages (72%) to a much greater extent than the FMNCs (58%) and DFs (35%). Also a larger proportion of EMFs (80%) and FMNCs (87%) have used their customer network to gain knowledge capability compared with the DFs (66%). Both EMFs (46%) and FMNCs (44%) networked with academic universities and research institutions to link, leverage and learn, thus echoing Mathew's (2006) LLL model.

Thus, alliances, collaborations, associations, treaties and strategic partnerships ("networks" in combined terminology) are the essential linkages through which knowledge capability is acquired and disseminated. High levels of networking are associated with high competitive advantages and higher knowledge leadership of the firms. The DFs' (42%) relatively low scores of "networking" clearly explain the causes of their relatively low knowledge capability and therefore confinement to domestic business as against the high knowledge capability associated with global linkages ("networks") of FMNCs (64%) and EMFs (66%). The knowledge based service industry is thus characterized by this trend of linkages and learning through "networking" that the traditional enterprises did not explore and exploit to the full extent in the past.

3.4.1.11 Human capital development issues at firm level

Inducting science and technology (S&T) trained manpower in the workforce is key to the firm's capability development and its continuous progression. It is also an indicator of the technological competitiveness of a firm (Saxena and Banarjee, 2008). The availability of S&T stock and skilled technocrats in the country is critical to the required continuous inflow of skilled manpower to enterprises. Contrary to the arguments in much scholarly literature that the competitive advantage of Indian firms came from an abundance of manpower, the facts point to the opposite. There is evidence to indicate that EMFs were and are facing challenges of severe manpower constraint when it comes to availability of highly skilled manpower with R&D capability and other skill intensive capabilities. Table 3.14 and Chart 3.5 below provide data evidence of the challenges faced by enterprises to progressively up-skill and remain competitive.

Table 3.15 shows that between 2001 and 2007 the S&T graduate and PhD stock has been steadily increasing, however the year on year average growth of stock has been less than 8% for graduates and around 4% for PhDs. This when compared to the exponential and rapid growth of the industry (between 25 to 50%) indicates the manpower shortage the firms have been facing (NASSCOM, 2009). The graduate ratio to population in the same period went up on a year on year average basis by 6% and the PhD ratio to population by 2%.

This indicates that the education index of the nation was going up but not at the rate of the globalization growth of the EMFs and the corresponding demand for skilled manpower and capability.

The steady growth graphs in Chart 3.5 stands witness to no unusual supply of skilled S&T manpower, thus creating increasing gaps between demand and supply.

Table 3.15: Indian Science and Technology Stock and Ratio

Year	**PhD** (30 Yr Stock)	**Graduate** (35 Yr Stock)	**Pop 25-59** (in 000)	**Pop 20-59** (in 000)	**PhD Ratio** (per 100000)	**Graduate Ratio** (per 1000)
2001	116564	21258229	409381	502228	28	42
2002	121164	22705587	416207	510602	29	44
2003	125765	24214410	422975	518906	30	47
2004	130365	25854682	429704	527161	30	49
2005	135228	27648704	436405	535381	31	52
2006	139958	29566947	443079	543569	32	54
2007	144878	31287861	449720	551717	32	57

Source : Saxena, Deepak and Banerjee, P. : Stock of Indian S&T Manpower 'India, Science & Technology:2008' utilizing primary sources like : (i) India Yearbook 2008 Manpower Profile, IAMR, (ii) UN Population Data (iii) Respective governing bodies (UGC, MHRD, Medical Council of India, Dental Council of India, Nursing Council of India).

http://www.nistads.res.in/indiasnt2008/t1humanresources/t1hr5.htm

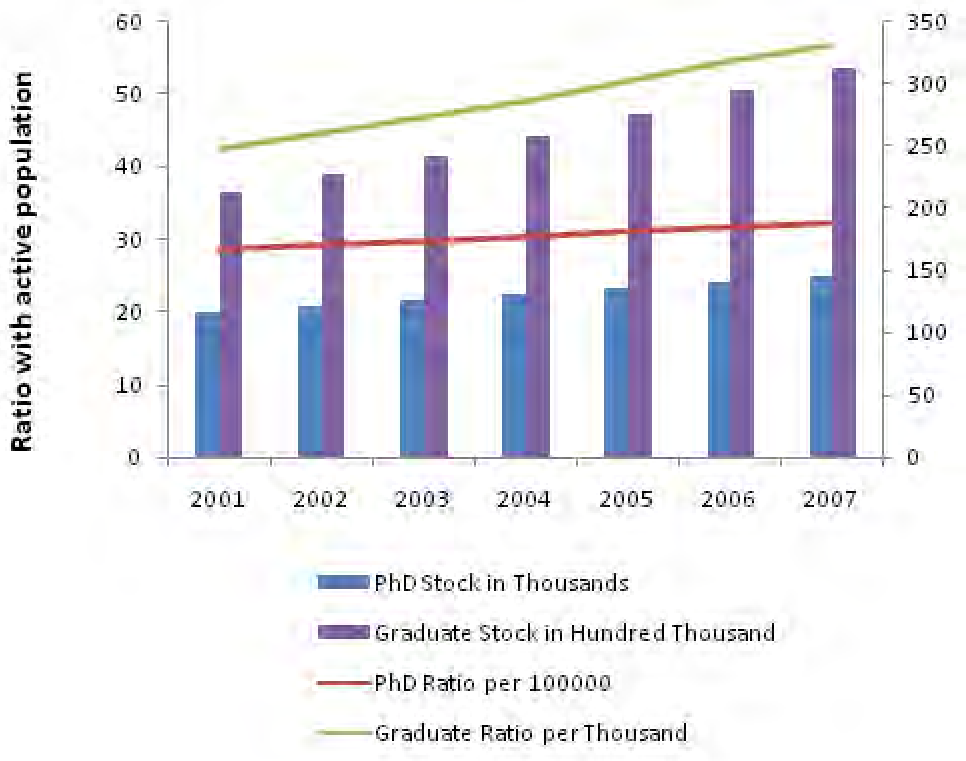

Chart 3.5: Indian Science and Technology Stock and Ratio (graphical)

Source: Saxena, Deepak and Banerjee, P. : Stock of Indian S&T Manpower 'India, Science & Technology:2008' utilizing primary sources like : (i) India Yearbook 2008 Manpower Profile, IAMR, (ii) UN Population Data (iii) Respective governing bodies (UGC, MHRD, Medical Council of India, Dental Council of India, Nursing Council of India).

http://www.nistads.res.in/indiasnt2008/t1humanresources/t1hr5.htm

To put the situation in perspective, Table 3.16 provides benchmark statistics comparing India to other BRICS countries. The tertiary education completion percentage of these five countries shows that Russia, Brazil and China are ahead of India. While China's higher education stock has grown from 21.9% in 2005 to 31.7% in 2010 (45% growth), Indian stock has gone up only from 18.1% to 19.6% (8% growth). More alarming is the data of young university graduates (20-24 years of age) which grew only by 0.5% in India between 2005 and 2010 compared to China which grew by 4%. These are good indicators of availability of human capital capabilities from a supply side perspective.

Table 3.16: Population % completed tertiary education

Year	2005	2005	2005	2005	2005	2005	2010	2010	2010	2010	2010	2010
Age Group	20-24	25-29	30-34	35-39	40-44	20-44	20-24	25-29	30-34	35-39	40-44	20-44
South Africa	0.1	0.4	0.7	0.7	0.6	2.5	0.1	0.4	0.4	0.7	0.7	2.3
India	3	3.9	3.4	3.7	4.1	18.1	3.5	4.7	3.9	3.8	3.7	19.6
Russia	1.9	2.9	3	8.6	11.8	28.2	1.9	2.9	3	3.4	8.6	19.8
Brazil	1.1	5.4	6	6.4	6.4	25.3	4.6	1.9	5.4	6	6.4	24.3
China	5.6	5	4	3.7	3.6	21.9	9.6	8.8	5.1	4.5	3.7	31.7

Source: Barro, RJ and Lee, JW (2010)

3.4.1.11.1 Attrition Issues impacting capability protection

Migration of talented manpower to other countries further added to the challenges of the development of human capital capabilities (Saxena and Banerjee, 2008). Table 3.17 shows that between 1998 and 2007 the brain drain from India has increased from 25,543 persons to 88,918 (3.5 times). The proportion of Chinese students migrating to the US was double compared to Indian students in 1998. However the data indicates that by 2007 they were almost equal. The cause could be partially traced back to US immigration policy but whatever the reason, the facts about brain drain and the corresponding challenges faced by Indian enterprises are adequately presented through these numbers.

Table 3.17: Migration of Students to US

Year	Total Students (W)	Students from India (I)	Students from China (C)	I/W (%)	C/W (%)
1998	564683	25543	54617	5	10
1999	567146	28335	57281	5	10
2000	659081	39795	68628	6	10
2001	698595	48809	72823	7	10
2002	646016	48708	68722	8	11
2003	624917	50884	56870	8	9
2004	620210	51191	63940	8	10
2005	1046421	61146	54574	6	5
2006	1168020	69790	70503	6	6
2007	1330959	88918	95698	7	7

Source: Saxena, Deepak and Banerjee, P. : Stock of Indian S&T Manpower 'India, Science & Technology: 2008' utilizing primary sources like Yearbook of respective years, Office of Immigration Statistics, USA.

Since in a highly competitive situation the best students would get the opportunity to immigrate to the US, the issue of retaining the best talents in the home country was another challenge for enterprises looking for the top S&T campus recruitments.

Therefore it is argued that the supply constraint induces and magnifies the talent and capability retention challenges.

The other secondary effect of the supply constraints and migration dynamics is its inevitable negative impact on dynamic capability development. The gap in supply and gross loss of headcount in migration is directly associated with the cumulative loss of talent and human capital capability.

The firm's capability to innovate stems from manpower retention and knowledge internalization. Therefore the EMFs and FMNCs were reported to have engaged in a number of strategies to reduce attrition rates and protect human capital capability in their firms, other than wage corrections.[19] One of the important factors that impacted capability protection was the learning environment. Studies indicate that the learning environment in the firm was the most important incentive for the worker to continue with their current employers (Abraham, 2007). A Gallup study of capability protection, employee motivation and expectation also points out that an important factor of employee retention and engagement is "learning" (Gallup, 2002).

3.4.1.11.2 Linkage and learning solutions to capability development

Networks and linkages entrenched in the regular operating environment of the firm provide the opportunity to its employees to develop and acquire tacit knowledge capability in a continuous process. Regular and systematic interaction of employees across the organization's network cross fertilizes the best practices, disperses the knowledge capability and promotes accelerated learning (Usuqueen, 2008). This linkage and learning model has become the characteristic of this industry and distinguishes the knowledge based service sector and technology domain from any other sector (Mathews, 2006a). More importantly, due to onshore and offshore models, employees at all levels are placed in a matrix organization that interacts actively across the organizations (Arora *et al.*, 2001). Therefore networking opportunities are embedded across the hierarchy giving a synergistic effect leading to accelerated learning and capability development at both micro and macro organizational levels. The workers engaged in direct interaction with the network entities ultimately become the agents of cross pollination and the carriers of new knowledge and capability (Joseph and Abraham, 2005). Therefore learning and capability development is built into the firm level network system and not required to be imparted separately with any structured programs. This becomes advantageous for latecomer enterprises and creates a level playing field for the newcomers (Friedman, 2006a, 2006b). Consequently the focus of capability development strategy shifts to talent acquisition as against experience acquisition, since knowledge upgrade is inbuilt in networked and matrix organizations. For base level recruitment, knowledge firms do not need to seek highly experienced skilled workers and can manage effectively with fresh recruits through campus placements. To keep the wage pressure low, fresh graduates without industry experience are usually preferred, based on potential and talent. Therefore the top scientific, engineering and management institutions become the popular recruitment targets.

The literature indicates that organizations recruit fresh graduates not only on the basis of their specific technical skills and competency but on the basis of their attitude, flexibility and ability to learn (Abraham and Sharma, 2006; Rothboeck *et al*., 2001). Thus positive aptitude and attitude towards knowledge is used to create engaged employees and a workforce with a predisposed learning culture. This means capability development is assisted and aided by human attitude, flexibility and learning skills.

The scholarly literature (Abraham and Sharma, 2005; Carrington and Detragiache, 1998) demonstrates that the EMFs and FMNCs have been able to overcome their talent sourcing, growing and retaining challenges by providing strong learning and capability developing environment, joined with tangible reward programs like employee stock options built into their remuneration package. This has worked well as a strategic intervention in human capital capability development and benefit realization.

Earlier studies indicated the strategy of wage corrections as the main means of employee retention and capability protection but explanations are not provided on how this overcomes the counterproductive effect of becoming less competitive with a higher wage bill that has a negative spillover effect in their competitive advantage.

3.5 Early Evolutionary milestones of capability development

3.5.1 Early evolutionary milestones of the Indian IT capabilities

In 1970s EMFs (emerging market firms) were mostly providing services in the premises of their foreign customers (onsite development). This phase was termed the "linkage phase" for resource access where services delivered were at the low-end, which nonetheless provided important foundations. Apparently the EMFs' continuous growth, led by slow and steady capability creation at this stage, was not threatening to their foreign competitors (FMNCs) and they were left unnoticed and unobstructed. However this phase is invaluable in explaining the unconventional model of growth and capability development of these EMFs. Without a meaningful competitive pressure the EMFs got a smooth run to firmly establish themselves in the home markets of global MNEs. In turn, it was this very linkage that allowed EMFs to establish the mainsprings of critical dynamic capabilities required for gaining competitive advantage in a global market and to become giant entities of the future.

In contrast to the view that was held by some (Arora *et al*. 2001), this phase was not characterized by IT sector innovation or state supported growth by incentivizing software production and exports (Joseph, 2002, 2009; Parthasarathi and Joseph, 2002; Kumar and Joseph, 2005; Balakrishnan, 2006).Instead, it is a phase best described as latecomers' long term growth strategy of working silently with a single focus of B2B relationship development through organizational engagement.

The Indian Government by then had allowed 100 per cent foreign owned companies to set up software export operations in the SEP Zones like Santacruz Electronics Export Processing Zone (Parthsarathi and Joseph, 2002). An explicit software policy was announced in 1986 and software was identified as one of the key sectors in India's agenda for export promotion. The policy underlined the importance of an integrated development of software for the domestic and export markets (Department of Electronics, 1986) and came up with various measures to accomplish these objectives. A notable institutional intervention by the state that facilitated offshore development has been the establishment of Software Technology Parks (STP) to provide the necessary infrastructure including data communication facilities for software export.[20] As a result of these initiatives the share of onsite services (in foreign locations) compared to total exports declined from about 90 per cent in the mid-1970s to 30 per cent by the late 1990s. These initiatives, which helped build domestic IT infrastructure capability, are also likely to have influenced the decision of FMNCs to invest in R&D centres in India.

The early evolutionary milestones and linkage based leveraging strategy used by the EMFs provides valuable insights into the means and tactics deployed by EMFs for their capability development and globalization.

3.6 Capability development triggered by changing Business Models:

Another important finding is the transformation of global technology leaders from being closed and protected sole operators to engaging and alliance forging entity that operated in a matrix global structure. Findings also indicate that significant capability transformation of the EMFs had to be created due to their migration, i.e. from being a participant in the global production network (GPN) to a participant in the global innovation network (GIN). The following subsections investigate the impact of changing business models and its relationship with capability developments.

3.6.1 Early business model of Indian IT companies

The erstwhile consensus view in the empirical literature is that the early (1980s and 90s) business models of the majority of Indian software firms were mainly confined to the lower end of the value chain. Influential writings (D'Costa, 2003; Kattunam and Iyer, 2001) points to the low end, manpower intensive services provided by a majority of the firms. Arora *et al*. (2001) observed that although the software sector is human capital intensive, the Indian software industry did not require exceptional skills beyond academic training at the first-degree level. Analysis of NASSCOM (1999-2000) points out that large numbers of firms were offering the same kind of services and competing with each other on the basis of cost-price-efficiency advantage. Therefore the capability requirements in that early model were not very significant. However as the EMFs moved up in the value chain, dynamic capability development became an important element in their business model for success.

3.6.2 Transformation of the business model by the IT industry

In the 80s the IT industry demonstrated that their business model could be purely based on "service". In the earlier times the traditional concept of business involved mainly "goods". Early scholars like Bhagwati (1984) documented this emerging trend as an innovation of the business model by the splitting of goods from services. Subsequently the world saw the internationalization of services as a sizable business domain. The contribution of the IT industry therefore is in bringing in this differentiation in the business model of "services" from the traditional tangible "goods".

The view point of early scholars on the service industry was that the progressive part of the old business proposition would be incorporated in a material "product", leaving behind a reduced and unprogressive "service" part. The latter part is the one that bears high transaction cost and needs to be internationalized. Both innovations and internationalization are the intended actions of top multinationals of the world; with emerging market firms countries being at the bottom of this process. However the EMFs from the IT industry transformed the business model to demonstrate rapid growth and internationalization in knowledge based service delivery model. Correspondingly the capability model also changed from production of "goods" to delivery of "services". The rapid pace of technology change, growing complexity and technological convergence are intrinsic factors motivating this change. Thus the knowledge based service industry did spearhead the technological developments and advancements of service sector. This new trend led to"globalization of innovation" (Krishna and Bhattacharya, 2007). Thus in a technology driven world, the innovation capability is the unique characteristic that transformed the business model.

3.6.3 Capability development through Off-shoring model

The evolution of off-shoring knowledge based service delivery is one of the most significant capability crafting and transformation phenomena that changed the IT services industry. Off-shoring was introduced as a new service delivery mechanism for protecting the competitive advantages of the global multinational companies (FMNCs). US firms actively embraced this system to save their costs since they had experienced post-dot.com recession. Initially off-shoring was mainly via a captive development centre or subsidiary established overseas by FMNCs. Texas Instruments (TI) is the pioneering example of an American MNC off-shoring in India. TI set up its captive development centre, in 1985 in Bangalore. The captive development centre (subsidiary) employed low wage Indian knowledge workers, and required them to write software exclusively for TI US.

These subsidiary models of MNCs were excellent for saving their costs without diffusing valuable and proprietary intellectual capability. However they had several disadvantages. MNCs had to invest their capital heavily, show commitment, and struggle with local regulations and cultural differences in order to set up and operate their subsidiaries. Indian IT service firms, especially Infosys, had been watching carefully TI's captive centre to identify a niche opportunity (Varghese, 2006). They discovered that their niches were well placed in dealing with all things on behalf of MNCs' off-shoring subsidiaries in order to mitigate MNCs' disadvantages of setting up and operating in a foreign land.

The main advantage of the offshore model of Indian IT service firms was in eliminating the risks of those US firms. Local companies were more familiar with factor markets (Khanna *et al*., 2004) and local companies had better access to resources (Porter, 1990) at the early stages. The business model changed from "onsite model" to "off-site model". This drove the capability requirements to be changed to suit the business model transformation.

3.6.4 Capability development due to shift in business model from Global Production Network to Global Innovation Network

Recent trends show significant shifts in the business model of EMFs towards dynamic innovation in the new products and services areas. The existing firms are transforming their business model from producing and delivering services to innovating new services for newer products. In other words EMFs are transforming their business model from being a player in the GPN to GIN.

Innovation networks are increasingly being used in IT for client tailored innovation services to design custom chips and supply chain software algorithms. This brings in a new class of services, namely "product engineering services". New technological developments such as ASIC chip are facilitating this process. Thus in this new scenario, firms do not simply source low-cost talent but invention services (R&D services) in one country and transformation services (manufacturing services) in another country to build products for a global economy. Radjou (Forester Research, 2006) increasingly sees the role of India and China in this type of configuration with US firms; with India expected to do the invention service and China the transformation service. Chesbrough (2003) has termed this a capability driven"open innovation" model, a new paradigm of innovation where firms will not carry the baton of innovation all by themselves. As Ernst (2005, p. 72) observes, even big firms like IBM are in no position to"mobilise all the diverse resources, capabilities and bodies of knowledge internally".

In the last few years there are indications of this type of shift occurring, with EMFs undertaking higher investment in R&D, and creating the other essential requirements that are pre-requisites of research based firms. The linkages with international firms have also expanded in breadth and scope and in some cases have translated into higher order vertical linkages. Leading firms such as Infosys, TCS, and WIPRO are involved in"product engineering services", protocol standards, and participating in international innovation chains. All these are indicators of advanced technological capabilities.

A good example of an EMF in the globally dispersed innovation network is Infosys participating in Automotive Open Systems Architecture (Autosar). Autosar is the network of major global automobile manufacturers involved in capability development through R&D and standardization of software for auto electronics innovation. Firms such as Toyota, Bosch, BMW, Volkswagen, Siemens, Ford, DaimlerChrysler and Continental Teves are partners in this global network (Krishna and Bhattacharya, 2007). A handful of small companies such as Sasken, ittiam, i-flex and others are trying to break the mould of IT services and develop their own patents and license to others (*The Economist,* 2005). Advanced technological capability driven business model shifts can be discerned under three broad domains namely (a) Indian firms undertaking complex tasks (Kash *et al*., 2004) (b) creating global footprints through opening up international subsidiaries, merger and acquisitions and increasing their knowledge capability and competency (c) foreign firms establishing international research centres and independent laboratories developing novel products/process capabilities.

The emergence of the IT sector as an independent business stream with service orientation, in contrast to the pre-IT era of a goods orientation, required different sets of skills, competency and delivery processes which were the key impetus for acquiring new capabilities by EMFs. Further evolution of the IT firms from sole operator to a networked entity required once again a different set of skills, orientation, mindset and strategy that drove the need for another phase of changes in their competencies and capabilities inventory. Lastly, progressing from a service production and service delivery business model to being part of a global innovation network demanded a substantial upgrade of skills, vision, aptitude and capability. Thus this background context explains the needs, reasons, circumstances and externalities that put continuous pressure on the EMFs to develop dynamic capabilities progressively to remain competitive and grow globally.

3.7 Future Directions of capability trends

3.7.1 Future Trends of dynamic capabilities

Researching multidimensional factors of industry and firms is not complete without gathering some facts and figures that clearly indicate the direction of the IT sector in the future.

The spillover effect of Indian firms from dominance in the software sector is observed to shift to hardware manufacturing in recent times (IEEMA, 2011). A number of companies have progressed in setting up chip design and manufacturing centres in India. Amongst the global giants IBM, Intel, Advanced Micro Devices (AMD), Broadcom, and Cisco announced major investments in chip design in India, amounting to billions of US dollars and implying sharp increases in the number of company employees working in the country (semiconductor association 2011). Largely because of these commitments, another level of linkages is witnessed between FMNCs and their subsidiaries, and FMNCs and EMFs in India. The high-end of learning (technological capability) involved in chip design is diffused from Silicon Valley to emerging clusters in India. Anecdotal reports indicate that the chips manufactured in India are conceived and engineered in India. Therefore the capability extension is already evident from software to hardware.

A cross validation (NASSCOM, 2006) showed that enormous growth in demand was forecast for the custom chips for India's growing information and communication technology and consumer electronics industries. As a result the focus was shifting to developing infrastructure and skills in hardware manufacturing to drive some of the major global developments in chip design in the coming years. Currently (2012) around 50 manufacturers of ASIC and VLSI chip design are well established in India (list search asic.co.in, 2012). This trend could be validated by tracking the facts of the cases of a couple of these global multinationals. For example, Cisco Systems announced its intention to undertake chip design work in India. Cisco announced that the company would put US $750 million into its own operations in India during the next few years, to beef up its chip design laboratory in Bangalore (CEO John Chambers). Cisco's team in Bangalore claims it already represents the world's largest ongoing developer of custom-designed application-specific integrated circuits (ASICs). Cisco India started with ASIC verification in 1999, but by 2006 they were designing platforms, which would go in the Cisco products to be rolled out in two years. Cisco is now committing more than a billion dollars to India in new investments, including $100 million in venture capital to spot and support start-ups where Indian entrepreneurs could support their consumer electronics acquisitions of set-top-box maker Scientific-Atlanta Inc. and Denmark's networked-entertainment company KiSS Technology A/s (corporate report 2011).

Microsoft's company chairman and chief architect Bill Gates announced investments of $1.7 billion, with $250 million dedicated to a venture capital fund supporting development of the Xbox, Internet television technology, and its concepts for home media centres to become a big player in consumer electronics (Annual Report 2011). This demonstrates a competitive strategy to retain leadership in the consumer electronic space, leveraging resources and capabilities from emerging markets like India.

However the emerging market has also its own challenges and learning curve to match the stringent ethics, probity, protection of intellectual property and related issues. For example Intel shelved its Bangalore Intel India project of developing a multicore-processor for servers because of doubt about personnel irregularities at Intel's Bangalore lab, and shifted it to Israel.

The momentum effect is however inherent in any acceleration process. In this case the momentum of a fast changing global shift of manufacturing and innovation activity saw that such losses were quickly made up by gains, as almost immediately IBM picked HCL Technologies in Noida (near Delhi), to be the only outside contractor doing design work on IBM's Power Architecture chip family. This enabled HCL to sublicense PowerPC cores while continuing to provide its customers with system-on-chip integration and other chip and board development services. The motivation of IBM was market access,[21] mainly focusing on applications in high-definition television systems, set-top boxes, networking, telecom, medical imaging, and the automotive sector.

For example Dallas-based Texas Instruments Inc. (TI) was among the first to start semiconductor design work in India, along with ST Microelectronics, based in Geneva, and AMD, headquartered in Sunnyvale, California. It has been designing mission-critical chips on the subcontinent for some years. A notable example was the single-chip phone by TI which it co-developed with Freescale Semiconductor India Pvt. Ltd., in Noida. Freescale-India came up with the phone's MXC (Mobile Extreme Convergence) architecture. It also contributed to development of the Neptune platform used in Motorola's Razr and Rokr cellphones (company reports).

A Freescale company source (Ganesh Guruswamy, director and country manager) indicates that India has enormous appeal for different parts of the semiconductor value chain, from board, chip, and systems design to finished electronic products. It is emerging as a major design centre for integrated circuits, field-programmable gate arrays, and systems on chips. Both TI and Philips Semiconductors have Indian engineers at their Bangalore labs working on chips with feature sizes of 90 and 65 nanometres, for wireless, broadband, and multimedia which are state-of-the-art and complex chips in the semiconductor domain (Rajeev Mehtani, Director of the Philips laboratory), thus indicating the FMNC’s transfer of preferred location for high end product design and manufacturing to India. This in turn will help in capability and competence upgrades for the network entities and the cluster. India's strengths in software engineering is leveraged into chip design as software is now embedded into chip architecture, and chip designers increasingly seek to share basic features of architecture early in the design process with the software engineers who write the programs that run on the chips.

It can therefore be inferred that capabilities are developed both horizontally and vertically. The competency required for standalone software development is substantially different from the skills and knowledge required for system integration (of hardware and software) in the embedded technology. Thus the evolution of the dynamic capability development is well witnessed through these cases that also explain the circumstances, externalities and paths followed by the production and innovation partners (FMNCs and EMFs) to leverage opportunities.

Open Silicon, a firm based in Sunnyvale and Bangalore, which was started by ex-Intel engineers Satya Gupta and Naveed Shervani in 2003, offers engineering services to guide the way chips are produced (company reports). This is a sophisticated process in the high tech space and yet they provide global customers like Intel and IBM the flexibility to decide what intellectual property they want to use, pick a foundry and packaging, try out vendors, and check design status at any time. Bangalore-based company Ittiam Systems Pvt. Ltd, which started as a maker of digital signal processors in Bangalore, decided to get into licensing intellectual property for chips. It now designs applications that run on digital signal processors, such as streaming video, digital still photography and so on, which are key innovations for application engineering products (Annual report 2011).

In the fast changing technology era, capability development by creating internal knowledge libraries in a controlled and protected environment within the organization is not practical due to time constraints, global competition between parallel innovation activities, high opportunity cost of delay in innovation and fast obsolescence. For example, demand for VLSI design engineers is set to double in the next four years. The Indian

Semiconductor Association in Bangalore actively engages in talent hunting covering the 40 top engineering colleges and more than 10 000 job candidates(Poornima Shenoy, president ISA), as they expect significant shortfall in talents and appropriate technological capability. With high attrition and churn rate, the capabilities developed in VLSI projects remain and migrate with the individual human resources, posing a big threat to enterprises that sponsor the innovation activities and lawful owners of the intellectual property. Tacit knowledge and capability centred on individual talent is unprotected and therefore has a detrimental impact on investments at firm level on such individual capability development (Swami, 2006).

Therefore increasingly the enterprises are relying on research institutions and universities for capability research and knowledge. The market research firm iSuppli Corp., in El Segundo, California predicted that India's semiconductor design industry would triple in size, from $624 million in 2005 to $1.7 billion by 2010. This will present a significant challenge on the gross availability of competency, skill, capability and proficiency that could be leveraged to deliver these numbers. No doubt there will be immense pressure on the Indian polytechnics, research institution and universities to keep up with such capability and talent supply.

The critical observation that summarizes the above is the need to clearly identify the areas of technology progression and the associated capability requirements. The software maintenance and development skills are being supplemented with high tech innovation capability in the hardware and embedded system areas. The journey that started being a mere lower end service provider has reached a stage where EMFs are participating in the global innovation network and driving technology to the future. Linkages that initially helped EMFs to establish as a globalized enterprise are now being leveraged into strategic partnerships to contribute to the global innovation network and deliver tomorrow's technology.

3.8 Discussion

The extensive multidimensional investigation of capability development at the industry and firm level has provided a glimpse of how incremental and micro level capabilities have accrued over time and the resultant impact on the globalization of EMFs. It explained the foundations and models that gave rise to early capability requirements and mapped how this transformed over time to adopt and align with modern trends and future requirements. It also established the causes that drove the capability enhancements in stages and phases of the EMFs' internationalization process with precise locations (dimensions) of the capability accruals that explained holistically the causal relationship and their capability utilization for internationalization and growth.

This inquiry noted several instances of how EMFs developed process capability (separating locus of innovation from locus of production); knowledge capability (advanced analytics as they moved up the value chain) and project delivery capability (when business model shifted from on-site to off-site). All these enhanced the EMFs' "operational capability" and thus created competitive advantages. The operational capability enhancements provided EMFs with higher productivity, streamlined workflow, global service delivery, lowered project turnaround time and accelerated delivery of critical paths in the project schedules to achieve the competitive advantage and rapid internationalization. Thus enhancements in operational capability constituted an important dimension that explains the internationalization phenomena in EMFs.

The process that is mapped through these investigative insights points out that "reengineering capability" at various stages and phases amounted to "capability transformations". EMFs progressively and consistently transformed their capabilities to remain significant and contemporary in the technology driven world market.

"Intersectoral capability" is another dimension that has been enhanced by the EMFs through their R&D outputs and innovation. The linkages with global innovation network partners helped EMFs develop their intersectoral capability and extend their businesses into multiple domains. The investigation provided insights on vertical enhancement of intersectoral capability in terms of software to embedded technology in hardware, semiconductors, etc, as well as horizontal extensions in domains like aviation electronics, automotives network, communication and mobile telephony, consumer electronics, etc.

Lastly, the inquiry provides evidence that capabilities were crafted (created) by EMFs and not always acquired. The global delivery model is an example of such "capability crafting". Therefore this multidimensional inquiry explains several elements of capability dimensions and how the sum total or the resultant capabilities cumulatively helped the overall holistic capability development of EMFs systematically to internationalize rapidly.

3.9 Integrating discussion for further research actions

3.9.1 Future research actions

This multidimensional review on capability development provides an insight into and an explanation of the phenomenon of rapid globalization of enterprises from emerging economies like India. The analysis illustrates the knowledge base of the IT industry, business models, and transformations that explain the causal relationship with the macro environmental factors, micro governance issues, state interventions and global competitive dynamics with the resultant evolution and progress of dynamic capability development.

Thus a funnel approach was taken in structuring this research, where a detailed investigation of the industry and firms provided valuable insights on varied dimensions concerning the research topic. This approach is therefore expected to complement the specific case studies in the subsequent chapters to supplement the observations and inferences postulated till now. Thus a progressive funnel approach of starting with a broader perspective and narrowing down to specifics would provide a systematic approach to research.

This multidimensional industry inquiry also suggests that some factors and dimensions cannot be validated purely from case study data (due to the inherent limitations of the case study methodology) and therefore an empirical (quantitative) data analysis is required as a logical step forward. Thus the structuring of the research design is further developed with the quantitative modelling and hypothesis testing subsequently in this study.

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[1] One must note that this does not include the software developed by users themselves, nor does it include embedded software. This implies that the figure is an under-estimate. Indeed, the estimates of the size of the market are not very precise or reliable.

[2] To put things in perspective, the Indian industry sector grew at an average rate of 7.6 % while the service sector grew at an average rate of 8.2% over the same period. Source: A Report on the Indian Budget 1999-2000 Table1.2a also at http://www.ieo.org/budget99/table12a.html

[3] International Data Corporation: a US based firm that deals with the dissemination of information on the IT industry worldwide.

[4] Other industry commentators have also linked the rise in offshore outsourcing to the shortage of software talent.

Barr and Tessler (1996 and 1998) claim that the shortage is part of a secular trend that had, in the past, been disguised by cuts in defence spending in the US between 1988 and 1993, that resulted in 75,000 programmers being laid off in Orange county alone. The shortage was further masked by downsizing in the IT departments of many major corporations. http://www-scip.stanford.edu/scip/avsgt/how1197.pdf.

[5] Moreover while the 3Is stand somewhat separately because of a set of peculiar features (e.g. the "diaspora", English-speaking human capital, large export shares), the patterns observed for China and Brazil bear greater similarities with other non G7 countries. For example, in South Korea too the software industry has relied mainly on the domestic market, and on spillovers from leading industries like hardware and electronics.

[6] The Irish MNC sales are most likely inflated by accounting devices guided by the substantial tax concessions offered by the country. Indeed, the MNCs in Ireland have employment levels comparable to that of the indigenous firms (15,300 and 12,600 respectively in 2002), while their sales are over 8 times as much. Since they mostly localize their products in Ireland not design them, this gap must arise mainly from accounting reasons, not superior value added.

[7] This excludes what NASSCOM calls IT enabled services, such as call centres and help desk operations, which employ 160,000. Another 260,000 software professionals are estimated to work in what NASSCOM calls user organizations.

[8] In addition to these firms that focused on software exports, there were others that served domestic users, most notably Computer Maintenance Corporation, or CMC. Responsible for maintaining computer systems after IBM left India, CMC has grown to over 2000 employees and developed the ability to create and implement large and complex projects, especially for infrastructure systems. CMC has also proved to be a good training ground for managers that would later be employed by other private sector firms.

[9] Patni Computer Systems (PCS), a privately held firm, was another early entrant. It started with a data conversion project because India was seen as a cheap supply source at the time. However, steep import duties on computer equipment imports (including keyboards and CRT screens), as well as union regulations, caused much data conversion work to be shifted to China and Taiwan. PCS also formed an alliance with Data General, a mainframe computer firm, whose equipment PCS marketed and for whom PCS also provided some programming services.

This hardware tie-up is apparently typical of other older software firms such as TCS-Burroughs, TUL-Unisys, Hinditron-DEC, and Datamatics –Wang.

[10] AICTE 1990-2011, All Indian Council for Technical Education (AICTE), various publications, data and statistics.

[11] http://www.niit.com/Pages/DefaultINDIA.aspx

[12] The magnitude of the problem has been illustrated by an estimate from Lotus Development Corporation that in the early 1990s of the 150,000 copies of Lotus 1-2-3, 140,000 were pirated. (Schware 1992).

[13] The copyright of computer software has been protected under the provisions of the Indian Copyright Act of 1957. Major changes were made to the Copyright Law in 1994. Accordingly, it was made illegal to make or distribute copies of copyrighted software and therefore punishable. Section 63 B of the Act stipulated a minimum jail term of 7 days, extendable up to three years. The Act further provided for a fine ranging from Rs 0.05 million

to Rs 0.2 million. In addition, the government, in co-operation with the NASSCOM, conducted regular anti piracy raids to discourage software piracy.

[14] For example, Tally, a popular accounting package for small and medium enterprises which is being used by 50,000 companies and has been approved by the accountants' professional bodies in India and the UK has been developed by a smaller highly specialized software company (Kumar, 2001)

[15] Joseph and Abraham estimated the index of top IT firms like Infosys, Wipro, TCS and Satyam to be more than 75 per cent.

16 National Council of Educational Research and Training (NCERT): Various publications, data and statistics 1990- 2011.

[17] The histogram in Chart 3.3 shows the frequency distribution of the companies in Y axis and the Indian promoter's share in the x axis. The descriptive statistics are: mean 33.3030, median 30.3700, standard deviation 23.19139, skewness 0.581, minimum 0.00 and maximum 99.03.

[18] The European Commission's survey aimed at determining the extent to which innovation is taking place in globally dispersed networks. The Project was co-funded by the European Commission within the Seventh Framework Program (2007-2013). Complete original dataset, coding, methodology, questionnaire, reports etc are fully available on public domain. The IT sector was surveyed in India, China, Sweden, Norway and Estonia. The Project started in January 2009 and the duration was 36 months. The lead contractor was the University of Pretoria/Gordon Institute of Business Science (UP/GIBS, Participant no.12).

[19] Other popular strategies to retain workers, apart from salary hikes and learning opportunities, include recruitment through employee referral system, which exploits kinship and friendship based ties to retain workers; productivity based incentive component in the wages which acts as a sieving mechanism to retain productive workers; providing equity options with a lock-in period for realization, and enhancing career mobility within the firms.

[20] The first ones to come into being were those at Bangalore, Pune and Bhubaneshwar in August, October and December 1990 respectively. In 1991, four more STPs were set up by the Department of Electronics at Noida, Gandhinagar, Trivandrum and Hyderabad.

[21] "According to the Indian Semiconductor Association, the country's consumption of semi-conductors, currently at $3.3 billion, is expected to reach $43 billion by 2015, when consumption of finished electronic products is expected to reach $155 billion (currently $25 billion)". Source Basu 2006.

Chapter 4

Dynamic Capability Development by EMFs: a Case Study of Infosys

4.1 Introduction

The closing decade of the last century witnessed the rapid transformation of emerging market firms (EMFs) in knowledge based services, however much is yet to be explored in academic literature. The Indian IT Industry is a leading exponent of this rapid transformation. There is a notion that IT EMFs broke away from the treadmill routes that incumbents took[1] (*Business Express*, 2005) and emerged from a position of disadvantage to leapfrog in global competition. According to *The Economist*, the Indian trio – Wipro, Infosys and Tata Consulting Services (TCS) - built an IT outsourcing industry that moved upmarket, and went global chasing rich-country leaders such as Accenture and IBM.[2] Yet, there are those who believe Indian IT firms specialize in the low-end services, which limits their learning and confines them to the so called low-road in competition (D'Costa, 2003). Hence the germane question is whether India's export success is a story of increased productivity arising from dynamic capabilities which enable them to leapfrog in the global IT industry (Athreye, 2005).

The objective of this chapter is to explore how an EMF can develop and leverage capabilities to leapfrog in knowledge intensive industries such as the global IT industry. The study explores how an IT major "moved up the value ladder," moving out of the "low road" where the barriers to entry are low and competition is based mainly on price and squeezing wages, to the "high road" where competition is based on differentiation (Pietrobelli and Rabellotti, 2011). Little has been theorised or systematically explored in the academic literature about capability development by Indian IT companies in knowledge based services. Much of the academic literature has focused on globalization of MNCs from developed countries, mainly in the OECD (Mathews, 2002; Gaur and Kumar, 2009). Therefore, a closer look at how some EMFs circumvent their traditional disadvantages of being cut-off from the main centres of innovation, to be transformed into powerhouses of strength in specific business sectors like IT-enabled service delivery, gives a valuable insight (Sinha, 2005).

This study explores how an EMF may gain resources and capabilities by first becoming embedded in value chains of MNCs by exporting intermediate value added services (Terjesen *et al*., 2008; Fletcher 2012: 290). Through linkages with MNCs, an EMF could obtain a platform provided by MNCs to gain access to markets, technology, and reputation (Kuemmerle, 1997, 2001, 2002). In the process, MNCs spillover valuable knowledge and resources, transferring the missing elements of technology, skills and capital needed to complement local capabilities if they see a competitive product at the end of the investment (Lall, 1994, 1995, 1996, 1999, 2004, 2005, 2006). MNCs disseminate both explicit and tacit knowledge to local suppliers in low-cost locations, which catalyze local capability formation (Ernst and Kim, 2002a, 2002b).

This chapter maps the sequence of strategies followed by a leading EMF in the Indian IT industry to enhance its capabilities. Investing heavily in human not financial capital, the EMF initially leveraged its low cost human resources using the backbone of investments in education and training and the positive externalities generated through research undertaken by their government in their home environment (Das, 2006; Birkinshaw, 2008; Birkinshaw and Heywood, 2010). Simultaneously, it leveraged technological resources from MNCs and augmented its knowledge bases by internalizing the spillovers from the interchanges with MNEs for the next stage of international expansion. The positive externalities arising from this exercise became larger than anyone could predict. Though the EMF started off in the so called low-road of competition, the inculcation of dynamic capabilities enabled it to compete in the high-road (Athreye, 2005) through an evolutionary process. On the promise of knowledge based value propositions to multinational enterprises, a large talent pool delivered high-end applications, supported by firm specific efforts to stretch out their dynamic capabilities to serve global IT MNCs (Friedman, 2006a, 2006b). Knowledge embodied in human capital emerged as the principal differentiator, with innovative service delivery mechanisms in an increasingly complex global business environment.

The study observes the phenomenon in its real world context. More specifically the research looks at a specific case study of Infosys (a leading EMF from India), the favourite of NASDAQ (New York stock exchange) as the most profit delivering entity from the developing world (Das, 2005). Infosys's model of rapid expansion, gives insights into a new model of globalization, which is instructive for those studying how EMFs muster dynamic capabilities through internationalization. The global strategies of these EMFs are new and unconventional, rather than previously carved out in history, as observed in this study.

4.2 Internationalization and capability development

From a resource based view, the advantages of large firms may be argued to stem from their dynamic capabilities to identify, acquire, develop, recombine, and integrate resources in changing environments and circumstances (see Teece and Pisano, 1994; Teece *et al*., 1997; Eisenhardt and Martin, 2000, Athreye 2005 on related discussions). However, unlike large MNCs, many emerging economy firms which are late entrants in global competition do not start from a position of advantage: they have to acquire these ownership specific advantages in order to overcome their disadvantages (Gaur and Kumar, 2009; Child and Rodrigues, 2005). The question is how these knowledge resources may be garnered by EMFs to seize advantage in the new knowledge economy.

Mathews' (2002a) LLL model explains EMFs pathway to attaining dynamic capabilities. The critical starting point for the EMF is that it is focused not on its own advantages, but on the advantages which can be acquired externally, i.e. on resources which can be accessed outside of it. A global orientation becomes a source of advantage – since the resources to be gained are likely to be found in the global market rather than in its domestic environment. EMFs form collaborative partnership as a means of gaining entry to the foreign market; they leverage their own expansion as contractor to an existing multinational, or being carried by a global customer into new markets (Anderson and Tushman, 1990; Andersen *et al*., 1997). The model explains how the EMF's *linkages* with foreign firms (buyers of their services) provide the required knowledge resources to be *leveraged*. In subsequent stages EMFs undertake *learning* to demonstrate value and win business contracts rapidly. Repeated application of linkage and leverage processes may result in the firm learning to perform such operations more effectively (organizational learning) Elsewhere Mathews propounds the linkage, leverage and learning as strategies of catching up that are available to EMFs. They enable the firms to make connections with the wider global economy, and draw from these linkages skills, knowledge and technology resources that would otherwise lie well beyond the reach of the latecomer firm (Mathews and Snow, 1998; Mathews, 2006a). It makes sense for latecomers to utilize all the resources from the advanced world that they can acquire, in return for providing services such as low-cost manufacturing. Applying strategies of linkage and leverage enable EMFs to overcome their disadvantages and exploit their few advantages as latecomers to the full.

Thus, Mathews (2006a) argues that from the perspective of EMFs who lack resources, the strategic issue is to identify the resources and technology that can be leveraged. EMFs need to work out how to implement a framework that actually taps these resources as a base for learning and improving their technological innovation capabilities (Matthews, 2001). Mounting the global value chain in the upstream (or downstream) elements of the chain, it can secure resources from a wider resource network through contractual connections and strategic networking (Mathews, 2002b). In the process, EMFs learn by combining foreign elements with its own stock of knowledge to eventually become technologically proficient. This leads to new innovations. Multiplying linkages with advanced firms in an interconnected global economy provides the EMF with wider learning opportunities (Mathews, 2002c, p 476). If it can fashion a strategy of linkages that complements the strategies of incumbents by meeting their needs and offering services, then it opens the door for further advance and industrial upgrading (Mathews, 2002a, p 476).

The literature reports that Indian IT firms leveraged teams of talented human capital to deliver technical solutions to customers around the world and earned a reputation for their skills in using a variety of software languages and systems that incumbents found expensive to acquire (Athreye, 2005). The trajectory of these IT firms can be mapped in an inter-temporal setting that informs how they learnt to transform programming skills into dynamic capabilities, by deploying and redeploying their existing and new assets in changing markets.

4.3 Model and methods

The study uses an intensive case study approach to examine an alternate model of capability development in EMFs. Since the focus was on explanations, the most appropriate methodology was the case study approach. The methodology determines if the study approach would pass the scientific scrutiny of being significantly different from the existing known models. Second, whether such a model would meet the criteria of a replicable conceptual framework that is both relevant (reliable x valid) and consistent, and which would produce similar results if used in similar circumstances. Hence the effort to gain dynamic capabilities by EMFs, witnessed in the new millennium, is mapped through descriptive research focused on the explanations of a contemporary phenomenon within its real life context (Darke *et al*., 1998). Context being part of the study, too many variables and complexity make standard experiment and survey designs (McClintock *et al*., 1979) impossible to address. The next objective was to choose an appropriate type of case study research i.e. *descriptions of phenomena* or *development of theory* (Darke *et al*., 1998).

In case studies, events are observed, recorded and analysed from real organizations. In fact, events in the real world context are reflected as data facts that had already gone through a whole lot of alterations, modifications, and adjustments. Hence, case facts represent the finished form of a stabilised experiment and reduce the need for further multi-point quantitative and survey research for validation. Campbell (1975) echoes similar views that the method can be applied even if there is a single case because the pattern must fit multiple implications derived from an explanation or theory. It was therefore concluded that a single case study focus with cross-case facts for comparison and pattern matching would be a valid and appropriate method to address the research quarry (the globalization pattern of EMFs).

Hence the appropriate research strategy is one that allows the researcher to integrate alternate sources of data and use a chain of evidence to explain the findings (Yin, 1981). The case study research elements had a combination of qualitative and quantitative evidence. Evidence came from secondary sources, namely archival records, verbal reports, business reports and academic cases, published reports of corporations and personal observations. Since the boundaries between phenomenon and context were not clearly evident, the approach was to collect primary data[3] from relevant informants, which provided an opportunity for the researcher to witness and experience the relevant events by direct observation (Yin, 1981).

The unit of analysis was an emerging market firm (EMF) engaged in the business of knowledge based service delivery. Such specificity of study object ensured low variance (skewness) in the population parameters. Although the rigour of parametric tests could not be incorporated in a case study approach, the basic principles of natural science research methods were incorporated to ensure that the process reflects robustness. A non-probability-sampling method was used to include study objects (EMFs), which is a valid statistical method when the existing knowledge on the *population* is sufficient. The *population parameters* were defined to constitute the industry segments engaged in the area of knowledge based service delivery and *sample statistics* were planned to be drawn from the lead player Infosys (a pioneering EMF).

Subsequently cross case evidences from EMFs like HCL, Sasken and Cranes were mapped to observe matching patterns (see chapter 5 for more details). Such comparative *research design* framework also helped in cross-validation and increased reliability. The key was to ensure *construct equivalence* before selecting the objects of study. HCL, Sasken and Cranes operated in a similar domain to Infosys and therefore these EMFs met the construct equivalence criteria. Furthermore, the *equivalence* premise was that in real life cases, significant diversity would exist in micro dimensions of the variables in the context, in spite of the phenomenon remaining same. Throughout the research the focus therefore remained on the overall and macro dimensions of the case facts. Since the real life case facts represents several complex dimensions of corporate functioning, for selecting equivalents, appropriateness and type of relationship between cross cases were used. In design terms, the research outputs and the explanations were expected to be valid if a *monotonic* relationship existed between these cross cases thus selected. Thereafter the study used the cross-case evidences to focus on the *presence* of similar systematic relationship between these cases, the *direction* of such relationship and the *strength of association* to infer and explain the phenomenon of globalization of EMFs. During case facts mapping and matching, the inferences were accepted if they met the criterion of *relevancy (i.e. reliability x validity)*.

Within-case data was segregated and segmented as period data to observe continuity and consistency. Cross-case data were designed to evaluate evidence and its applicability in a wider cross section of the industry. The data tabulations were done in bucketed segments that appropriately addressed the core research issues and consciously avoided narrative aspects of interviews, logs, and activity summaries (Yin, 1981). Evidence was organised around specific propositions, questions or activities with flexibility to be modified as the research progressed. Integration of evidence (Gross *et al.*, 1971) was done by collating data from different sources but on the same topic, in specific pre-defined segments that match the research query areas (Jick, 1979; Yin, 1980). The "meaningful events" (Yin, 1981) were tabulated culling out from the huge volume of case facts and data collected through interviews and desk research. This helped to remain focused and develop the *chain of evidence* (Yin, 1979: xii) that best explained a phenomenon. As one shifted from data collection to within-case analysis to cross-case analysis, this chain of evidence finally bound the outputs of all the methods used and established the evidence sequentially and continually to the scientific outcome and conclusions. For building explanations, the technique consisted of an accurate rendition of the facts, considering alternative explanation of these facts and then finding the most appropriate explanation congruent with the facts (Yin, 1981). Lessons from the cross-case study were compared to observe a common explanation that emerged (Derthick, 1972). As the search for an explanation is a kind of pattern matching process (Campbell, 1975), the systematic matching of evidence that caused the rapid globalization across several EMFs, gave rise to the final research conclusions.

The inquiry is assumed to be value-free (Darke *et al.*, 1998) and hence at all times the researchers remained detached, neutral and objective. In the following sections the outcome of the research is presented with the descriptive observations of the phenomenon and the explanations.

4.4 The global IT industry background and Infosys

The global IT services industry is reputed to be one of the most dynamic industries in the world. In the 1980s, two trends triggered the industry to become increasingly specialized. First, client companies' appetite for specialized software applications grew beyond most manufacturers' ability to provide them and most users' ability to generate them internally (Barnes 1990). For example, a commercial bank's software needed to be radically different from that of a hospital (Trimble, 2008). Hence companies began to require custom software development services to tailor their information systems to their specific business needs. The second trend was the proliferation of computers in terms of type, processing power, size and standards that resulted in the need for someone to integrate all these machines through networks so that all the computing power of an enterprise could reliably work together. This was the so called middleware segment involving systems design and integration.

With time, the software and services segment of the IT industry began to be broadly classified into the following three categories – packaged software, professional services and back office services.[4] Packaged software represented commercially available off-the-shelf software like operating systems, word programs, spreadsheets, databases, presentation graphics, financial/tax software, entertainment programs, home education, and desktop publishing programs. Leaders included Microsoft, IBM, Sun and so on. Professional services represented software consulting, custom programming, systems integration, data processing, and facilities management. Leaders in this segment were IBM, Electronic Data Systems (EDS), Computer Sciences Corporation (CSC), members of the "big six" accounting firms such as Andersen Consulting and KPMG, Digital, and Unisys. Operations and back-office services represented maintenance and back office work such as document conversion, data entry, claims processing, and medical transcription (Haag *et al.*, 2003). Most of these services were however sought from the OECD based suppliers, often locally from vendors located within the geographic boundaries of the buyers.

In the 1980s, developments in telecommunications and arbitrage factors led US MNCs to explore options of outsourcing their non-core functions to developing countries like India as they sensed the potential of huge cost savings. Initially EMFs' business proposition was offering talented human capital trained by the home country's elite educational institutions like the IIT and IIS,[5] that came with substantially lower cost. At the low end was the demand by foreign firms for on-site services, also referred to in a derogatory sense as "bodyshopping" (D'Costa, 1998, 2003; Khanna and Palepu, 2004). Indian programmers relocated to the host country, typically for a short period of time for a flat fee (D'Costa, 2003) and for significantly lower wages than local programmers in the host country (Khanna and Palepu, 2004). Clients received the services of the programmer"bodies" with not much by way of organizational knowledge from the software firms (Khanna and Palepu, 2004). This created the opportunity for the client MNEs to leverage favourable arbitrage factors and remain competitive. In other words, "staff supplementation" was the business model - substituting high cost onshore staff with low cost offshore dedicated manpower without compromising on quality and timeliness (Verghese, 2006).

In 2003 nearly 57 per cent of business came from low-value legacy application management and customised services (Nirjar, 2008 quoting NASSCOM, 2006). Low value services presented the classic problem of "locking-in" into a low road of innovation trajectory (D'Costa, 1998, 2004). The"high road" of innovation, namely software development, or customised software was a highly sought after segment which only the most well-established firms could covet.

As an EMF, Infosys envisioned competing in a range of activities from low value legacy application management maintenance as well as high value consulting, system integration, packaged software development. According to industry analysts (see Abraham and Sharma, 2005) Infosys progressively moved up the value chain and leapfrogged into the elite league of IT firms within the global industry. Total revenues in the first decade were $3.89 million, but Infosys grew at a compounded annual rate of 70% to have a market capitalization of $10 billion by 2005. By calendar year 2006, Infosys had exceeded $2 billion in annual revenues and hired its 50,000th employee across 30 locations in 17 countries, and the company emerged as the second largest IT firm in India. During this time, Infosys evolved from an offshore software service provider to an IT consulting firm. The total revenue of Infosys continued to grow at an accelerated pace and clocked at US $4.66 billion in 2009, $4.8 billion in 2010, $6.04 billion in 2011 and $6.99 billion in 2012. The gross profit in the same period grew from $1.96 to $2.83 Bn. The total number of employees reported as of March 2012 is 149,994.[6] Today Infosys's forte is consulting, systems integration, application development and product engineering services. Through these services, Infosys enables its clients to fully exploit technology for business transformation (Chacko, 2004).

4.5 The Founding Stage

Infosys was founded in July, 1981 when seven engineers working for Patni Computers, an Indian re-seller of US based Data General machines, decided to started their own enterprise (Birkinshaw, 2008; Singh, 1999). Among them were Narayan Murthy (currently Non- Executive Chairman and Chief Mentor), Nandan Nilekani (former CEO and now Co-Chairman) and Kris Gopalakrishnan (current CEO and Managing Director). The total capital the founders pooled together from their families was just Rs.10, 000 (~ US $200). The founding team had one aspiration: "*to become the most respected company in the world.*" (Mehta *et al.*, 2008; Singh, 1999). They carried on business from a cheap residential apartment and did everything possible to keep their costs low as an offshore software service provider (Mehta *et al*., 2007).

It was Murthy who envisioned the possibility of providing high-quality IT services at low cost by employing talented but lesser-paid engineers from India to serve clients in the developed world.[7] In the early years, Infosys faced tough hurdles – waiting a full year for government permission to purchase the company's first computer (Trimble, 2008). For a relatively simple task like importing a computer (no computers were manufactured domestically), a company had to demonstrate that it was generating significant revenues in foreign exchange and apply for an import license (Singh, 1999, 2011; Cappelli *et al*., 2010a, 2010b). These licenses took many months to approve. What was more, Infosys had neither the capacity to incur the cost of purchasing and maintaining its own computer in India nor the space to house such a computer. In other words Infosys management found themselves managing on the edge – facing extreme or unprecedented challenges that forced them to think afresh about traditional ways of working (Birkinshaw, 2008). Infosys's solution was ingenious: making do with scarce resources by having the computer installed on the premises of a major customer in India, and working on the customer's premises as a hired hand to maintain and update its clients' mainframe systems as their IT requirements evolved.[8]

Infosys's vision of international expansion enabled the company to leap into the global IT market and tap the colossal growth in demand for IT services in the 1990s (Birkinshaw, 2008). Murthy and his colleagues travelled to clients mostly located in the United States to work side by side with them. Infosys's first customer for its body shopping services was Data Basics Corporation in New York (Trimble, 2008). Indian programmers stayed in the US for several weeks or months to carry out these assignments at the customers' premises.[9] The company competed directly with US-based companies, but at a substantial discount. Infosys had to establish credibility first by demonstrating its capabilities by maintaining systems that were not mission critical (Trimble, 2008). During the time it came into the market, Murthy explained

> "When we went to the Fortune 1000 companies to sell our services, most CIOs didn't believe that an Indian company could build large IT applications".

In 1987, Infosys formed a joint venture with Kurt Salmon and Associates (KSA), a management-consulting firm located in Atlanta, which solicited software projects while the Infosys offices in India provided the body shopping personnel. Among the takers for the company's low-cost, high quality customized software solutions was sport-shoe maker Reebok International Ltd. Infosys managed to obtain a twenty-person a year project for designing and building an automated ordering and distribution system that would track and maintain Reebok orders worldwide. The project team overcame many hurdles, including the language barriers, and completed the project ahead of time, which won a new customer for life. Infosys gradually gained acceptance and came to be recognized as a quality provider of application services and, by 1993, it worked on projects for GE, Nestle, Holiday Inn, and many other firms (Singh, 1999).

Like other IT firms within India, Infosys was initially concerned with operational efficiency at the low level coding and unit testing, which involved lower risks and required less capabilities (Jarvenpaa and Mao, 2008). This meant low-level and low value-adding work for developers, as they were required to passively do everything according to the design specifications, without any need for intellectual input of their own. However one of the first tasks Murthy identified was to understand and emulate what MNCs did with human capital management (Chacko, 2004). Murthy observed:

> "the primary reason for our growth is that we opened our minds and learned from people who were better than us, and have competed with them on their own terms."

With its capabilities to do reliable work well demonstrated, Infosys began to be asked by clients to handle more critical tasks and to take on the development of custom software applications from scratch.[10] The experience of getting high quality service led to an international flurry of outsourcing from other countries. Competitive pressure faced by MNCs brought in more and more projects to EMFs. Bangalore became the hub centre for offshore processing activities and the Government's support on infrastructure development created a "cluster effect" of locational advantage that gave increasing returns of scale as well as network benefits. Offshoring allowed MNCs to focus their expertise on more critical value-added activity at home while delegating the lower-end, routine and repetitive work to more cost effective locations. It created leaner organization and generated higher profits for MNCs. For Infosys it created new jobs, more revenue and a larger scale and an entry into the global value chain. Infosys managed to incrementally develop their capabilities following a path that allowed them to move successively from coding and unit-testing work, to functional design, conceptual design, and even architectural design.

4.6 Development Stage

As the reputation of these software service organizations grew, more and more of the actual work began flooding into India, to take advantage of lower costs. 70% of the revenues of EMFs came from repeat business, or in other words, from the same client over and over again due to this long term partnership strategy.[11] Reputation effect was an externality related benefit that could plausibly upgrade Infosys from the operational level to developing dynamic capabilities. Scaling up was key for the vendors to obtain larger and more profitable contracts, which in return secures resources for explicit learning mechanisms such as CMM certification and richer forms of client engagement.

After it won contracts for developing mission-critical software for such high-profile companies as Nordstrom and Nortel, Infosys began to tackle more complex projects than software development, helping clients manage their transitions from mainframe systems to modern new-technology platforms (Trimble, 2008). An important benefit from achieving operational efficiency was that this led to rapid skill upgrading through learning-by-doing in the highly sophisticated IT markets around the world. Some of the major clients, especially those that had developed closer relationships with the company through a history of successful past projects, began sending their personnel to the company to train developers in process management (Jarvenpaa and Mao, 2008). Client-specific relationships began to be built on the basis of repeated interactions and contracts, investments in organizational design, and training in the client's service culture (Jarvenpaa and Mao, 2008). Infosys developed not only a better understanding of the clients' business requirements and customer service culture, but also efficient approaches to deal with clients' style of communication and requirements specifications (Jarvenpaa and Mao, 2008).

So that employees could accumulate experience in serving clients with similar needs across the industry and become more efficient, Infosys kept employees within the same industry business unit (IBU) for extended periods of time. To increase its revenue per IT professional and at the same time expand and diversify its base of IT professionals, it focused on building expertise in vertical markets, refining its software development and tools, and storing and disseminating institutional knowledge (Singh, 1999). The industry term for these IBUs became known as 'verticals' where senior employees leveraged long-term relationships with existing clients within the same industry (Trimble, 2008). To support these 'verticals', Infosys added enterprise capability units (ECU) which built deep expertise in capabilities that had applicability across many industries (Trimble, 2008). As one part of the reorganization, an existing competence area in implementing off-the-shelf software packages from companies such as Oracle and SAP was formalized as a new ECU, called enterprise solutions (ES). Infosys assigned employees to either an IBU or ECU for multiple years to deepen their expertise in either an industry or a cross-industry capability (Trimble, 2008). "Package implementation" business became part of the new strategic focus (Varghese 2006) enabling access to and staying in touch with the latest IT products in the industry at the same time provided further inroads into the client-partnership to do customization, bridging and upgrading, while maintaining these packages. In the case of Infosys, the package implementation business gave a new scale effect.

The second aspect of the strategic model was to focus on customization capabilities According the EIU (2005), in the new world of globalization, what will matter most is the personalization of services as interactions and customization become vital components of both customer service and worker behaviour.[12] The changing environment and the changing mindset would always require specialists to adopt, modify, transform and customise business solutions, in other words the game of being unique. Infosys's articulation of this strategy is "being unique requires that you create a layer of customization around even standard packing".[13] Customization became the leg on which Infosys ran this competitive race, to be a globalized enterprise from an emerging nation. The belief that drove the "customization" model is that the "products" could be obsolete and replaced by another in the marketplace but customized IT solutions would always be in demand. In other words Infosys would need to occupy the core space of software development - reengineer software from one technology to another or from one level of functionality to another. The fundamental definition of business was that as long as technology changes, demand for these services would exist. Adding new business verticals in the portfolio would insure their future and provide stability (Varghese, 2006).

Third, Infosys had to change organizationally from being a domestic company headquartered in India and providing services to a host of clients spread out across the globe to being a global company delivering local solutions to all of its clients (Singh, 1999). To reduce the cost of travel and leverage a vast pool of talented technologically savvy, English-speaking engineers in India, Infosys began to experiment with a radical notion (Trimble, 2008).

The mainspring of this leapfrogging stage became their service delivery model that was distinguishably different from the existing IT giants like IBM, EDS and Accenture (Mirchandani, 2006). Thus the global delivery model (GDM) was created where it leveraged "a global resource pool, a global infrastructure, global development centres and the philosophy to do the work where it makes the most economic sense".[14] The underlying framework for the global delivery model (GDM) was a distributed project management, executing the project at multiple locations with flawless integration. By leveraging global resources, GDM created new degrees of freedom that put incumbent models at a disadvantage.[15] The GDM was a model that split a large task into multiple subtasks in two categories: activities that have frequent interaction with customers, and activities that have little. Activities that have frequent interaction are necessarily delivered on site, and activities that have little customer interaction are delivered from remote, scalable, process-driven, talent-rich, technology-based, cost-competitive development centres in countries like India (Murthy in Trimble, 2008). Murthy explained:

> "We wanted to do the work where it could be done best, with the least amount of acceptable risk, and where it made the most economic sense, for example, by shifting costly project components from the client location to relatively cheaper locations around the world."

Hence in this phase an organizational innovation that led Infosys to realise a quantum leap in value creation was an "optimal sourcing and maximal utility/gain model" (Varghese, 2006). After a project was landed, a technical team would travel to the client's site to assess project requirements (Mehta *et al.*, 2007). Based on the project requirements, a team would be assembled at the software development centre to develop the software solution (Mehta *et al.*, 2007). Alternatively, if the project requirements dictated, a virtual team would be assembled from multiple software development centres worldwide (Baxi, 2007). After the software was developed, the technical team would revisit the client to install the software as well as training and maintenance (Baxi, 2007).

Traditionally, existing global giants like IBM used their "onshore" (local) support and service model worked on building significant infrastructure locally, close to the clients or housing adequate manpower locally. This offered a customized and dedicated service that satisfied clients. However, in an increasingly borderless world, the cost of such dedicated services appeared unsustainable and inefficient. Infosys identified this large gap and positioned itself as an alternative "global service provider" with matching quality at reduced cost, as against onshore or local service providers. Thus the concept of GDM became an alternate and more appropriate service delivery model. Being the creators, Infosys derived maximum benefit from this new strategic service delivery globalization model. The competitive proposition of EMFs was simple but quite powerful – local capabilities vs. global capabilities, in the service delivery.

This model was built in a strategic component-split, by location and specialization. The front end-architects, analysts, consultants and client servicing were localized on-shore whereas the back-end tasks, technical design, programming, lab-testing were done in emerging economy locations like India and China (off-shore) based on specialization. Thus the global delivery model (GDM) was created as an integrated network that delivered services through a geographically distributed, process-centric and low-cost mechanism.[16]

GDM became the new mantra and the IT industry norm in global service delivery. Now both onshore and offshore players have incorporated GDM in their service delivery strategy.[17] While the core activities of development and maintenance business continued to give ~50% revenue, the "new services" took the enterprise to a new league. The future would rest on "Solution Focus". U.B. Pravin Rao, Senior Vice President - Retail, Distribution and Consumer Products Group, summarizes this in one sentence.

> "Bringing solution focus to all that we do for our clients, weaving together services, GDM, alliances, execution excellence and deep domain knowledge to create innovative new solutions, enabled by a structure of industry focused sales and relationship management teams, business/domain consultants and technologists".[18]

4.7 Maturity

By 2000, Infosys confronted competitors in three categories: those that had their roots in infrastructure outsourcing, like IBM and Electronic Data Systems; those that had their roots in process design and consulting, like Accenture and Deloitte Consulting; and Indian rivals with roots in applications development delivered through a GDM, such as Tata

Consultancy Services and Wipro (Trimble, 2008). Infosys's cost advantage was rapidly eroding under pressure from two trends: rising wages and United States competitors building their own development centres in lower-cost countries, including India (Trimble, 2008). Infosys's overarching strategic imperative was to raise revenue per employee, by increasing productivity[19].

Infosys needed to make the transition to the kind of services that required a high content of human capital or intangible assets[20]. The business strategy needed to change into high end "analytics", the critical business function that created the sustainable competitive advantage for survival and growth. For Infosys, it would be a step forward – a deeper penetration into the inner circle of "corporate strategy group" of clients. If Infosys could provide end-to-end services that could reassess strategy, redesign a client's operations for executing the strategy, write the specifications for the IT systems, develop, test, and install the necessary new software applications, maintain the software and hardware systems as the client company evolved it could get into the elite league of a provider of end-to-end solutions right up to management consulting, the preserve of EDS, KPMG etc.

In the mature phase, the challenge was to master capabilities in management consulting, design and development of automotive and aerospace industries, medical and R&D content and services and the like. This model was critical to compete in the global market place as the EMFs now operated in the knowledge based end of the value chain that was otherwise the domain of the existing global giants like IBM, EDS and Accenture etc. Clients were looking at EMFs as independent assessors, knowledge leaders and sources of future technology steps. In other words the business entered the maturity stage of life cycle graph. The evolutionary pathway into the capability maturity, in the words of Chairman and Chief Mentor N.R. Narayana Murthy:

> "coming of age"…..this journey of 25 years has been a symphonic marathon".[21]

The phase three constituted a "re-positioning" of corporate capabilities and value propositions. Catchphrases like "powered by intellect, driven by values" and "nurturing ideas", revealed their new mission to operate in the domain of knowledge and innovation. Infosys was now expected to bring in new business dimensions, cutting edge technology and analytic capabilities[22]. With re-positioning, the business proposition diversified into several practice areas. From the initial focus on software re-engineering, and maintenance platform, the business now focused on enterprise solutions, systems integration, technology consulting, and IT outsourcing. The contribution of these "new–services" to the total revenue grew rapidly from 22% to 41% (Gopalakrishnan, 2006). In other words these became the engine of growth. The following figures 4.1 and 4.2 give a clearer picture of the migration of business platforms in the globalization model of Infosys.

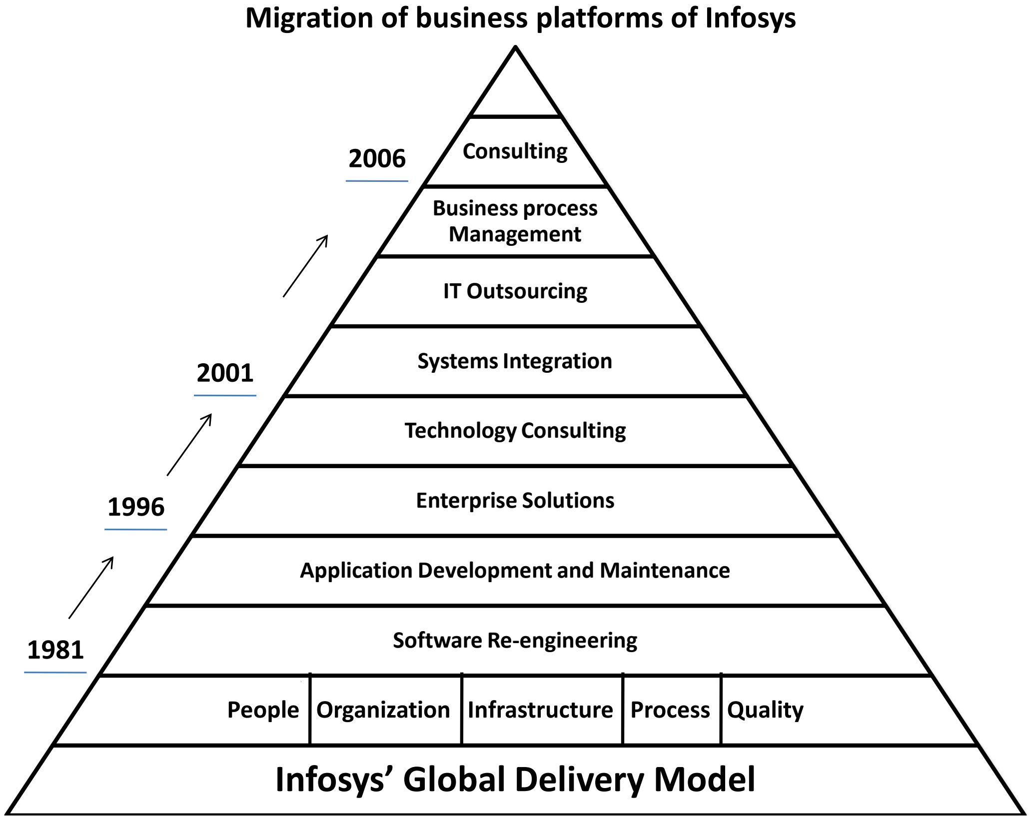

Figure 4.1: Migration of business platforms of Infosys

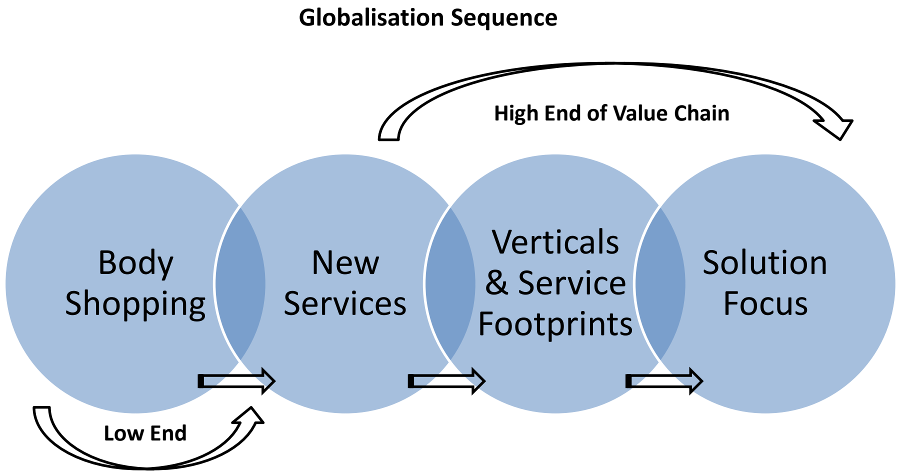

Figure 4.2: Globalization sequence

The business model in the next phase broadened from a business process outsourcing (BPO) to a knowledge process outsourcing (KPO) model. Infosys's focus shifted from the intermediate level of BPO services and system integration through GDM to the higher end of the value chain (Annaswamy, 2007). MNEs were looking to EMFs to bring in domain expertise in diverse areas like content development, database creation, financial modelling, competitive intelligence, to name a few. Infosys had to develop a reputation and inspire confidence in their clients about their capabilities.

With the shift in emphasis towards KPO, Infosys began focusing on the avionics domain as a high priority area, working on the project for various aircraft makers.[23] The challenge lay in providing safe, reliable and high integrity software which was affordable and maintainable.[24] Infosys avionics group, a part of Infosys's engineering services consulting practice (ESCP) group, had already developed capabilities in mission critical computers like flight control and management systems, navigation systems and air traffic management. Using these capabilities ESCP targeted satisfying markets such as automotive, aerospace and high-tech manufacturing by building a team of individuals and senior industry consultants in the field of cross-platform integration.[25] The ESCP built life–critical embedded software in avionics, automotive, defence systems and medical electronics.[26]

In 2002, aircraft maker Airbus Industries hired Infosys for wing design after seeing the capabilities Infosys had mastered. As software became the driving element in development and modernization of civil and military avionics systems, Hindustan Aeronautics Limited (HAL) when building the Sukhoi aircraft, outsourced 30 per cent of the work to various private sector players amongst whom Infosys was a key player.[27] In 2000 collaborations for Infosys included IBM for knowledge sharing arrangements and Microsoft Share Vision for Effective Enterprise Information Management. In 2004, Infosys launched Infosys Consulting, a unit that provided advisory services on strategy and implementation and thus took its place at the front end of Infosys's vision for end-to-end services. A typical Infosys consulting project included a strategy assessment, a redesigned system of processes to deliver on that strategy, and the specifications for the IT systems to make those processes as efficient as possible.

By the late 90s, staffing requirements no longer focused on inducting human capital in IT for operational profile but shifted to finding analytic talents of a global standard (Annaswamy, 2008). The biggest challenge for Infosys was how to recruit, enable, empower, and retain the best and the brightest talent (Trimble, 2008). Infosys hired people that it believed had the capacity to continue learning. It fine-tuned its induction process for new recruits so that they get trained and ready to work in less than four months. New employees, dubbed Infoscions, arrive in batches of around 500, three groups per month; and they are immediately sent to Infosys's educational facility in Mysore for 16 weeks of training in technical and soft skills (Birkinshaw, 2008).

The founders had experienced the necessity of ongoing learning as their own roles evolved from the level of software programmers to managers of a global service empire (Trimble, 2008). This phase entailed crafting a strategy of how to incorporate the most critical "people" strategy to address the structure issue. The globally reputed institutions like IITs (Indian Institute of Technology), IIS (Indian Institute of Science), TIFR (Tata Institute of Fundamental Research) and IIMs (Indian Institute of Management) provided a ready source of human capital. For decades the top brains from these institutions were picked up by global MNEs and now the same international opportunities and salaries (in US$) were offered by EMFs like Infosys to attract and retain talents at home. In 2004 Infosys established the Campus

Connect project in collabouration with Indian universities to steer their curricula towards Infosys's needs and to create awareness of the company on campus (Birkinshaw, 2008). Murthy attributed this to a pioneering dialogue with the Government of India that culminated in a forward looking fiscal policy which made it possible to attract and retain talents with employee share options. In his own words

> "I must say that this is one industry where the government has been very proactive, has gone out on a limb and made sure that the industry has a chance to succeed on a global level. I don't know how many of you know; today the best taxation regime for stock option plans is from India. It is much better than the US because in India what they have said is that stock options will be taxed only on the basis of capital gains at the time of sale of the stocks. The capital gain in India is just 11 per cent. For once we are even better than Hong Kong. I can tell you that's a rare thing."[28]

Infosys needed to be an organization which believed in leveraging knowledge for innovation; where every employee could leverage the knowledge of every other employee (Mehta *et al*., 2007). This required "learnability" – the ability to extract knowledge from specific concepts and situations and apply it to other situations (Mehta *et al*., 2007). Because the industry was very dynamic, Infosys realized that there was little point in focusing on mastery of a particular computer language or customer sector (Birkinshaw, 2008). Instead, it needed people who could thrive in a changing environment and who enjoyed mastering new languages and new challenges. Learnability required real-time access to a firm's knowledge resources, which could only be improved through better knowledge flows (Mehta *et al*., 2007; Trimble, 2008). The emphasis on learnability also required graduates without strong IT backgrounds, as such skills were easily learnable on the job. Murthy observed:

> "I will begin with the importance of learning from experience. It is less important, I believe, where you start. It is more important how and what you learn. If the quality of the learning is high, the development gradient is steep and, given time, you can find yourself in a previously unattainable place. I believe the Infosys story is living proof of this."

In order to improve learning, Infosys' project managers began documenting brainstorming and mentoring sessions and stored these documents in a central library for future reference. The library, termed Body of Knowledge (BoK), was later converted to an electronic format (Mehta *et al*., 2007). Over the years, a database for storing project-related artefacts, and a marketing assets repository consisting of client case studies was established.[29] Employees could visit the knowledge management (KM) system to access various forms of documented knowledge such as previous client proposals, client case studies, technical white papers, project summary and snapshots, and even reusable code (Jalote, 2000). Thousands of employees regularly participated in knowledge exchanges on the discussion forums.[30]

In 2005 tacit knowledge sharing became an important pillar of the KM program. Infosys employees had to constantly learn new skills in order to adapt to the rapidly changing technology landscape (Trimble, 2008). The capability required was leveraging internal and external sources of expertise involving knowledge sharing within business units (Mehta *et al*., 2007). This meant more technical seminars, so that employees could transfer what they had learnt from serving clients to other employees as well as across organizational levels (Kumar *et al*. 2008). They shared case studies about the company at its best and ensured that the stories were told and retold by others (Trimble, 2008). Due to the knowledge repository, timelines could be squeezed. J.K Suresh explained:

> "We had to make people want to share experiential knowledge about processes, technologies, customers, products, projects and trends - and to make people want to use Infosys knowledge" (Chacko, 2004).

In 1999, Infosys established an R&D group known as the Software Engineering and Technologies Labouratories (SETLabs). Deependra Moitra, a senior leader in the group, described SETLabs as a "business-relevant R&D organization," one that was closely connected to IBUs and customers. One of the group's core objectives from launch was to leverage technology advances to generate significant gains in Infosys's productivity in delivering projects (Trimble, 2008).

Table 4.1: Services Footprint

	2011	2010	2009	2008	2007	2006	2005	2004
Services:								
Application Development and Maintenance	**39.0**	**41.3**	**42.4**	**45.4**	**48.0**	**50.4**	**53.1**	**55.8**
Application Development	16	18	20.5	21.7	23.1	20.2	23.2	25.7
Application Maintenance	23	23.3	21.9	23.7	24.9	30.2	29.9	30.1
Business Process Management	5.6	6.1	6	5.7	4.7	4.0	2.7	1.6
Consulting Services and Package Implementation	25.5	24.4	24.9	23.8	21.1	19.7	18.8	18.2
Infrastructure Management	6.3	7.2	6.3	4.9	4.4	3.0	5.0	5.3
Product Engineering Services	2.4	2.2	2.2	1.6	1.6	1.8	2.0	2.2
Systems Integration	5.4	4.2	3.6	2.8	2.3	1.7	1.2	0.7
Testing Services	7.5	6.4	6.8	7.5	6.9	5.9	5.8	5.3
Others	3.4	4	3.9	4.7	7.1	9.7	8.4	8.1
Total services	**95.1**	**95.8**	**96.1**	**96.4**	**96.1**	**96.2**	**97.0**	**97.2**
Product revenues	**4.9**	**4.2**	**3.9**	**3.6**	**3.9**	**3.8**	**3.0**	**2.8**
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: Infrastructure Management and Systems Integration data between 2004 and 2006 is estimated

Table 4.1 shows how Infosys progressively increased its focus on consulting services, business process management, infrastructure management and engineering services. These figures are illustrative of how EMFs like Infosys typically moves up the value chain to the so called "high road" of global competition.

4.8 Discussion

It was Infosys's purposeful strategy that enabled them to leverage to the maximum the resources from their clients and learn how to exploit them in order to move into higher domains. The tasks mastered by Infosys in the initial stages were simple operational level routines that helped to deliver simple repetitive back-end operations and application maintenance to MNCs. In the body-shopping stage MNC clients generally received the services of the programmer 'bodies' with much less by way of organizational knowledge from the IT EMFs (Khanna and Palepu, 2004). As defined in the literature, ability to make use of existing resources, such as existing manpower without much by way of value addition are simple-operational level capabilities (Banerjee, 2003). Operational capabilities restrict and channel the range of individual action into predictable and knowable routines, with relatively formalised roles and responsibilities, centralized procedures and efficiency-oriented cultures (Ojha, 2004).

In the initial stages, MNCs transferred the missing resources, both technology and skills. Access to critical resources of MNCs such as technology platforms, software systems and products, internal processes, production and customer networks enabled them to learn client specific businesses and needs and design cost-effective communication and interaction patterns (Rajkumar and Mani, 2001). Linkages conferred upon EMFs an "image transfer" (i.e. acquiring the values of the commercial partners) and other benefits of association (e.g. access to distribution channels). Using a carefully calibrated mechanism for reputation enhancement through linkages with MNCs, Infosys was able to internalise the externalities of client-supplier relationships through learning to step into higher domain expertise and value added segments.

As observed by Mathews, repeated application of linkage and leveraging of resources from a variety of external sources may result in the firm learning to perform such operations more effectively and venturing into areas hitherto untapped. The specifics and idiosyncrasies of a variety of clients' needs and operating environments required EMFs to constantly adapt to changing environments, document the learning and share the tacit knowledge through the KM system (Jarvenpaa and Mao, 2008). The latter involved explicit knowledge articulation and knowledge codification mechanisms in the form of manuals, blueprints, and project management software. Explicit (codified in formal, systematic language) as per the classification is knowledge that can be combined, stored, retrieved, and transmitted with relative ease and through various mechanisms (Ernst and Kim, 2002). Transfer of knowledge in the form of blueprints, technical specifications, and technical assistance, to independent local suppliers to ensure that products and services produced by the latter meet the former's technical specifications (Ernst and Kim, 2002). Tacit knowledge refers to knowledge that is so deeply rooted in the human body and mind that it is hard to codify and communicate (Ernst and Kim, 2002). It is knowledge that can only be expressed through action, commitment, and involvement in a specific context and locality (Ernst and Kim, 2002). Tacit knowledge is based on experience: people acquire it through observation, imitation, and practice. Its diffusion requires apprentice-type training and face-to-face interaction. It can also be transferred, however, through the movement of human carriers of such knowledge, a fact that much of the literature on industrial districts used to neglect (Ernst and Kim, 2002).

Infosys also engaged in collective discussions as a learning mechanism that resulted in developing tacit knowledge based capabilities (see Eisenhardt and Martin, 2000 for a theoretical discussion). The routines by which managers reconnected webs of collaboration to generate new and synergistic resource combinations among businesses (e.g., Galunic and Eisenhardt, 1994, 1996, 2001) is a classic strategy of dynamic capability development by EMFs in the new knowledge economy. When firms recombine resources (Henderson and Clark, 1990) to produce new outcomes, they learn from the experience in recombining and utilize this learning in establishing higher order routines (Cohen and Levinthal, 1989, 1990; Cohen *et al*., 2000a, 2000b, 2001, 2002). This is accomplished by extending the learning effort as discussed extensively in the evolutionary literature (see Lall, 2004; Mathews, 2006b). For Infosys, moving up the value chain from the low road of back-end operations to the high road of technology consulting invariably involved learning about different functions of clients. These specific tacit learning experiences were then applied generically to other situations to provide solutions to clients. As observed by Birkinshaw (2008), one key attribute at Infosys is what they call learnability, the ability of an individual to derive generic learning from a specific situation and apply it to a new unstructured situation. The emphasis on learnability led Infosys to hire graduates even without strong IT backgrounds, as such skills are easily learnable on the job.

The inter-temporal transformation of Infosys from founding to development and finally maturity provides a fascinating account of how an EMF learned to develop higher level capabilities. Even as MNCs sent their personnel to Infosys to train developers in process management (Jarvenpaa and Mao, 2008) and transfer knowledge, the EMF undertook client and industry specific learning on the back of repeated interactions and contracts, investments in organizational design, and training in the client's service culture (Jarvenpaa and Mao, 2008). Infosys developed not only a better understanding of the client's business requirements and customer service culture, but also learned to contrive efficient approaches to deal with clients' style of communication and requirements specification (Jarvenpaa and Mao, 2008). Employees accumulated experience by serving the same clients with similar needs within the same industry business unit (IBU) for extended periods of time. It focused on building expertise in vertical markets, refining its software development and tools, and storing and disseminating institutional knowledge (Singh, 1999). Through GDM, it got access to the best resources located in any part of the world. Reaching maturity, Infosys instituted a formal knowledge management (KM) program to document implicit and explicit learning from experience. Knowledge acquired through linkages with MNCs, was transferred within the organization via the KM program which enabled human resources to learn from each other and from codified knowledge. Simultaneously, Infosys established Software Engineering and Technologies Laboratories (SETLabs) as a "business-relevant R&D organization to leverage technology advances (Moitra, 2001). High quality human capital inducted into the company and given intensive training provided the absorptive capacity to internalise the knowledge resources.

However, leapfrogging into dynamic capabilities could only be accomplished by bringing new human and technological resources into the firm and combining with conscious internal learning (see Lane and Lubatkin, 1998; Powell *et al*., 1996; Powell (1998); Zollo and Winter, 2002; Mathews, 2006b for a theoretical argument) through the KM program. It was able to capitalize on the highly educated but relatively cheap Indian workforce years before competitors such as IBM and Accenture. By developing a global delivery model (GDM) across 38 global centres that allowed it "to produce where it is most cost-effective and sell services where it is most profitable", Infosys could also tap into the best available resource and knowledge anywhere around the world.

Interestingly, successful EMFs did not make the often-repeated mistake of incumbents, as stated by Michael Porter of "competing with rivals on the same dimensions".[31] Instead they created a new value proposition in the "service delivery mechanism". Since the conduits through which services are delivered are integral and critical parts of successful implementation, this strategy worked in the rapid globalization thrust.

What is more, EMFs used an unconventional model of globalization that had many of the right ingredients for attaining dynamic capabilities. First, the opportunity mapping, next, sticking to core strategy, and finally, developing it further with naturally evolved and logically sound strategies, identified above. The core business of developing and maintaining software were never abandoned even though it was relegated to the lower end of value chain and "body shopping" categories. Significantly it gives EMFs half of their revenue even today, and sustains the reputation in this domain of knowledge. However, these enterprises steadily and rapidly moved up the value chain by integrating a new services business to the existing strong core. The core gave the critical mass to rely on, and develop strong infrastructure. The induction of the comprehensive "verticals" gave the required organic growth. The "service footfalls" across diversified yet integrated domains and geographies became the growth engines and the global delivery model created an unbeatable competitive niche that even giant competitors like IBM, EDS, Accenture had to incorporate in their revised strategy (Mirchandani, 2006).

The mass of human headcount of emerging economies that once seemed a national liability got transformed into technology powerhouses, in a new globalization model, especially in the knowledge based business space.

4.9 Conclusions

This chapter mapped the sequence and strategy of an EMF through its evolutionary stages and demonstrated how it rose above the infirmities in micro economic environment and converted their disadvantages into strengths. It showed how human capital can be used to create an alternative model of globalization in the IT enabled service sector. The IT EMFs followed a new and unconventional pathway of achieving dynamic capabilities that concentrated not on the home country but targeted strategically a global market with core knowledge competencies and factor strengths of the home environment. EMFs used an "intermediate path" where they initially got themselves embedded in exporting intermediate knowledge on behalf of overseas companies (Terjesen *et al*., 2008; Fletcher, 2004: 290) but later gained higher-end international market-segments as a spillover. EMFs chose this path because they were based in small domestic markets and required a platform provided by MNEs to internationalize as a tool to gain resources and dynamic capabilities. Driven by human resources trained in the home country's elite educational institutions, but reinforced with critical knowledge resources from client MNCs, these EMFs showed that in the technology driven business model, knowledge workers can assist the development of emerging economies to expand rapidly. Infosys initially focused on leveraging arbitrage factors and on core IT-enabled services but soon re-engineered their value proposition to position themselves at the top end of the value chain. It internalized businesses and customized services by adding "verticals" and new "service footprints" to accelerate their globalization goal.

Its innovative global delivery model (GDM) changed the global benchmark of service delivery to the extent that the existing global giants had to follow in their footsteps.[32] The foresight of Infosys top management to identify a global trend early, building the strategy around that trend, and more importantly, sticking to the goal was critical in its spectacular rise. In Porter's (2005) words: "continuity of strategy is fundamental to sustainable competitive advantage because it allows the organization to understand the strategy; it builds truly unique skills and assets related to the strategy; it establishes a clear identity with customers, channels, and other outside entities; and it strengthens the fit across the value chain".

The compulsion to change, driven by technology, presents enormous opportunities to the emerging world's solution providers. The entities that identified this global trend, captured this strategic space early, and created a business model around this, have been able to grow and globalize. This strategic thrust to the new business model is similar to the outward looking OLI model of Dunning's (1988) eclectic theory of MNEs. While OECD MNCs internalized low cost resources (locational advantage of India), EMFs leveraged firm-specific intellectual capital from MNCs.

Figure 4.3 below summarises these sequences and the strategy. Finally, further externalities like spillovers of reputation created alternate Silicon Valley type "clusters" in places like Bangalore that further helped to accelerate their globalization goal. In summary, performance led to reputation, reputation brought respect, and respect enhanced the power to globalize rapidly.

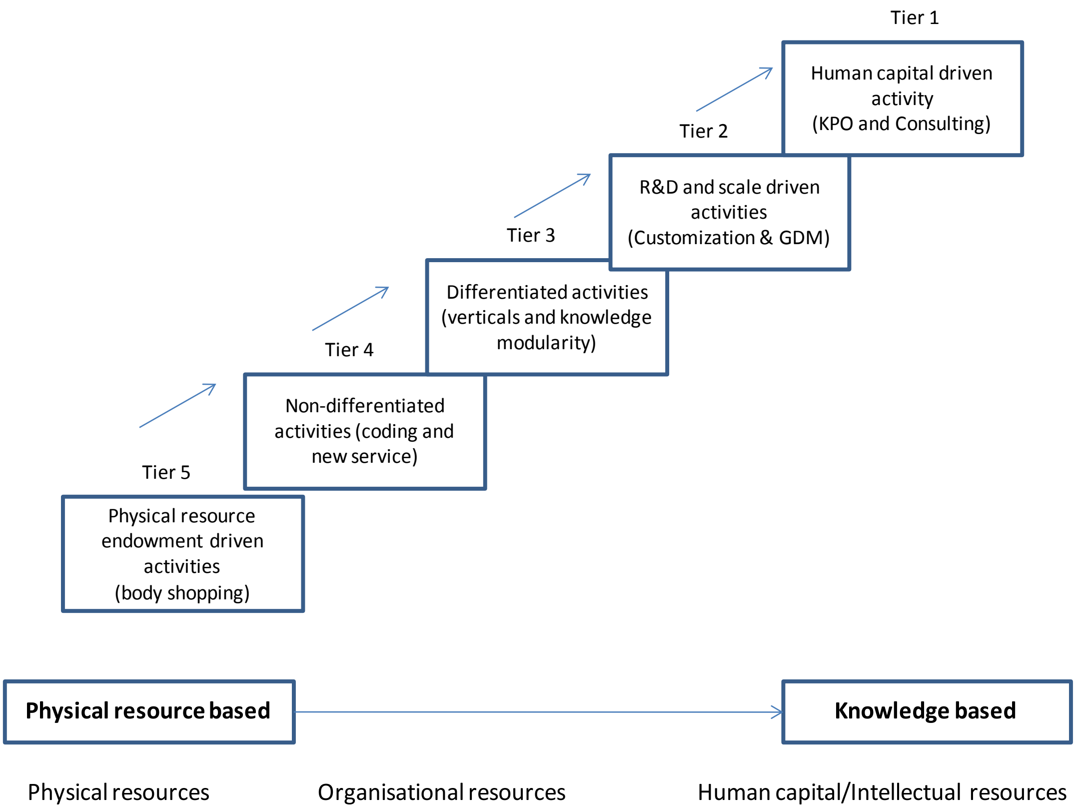

Figure 4.3: Sequence and strategy of EMF's evolutionary stages

4.10 Limitations

It is now pertinent to discuss some limitations of this study. First, being a single case, the obvious question is to what extent its findings could be generalized across the Indian IT industry. The answer lies in subsequent studies which may replicate or refute the observations and conclusions drawn in this study. Second, the study did not have a theoretical framework to start off with and hence could not use theory testing logic. Testing theory needs the specification of theoretical propositions derived from an existing theory (Darke *et al.*, 1998). However, little has been theorised in the academic literature about rapid globalization in the knowledge based service delivery of Indian IT companies to date. Hence this research area is currently under investigated. A more broad based study needs to be conducted and documented in the academic literature. For theory development and testing, comparison of case study findings with the expected outcomes predicted by propositions (Cavaye, 1996) would be needed. With time, the availability of secondary data on the trend and direction of these EMFs' globalization progress would make theory development and testing a viable proposition.

Infosys Milestones

1981 Incorporated as Infosys Consultants Private Limited at Mumbai

1993 The company entered into an agreement with Analog Devices Inc., USA, under which ADI will sell GAMANA Vector, Tutorial software package (GVT), GAMANA Motion Control Development System (GMCDS) boards, GAMANA chip-sets and related software

1994 Set up marketing offices in 4 major cities in US

1995 Established Yantra Corporation, a wholly owned subsidiary in USA investing US $ 5, 00,000 in the equity of the said subsidiary.

1998 Signed up with the US-based Copeland companies to set up a client services workstation (CSW) providing retirement planning products and services to non-profit organizations (NPOs).

1999 Tied up with Alpha Data, to support banking software products in the UAE. Announced a strategic alliance with CyberSource Corporation USA, providing E-commerce transaction processing services

2000 Tied-up with Japan's Toshiba Corporation to provide enterprise resource planning (ERP) software solutions for Toshiba's business processes

- Signed an agreement with Quintessent Communications Inc to develop and test selected applications that automate data exchange between telecom carriers
- Launched BankAway - It offers end-to-end mobile banking services to all customer segments

- Launched Finacle, an integrated, centralized, multi-currency and multi-language-enabled and functionally rich banking solution to address retail and corporate banking requirements
- Microsoft Corporation and Infosys Technologies form an alliance
- Tied up with Delphi Automotive Systems for embedded software development for its worldwide operations
- Joined with Nortel Networks to set up a Wireless centre of Excellence in Bangalore.

2001 Partners with Citadon, the leading provider of online solutions for collabouration on the design, construction and operation of large, complex capital projects,

- Airbus Industries hires Infosys for wing design
- Ties up with Citigroup for formation of a new company, Progeon, for Business Process Management (BPM)
- Eastman Chemical Company, a leading international chemical supplier headquartered in Kingsport, Tenn, chooses to expand its work with Infosys in order to take greater advantage of the consulting and IT service provider's global delivery model
- Ties up with IBM for knowledge sharing arrangement
- Assessed at Level 5 on the PCMM model by KPMG Consulting, becoming the first company in the world

2003 Infosys Technologies awarded SUN Microsystems' Strategic Partner Award

2006 Infosys & Microsoft share vision for Effective Enterprise Information Management

[1] *Business Express*, (2005) Infosys goes past TCS in market cap, [www document] May 9th 2005 (accessed 2nd July 2006).

[2] *Economist* 12th Jan 2008

[3] Interview Transcripts: Interviews found in secondary data - annual reports, media reports, consultant reports at Infosys, TCS, Wipro, IBM, EDS, and Accenture in India. Information arranged and analysed to match patterns with the primary data. The chain of evidences was used for validation, conclusions and the final observation of the phenomena and the explanations. Details of the process given in the methodology section.

[4] IEEE (2003); Proceedings Ninth IEEE International Conference on Computer Vision, Nice, France 2003.

[5] IIS is Indian Institute of Science and IIT is Indian Institute of Technology, termed as world's "hardest to get in" Science and Technology Institute: put Harvard, MIT & Princeton together (CBS network, USA; BW-McGraw-Hill, Nov 1998) and ranked as Asia's top 5 engineering College, AsiaWeek.com (2005) survey.

[6] Infosys Company data http://www.infosys.com

[7] Infosys Annual reports 1990 to 2011

[8] Infosys Corporate Brochures 1990-2011

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[20] Infosys Annual Report 2000.

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[23] Business Standard Feb 19 2002.

[24] Business Standard Feb 19 2002.

[25] Business Standard Feb 19 2002.

[26] Business Standard Feb 19 2002.

[27] Carvalho, Business Today Dec 18 2005 p 84.

[28] Murthy, Narayana, 2000, *Asia Society* Hong Kong Centre and Bank of America Presentation Hong Kong, 8 May 2000 [www document] (accessed 30th June 2006)

[29] Infosys Publications: accessed through http://www.infosys.com/infosys-labs/publications/infosyslabs-briefings/pages/index.aspx

[30] Instep : *Infosys Instep* is a flagship student *internship program* partnering leading *global* universities accessed through http://www.infosys.com/instep/default.asp

[31] Special Lecture by Michael Porter December 1, 2005 - Strategy: Competing to Be Unique, Graduate School of international corporate strategy (ICS) Hitotsubashi University [www document] (accessed 4th July 2006).

[32] IBM Corporate Brochure 2006.

Chapter 5

The Evolution of Dynamic Capability in the Indian Software Industry: Cross Case Validation Studies

The previous chapters have identified several areas of dynamic capability development. In this chapter the research looks at three cross cases from the Indian IT Industry to validate these inferences.

5.1 Introduction

According to the "resource based view", enterprise performance is predicated upon the possession of certain unique firm-specific resources which allow the firm to gain an above-average performance over its rivals in a given industry. However, as late entrants in global competition, emerging market firms (EMFs) from less-developed countries do not possess such unique bundles of resources or capabilities. Yet in recent times the world has witnessed the rapid ascent of EMFs in knowledge based industries. The Indian IT industry is a leading exponent of this rise. Hence the literature is in a quandary as to how despite not possessing the requisite capabilities, EMFs leapfrog into knowledge intensive service industries such as information technology.

Indeed the extant literature has yet to map the exact processes of upgrading to dynamic capabilities that occur in EMFs.

As indicated in the earlier chapters, the aim of this study is to fill this gap in the literature. The objective of this chapter is to further examine and validate how emerging market firms leapfrog in international competition by developing several dimensions of dynamic capabilities. The previous results indicate that Indian EMFs leapfrog in international competition by moving rapidly from operational level capability to dynamic capability based on a novel strategy. The previous chapters also indicates that EMFs leveraged their critical resources and learnt how to reconfigure these basic resources into dynamic capabilities to offer new value propositions for the top end of the innovation value chain and they did that by striking appropriate linkages with global incumbents in the industry. Through the lens of Mathew's (2002) framework of linkage-leverage-learning (LLL), the study empirically describes how location specific (comparative) advantages such as low wage labour, initially used for internationalization, were reconfigured to develop dynamic capabilities which enabled EMFs to shift into a new and unique model of innovation. By using cross case studies of Indian IT firms in this chapter, the study maps and attempts to validate the patterns, processes and strategies deployed by EMFs in an inter-temporal setting, to uncover the phenomenon of reverse learning and extend the LLL framework.

5.2 Theoretical underpinnings

As late entrants in international competition, most EMFs start off with a series of resource disadvantages along several dimensions – production, administration, marketing and innovation. In the presence of learning costs, EMFs necessarily face a disadvantage compared to those that have undergone the learning process. Their lack of resources in technology translates into a weak competitive position in international markets. What is more, being from a developing country, EMFs are considered to be usually backward in engineering, technical skills and R&D (Lall, 2003).

In order to gain technological capabilities, an EMF has therefore got to start by examining its resource base, appraising its strengths and weaknesses relative to competitors and then look at how these resources may be used to gain capabilities which can be the basis of sustained competitive advantage (Mathews and Cho, 1999).

The resource based view (RBV) of the firm (Amit and Schoemaker, 1993; Barney, 1991, 1995; Peteraf, 1993; Teece *et al*., 1997) postulates that competitive advantage comes from having resources that create value. While *organizational resources* refers to an asset (tangible or intangible) of an organization, *organizational capability* refers to the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result (Helfat and Peteraf, 2003). The resources leveraged by the EMF can be *physical* (e.g. tangible as in specialized equipment, geographic location), *human* (e.g. knowledge and expertise in technology or "competencies" such as skills in software programming), and *organizational* (e.g. superior customer service, marketing) assets that can be used to implement value-creating strategies (Barney, 1991, 1995; Wernerfelt, 1984, 1995). For example human capital is used broadly here to include not just the skills generated by formal education and training, but also those created by on-the-job training and experience of technological activity, and the legacy of inherited skills, attitudes and abilities that aid industrial development (Lall, 1992). However past literature has not given an exhaustive articulation of some other critical success factors like entrepreneurial capability, intersectoral capability, process and project delivery capabilities, adoptability capabilities that has been observed in the previous chapters of this study of the evolution of EMFs' dynamic capabilities.

Traditional literature states that capabilities can be either ″operational″ or ″dynamic″, (Helfat and Peteraf, 2003). An operational capability is defined as ″a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type″. In this definition, the term routine refers to a "repetitive pattern of activity" (Nelson and Winter, 1982: 97). An operational capability generally involves performing an activity, such as manufacturing a particular product, using a collection of routines to execute and coordinate the variety of tasks required to perform the activity.

Dynamic capabilities consist of knowledge creating routines by which managers alter their resource base, i.e. acquire new resources, integrate them together, and recombine them while sensing, shaping and seizing market opportunities. These include knowledge creation learning routines whereby managers and others build new thinking within the firm (Teece *et al.*, 1997, Eisenhardt and Martin, 2000; Helfat, 1997; Henderson and Cockburn, 1996; Rosenkopf and Nerkar, 2001). Dynamic capabilities involve adaptation and change, because they build, integrate, or reconfigure other resources and capabilities (Helfat and Peteraf, 2003). In science-based regimes possible recombination of capabilities through acquisitions (Eisenhardt and Martin, 2000), eventually inculcates dynamic capabilities in smaller firms or late entrants.

Both resources and capabilities evolve and change over time. Taking an evolutionary economics approach Helfat and Peteraf (2003) describe trajectories of capabilities (see Helfat and Peteraf, 2003; Helfat, 1997) through the concept of capability life cycle (CLC) which envisions a newcomer firm's capabilities evolving through various stages – founding, development and maturity. The founding stage lays the foundation for subsequent development of capabilities by acquiring the necessary resources and bringing in human and social capital; the developmental stage entails building of capabilities in which organization may decide whether to build from scratch or imitate a capability from another organization depending on the risk disposition of individuals – which entails organizational learning and inevitably results in path dependencies. In the mature stage capability building ceases but can be branched and extended to be renewed, redeployed or recombined (Helfat and Peteraf, 2003).

The CLC approach however does not explain how the relationship between capabilities and resources will evolve. For example, what would be the relative importance of physical resources versus human capital as the firm evolves from founding to maturity? The CLC model also cannot predict what will happen in a particular setting, viz, in a developing country, which does not possess enabling institutions, resources and capabilities and which have been hitherto disconnected from the main centres of innovation. A limitation of this analysis becomes apparent when one attempts to apply it in a developing country context. Unlike newcomers in developed countries, EMFs may not be able to access or acquire resources instantly and leverage them into capabilities without time lag. For instance, it may not be able to access a highly trained workforce with prior experience and learning, with the necessary absorptive capacity to integrate resources. In other words, the analysis of dynamic resource based theory is context-specific to developed countries and begins at an intermediate point of analysis. We therefore need a new theory to explain the development of EMFs.

5.3 The emerging market firm

The rise of EMFs in the global economy can be traced through understanding how it moved along the trajectory of building, acquiring, and reconfiguring resources, and move from basic level capabilities to dynamic capabilities. Due to its inherent disadvantages, it focuses, at least in the initial stages, not on its own internal resources but how it could acquire resources externally (Mathews, 2006b). Striking up a connection with the global incumbents is therefore crucial because access to resources comes only through relationships struck with these entities (Mathews, 2006b). A variety of sources (e.g. through licensing of codified technology, purchase of embodied technology (equipment), hiring of competent engineers, etc, enables EMFs to rapidly assemble or combine these into a coherent production and marketing system (Mathews and Cho, 1999)[1].

The strategy of acquiring dynamic capabilities can be captured through the alternative linkage, leverage and learning (LLL) framework. The EMF acquires knowledge and technology from a variety of sources (tech licensing, purchasing equipment, hiring of competent engineers) and faces the challenge of rapidly assembling or combining these discrete factors into a coherent production or marketing system (Mathews and Cho, 1999, 2000). The process of building competencies and knowledge within the EMF is best described as organizational learning (Mathews and Cho, 1999: 143). This learning may be partly the automatic result of experience in doing some value added activity like production or marketing, but can also come as a by-product of internationalization which is a catalyst. The repeated application of linkage and leverage processes leads to organizational learning and transforms basic level capabilities to dynamic ones based on innovation. Learning requires physical investments, human capital and technological effort.

Thus reaching out to sources of knowledge in the markets into which the firm expanded facilitates their dynamic learning process and their international expansion at the same time. It finds ways to complement the strategy of incumbent MNCs through offering contract services to find resources that would be otherwise unavailable to a late entrant in a two-way trade. Through these "complementary" strategies EMFs gain the resources, and leverage their potential. Hence EMFs establish their presence in the emergent global economy, not on the basis of their existing resource strengths, but on the basis of their capacity to leverage resources from the strengths of others, through making international connections (Mathews, 2006). Thus a global orientation becomes a source of advantage—since the opportunities through which it can expand are likely to be found in the global market rather than in its domestic environment. Under the new conditions created by globalization, EMFs attach the highest importance to ensuring that they progress from being national firms to become international and global players as fast as possible, through accelerating their internationalization (Mathews, 2006). Thus a reversal of the traditional perspective is observed - in contrast to OECD MNEs that internationalize to exploit existing proprietary resources and ownership advantages as per the OLI model, EMFs internationalize to pursue resources and build ownership advantages.

The study of progressive capability development through the innovation phases of the EMFs are thus founded on the above industry scenario and the context provided above would present a better understanding and explanation of the case facts from other enterprises in the following sections.

5.4 Cross case studies on dynamic capability development through innovation strategies of Indian firms

The trajectory of EMFs may be mapped in an inter-temporal setting that indicates how they learnt to transform programming skills into dynamic capabilities deploying and redeploying their existing and new assets in changing markets. The literature reports that Indian IT firms leveraged teams of talented human capital to deliver technical solutions to customers around the world and earned a reputation for their reliability and skills for using a variety of software languages and systems that incumbents found expensive to acquire (Athreye, 2005). In the early stages, tasks undertaken included data conversion projects executed on behalf of foreign firms on-site (in their premises). In the later stages, EMFs mainly leveraged goodwill and reputation among previous clients to expand into emerging global demand. For example they wrote migration software which required diverse software languages and protocols which once again incumbents found expensive to accumulate internally. Indian EMFs built up a reputation for outsourced service delivery off-shore particularly in software process management, integrating software writing services with front-end customer management, technical assistance and managing global operations. Leading EMFs saw BPO as a part of a continuum to evolve towards end-to-end consulting.

In the previous chapter it was observed that at the advanced stages of their evolution, leading EMFs such as Infosys were integrated into a global innovation network, specifically in areas like ”product engineering services” and software “protocol standards” The study of Infosys was a good example where this Indian firm played a crucial role in the globally dispersed innovation network through its participation in the Automotive Open Systems Architecture – Autosar – a network of major global automobile manufacturers involved in R&D and standardization of software for auto electronics. Firms such as Toyota, Bosch, BMW, Volkswagen, Siemens, Ford, DaimlerChrysler and Continental Teves are partners in this global network (Krishna and Bhattacharya, 2007). What is instructive here is that a handful of small EMFs such as Sasken, ittiam and i-flex are also trying to break the traditional model of ICT services by developing their own patents in the intermediate product segment and licensing those to others.[2]

Using the replication logic, the purpose of this chapter is to map the evolution of three IT EMFs in a multi-case framework to gain an insight into how their dynamic capability was developed and thus to identify matching patterns with the previous findings and thereby validate the results.

In order to simplify the understanding of the pathway of evolution, the different phases of the EMFs in the Indian IT industry was mapped as founding, development and maturity – in line with Helfat and Peteraf's (2003) postulations. It describes the strategies of how EMFs developed dynamic capabilities by linking-leveraging-learning at each stage if their evolution eventually to become a contributor to global innovation themselves.

5.4.1 Cranes Software International Limited

5.4.1.1 Founding Stage

Cranes Software International Limited (formerly known as Eider Commercial Ltd), was founded in 1991. In the early phase, Cranes was a software distribution company. Later, it linked with Texas Instruments (TI) and strengthened its position from a distributor to a "sole distributor of reputed softwares".[3] Reseller arrangement with Texas Instruments for digital signal processing (DSP) tools was an important tie-up in this initial period which characterised their growth in this phase. The linkage with TI was leveraged for capability development and moving up the value chain.[4]

Cranes accelerated its growth through a merger and acquisition (M&A) strategy that enabled it to evolve as a specialized company in three differentiated technology categories: (i) mathematical modelling and simulation tools; (ii) embedded software and controls; and (iii) business modelling and simulation solutions, all in the realm of the high end of the value chain (Bhattacharya and Lal, 2010). The acquisitions in 2000 of the US-based AISN Software's range of visualization software products[5] and from SPSS their highly acclaimed statistical software SYSTAT, brought with it a global base of over 64,000 licensed users.[6] Subsequently it acquired marketing, licensing and development rights for the Sigma product line from SPSS Inc., including the flagship SigmaPlot® offering, SigmaStat® statistical analysis package, and SigmaScan® image analysis software.[7]

These acquisitions transformed Cranes from a low end software distributer to a company having its own line of products. These statistical packages were highly complementary to Cranes' existing portfolio in terms of cross-selling potential within existing users and addressable markets. The acquisition resulted in 100,000 customers largely in the pharmaceutical and biotechnology, personnel, fixed assets and all related intellectual property areas.[8] Users included Merck, Eli Lilly, Pfizer and NASA, each of which had over a thousand desktop installations. In 2005, Cranes made another significant transition by acquiring the Indian arm of Engineering Mechanics Research Corporation (EMRC).[9] This acquisition added a new domain of business line that is different from the statistical products and entered in to the domain of services based on computer aided engineering (CAE). We observe that these examples demonstrate progressive and dynamic capability development through linkages that are leveraged to grow and globalize.

5.4.1.2 Developmental stage

The series of acquisitions of intellectual property made in their founding stage helped Cranes to acquire domain knowledge of the different features and applications of the software. Once these were mastered, Cranes upgraded these to address its clients more effectively and create potential customers. For example, Cranes upgraded the SYSTAT software by bringing new rich features; upgraded its platform from FORTRAN to C and incorporated several new features such as Markov Chain Monte Carlo (MCMC) techniques and quality analysis. These innovations helped the firm to target specific user groups. Additionally, it created Japanese and Korean language versions of this software[10] which helped it to penetrate the user base in two lucrative national markets.

To add further value to its products as well as gain deeper insights into the user preferences, in 1998 Cranes Software diversified into training to form the Cranes Varsity to provide post-professional technical training in niche domains such as digital signal processing (DSP), real time embedded systems (RTES) and mathematical modelling in 1998 for the academic and corporate sectors. Cranes Varsity partnered with Texas Instruments and Rational (a subsidiary of IBM) to enhance the usage of technical software at engineering colleges and universities across the country. It also emerged as the preferred training destination for several leading local and multinational companies in India. Cranes Varsity trained over 2500 engineers for the likes of TI, GE's John F. Welch Technology Center, GE Transportation, Robert Bosch, Delphi System, Wipro, Infosys, Honeywell, Intel, Sasken, Tata Elxi, TCS, etc. (Crowe, 2010).

Strong relationships with one of the premier universities in India, namely the Indian Institute of Science (IISc), during the early 2000s,[11] was instrumental in its entering the area of wireless and wireline networks, and micro-electro mechanical systems (MEMS). A strategy of investment in locally developed knowledge and R&D capabilities through collaborations with knowledge centres and knowledge leaders was pursued. In association with IISc, it created CranesSci MEMS design and test laboratory in 2004.[12] Such a test facility built the foundation to progress towards and participate later in the global innovation network. This laboratory worked on cutting edge research in MEMS and nanotechnology that has wide applications in textile designing and farming technique. The contracts specify that IISc and Cranes jointly own the intellectual property for technologies and products developed by the lab.

5.4.1.3 Mature stage

Cranes consolidated its strengths more firmly in 2008 by leveraging its CAE capabilities to enter the automotive sector. This was achieved by acquiring two companies namely Engineering Technology Associates Inc. (a US firm), and Tilak Auto Tech (an Indian firm).[13] The assets of these two firms were leveraged by Cranes to develop market specific and target specific capabilities to design embedded control systems for the automotive sector, particularly in the areas of auto safety, vibration, and noise testing products. The firm entered the aerospace and industrial instrumentation area using the same tools and knowledge it had acquired earlier. The company also diversified into e-banking and mobile solutions by making a number of acquisitions of small foreign and Indian firms from 2007 onwards (Crowe, 2010).

Its earlier association with IISc enabled Cranes to acquire microelectronics knowledge to understand the embedded software and control systems and develop solutions for the automotive sector (where acquisitions also played an important role), and industrial control and measurement systems applicable to various industries.[14] Microelectronics knowledge also helped the firm to develop real time operating system on the SIC33209 32-bit processor – a low power processor useful for battery operated hand held devices such as mobile phones, palm tops, iPads etc. Since long hours of battery performance were critical for consumers, this was a significant area to develop capability and products.[15] Cranes also engaged in designing a new operating system to improve the utility of this chip by intensively collaborating with IISc's industrial interaction initiative which is an incubator programme entity called Society for Innovation & Development. A spin-off firm named ESOUBE Communication Solutions Pvt. Ltd was created through this collaboration. ESQUBE has developed a proprietary voice dialler application, speech recognition algorithms and audio coder (TARANG), which is an alternative to MP3.[16]

These examples provide insight on Cranes' initiatives to develop dynamic capabilities through alternative technology and breakthrough innovations.

Next, Cranes' initiatives were directed towards research to build WiMAX base station being aimed to add another vertical in their business model and make them a participant in the state of the art technological space.[17] In order to cope with growing competition from other 4G operators,[18] WiMAX operators had to find a way to innovate and create a strong, differentiating brand. This led WiMAX service operators to partner with Cranes to leverage its experience and expertise to provide a cost effective solution.[19] A high performance base station with an innovative design and a flexible portfolio enabled operators to customize their business models, increase capacity, reduce costs, and speed time to revenue through a differentiated customer experience. Thus Cranes aimed to provide that leadership in the hardware technology solution and link with the forward integrated operators in their hardware delivery model.

Cranes eventually managed to establish a presence in 39 countries across the world with a 350,000 strong global user base. It was named as one of the fastest growing Indian technology companies by Deloitte's Asia Pacific Fast 500 for 2003, 2004 and 2005 and received the Innovation for India Award for its business model which was rated as "unique and innovative to industry".[20]

5.4.2 HCL Technologies Limited

5.4.2.1 Founding Stage

The HCL enterprise, India's oldest hardware firm, was founded in 1976 by its founder director Shiv Nadar and his five colleagues who quit a major Indian enterprise, DCM, to make personal computers. An opportunity had arisen when IBM left India due to the government's unfavourable FERA rules. IBM's departure from India left a major vacuum and this was the vacuum in which Shiv Nadar spotted an opportunity. He stepped in and customers began to trickle in.

With not enough cash to bring his idea of manufacturing computers to fruition, Nadar started selling calculators – a venture that would throw up enough cash to allow the founders to give shape to their ultimate dream to manufacture computers in India, at a time when computers were just sophisticated cousins of the good old calculator. Support also came from the Uttar Pradesh government. HCL launched its first commercial personal computers (PCs), by then a mature technology, in 1978.

HCL's first brush with international business came about in 1979 when it set up a venture in Singapore; it was called Far East computers. HCL however failed to enter the US market with its computers which did not get environmental clearance. Setting aside its first failure in the US in 1991, HCL entered into a partnership with HP (Hewlett-Packard) to form HCL HP Limited to firm up its revenues. In 1994, HCL looked beyond PCs and tied up with Nokia cell phones and Ericsson switches for distribution.

However, it was difficult for the group to tap into the international market through hardware operations. Therefore for its globalization ambition, the company had to change its business proposition from products to services; in other words, from personal computers to software.[21] In 1991, HCL created a separate entity named HCL Technologies (HCLT) to diversify into software business reengineering, shifting its core business model from the hardware domain to the software domain in order to globalize. This redefinition proved to be perhaps the most significant step in HCL's strategy that catapulted them into becoming a global corporation by the next decade. In 1997, HCL was already a multi-dimensional company having spun off HCL Technologies Limited to mark its entry into the global software space. Shiv Nadar now put aside his dream of becoming a global hardware major and ventured into software with an open mind and a clean slate. The company started its business in the US in 1994 and its European and Asia Pacific business in 1998. The software operation of HCL enterprises grew enormously in the late 1990s to dominate its overall business — the ratio of hardware to software declining from 83:17 in the early 1990s to 38:62 in 1997–98 and then to 23:77 in 2000–01.[22]

5.4.2.2 Development Stage

The growth in software business was achieved by a shift in strategy into outsourcing, offshoring, and business process outsourcing type of operations. By definition their business model was primarily "service operations" (or customer service operations) which are a configuration of technology and organizational networks designed to deliver services that satisfied the foreign multinational's needs.[23] The firm operated in this stage on the activities required to manage and operate the services of their clients and maintain their functionality.[24] This period was essentially customer driven, which characterised HCL's initial global foray at the low end of the value chain.

With the resources gained, HCL Technologies pursued an inorganic growth route from early 2000 by extensively using mergers and acquisitions and joint ventures as its strategy for entering/consolidating in new areas and new markets in embedded software (Bhattacharya and Lal, 2010). In order to become a player in the high end of the value chain HCL started a joint venture with Perot Systems Inc. (US) in 2003 that led to the creation of the new entity HCL Perot System.[25] It helped the firm to become a leading outsourcing and systems integration company with major clients in the banking, energy, healthcare, insurance, manufacturing and telecommunications industries.

HCLT enhanced its engineering knowledge by its association with NEC Corporation (Japan). In 2005, NEC and HCLT came together in a joint venture to set up a new facility, NEC HCL System Technologies Ltd to provide high-end offshore-led software engineering solutions in network and security, embedded software, hardware design, research and development, high performance computing and mobile technology.[26]

In 2008 HCL Technologies acquired the UK-based SAP consulting company and Axon Group Plc (AXON) that added significant verticals in enterprise resource planning area in its business model. The acquisition was at that time the largest acquisition in the technology industry by an Indian company.[27] HCL merged SAP's practice with Axon to bring new capabilities to the market with a global delivery model that provided a full set of services. This SAP (System Analysis and Program Development) capability acquisition for £441 million ($658 million) in 2008 helped this EMF to enter the global SAP market estimated to provide $26 billion market. Next came a venture with NEC, Japan. It even bought out the joint ventures Deutsche Bank and British Telecom's Apollo Contact Centre. In the same year, HCL Infosystems launched it sub Rs 10,000 personal computer and joined hands with AMD and Microsoft to bridge the digital divide.

5.4.2.3 Mature Stage

In the maturing phase, the knowledge expertise it developed helped HCLT to diversify into aerospace and forge a partnership with Airbus for co-development of an embedded chip based system for communication with ground control (TC, 2007). Successful development of this chip led to its implementation in the Airbus A380.[28] Close on the heels of its Airbus tie-up, HCL also signed a multi-million dollar software development agreement with Boeing for the 787 Dreamliner project.[29] This was an important endorsement of their capability in the avionics systems - both airborne and ground-based.[30] Thereafter, HCL moved on to provide advanced level component innovation in product engineering in the global innovation networks of both civil and military avionics.[31] Some of these included hosting the platform for the flight test computing system, embedded software, CAD/CAE and application development. The company earned 6% revenues from this segment which was expected to jump to 20-22% in future.[32]

In order to contribute to several other global innovation networks, HCLT leveraged its capability in embedded systems. The company filed a patent application in the Indian Patent Office on a GPS based navigational tool for finding potential fishing zones, weather forecasting and environment protection. This innovation fetched HCLT, Germany the Galileo Masters Award in 2004 for marine navigation for fishermen using GPS and IPWV (Integrated Perceptible Water Vapour Technique Systems) (Anwendungszentrum, 2005).

Using its knowledge in embedded technology, HCL created a micro-chip that measured how much insulin is needed to be injected in a patient who requires external insulin intake.[33] This chip could mitigate the difficulty in giving accurate and timely dosages, particularly for those patients who require intravenous injection of insulin. HCL also entered the domain of software based applications in "mathematical modelling and statistical applications" by collaborating with Saila Systems Inc. (Japan). The partnership resulted in the development of a statistical analysis tool (Panax Finder), useful for the pharmaceutical companies in the drug discovery process (Bhattacharya and Lal, 2010), being more efficient and economical in terms of manpower involvement and in finding the desired candidate molecules in scientific drug research. The software utilises 3D quantitative structure activity relationship (QSAR) to guide the chemical synthesis.

5.4.3 Sasken Communication Technologies Limited

5.4.3.1 Founding Stage

Sasken was established in Fremont, California in 1989 but it later shifted its headquarters to Bangalore. In its initial phase, Sasken's software business emerged from its provision of embedded communications solutions like wireless software services for mobile phones, wireless software products and software services for Network OEMs, semiconductor vendors, terminal device OEMs and global operators.[34] It established early linkages with foreign MNCs like Nokia, Motorola, Philips, Samsung and Vodafone who provided the vital opportunity for engagement arising from their need to source cost effective suppliers.[35] Sasken also used mergers and acquisitions to link with key foreign enterprises.[36] In 2004 Sasken acquired Blue Broadband Technologies business[37] and formed a wholly owned subsidiary namely Sasken Network Engineering Ltd (SNEL). This subsidiary accessed knowledge through this acquisition and with its enhanced capability provided services in the area of network planning, deployment, commissioning integration and network operations support to network equipment vendors and operators.[38] It also became software development partner for Philips Nexperia's home and mobile products (Bang, 2010).

5.4.3.2 Developmental Stage

In the subsequent period (2006 to 2011), Sasken built its business by investing more than 10 per cent of sales in R&D and recruiting highly qualified manpower.[39] The R&D centres became involved in joint research activities as well as work in specific niche areas. In this period, the company employed reputed academics on the list of its directors which established their linkages with academia in their pursuit of capability development. Over the years Sasken established R&D centres in Bangalore, Pune, and Chennai (India); Kaustinen, Tampere, Oulu and Turku (Finland), and Monterrey (Mexico) (Thanuja, 2006).

During this phase, the company shifted focus from software products for telecommunications to a product-and-service strategy by establishing an international development and support centre in Mexico, another example of investments in infrastructure development and in global R&D centres. This centre of excellence was established under the ARM processor's[40] approved "Design Centre Program". Through this move, Sasken became a provider of components in the global production network by the mid 2000. About 98% of the more than one billion mobile phones sold each year used at least one ARM processor which consumed low power and was most suitable for the mobile and embedded electronics market. The output of R&D, e.g. new technology in wireless communications, helped them to move to the higher end of the value chain.

To continue moving up the value chain, Sasken acquired capabilities in "testing services" through its acquisition of Botnia Hightech[41], a Finland based wireless R&D company known as a global provider for its capabilities in testing services. Subsequently in 2007 it acquired Integrated Soft Tech

Solutions Pvt. Ltd. (iSoft Tech).[42] The capability deficiency of connectivity in software was resolved through the acquisition of another foreign firm, Nokia's Adaptation Software R&D, Germany in 2008.[43] This helped Sasken to move into the high end of the value chain, offering services in the area of data network wireless LAN, hardware and mechanical design, RF design, and testing.

For horizontal diversification, Sasken entered a new sector - the automotive sector - in 2008 primarily through its association with TACO (a Japanese firm). A joint venture was formed, leading to the creation of a new entity, TACO Sasken Automobile Electronic Pvt. Ltd.; to create software solutions for the automotive sector.[44]

5.4.3.3 Mature Stage

Sasken's innovation efforts built up its patent portfolio from 2001, mainly in two key ICT domains: power reduction, and network management. These patents address power efficiency reduction in micro-processors and the mobile 3G system, congestion reduction in networks, and multimedia applications (picture retrieval, efficient transmission of multimedia content).[45] The innovation in optimized multimedia subsystems - as evidenced by its deployment in commercially released mobile handsets by many tier-1 manufacturers in more than 50 models and over 50 million phones across networks in Australia, China, Europe, Hong Kong, Japan and Taiwan[46] - demonstrate Sasken's evolving capabilities.

The Indian Government's announcement of its 3G policy in August 2008[47] brought new opportunities in the areas of mobile value added services. Sasken was well placed to exploit this opportunity. Indeed the intellectual knowledge development and proprietary patents developed through its R&D became Sasken's major driver of growth. In the advanced stage of its lifecycle, the company developed "Symbian", a leading wireless handset operating system that is certified by Texas Instruments as an independent OMAP (open multimedia application platform) technology.[48] The OMAP family of semiconductors are specifically designed for use in 3G wireless communication and application processing. Sasken also developed high speed packet access (HPSA), a collection of mobile telephone protocols, which augments 3G technologies to a high bandwidth path. The HPSA innovation allowed globally value added services like pictures, ringtones and multimedia data to be delivered at high speed through mobile telephony, and was therefore considered a valuable innovation in the mobile and embedded electronics market.[49]

To cut the costs of packaging of the silicone chip, Sasken developed a single mixed signal chip that replaced multiple chip handling baseband, RF, memory, PLL, etc. Subsequently, Sasken joined the S60 product creation community for the Symbian smartphone operating system, which enabled it to add value to the S60 ecosystem. Sasken's patented components became well accepted by the world's leading wireless vendors including Nokia, Ericsson, Alcatel, and Siemens in Europe and especially in the Nordic countries like Finland. Acceptance in the birth place of GSM9 and 2G technology endorsed Sasken's capabilities and IP components in the global technology community. As a result of its foray into Europe, Sasken was able to fit its own IP components in over 4% of the phones shipped in 2005, and over 7% of phones shipped in 2006 across the world.[50]

Next, Sasken created proprietary technologies in network engineering services through another joint venture with Connect M Technologies Solution Pvt. Ltd.[51] which gained it 16 patents in the US, with another 13 and 18 patent applications pending in the US and India respectively (Babu, 2011). The knowledge acquired by Sasken in developing the multimedia subsystem in mobile phones has effectively been used in the development of the company's other products. Their R&D is engaged in enhancing the system to include new features such as mobile TV using DVB-H and video over IP. Of the 3800 employees of Sasken in 2012, 300 were deployed full time in R&D.

By building on its accumulated technical expertise in wireless and broadband technologies, signal processing and IC design, Sasken delivered end-to-end solutions that enabled richer content delivery on next generation networks (NGN). The company's mobile software group successfully launched several data protocol stack products like GPRS (general packet radio service) and 3G.[52]

5.5 Discussion

The portrayal of three organizations in an inter-temporal setting in the previous section paints an interesting picture of how EMFs develop dynamic capabilities. From the cases it is unequivocal that the movement from operational to dynamic capability is not automatic: linkages with foreign firms and local institutions enable EMFs to accumulate resources to make an entry into global markets and pursue their globalization goals. The backward and forward linkages are the pathways through which EMFs master initially simple tasks entailing routines marked by repetitive patterns of activities, as in providing back-end client services or forward end marketing and sales services like software distribution. Through these linkages, EMFs learn about new customer requirements, and develop capabilities of how to serve them. They then leverage their internal knowledge and reputation gained in serving clients to deepen linkages with foreign firms which are on the lookout to outsource their value added operations as it is too expensive for them to internalise it within their firm-boundaries. Later, increasingly complex tasks are mastered and new customers with different needs are served. Reputation and investments in quality substitute for large marketing and capital investment outlays while interaction with incumbents provided first-hand knowledge about which investments were critical. While foreign firms provide the global infrastructure, and technology, Indian EMFs provide the personnel to execute the projects. These findings are in line with Athreya (2003) who found similar patterns.

The literature characterizes dynamic capabilities as complicated routines that emerge from path-dependent processes (Nelson and Winter, 1982; Eisenhardt and Martin, 2000). The focus on niche areas - Sasken in telecommunications, HCL technologies in engineering solutions and Cranes in software based scientific and engineering tools – created path-dependencies in how resources were reconfigured. Sasken designed an embedded multimedia chip for mobile handsets while Cranes developed the operating system for the SIC 32 bit processor, and HCL partnered with Airbus for designing an embedded chip for communication with ground control. Each of these firms used knowledge modularity to become an innovator in their advanced stages. Accumulation of knowledge was effected through various modes: linkages with FMNCs, joint ventures, or M&A with other firms, as well as partnering with local universities and research institutions. Acquired knowledge was upgraded through R&D investments to deliver highly value added products that gave them the competitive advantages to globalize rapidly.

The formation of capabilities is catalysed by leveraging both explicit and tacit knowledge by recipients (Ernst and Kim, 2002). Explicit knowledge (codified in formal, systematic language) is knowledge in the form of blue prints, technical specifications, and technical assistance (Ernst and Kim, 2002). Tacit knowledge refers to knowledge that is experiential and acquired through observation, imitation, and practice. Its diffusion requires apprentice-type training and face-to-face interaction. It can also be transferred, however, through the movement of human carriers of such knowledge (Ernst and Kim, 2002). Incumbents including MNCs also transfer embodied knowledge across borders through equipment, machinery and software – a major source of process innovation for their users (Abernathy and Utterback, 1978).

According to Henderson and Cockburn (1996), external linkages are crucial to effective knowledge creation processes of the pharmaceutical industry (see Eisenhardt and Martin, 2000). Powell *et al*. (1996) report that knowledge creation processes entail external linkages in the form of significant alliance relationships which lead to superior R&D performance within biotech firms. When applied to the developing country context, linkages are even more critical as EMFs lack internal knowledge which perforce leads them to gravitate towards the external environment for resources. Linkages enable EMFs to gain the missing elements of technology, knowledge and skills to complement local capabilities (Lall, 2004).

The relationship between resources accumulated and assimilated on the one hand, and capabilities gained on the other, can be mapped through the model below which conceptualises the evolution of EMFs. In the first phase of capability life cycle, the routines used are simple, dependent mainly on explicit-codified and embodied knowledge. Repetitive operations through practice helps to optimise tangible resources such as equipment, processes and technology (EPT) and groove routines more firmly and effectively (see Eisenhardt, 1989; Eisenhardt and Martin, 2000 for a discussion). Codification of that experience into technology and formal procedures makes that experience easier to apply and accelerates the building of routines (Argote *et al*., 1990; Zander, 1999; Zander and Kogut, 1995; Zander and Zander, 1997).

However, competitive advantage is greatly enhanced when the related resource configurations are deployed into synergistic activities (Collis and Montgomery, 1995; Milgrom and Roberts, 1990a, 1990b; Porter, 1985; Prahalad and Hamel, 1990) that managers leverage to build dynamic capabilities. Upgrading entails intensive use of human capital, R&D and modularising of knowledge through functional, product/process and inter-sectoral resource reconfigurations. Through each round of linkages these EMFs learnt how to leverage the modularity of knowledge which became their basis for developing dynamic capabilities. This is demonstrated in Figure 5.1 below.

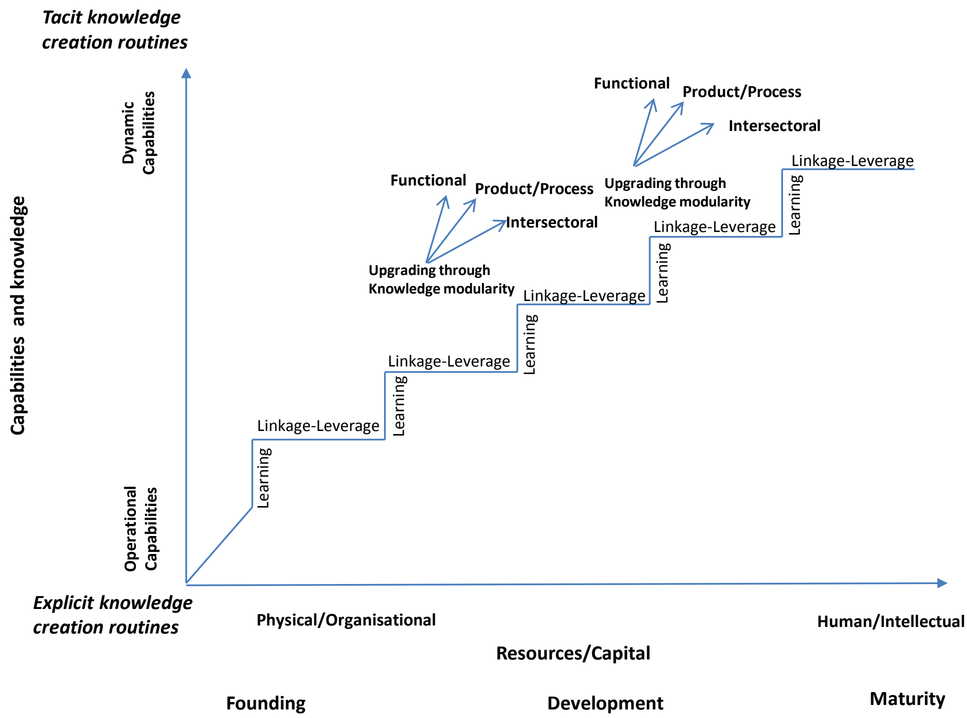

Figure 5.1: A framework of dynamic capability development in EMFs

We observe that each of these EMFs accelerated their globalization by starting at the low end of the value chain but soon progressed to the high end, becoming an innovator with self developed processes and patents. Thereafter, they leveraged this knowhow and component innovations in order to be included in the global innovation network as a valuable contributor to innovation. These case facts tell how EMFs transformed from a recipient of knowledge to a contributor of knowledge to the global community in technology. Hence the globalization of EMFs was an evolutionary process where each phase was characterized with a specific driver of their growth and the subsequent phases provided the EMFs with stronger platforms and rapidly progressed them toward maturity. In all these periods the EMFs learned from their linkages and leveraged them for growth. This learning may have been partly the automatic result of experience in doing some value added activity like production or marketing, but also came as a by-product of internationalization which was a catalyst. The repeated application of linkage and leverage processes furthered organizational learning to transform basic level capabilities to dynamic ones based on innovation. However at the advanced stage they reversed their role to complete the loop and integrated themselves back to their mentors and sponsors, to become new members in their innovation network for technological advancement of the world.

5.6 Summary and Conclusions

This study matched patterns of the EMFs model of dynamic capability development at various periods of their capability life cycle. These include the progressive evolutionary development of their growth and distinctive foci in different periods. It observed that linkage, learning and leveraging were tools used by EMFs in their accelerated growth of globalization. It also noted their specific and unique achievements in the mid to advanced period of their lifecycle that demonstrates their continuous and dynamic capability development so as to become an innovator in the product engineering domain of technology. Lastly it was observed that their unique capability led to innovations have been a valuable contribution to several innovation networks in the areas of civil and military aviation, pharmaceutical drug research, environment protection, weather forecast, fishing industry and enterprise resource planning areas.

Thus the following propositions arise from the facts of the three cross case studies, similar to the findings from the focused single case facts in the previous chapter:

Proposition 1: In the founding stage, EMFs leverage foreign linkages to develop operational level capabilities.

Proposition 2: In the development stages, EMFs' in-house learning efforts enable them to develop dynamic capabilities.

Proposition 3: In the mature stage, EMFs evolve from a recipient of knowledge to become contributors of novel knowledge based on innovation.

To examine these three propositions in a capability development model the research needs to develop a set of appropriate hypotheses and thereafter test these hypotheses in an empirical framework. This leads the research to its final stage of empirical analysis in the following chapter.

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[1] Hyundai had trouble internalizing technical capabilities in its semi-conductor business. After having purchased both product and process technologies for 64 and 256K DRAMS from the US, start-ups remained unprofitable for eight years. The process technology was constantly evolving and along different technological trajectories. Hyundai's development engineers were unable to decide which direction to move in and were missing opportunities for innovation. Hyundai's inability to efficiently leverage external resources was resolved with the hiring of a Dr Min who had been working at Intel for six years and had a wide experience of semiconductor technology. He took on leadership of the new product development project and introduced new organizational practices for product development (Mathews and Cho, 1999).

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[38] CTMS, Centre for Telecom Management Studies, Strategic Plans, 2000-2010

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Chapter 6

EMF's Model of Capability Development – a Multivariate Analysis

6.1 Introduction

The object of this chapter is to examine with quantitative analysis the precise factors that assist EMFs to leapfrog in knowledge intensive industries, and to develop a final model of the EMFs capability development. Empirical literature is sparse in conducting detailed analyses of how EMFs transform basic level operational capabilities into advanced level dynamic capabilities to challenge incumbents on their own turf. Conventional trade theory assumes that the advantages of firms from developing countries stem from factor endowments such as low wage labour, etc. (Lall, 2000). In this view, technological capability plays little role in competitiveness. In the context of the Indian IT industry, literature suggests that competitiveness is due to the low cost human resources exploited by MNCs to conduct back-end and low tech processes (Hanna, 1994; Heeks, 1996). Low wage labour, language proficiencies and time-zone differences explain IT firms' exports to the developed world - not technological capability. Low value added services present the classic problem of "locking-in" into a low road of innovation trajectory (D'Costa, 2003, 2004).

The contention of this study is that the rise of EMFs is not explained by these basic factors alone. If anything, the Indian IT industry suffers from some compelling disadvantages, namely inefficient input industries and weak telecommunications infrastructure. Export competitiveness has been achieved without a domestic market base and despite inefficient input industries and infrastructure of telecommunications – going counter to Porter's diamond framework (Ghemawat and Patibandla, 1999; Patibandla *et al.*, 2000; Patibandla and Petersen, 2002). Despite such disadvantages, the industry has established a formidable presence in customization of services and going up to the top of the value chain in terms of attaining dynamic capabilities.

In the Indian context, Athreye (2005) argues that the untold story of EMFs in the Indian software industry is about how pioneer firms learnt to transform the programming skills of their labour force into firm specific dynamic capabilities to challenge the incumbents. Their ability to assemble teams of professionals and deliver highly sophisticated services anywhere in the world was both a model of organizational as well as technological innovations. Unlike other countries, local rather than foreign firms led export growth where out of the top 20 exporters only five were of foreign origin (Athreye, 2005).

The hypothesis tested in this study is that behind the success of the Indian software industry is human capital accumulation and firm level learning efforts to gain capabilities. Initial endowments were crucially supplemented by building firm level capabilities with continuous interaction with resources and technologies from incumbents from developed countries (see also Patibandla and Petersen, 2002). In Lall's (2000) terms they are the outcome of long, cumulative processes of learning, agglomeration, institution-building and business culture. Operational level capabilities explain export competitiveness on the back of linkages with foreign firms in the initial stages. However, later, export competitiveness is predicated on the possession of dynamic capabilities – contrary to the conventional H-O(new acronym) model of endowed country specific comparative advantage. Competitive advantage is built up slowly under a dynamic pattern, and is not a one-off jump from one equilibrium to another.

This chapter is arranged as follows: Section 6.2 begins with a discussion of the theoretical underpinning. Section 6.3 develops the hypothesis on capability development in EMFs. Section 6.4 discusses the constructs and measures. This is followed by Section 6.5, a short note of the statistical methods used. Section 6.6 reports the results, followed by discussion. Finally section 6.7 gives the conclusion.

6.2 Theoretical underpinnings

As observed in the previous chapters, from a resource based view (RBV) capabilities can be either "operational" or "dynamic", (Helfat and Peteraf, 2003). An operational capability is defined as "a high-level routine (or collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decision options for producing significant outputs of a particular type". In this definition, the term routine refers to a "repetitive pattern of activity" (Nelson and Winter, 1982, p. 97). An operational capability generally involves performing an activity, such as manufacturing a particular product, using a collection of routines to execute and coordinate the variety of tasks required to perform the activity. These operational capabilities emerge through a "learning by doing" approach. In learning by doing, the firm becomes more practised and hence more capable at activities in which it has already previously engaged. The effect of prior learning experience on subsequent learning tasks can be observed in problem-solving skills which are built up over many practice trials on related problems (Harlow, 1959 in Cohen and Levinthal, 1990).

A firm's operational capability acts as a basic foundation of competitiveness and its dynamic capability gives further sustainable competitive advantage. Using resources as basic building blocks (Thomas, 2006) the proponents of the RBV view, starting with Penrose (1959) and Wernerfelt (1984), argue that firms are unique bundles of idiosyncratic resources and capabilities in which knowledge is critical to organizational learning, management of technology and its application – which explains their superior performance vis-à-vis firms not in possession of such assets. The concept of dynamic capabilities has been addressed by a number of authors in various ways. For example, "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). According to Teece, competitive advantage is a function of how firm specific assets can be deployed and reconfigured in a changing market. Dynamic capabilities enable the strategic decision makers of the firm to develop, acquire, integrate, reconfigure and recombine resources in rapidly changing circumstances (Teece *et al*., 1997; Eisenhardt and Martin, 2000).

Both resources and capabilities evolve and change over time. Taking an evolutionary economics approach, Helfat and Peteraf (2003) describe trajectories of capabilities (see Helfat and Peteraf, 2003; Helfat, 1997) through the concept of capability life cycle (CLC) which envisions a newcomer firm's capabilities evolving through various stages – founding, development and maturity. The founding stage lays the foundation for subsequent development of capabilities by acquiring the necessary resources and bringing in human and social capital; the developmental stage entails building of capabilities which the organization may decide whether to build from scratch or imitate a capability from another organization depending on the risk disposition of individuals – which entails organizational learning and inevitably results in path dependencies. In the mature stage, capability building ceases but can be branched and extended to be renewed, redeployed or recombined (Helfat and Peteraf, 2003).

The relationship between resources accumulated and assimilated on the one hand, and capabilities gained on the other, can be mapped through the CLC model which helps to conceptualise the evolution of EMFs. In the first phase of the capability life cycle, the routines used are simple, dependent mainly on explicit-codified and embodied knowledge. Repetitive operations through practice help to optimise tangible resources such as equipment, processes and technology (EPT) and groove routines more firmly and effectively (see Eisenhardt, 1989 for a discussion). Codification of that experience into technology and formal procedures makes that experience easier to apply and accelerates the building of routines (Argote *et al*., 1990; Zander and Kogut, 1995).

To develop dynamic capabilities, firms internalize physical, human and organizational resources, for unique value-creating strategies that address specific markets and customers in distinctive ways, and so lead to competitive advantage (Prahalad and Hamel, 1990). Teece (1998) defines dynamic capabilities as the "ability to sense and then seize new opportunities and to reconfigure knowledge assets, competencies and complimentary assets and technologies to achieve sustainable competitive advantage". In a dynamic market environment a firm possessing dynamic capabilities is capable of recognizing, utilizing and advancing its technical, managerial and functional capabilities and expertises that are available locally or externally to the firm (Teece and Pisano, 1994, Eisenhardt and Martin, 2000).

6.3 Hypotheses on emerging market firms

Much of the international business literature has been primarily based on the observation of the internationalization behaviour of large firms from developed economies (Mathews, 2002a; Gaur and Kumar, 2009). These firms' proprietary assets engender dynamic capabilities which are critical to responding to rapid environmental changes under globalization. Many emerging economy firms, on the other hand, internationalize, not from a position of strength in the domestic market, but to strengthen their position in the domestic and international markets, and to overcome the disadvantages they face if they operate only in the domestic markets (Gaur and Kumar, 2009; Child and Rodrigues, 2005).

It is useful to view EMFs as latecomer firms which lack essential resources and capabilities vis-a-vis the capabilities of MNCs. Most EMFs start off with a series of resource disadvantages along several dimensions – production, administration, marketing and innovation. Their lack of resources in technology translates into a weak competitive position in international markets. What is more, being from a developing country, EMFs are usually considered to be backward in engineering, technical skills and R&D.

Hence, the existing stock of resources and capabilities that the EMF possesses is an important determinant as to how they go about addressing the gaps that exist. According to Matthews (2003 ICC), firms have the strategic option of building up stocks of resources through internal accumulation, or through external sourcing, or, as is usually the case, through a combination of both. Recent developments in the literature show that some critical resources can be obtained from established MNCs in the global value chain.

It is the contention of this study that linkages are the pathways through which EMFs initially leverage essential explicit-codified knowledge inputs, to conduct simple tasks entailing simple routines marked by repetitive patterns of activities, as in providing back-end client services or forward end marketing and sales services like software distribution. Through these linkages, EMFs learn about new customer requirements, and develop basic/operational level capabilities of how to serve them. More importantly, these linkages enable EMFs to compete in export markets in value added services to gain export revenue.

6.3.1 Inter-firm linkages and operational capabilities

Mathews argues that EMFs can improve their capabilities by exploiting the interconnected nature of the global economy (Mathews, 2002a, p. 476). International *linkages* can play a crucial role in addressing the resource gaps in EMFs by accessing technological knowledge, enhancing learning and innovation in EMFs (Gereffi, 1999; Gereffi and Kaplinsky, 2001; Pietrobelli and Rabellotti, 2011). The dispersion of value added activities by MNEs throughout the world enable EMFs to mount the global value or supply chain (Gereffi, 1999; Gereffi and Kaplinsky, 2001; Gereffi *et al*., 2001; Pietrobelli and Rabellotti, 2011) as suppliers – such as conducting labour intensive operations such as back-end operations and coding in software. By specializing in comparatively advantageous activities EMFs can form strategic linkages with foreign firms to gain access to markets, technology, and reputation (Kuemmerle, 2002). Through such business arrangements they secure a foothold in global value chains of production. Using this foothold the LCF(new acronym) is able to leverage further resources to build further capabilities to gradually increase the quality and reliability of production (Mathews and Cho, 1999). Linkages with MNC buyers enable *leverage* of skills, knowledge, technology and market access that would otherwise lie well beyond the reach of the EMF. The resources that can be leveraged will be used as a base for *learning* and improving their capabilities (Matthews, 2001). Access to resources can be secured via the exchange of low cost manufacturing services as suppliers or via technology licensing. The effect of applying strategies of linkage and leverage is that EMFs are enabled to overcome their disadvantages and exploit their few advantages of low labour costs and physical resources.

Transfer of knowledge in the form of specifications and technical assistance ensures that products and services produced by the latter meet the former's specifications (Ernst and Kim, 2002). Resources such as codified technology and the purchase of embodied technology (equipment) are assembled into a coherent production and marketing system. This is defined elsewhere as operational capabilities (see Baranson, 1967; Lall, 1992; Ray, 2004). Resources can be acquired both through licensing in product/process technologies, as well as through know-how transfers from foreign suppliers. High technology imports are positively linked to domestic innovation in both industrial and developing countries (Schneider, 2005, in Mendoza and Vernis 2008). Payment for knowledge is usually made by way of know-how and royalty fees. Therefore the first hypothesis is

H 1: EMF's foreign linkages will have a positive impact on exports of knowledge based services during the initial phase of capability development.

6.3.2 Learning and dynamic capabilities

While operational level capabilities based on low wage labour can be initially used for exports, it is dynamic capability that delivers improved productivity (Athreye, 2005). In evolutionary terms (see Nelson and Winter, 1990) the processes of building dynamic capabilities within the firm can be achieved through organizational learning which transcends (is more than) the acquisition of knowledge or competencies by individuals. Learning is analogous to the notions of technological effort in the developmental literature (Mathews, 2002a). EMFs *learn* in the process of combining foreign elements with their own stock of knowledge to eventually become technologically proficient. Hence firm level *learning* and investment in human capital can gain the EMF dynamic capabilities.

It is through the exercise of combinative capabilities that a firm is able to put together (or assemble) different types of process and product technologies efficiently and effectively to achieve performance (Mathews and Cho, 1999). The process of integration leads to "learning by doing" and creates firm knowledge. Thus, according to Mathews, capabilities are enhanced through the routines and methods learned and that are integrated through the exercise of its "combinative capabilities" needed to assemble disparate items of process technology and bring them to a high level of coherence and performance in mass production, in time for a new product before the technological frontier moves on (Mathews and Cho, 1999).

Learning requires social investments by the firm; in search of new technical and other knowledge and developing the organizational capacities to create, communicate and diffuse knowledge internally (Nelson and Winter, 1982). In advanced industrial activities, the absorption of new technologies involves the undertaking of formal research and development (Lall, 1993, p. 100). Firm investments in capability building are signalled by its cumulative R&D efforts over a period of time (Cohen and Levinthal, 1990). Performing R&D internally might be relevant in two ways. First, internal R&D creates firm-specific knowledge resources upon which the redeployment processes of external knowledge can be based (e.g. Barney 1995; Simon, 1992).

Maintaining strong internal R&D activities also means that client firms gain the absorptive capacity necessary to discern and unfold the full potential of codified external knowledge.

Eventually, knowledge resources from MNCs engender a process of human capital accumulation and growth which leads to a higher degree of spillovers to local industry and workers. Different MNCs train local workers on different technologies, which results in a diverse range of skills in the local industry (Patibandla and Petersen, 2002). Export-oriented firms forming into a cluster causes faster aggregate human capital accumulation. High-tech industry clusters engender agglomeration economies, which contribute to aggregate human capital accumulation. The accumulation of dynamic capabilities enables EMFs to engage in reverse knowledge transfer. Therefore the second hypothesis is

H 2: EMFs' in-house learning will have a positive impact on exports of knowledge based services in the later stages of capability development.

The transformation of EMFs also occurs when internationalization of EMFs takes a more sophisticated form where EMFs' own innovation contributes to the foreign partner's innovation efforts in host locations. EMFs evolve through "learning by doing", having generated innovation level capability to create and carry new technological possibilities into commercialization (Westphal *et al., 1*985). Local firms progress from being part of a "global production network" to being important contributors in the "global innovation network". This transformation is evident in EMFs' contributing back independently and significantly towards the global knowledge pool that is critical for fast paced technological innovations. As per the OLI(new acronym) model, FDI is the key vehicle through which the ownership specific advantage in terms of superior knowledge and capabilities are exploited in foreign territories. Therefore the third hypothesis is

H 3: ***EMFs' leveraging of their own innovation capabilities will have a positive impact on exports of knowledge based services in the later stages of capability development.***

6.4 Constructs and Measures

6.4.1 The dependent variable

As per the literature (see Mathews, 1998, 2004) the basic explanation of how EMFs internationalize can be located in how they craft a strategy of meeting the needs of their foreign clients (MNCs) through the provision of services. In the case of Indian IT companies this provision of service is exports of knowledge based services. Therefore, the proxy used in this empirical analysis for product-market internationalization is "exports of knowledge based services" by Indian EMFs in the software industry. The EMFs considered internationalization through foreign multinational enterprises because they required a platform provided by these foreign MNEs to sell knowledge based services. Therefore exports of knowledge based services would serve the purpose of a good dependent variable.

6.4.2 Independent Variables

Knowledge Inputs / Constructs	Source of knowledge	Measure
Linkage Leverage	Linkages for relationships with MNCs (through I-FDI)	Foreign dividends paid
	Leveraging codified knowledge resources and embodied technologies from MNCs and local institutions	Foreign royalty/Sales Foreign knowhow/Sales Foreign finished goods/Sales Foreign capital equipment/Sales Local royalty/Sales
Learning	Firm level learning effort to build tacit technological capabilities through R&D scientists and embodied knowledge	R&D current/Sales R&D capital/Sales
	Firm level capabilities through investment in human capital	Human capital/Sales Outsourced professional/Sales
	Firm level learning effort to build tacit technological capabilities from observation, interaction with clients etc	Foreign travel/Sales
Reverse Learning	Firm level reverse learning to diffuse knowledge to foreign clients	ExportKnowhow/Sales OFDI/Sales Foreign dividends earned/Sales
Controls		Age Advertising/Sales Sales Log

Linkages are signalled by firm level expenditures on striking inter-firm relationships through such mechanisms as investments in foreign firms and expenditures on purchase of knowhow from both foreign and local institutions.

Foreign dividends paid represent inter-firm linkages with foreign firms via payments of dividends for equity held in local firms by foreign firms.

Foreign royalty fees paid represent linkages with foreign firms via expenditure on codified knowhow.

Foreign knowhow fees paid represent linkages with foreign firms via expenditure on both codified and tacit knowledge transfers.

Foreign capital equipment represents linkages with foreign firms via expenditures on embodied technologies. Acquisition of capital goods or *embodied knowledge* has the advantage of low cost of implementation vis-à-vis purchasing of some disembodied technology (see Franco *et al.*, 2011),

Foreign finished goods (import) represent linkages with foreign firms via expenditures (import) on finished goods such as operating systems and applications to be used either as inputs in the production function or for re-sale.

Local royalty fees paid represent linkages with local institutions via expenditure on codified knowhow.

Learning is signalled by firm level expenditures in R&D, human capital and creation of tacit knowledge through interaction with customers.

R&D current creates explicit and tacit knowledge which contributes to learning. It is measured by expenditures on current account which consists primarily of wages of R&D scientists.

R&D capital enables embodied knowledge such as equipment technology to generate new technological innovations. R&D capital refers to the expenditure associated with the purchase of embodied technologies. It covers R&D efforts expended to gain systemic knowledge, as well as occasional product and process engineering activities.

Human capital accumulation provides the requisite quality, education, skill levels and experience (De and Dutta, 2006). This is measured by salaries and wages. Consistent efforts to raise the quality of human capital are also measured by investments in outside professionals and expertise.

Foreign travel facilitates interaction with customers and markets. This creates the capacity to learn about customer needs and gain knowledge from the market. This creates tacit knowledge and enhances its technological capability (Cohen and Levinthal, 1990). Foreign travel refers to the expense incurred in travelling and other such incidental expenses, the payment for which has been made in foreign currency.

Foreign direct investment signals reverse learning and dissemination of knowledge based services in global markets

Exports of knowhow signal the EMFs' maturity into the elite league of knowledge intensive exporters

The basic prediction of the study is that mature technology transfers as in codified knowhow, capital equipment and finished goods will explain product market internationalization of EMFs in the first phase of their capability development. In the advanced phase of their development, it will be more firm level learning efforts and human capital accumulation that will explain product market internationalization.

6.5 Statistical Methods

The statistical data for analysis was derived from the Prowess database of the Centre for Monitoring Indian Economy (CMIE). We used panel data from 1991-2008 which gave a sample size of 703 companies. The dependent variable found to be most representative indicator of globalization was export of services. All data was standardised by size of firms measured by sales revenue to ensure comparability of variables across the time series. The panel data method using the random effects model with datasets stratified over two periods punctuated the evolution of capability development. The output was checked for collinearity, Mahalonabis' and Cook's distances, t values and VIF for each variable before interpretation. The output tables were analysed to infer the results which are narrated below.

6.6 Results and Discussion

Table 6.1: Results of Panel data method

Random effects	**Model A Period I (Initial Phase)**	**Model B Period II (Later Stage)**
Intercept	17.59***	25.27
	(3.89)	(3.33)
Outsourced Professional Jobs	-.17	-.14***
	(.31)	(.04)
Advertising	-.49***	-.84***
	(.14)	(.19)

Random effects		Model A Period I (Initial Phase)	Model B Period II (Later Stage)
R&D Capital		-.33	.22
		(1.30)	(.55)
R&D Current		.13	-.34
		(.51)	(.28)
Salaries and Wages		-.08	.07**
		(.09)	(.03)
Foreign Dividend Earned		.41**	-4.16*
		(.13)	(1.69)
Export of Know-how		.81***	.65***
		(.18)	.06
Import of Finished Goods		-.14	-.08
		(.16)	(.17)
Foreign Capital		.00	.00
		(.21)	(.00)
Foreign Dividend Paid		14.72**	1.48**
		(5.53)	(.50)
Foreign Travel		1.61***	.57**
		(.28)	(.18)
Foreign Royalty Paid		.86***	.31
		(.21)	(1.67)
Foreign Know-how Fees		1.00***	.57***
		(.12)	(.04)
Local Royalty Paid		.39	-.10
		(.30)	(.44)
Foreign Investment		-.02	.04 †
		(.22)	(.02)
Sales Log		5.40*	7.70***
		(2.31)	(1.21)
		-.07	.30
Age		(.32)	(.20)
R-square	Within	.28	.30
	Between	.51	.45
	Overall	.60	.41
Wald Chi-Square		162.86***	546.96***

Hypothesis 1 *predicted EMFs' foreign linkages will have a positive impact on exports of knowledge based services during the initial phase of capability development.*

The results of Model A (initial phase) indicate that for every unit increase of foreign investment, there is a 147% increase in exports - see foreign dividends ($\beta = 14.7$, $p < 0.001$). It appears internationalization of EMFs is greatly influenced in the initial phase by the foreign equity participation of FMNCs by way of ensuring protection of privacy and secrecy of business operations – always an important consideration for FMNCs. The need for safeguarding stakeholders' interests with proper controls and monitoring is well known for reducing transaction costs. This is achievable only if FMNCs participate with FDI in equity in the EMFs, gain control of the organizations, and protect confidentialities. The other measures, as in foreign royalties paid ($\beta = 0.86$, $p < 0.001$) and foreign knowhow ($\beta = 1.0$, $p < 0.000$) are also significantly and positively related to exports which establishes the fact that leveraging foreign knowhow and expertise was critical for internationalization in the initial phase.

Interestingly in model 2 (later stage), foreign linkages continue to have a significant influence on product-market internationalization. In this phase, foreign dividends ($\beta = 1.48$, $p < 0.001$) and foreign knowhow ($\beta = 0.57$, $p < 0.000$) have positive impacts on exports of services. The significance of foreign knowhow can be explained by the fact that the need to leverage the domain knowledge of the clients' systems continued in the advanced stage and therefore the need to import codified knowledge is shown as significant in the later stage through the payment of royalty and knowhow fees.

The results for model 1 (initial phase) also suggest that informal learning efforts as reflected in foreign travel ($\beta = 1.61$, $p < 0.000$) have a significant and stronger positive impact on exports of services in the initial phase – a measure of success of internationalization. This is different from the model II (later phase) data ($\beta = .57$, $p < 0.001$). The stronger positive and significant association of learning during this initial phase appears to suggest that informal learning is a critical part of the equation and starts early. In other words, it is not linkages alone that are responsible for internationalization of EMFs. However, any increase in spending on local linkages in this initial phase has no effect on exports. Also, embodied knowledge through imports of capital equipment does not emerge as significant, going counter to the predictions of the model. In both phases, import of capital equipment has no contribution to export of services either.

Hypothesis 2 *predicted EMFs' in-house learning will have a positive impact on exports of knowledge based services in the later stages of capability development.*

Results show that variable human capital has a significant and positive impact on exports ($\beta = 0.069$, $p < 0.05$) meaning a unit expenditure increase in human capital has a 7% increase in exports. This signifies a shift from the body shopping phase when EMFs were used mainly for low-wage labour towards depending on high quality human capital to create tacit knowledge for innovation led internationalization. The results provide evidence that enhanced quality of manpower deployed at this advanced stage makes a significant difference to exports of knowledge based service. Again, in line with hypothesis 2, the results show foreign travel ($\beta = 0.57$, $p < 0.05$) has a significant and positive impact on exports of services. Foreign travel overseas to customers' location is presumably undertaken to understand and deliver solutions. From a learning perspective, close interaction with and coordination between principals is critical to creating tacit knowledge about functions, processes and industries at this stage. Moreover, getting precise information of the outsourcing activity and how this may be accomplished was an essential element of learning which confirms that an increase in

learning has a positive impact on exports of services. However results show the measures R&D current or R&D capital have no impact on exports. Hence it appears that international competitiveness in knowledge based services in the EMFs' advanced stages of the value chain is positively associated with learning effort and capability development through foreign travel and human capital investments but not firm level R&D. The insignificance of formal R&D in the results does not however warrant rejection of the learning hypothesis, but perhaps indicates that learning is multidimensional, and is captured both via informal means, as in foreign travel and human capital investments.

The lack of significance of foreign royalty paid during the second phase is indicative of the fact that mature technology imports via codified knowhow is no longer necessary for dynamic capability development. As well, the lack of significance of finished goods and capital goods imports in both periods questions the earlier contention by Arora *et al*. (2001) that exports of value added services by Indian EMFs are mainly driven by operational capabilities using low tech mature systems and physical capital equipment.

Hypothesis 3 *predicted that EMFs' leveraging of their own innovation capabilities will have a positive impact on exports of knowledge based services in the later stages of capability development.*

The results in Table 5 shows that O-FDI ($\beta = 0.04$, $p < 0.10$) has a positive and significant relationship with exports of knowledge based services. These results are indicative of the fact that FDI is essential for delivering knowledge based services to global clients because setting up a presence on-shore (host country) shows a larger commitment to foreign clients via an on-shore presence Bilateral equity investments in foreign firms are also essential for establishing the crucial forward linkages to sell output in foreign territories.

Also significant is export of knowhow ($\beta = 0.81$, $p < 0.000$ in phase 1 and $\beta = 0.65$, $p < 0.000$ in phase 2) which has a positive impact on exports of services. This suggests that internationalization of EMFs through exports of services has taken a more sophisticated form where EMFs' own innovation is contributing to the foreign partners' innovation efforts in host locations. The results of these empirical analyses corroborate the fact that the EMFs have reversed their role from being a recipient of knowledge transfers to a supplier of knowhow. Our inference is that the EMFs traverse an entire circle of life-cycle to transform from a latecomer in the technology space to a significant contributor to innovation. This made them an experienced entity where their capabilities have been dynamically developed over the phases of their inception, growth, and diversity to maturity. What is also significant is human capital ($\beta = 0.182$, $p < 0.000$). The hiring and engaging of high quality employees, as proxied by salaries as a proportion of revenue, has a significant positive impact on delivery of high end services in the value chain. We argue that this provides a valuable insight to our globalization model of EMFs and their life cycle of growth and maturity in that the EMFs are **reverse linked** and have sufficient IP as internal resource to be a valuable partner in the global innovation network.

This signifies that the relationship between FMNCs and EMFs matures to be a partnership of equal status with time, delivering the innovation tasks in the fast paced technological evolution. The results show EMFs eventually mature to become global partners of FMNCs and become accepted in the global innovation network where there is mutual sharing of intellectual property in the process of innovation and technological development of products and services.

Overall these results lend support to the hypothesis that internationalization in the early stages is contributed to by leveraging foreign linkages at the firm level and in the later phases it is driven by firm level efforts in learning. However, the results also suggest that linkages continue to be significantly and positively related to internationalization in the later phase when learning becomes an essential tool for developing innovation capabilities (dynamic capability development). What is even more interesting is that in both phases, exports of knowhow are significant in the export of services.

The hypothesis tested in this study was that linkages are the pathways through which EMFs initially gain operational capabilities, however it is the learning effort that results in dynamic capabilities via tacit knowledge creation. Gaining proficiency in performing simple tasks marked by repetitive patterns of activities, as in providing back-end client services or forward end marketing and sales services like software distribution, is the first step. Through linkages, EMFs get codified and embodied knowhow and learn about new customer requirements, and develop deeper insights and knowledge about multiple requirements and how to serve them. Access to critical resources of MNCs such as technology platforms, software systems and products, internal processes, production and customer networks, enables learning specific client businesses and needs and designing cost-effective communication and interaction patterns (Rajkumar and Mani, 2001). As observed by Mathews, repeated application of linkage and leveraging of resources from a variety of external sources may result in the firm learning to perform such operations more effectively and venturing into areas hitherto untapped. Leapfrogging through dynamic capabilities is accomplished by bringing in new human and technological resources into the firm and combining with conscious internal learning (see Lane and Lubatkin, 1998; Powell *et al*., 1996; Zollo and Sidney, 2002; Mathews, 2006a for a theoretical argument). The research results show that dynamic capability in the form of powerful intellectual property matures EMFs from service provider to a partner status. EMFs progress from being recipients of knowledge to being part of a global production network to a phase where they have become important contributors in the "global innovation network". This transformation is evident in EMFs contributing independently towards the global knowledge pool that is critical for fast paced technological innovations. In other words, MNCs are "linking" EMFs for "leveraging" their intellectual assets in the technological products and services component development and "learning" how to add value in their technologically innovated products and offerings for sustainable competitive advantages.

Thus the results suggest reverse learning is an additional "loop" in the final phase of leapfrogging, when EMFs become knowledge contributors to MNCs with innovative services. Reverse learning where partners have a mutually integrated relationship signifies maturity of the relationship between FMNCs and EMFs, and transforms EMFs from a position of service provider to a partner in the global innovation network. The simultaneous two way linking-leveraging-learning (LLL) phenomenon is evident from the results in Table 6.1 which indicates both contribution to knowledge and receipt of knowledge. These results signify that the EMFs continue to learn by leveraging knowhow from their network partners.

The looped LLL appears to operate by mutual sharing of and contributing to technological innovations and knowledge based services as a network, rather than FMNCs driving it alone. Through this descriptive mapping of the phenomena observed in the globalization phases of the EMFs this research makes a new contribution to the literature on emerging market firms.

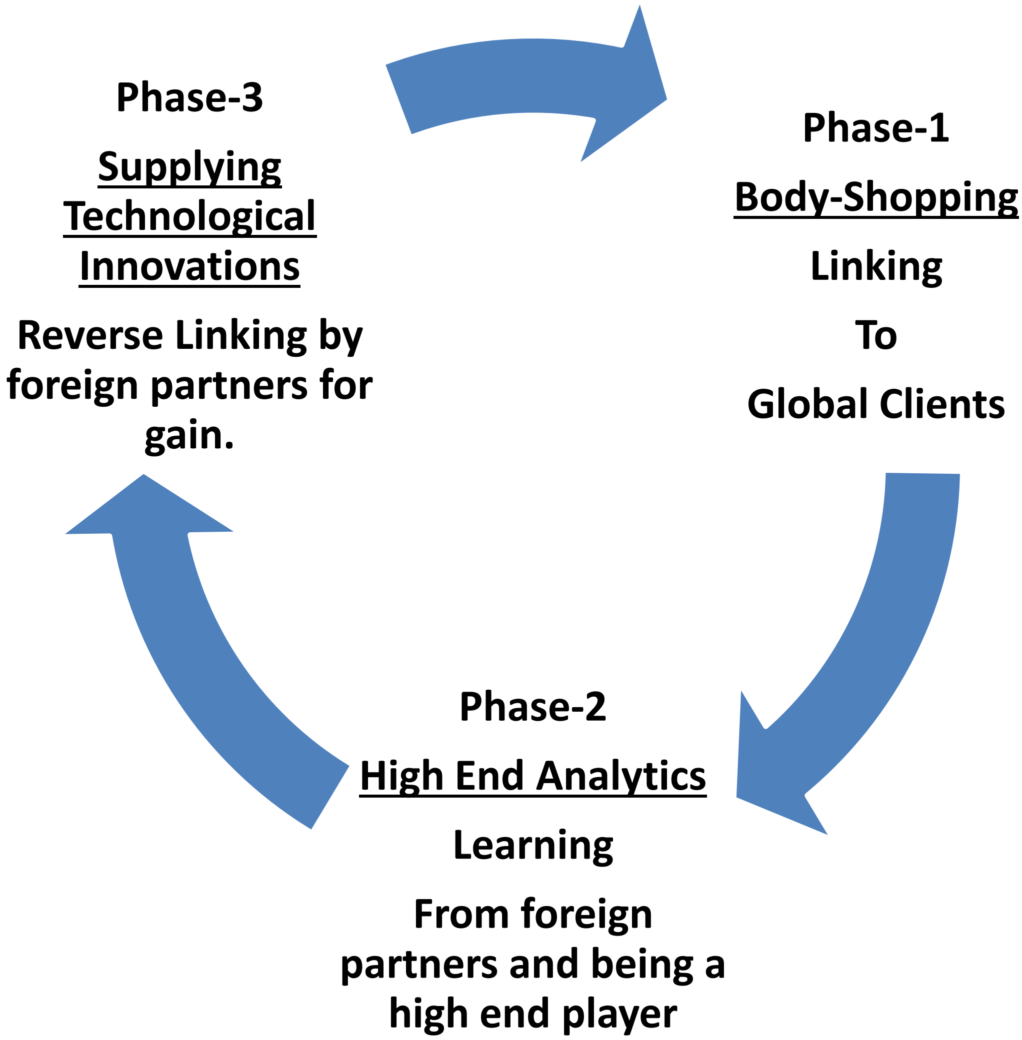

Figure 6.1: EMFs model of capability development: Linking-Learning-Leveraging-Looped (Reverse) Linking

6.7 Conclusion

In line with the case studies, empirical results of the inter-temporal settings show EMFs started as the receiver of knowledge and ended by being a contributor to knowledge. Their evolution from operational to dynamic capability appears to be driving the growth of the technological innovations in the global innovation network.

It is evident that in the initial phase the drivers of growth for EMFs' globalization were "linkage" formations with foreign clients (FMNCs). The second phase is marked by mounting increased "learning" effort for "capability development". Also in this phase the main driver was "leveraging own innovation capabilities and Intellectual properties" or "looped reverse linkage" where EMFs could grow rapidly due to their ability to contribute to their network of foreign partners' innovation efforts with their own innovations. These results also depict a clear picture of the life-cycle of the EMF's inception, growth, maturity and contribution in the domain of global knowledge based service industry. The results provide evidence to challenge the views of Arora *et al*. (2001) and D'Costa (2004) that the Indian software industry presents the classic problem of locking-in a low road of innovation trajectory.

Annexure

Variable names:

No.	Variable Names
1	Incorporation Year (age)
2	Capital Expenditure on R& D as a percentage of total revenue
4	Current expenditure on R&D as a percentage of total revenue
5	Salaries & Wages as a percentage of total revenue
6	Gross Intangible Asset (IP) (knowledge Resource) as a percentage of total revenue
7	Import of Capital Goods (cif) (Foreign Capital Equipment) as a percentage of total revenue
8	Forex Spending on yearly dividends as a percentage of total revenue
9	Forex Spending on travelling as a percentage of total revenue
10	Forex Spending on royalty payments as a percentage of total revenue
11	Forex Spending on knowhow as a percentage of total revenue
12	Expense on local royalty payments as a percentage of total revenue
13	Expense on technical knowhow as a percentage of total revenue
14	Expense on license fees as a percentage of total revenue
15	FDI Investment Abroad
16	Expenditure on depreciation
17	PBT (control)
18	Expenditure on Salaries & Wage - Director's Remunerations
15	Dependent Variable : Export of Services

Chapter 7

Conclusion: Evolution of Dynamic Capabilities in Emerging Market Firms

This final chapter returns to the research question *"How do EMFs develop capabilities to leapfrog in knowledge intensive industries eventually to take a leadership position in global markets"*, to run through the main findings of the thesis. The study's objectives were to examine *a) the capabilities that EMFs must develop to globalize rapidly and b) the factors that favour the leapfrogging process of EMFs.* The study mapped capability development in Indian IT firms in an inter-temporal setting, employing both a case study and an econometric approach to examine the hypothesis whether their internationalization was driven by dynamic capabilities, as is the case with major MNCs from the OECD.

Thus far, the literature on competitiveness has tended to focus mostly on manufacturing firms from the OECD, some exceptions notwithstanding. Whereas firms from the OECD are well endowed in resources, firms from developing countries are generally resource poor and their establishment, development and international expansion have taken place within an environment different from those found in western economies. To reiterate, what is untold in the literature is how EMFs, despite being endowed with only limited resources, learn to transform comparative advantages into dynamic firm-specific capabilities.

As EMFs increasingly originate from developing countries, opportunities exist for a more in-depth inquiry into, and the analysis of, the sources of their international competitiveness. Mathews (2002a) showed how EMFs redress their weaknesses by seeking out resources from the developed world. As explained in his analysis, linkage (to foreign markets through MNCs), leverage (resources and innovation) and learning (technology and processes) are the processes through which EMFs gain resources in the global economy. However Mathews work falls short of providing insights into the organic change that occurs within EMFs as they go up in the trajectory from basic to dynamic capabilities. Moreover the empirical literature is rather sparse in conducting detailed analyses on the recombination process of resources within EMFs and the upstream processes that are involved in transforming basic level capabilities to advanced capabilities. This is what the thesis set out to accomplish. In this way the work represents a novel contribution to the literature on emerging economy firms and their distinctive learning processes that lead to dynamic capabilities.

This concluding chapter discusses the core aspects of the thesis and is divided into the following sections. Section 7.1 provides a summary of the main findings of development of capabilities in EMFs which also presents the main conclusions from this research. Section 7.2 indicates the contribution to knowledge. Section 7.3 presents theoretical and practical implications of this research, for both policymakers and business managers. Section 7.4 summarises the research limitations, followed by future directions in section 7.5.

7.1 Summary of Research Findings

The discrete chapters of the study covered: a) An extensive industry and firm level investigation of the evolution, causes, dimensions and accruals of dynamic capabilities of EMFs b) focused case study of a targeted EMF, Infosys, to document the linking, learning and leveraging processes used by them to progressively enhance their dynamic capability and internationalize rapidly c) cross case evidences which map the evolution of both new and established EMFs to discern distinctive patterns, variations and anomalies and d) empirical validation using panel data method to test hypotheses of dynamic capability evolution model and the corresponding growth and internationalization of EMFs using firm level data of Indian IT firms. The methodology used in this research was based on scientific research – based on validity, reliability and robustness. The contribution to knowledge through this route is the establishment of several relevant and causal dimensions of dynamic capability as well as a description of the phenomena observed in knowledge based service industry in an emerging economy.

The single case study of Infosys explored how it leapfrogged in a highly knowledge intensive industry, moving out of the "low road" to the "high road", where competition is based on differentiation. It looked at how the EMF circumvented its traditional disadvantages of being cut-off from the main centres of innovation, to be transformed into powerhouse of strength in IT enabled service delivery. By using an inter-temporal setting the study mapped the sequence of strategies followed by Infosys to enhance its capabilities.

Infosys' development trajectory revealed how its initial investments in human not financial capital, enabled it to leverage its low cost human resources using the backbone of investments in education and training and the positive externalities generated through research undertaken by their government in their home environment (Das, 2006; Birkinshaw, 2008). Simultaneously, it leveraged technological resources from FMNCs and augmented its knowledge bases by internalizing the spillovers from the interchanges with MNEs for the next stage of international expansion. The tasks mastered by Infosys in the initial stages were simple operational level routines that helped to deliver repetitive back-end services and application maintenance to FMNCs. In the so called 'body-shopping' stage, FMNC clients generally received the services of the programmer 'bodies' with much less by way of organizational knowledge from the IT EMFs (Khanna and Palepu, 2004).

As defined in the literature, ability to make use of existing resources, such as existing manpower without much by way of value addition are simple-operational level capabilities (Banerjee, 2003). Client interaction and access to critical resources such as technology platforms, software systems and products, internal processes, production and customer networks enabled Infosys to learn client specific businesses and needs and design cost-effective communication and interaction patterns (Mani, 2001). Linkages enabled an "image transfer" and helped it to acquire the values of the FMNC partners and other benefits of association (e.g. access to distribution channels). Using a carefully calibrated mechanism for reputation enhancement through linkages with FMNCs, Infosys was able to internalise the externalities of client-supplier relationships to step into higher domain expertise.

As observed by Mathews (2002a), repeated application of linkage and leveraging of resources from a variety of external sources may result in the firm learning to perform such operations more effectively and venture into areas hitherto untapped. For example idiosyncrasies of a variety of clients' needs and operating environments required Infosys to dynamically adapt, document the learning, and share the tacit knowledge through the KM system (Sirkka and Mao, 2008). Indeed the KM entailed explicit knowledge articulation, and knowledge codification mechanisms in the form of manuals, blueprints, and project management software.

Therefore, moving up the value chain from the low road of back-end operations to the high road of technology consulting was facilitated by learning about different functions of clients. These specific tacit learning experiences were then applied generically to other situations to provide solutions to clients. As observed by Birkinshaw, (2008) one key attribute at Infosys was 'learnability', the ability of an individual to derive generic learning from a specific situation and apply it to a new unstructured situation. The emphasis on learnability led Infosys to hire graduates even without strong IT backgrounds; as such skills are easily learnable on the job.

Thus, the evolution of one of India's leading IT firms Infosys provides a real world example of how EMFs leapfrog in knowledge intensive industries through learning – which becomes the core pillar of gaining dynamic capabilities. At the advanced stages of its evolution, Infosys was an integral player in a global innovation network, specifically in areas like 'product engineering services' and software "protocol standards".

Using the replication logic, the purpose of chapter 5 was to map the evolution of three IT EMFs in a multi-case framework to gain an insight into how their dynamic capability was developed. In order to simplify the pathway of evolution, the study mapped the different phases of evolution as founding development and maturity – in line with Helfat and Peteraf's (2003) postulations. It described the strategies of how Sasken, Cranes and HCL linked-leveraged-learned at each stage of their evolution, eventually to become a contributor to global innovation based on dynamic capabilities.

Once again, linkages with foreign firms and local institutions enabled EMFs to accumulate resources to make an entry into global markets and pursue their globalisation goals. The backward and forward linkages were pathways through which EMFs mastered initially simple tasks entailing simple routines marked by repetitive patterns of activities, as in providing back-end client services or forward-end marketing and sales services like software distribution. Through these linkages, EMFs learnt new customer requirements, and developed capabilities of how to serve them. They then leveraged their knowledge from learning to serve clients in order to deepen linkages with foreign firms which were on the lookout to outsource additional value added operations. Later, increasingly complex tasks were mastered and new customers with different needs were served. Reputation and investments in quality substituted large marketing and capital investment outlays while interaction with incumbents provided first-hand knowledge about which investments were critical. The focus on niche areas; Sasken in telecommunications, HCL technologies in engineering solutions and Cranes in software based scientific and engineering tools – created path-dependencies in how resources were reconfigured. Sasken designed an embedded multimedia chip for mobile handsets while Cranes developed the operating system for the SIC 32 bit processor, and HCL partnered with Airbus for designing an embedded chip for communication with ground control. Each of these firms used knowledge modularity to become an innovator in their advanced stages. Accumulation of knowledge was effected through various modes: linkages with FMNCs; joint ventures or M&A with other firms as well as partnering with local universities and research institutions. Acquired knowledge was upgraded through R&D investments to deliver highly value added products that gave them the competitive advantages to globalise rapidly.

As pointed out in the literature, competitive advantage is greatly enhanced when the related resource configurations are deployed into synergistic activities (Collis and Montgomery, 1995; Milgrom and Roberts, 1990a; Porter, 1990; Prahalad and Hamel, 1990) that managers leverage to build dynamic capabilities. Upgrading entails intensive use of human capital, R&D and modularising of knowledge through functional, product/process and inter-sectoral resource reconfigurations. Through each round of linkages these EMFs learnt how to modularise the knowledge gained to form the basis of dynamic capabilities.

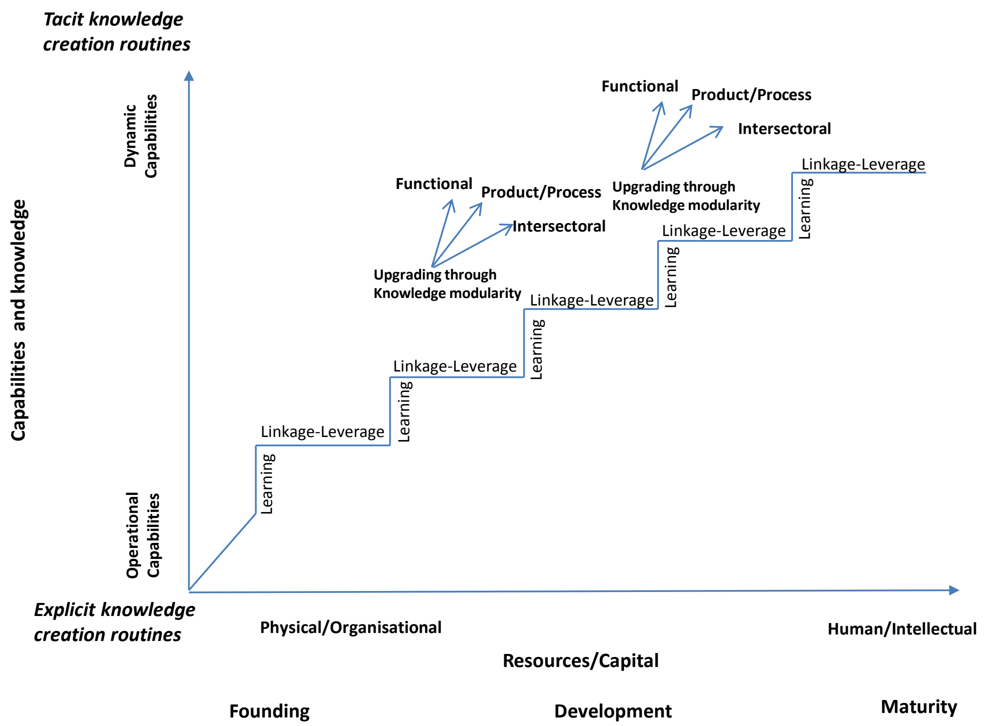

Figure 7.1: A framework of dynamic capability development in EMFs

In Chapter 6, an empirical examination in a multivariate framework was conducted to determine the precise factors that assist EMFs to leapfrog in knowledge intensive industries. The hypothesis harboured was that behind the success of the Indian software industry is human capital accumulation and firm level learning efforts, through linkages with foreign firms. The econometric testing was conducted in a comparative-static framework, with firm level data stratified into two periods. Exports of knowledge based services were the dependent variable as an indicator of EMFs ability to gain international market share. In line with the hypotheses, the results indicate that increase of foreign linkages (foreign investment and foreign knowhow) have a significant impact on the EMFs ability to internationalise in knowledge based services. Foreign linkages are not only important in the first phase but also in the mature phases of EMFs, signifying that these continue to have a dominant influence even when EMFs reverse their role from being a recipient of knowledge to a contributor of knowledge. What is more, internationalisation of EMFs in knowledge based services is associated with increased levels of learning efforts as indicated by accumulation of human capital which has a significant and positive impact on exports. Enhanced quality of manpower deployed at this advanced stage makes a significant difference to exports of knowledge based service. The positive and significant association of informal learning with exports is also indicated in both phases. From a learning perspective, close interaction with and coordination between principals are critical to creating tacit knowledge about functions, processes and industries at this stage. Moreover, getting precise information of the outsourcing tasks, and how these may be accomplished appears to be an essential element of learning. This confirms that an increase in learning has a positive impact on exports of services.

What was however most interesting was that in the advanced phase, EMFs exports are increasingly associated with its own sale of knowhow in export markets – signalling the transformation from EMFs being used mainly for low-wage labour to depending on high quality human capital to create tacit knowledge for innovation led internationalisation.

7.2 Contribution to Knowledge

In general terms, the findings of this study present a novel and contemporary insight on how EMFs evolve to develop dynamic capability, which enables them to globalise rapidly in a fast changing technology space. This is a subject which has remained under-investigated till date. It is hoped that the study's findings about capability enhancements from the early stages of internationalization of EMFs until now (2012) will serve as a valuable reference to scholars and researchers in the areas of rapid and fast changing technology world. The scientific and evidence based insights from systematic case studies and cross case validation combined with econometric analysis makes a new contribution to knowledge. The contributions of this study are now deliberated vis-à-vis the study's objectives next.

First, the study aimed to scrutinize the generalised notion prevailing in the international academic community that India's IT services were stuck in the low road of competition and that the bulk of her IT services was based on low wage labour producing low value added services on behalf of OECD MNCs. However, if anything, the evidence presented in this study shows otherwise. It brings into question the earlier contention by Arora *et al*. (2001) that exports of value added services by Indian EMFs in mainly driven by operational capabilities using low wage labour, low tech mature systems and physical capital equipment. The results of the study shows that dynamic capability in the form of powerful intellectual property, enable EMFs to evolve from service provider to a partner status. EMFs progress from being a recipient of knowledge being part of a: global production network to a phase where they have become important contributors in the "global innovation network". This transformation is evident in EMFs contributing independently towards the global knowledge pool that is critical for the fast paced technological innovations. Hence this study goes some way in dispelling certain myths associated with Indian IT industry, particularly insofar as its alleged low-tech space in global markets.

Second, the unique contribution of this study lies in mapping the relationship between resources accumulated, and capabilities gained, which conceptualises the evolution of EMFs. In the first phase of capability life cycle, the routines used are simple, dependent mainly on explicit-codified and embodied knowledge. Repetitive operations through practice helps to optimise tangible resources such as equipment, processes and technology (EPT) and groove routines more firmly and effectively (see Eisenhardt *et al*., 2000 for a discussion). Codification of that experience into technology and formal procedures makes that experience easier to apply and accelerates the building of routines (Argote *et al*., 1999; Zander and Kogut, 1995). Continuous learning from experience builds tacit knowledge, which then facilitates EMFs' the pathway to faster expansion and dynamic capabilities.

Third, the study validates that globalisation of EMFs is an evolutionary process where each phase provided the EMFs with stronger platforms to rapidly progress towards maturity. In all these phases the EMFs learned from their linkages and leveraged them for growth. This learning was partly the automatic result of experience in doing some value added activity like production or marketing, but also came as a by-product of internationalisation which was a catalyst. The repeated application of linkage and leverage processes promotes organisational learning to transform basic level capabilities to dynamic ones based on innovation. At the advanced stage they reverse their role to complete the loop and integrated themselves back to their mentors and sponsors to be a new member in their innovation network for technological advancement of the world.

Fourth, through the lens of classic capability life cycle model, the research identified the distinctive capabilities of EMFs in each lifecycle period that became the drivers of leapfrogging in the next phase. By design this research established the phase-breaks (period boundaries) by observing the points of inflection where the drivers of growth significantly changed indicating a new stage or phase of internationalization of EMFs. It uncovers the association between different strands of academic theories like the evolutionary model, capability life cycle and dynamic capability; linkage-leverage- learning (LLL); and the empirical evidence that concern the growth of EMFs from major emerging economies like India. The study tests the reliability of existing models to explain the growth of EMFs and provides valid and reliable tools and constructs in explaining the dynamic capability development model of the EMFs through their phases of life cycle namely founding, development and maturity. The study invoked unique analytical tools, by drawing from the CLC model of Helfat and Peteraf, and fusing upon it, the Mathews LLL framework – set in an evolutionary backdrop. In the first exploratory in-depth case analysis, the propositions of the study were deliberately kept implicit, and the analysis focused more on the description of the phenomenon whether the constructs from evolutionary theories would be relevant or not.

7.3 Theoretical and Practical Implications

The findings of the present research provide practical implications for academic researchers, business managers and policymakers.

To the empirical researchers studying EMFs, this research demonstrates that these existing theories are extendable, as the scaling (extension) needed to explain the third or last phase (current phase or post 2008) that give rise to adding a completely new dimension to these theories. The LLL theory falls short of explaining the phenomena of role reversal of EMFs from being the recipient of knowledge to contributors of knowledge. The case study shows that the third phase of the life cycle of the EMFs was a reverse loop where they started contributing to the global innovation network with their internally developed innovations and knowledge capabilities. This means that there was a reverse linkage by FMNCs (foreign multinational corporation partners) to leverage off the EMFs' intellectual property or knowledge for their own learning. The FMNCs' use of the EMFs' innovations (knowledge capabilities) sustain their continuous product and service innovations to remain competitive in the global market. Thus the research finds that roles are reversed in a linkage-leverage-learning model in the advanced stage of the lifecycle and the theory could now be extended to add another "L" which represents the "loop" of reverse linkage (see Figure 6.1 in the previous chapter). The future researchers can now work with the new theory of LLLL, being the modified or the evolved LLL theory of John Mathews.

For practitioners, the findings of this research can be a useful tool to map their current capability status. By matching the phase characteristics with their current capabilities they can easily locate their current status and predict the future direction to bridge the capability gaps with benchmarked enterprises. They can also establish what they need to do to progress to the next phase. This research and the phase characteristics will provide them with clear direction of how to evolve to the next phase of their dynamic capability model by focusing on the established key drivers without having to reinvent their strategy by trial and error.

For policymakers there are four major implications. First, policymakers in emerging economies need to calibrate mechanisms that enhance the inflow of FDI because the interaction with FMNCs generates many positive externalities for the innovation related efforts of both FMNCs and EMFs. Second, policymakers need to pay heed to the importance of crafting vertical policies vis-à-vis the IT industry since industry dynamism depends on a number of factors such as skills creation in educational institutions, financial incentives and tax offsets, promotion of input industries, the creation of infrastructure for high speed telecommunications and so forth. Third, sufficient incentives that promote R&D expenditures by private enterprises, through R&D grants and tax offsets, need to be explored (Lall and Teubal, 1998; Franco *et al*., 2011). For India much of the R&D is conducted in the government sector consisting of government research institutes and public sector undertakings (Mani, 2001). This structure needs to shift toward private R&D. Moreover, FMNCs should be encouraged to do more R&D (Franco *et al*., 2011). The fourth implication is that EMFs need to be encouraged to patent the intellectual property they have self-created. Unless governments can ensure that patents (and appropriate royalties) are generated and reside in the country, incentives and subsidies to encourage R&D may not provide the desired results to the local economy (Ray, 2004). Finally, as is clear from the results, policymakers in the emerging nations need to induce and encourage all small domestic focused businesses to expand globally—as many pharmaceuticals, automotive and electronic component makers are doing in India. This expansion will help to enhance learning in small businesses by undertaking the hard work of competing in international markets.

7.4 Research Limitations

Like most empirical studies, certain limitations constrain the generalizability of this study. First, the study was restricted to a single industry (namely, the IT sector), which accounts for the main, yet unavoidable, limitations of this study. Being a single industry study, the obvious question is to what extent its findings could be generalized across other industries. Second, this is also a single country study, albeit the research question is concerning EMFs from a major emerging economy. The question therefore is to what extent its findings could be generalized to other emerging economies or even developing economies. The institutional context of each country is different; hence it is not always possible to predict whether what worked in one country will work in another. The answer to these limitations lies in deductive studies which may replicate or refute the observations and conclusions drawn in this study. We need multiple industry studies involving more developing countries for a comprehensive inquiry. Third, while some of the secondary data was exclusively available to the researcher, the weakness of the study comes from the fact that it is reliant exclusively on secondary data. A final limitation is the lack of a fully dynamic longitudinal quantitative study. Firm behaviour in certain dimensions averaged over several segmented periods or years would give a more accurate picture when compared to a couple of phases or periods studied.

7.5 Future Directions

New technological evolution and a changing world order have witnessed many new competitors from developing and emerging nations whose upward trajectory into global competition has yet to be well documented. For future research, one hopes that prospective studies would focus on individual nuances of firm behaviour like technology development, product differentiation, and vertical integration over a larger span of industries as well as time. Maturity can change the behaviour and linkages of firms over time. Individual aspects of behaviour when studied over time can lead to a better understanding of the nuances of the dynamic interaction between the firm and the environment. This understanding can facilitate the application of the resource-based view and combine it with the framework in industrial organizations to offer a more eclectic perspective in future research.

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